1881.) The yield of ash varies, according to the researches of H. W. Jones (*P. J. Tr*, ix. 673), from 4·69 to 4·40 in *B. betulina*, 4·32 to 5·39 in *B. crenulata*, 5·03 to 5·22 in *B. serratifolia;* the ash itself was remarkable as containing a great deal of manganese. The short-leaved buchu was found by Mr. P. W. Bedford to yield an average of 1·21 per cent. of volatile oil; while the long-leaved, though more highly valued in the market, gave only 0·66 per cent., showing its great inferiority in strength. (*Proc. A. P. A.*, 1863, p. 211.)

Medical Properties. The Hottentots have long used buchu in a variety of diseases. From these rude practitioners the remedy was borrowed by the resident English and Dutch physicians, by whose recommendation it was employed in Europe, and has come into general use. Its activity depends upon the volatile oil which is eliminated by the kidneys. Under its action there is no marked increase in the amount of the urine, hence the remedy is of no value in dropsies; but the oil affects very decidedly the mucous membrane of the genito-urinary tract. The remedy is very useful in diseases of the urinary organs, such as gravel, chronic catarrh of the bladder, morbid irritation of the bladder and urethra, diseases of the prostate, and retention or incontinence of urine from a loss of tone in the parts concerned in its evacuation. It should be given when the inflammation is not severe, but not when it is in that condition of chronicity requiring oil of turpentine, tincture of cantharides, or other more stimulant diuretics. The best preparation for use is the fluid extract, of which the dose is a fluidrachm (3·75 C.c.) repeated three or four times a day.

Off. Prep. Extractum Buchu Fluidum, *U. S.;* Infusum Buchu; Tinctura Buchu. *Br.*

CADMIUM. *Cadmium.*

Cd; 112. (CĂD'MI-ŪM.) Cd.; 56.

Cadmium, *Fr.*, *G.;* Kadmium, *G.*

This metal was introduced into the U. S. Pharmacopœia of 1870 because used in the preparation of sulphate of cadmium. It is associated with zinc in its ores, and, being more volatile than that metal, comes over with the first portions of it distilled in the process for obtaining it. (See *Zincum.*) The cadmium is separated by dissolving the mixed metal in dilute sulphuric acid, precipitating the sulphide by sulphuretted hydrogen, treating the precipitate with hydrochloric acid, and again precipitating with carbonate of ammonium. The carbonate of cadmium thus obtained, after being washed and dried, is mixed with charcoal, and exposed to a dull red heat in an earthen retort, when the reduced metal distils over.

Properties. Cadmium is a white metal, resembling tin, but somewhat heavier and more tenacious. Like that metal, it crackles when bent. Its sp. gr. is 8·7, melting point 316° C. to 320° C. (601°–608° F.). It begins to volatilize at a temperature slightly above this, but under the boiling point of mercury, while it boils only at 860° C. (1580° F.). It is little affected by the air, but, when heated, combines with an atom of oxygen, forming a reddish brown or orange-colored oxide, CdO, which combines with the acids to form salts. From its saline solutions the oxide is precipitated by the alkalies in the form of a white hydrate. Cadmium also combines with chlorine, iodine, bromine, and sulphur. It is distinguished by forming a colorless solution with nitric acid, from which sulphuretted hydrogen or ammonium sulphydrate precipitates a lemon yellow sulphide insoluble in an excess of the reagent, or in potassa or ammonia, and not volatilized at a red heat. Potassa produces a white precipitate insoluble in an excess, and ammonia a similar precipitate soluble in an excess of the precipitant. Zinc precipitates cadmium in the metallic state. "A neutral solution of the metal in nitric acid, after having been fully precipitated by carbonate of sodium in slight excess, yields a filtrate which is not affected by ammonium sulphide." *U. S.* 1870. This proves the absence of arsenic.

Medical Uses. According to Prof. Simpson, of Edinburgh, cadmium resembles antimony in its effects on the system. Dr. Garrod considers the metal, in this respect, more closely allied to zinc. In overdoses its salts appear to act as corrosive poisons. Three cases are recorded in which serious consequences resulted from in-

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haling the powdered carbonate, while used in polishing silver. The chief symptoms were constriction of the throat, embarrassed respiration, vomiting and purging, giddiness, and painful spasms. (*Annuaire de Thérap.*, 1859, p. 229.) Experiments by Dr. Wilh. Marmé demonstrate that the sulphide of cadmium is not poisonous, but that all its compounds soluble in water or in diluted acids at the heat of the body are so; and they all operate in an analogous manner, locally as powerful irritants, and internally producing giddiness, vomiting, purging, slowness of pulse and respiration, prostration, loss of consciousness, and spasms. (*Neues Repertorium*, 1867, xvi. 303.) It is chiefly, if not exclusively, for external application that the preparations of this metal are used. Two of them have especially engaged attention; the iodide and sulphate. The former is officinal in the British Pharmacopœia (see page 306), whilst the latter, which was officinal in the U. S. P. 1870, was dismissed at the last revision. On account of its being still used, it merits a notice here.

Off. Prep. of Cadmium. Cadmii Iodidum, *Br.*

Cadmii Sulphas. *Sulphate of Cadmium.* U. S. 1870, $CdSO_4, 4H_2O$. "Take of Cadmium, in small pieces, *a troyounce;* Nitric Acid *two troyounces;* Carbonate of Sodium *three troyounces;* Sulphuric Acid *four hundred and twenty grains;* Distilled Water *a sufficient quantity.* To the Cadmium and two fluidounces of Distilled Water, contained in a glass vessel, add by degrees the Nitric Acid, and, when the action slackens, apply a gentle heat until the metal is dissolved. Filter the solution, and, having dissolved the Carbonate of Sodium in six fluidounces of Distilled Water, mix the solutions thoroughly. Wash the precipitate obtained until the water passes tasteless, and dissolve it in the Sulphuric Acid, diluted with four fluidounces of Distilled Water. Then evaporate the solution to one-third, and set it aside to crystallize. Lastly, dry the crystals on bibulous paper." *U. S.* 1870.

A nitrate of cadmium is formed first, in consequence of the greater facility with which nitric acid acts upon that metal than sulphuric acid. The cadmium is oxidized at the expense of a part of the acid, with the production of fumes of nitrogen tetroxide, and the resulting oxide unites with the undecomposed part of the acid to form the nitrate, $3Cd_2 + 6H_2SO_4 + 4HNO_3 = 6CdSO_4 + 8H_2O + 2(N_2O_2)$. This is then decomposed in solution by carbonate of sodium, with a mutual interchange of principles; the nitric acid of the nitrate of cadmium taking the soda of the carbonate, and forming nitrate of sodium which is retained in solution, while the insoluble carbonate of the metal is deposited. This, having been washed, is treated with dilute sulphuric acid, by which the carbonic acid is expelled, and the sulphate of cadmium remains in solution, from which it is obtained by concentration and crystallization.

Properties. Sulphate of cadmium crystallizes in oblique prisms with rhomboidal bases, which are transparent and colorless, and said to resemble those of sulphate of zinc. They have an astringent, slightly acidulous, and austere taste, effloresce on exposure to the air, and are very soluble in water. The solution, even though acidulated, gives with hydrosulphuric acid a yellow precipitate, becoming orange yellow, of sulphide of cadmium, which is dissolved by strong hydrochloric acid, but is insoluble in solutions of potassa or ammonia, and is thus readily distinguished from the sulphide of arsenic. With sulphide of ammonium it gives a yellow precipitate insoluble in an excess of the sulphide. Ammonia produces a white precipitate, soluble in an excess of the precipitant; carbonate of ammonium a white one insoluble in an excess; ferrocyanide of potassium a white precipitate not dissolved by hydrochloric acid; and the ferricyanide a brownish yellow one soluble in a large excess of that acid. (*Brande and Taylor.*) By these tests sulphate of cadmium is distinguished as a salt of that metal. As a sulphate it is known by yielding a precipitate with chloride of barium not soluble in nitric acid. Zinc precipitates cadmium in the metallic state from the solution. Cadmium suspended in a solution of sulphate of copper precipitates that metal, leaving sulphate of cadmium in solution; and this has been proposed as a method of obtaining the salt. The formula of sulphate of cadmium, according to M. de Hauer, is $3CdSO_4.8H_2O$. (*Chem. News*, Nov. 29, 1862, p. 268.)

Medical Uses. Sulphate of cadmium is said to resemble but to exceed in power sulphate of zinc as an astringent and emetic. Besides these properties, it possesses,

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according to M. Grimaud, valuable powers as a remedy in syphilis, rheumatism, and gout, but it has been used almost exclusively as an astringent and stimulating remedy in diseases of the eyes and in gonorrhœa. In specks and opacities of the cornea it has been employed successfully by both American and European surgeons. It is used either in solution, in the proportion of from half a grain to four grains to the fluidounce of distilled water, or in the form of ointment, made by mixing two grains with four scruples of fresh lard.

CADMII IODIDUM. *Br.* *Iodide of Cadmium.*

CdI_2; 366. (CĂD'MĮ-Ī Ī-ŎD'Į-DŬM.) CdI_2; 366.

Cadmium Iodatum, Iodidum Cadmicum; Iodure de Cadmium, *Fr.;* Jodcadmium, Kadmiumjodür, *G.*

Iodide of cadmium may be prepared by mixing iodine and filings of cadmium in a moist state, or by dissolving the metal in hydriodic acid, or by double decomposition between potassium iodide and cadmium sulphate. It is soluble in water and alcohol, and may be crystallized from either solution, in large, white, transparent crystals, in the form of six-sided tables, of a pearly lustre. These are permanent in the air, melt at about 315·6° C. (600° F.) forming an amber-colored liquid, and give off violet vapors at a dull red heat. The salt is freely soluble in water and in alcohol, and the solution has an acid reaction. The Br. Pharmacopœia gives the following tests. The aqueous solution gives a yellow precipitate with sulphuretted hydrogen or sulphide of ammonium, insoluble in excess of the sulphide; and a white gelatinous precipitate with excess of solution of potash, the filtrate from which is unaffected by sulphide of ammonium. Ten grains dissolved in water gives with an excess of nitrate of silver, a precipitate which, washed with water and afterwards with half an ounce of water of ammonia and dried, weighs 12·5 grains.

Iodide of cadmium was introduced as an external remedy by Dr. A. B. Garrod, of London. He has employed it, with good effects, in the form of ointment, made of one part of the iodide to eight of lard, as a local application by friction to enlarged scrofulous glands, nodes, chronic inflammations of joints, certain cutaneous diseases, and chilblains. The ointment is soft and white, readily yields its iodine for absorption, and is preferable to the corresponding ointment of iodide of lead, the use of which endangers lead poisoning. (*P. J. Tr.* 1857, p. 260.)

Off. Prep. Unguentum Cadmii Iodidi, *Br.*

CAFFEA. *Coffee.*

(CĂF'FĘ-Ą.)

"The seed of Coffea Arabica." *U. S.* 1870. (*Nat. Ord.* Rubiaceæ.)

Semen Caffeæ; Café, *Fr.;* Kaffee, *G.;* Caffè, *It.;* Café, *Sp.;* Bun, *Ar.;* Copi cotta, *Cingalese;* Kaeva, *Malay.*

Although this substance was omitted in the Pharmacopœia of 1880, its great importance as a dietetic and its use as a medicine require a notice here.

Gen. Ch. "*Calyx* with a small, 4-5 toothed limb. *Corolla* tubular, funnel-shaped, with a 4-5 parted spreading limb. *Stamens* 4-5, inserted in the middle of the upper part of the tube, exserted or enclosed. *Style* bifid at the apex. *Berry* umbilicate, naked or crowned with the calyx, containing two seeds enclosed in a parchment-like putamen." *Lindley.*

Coffea Arabica. Linn. *Sp. Plant.* 245; *Bot. Mag.* t. 1303; *B. & T.* 144. The coffee plant is a small tree, from fifteen to thirty feet in height. The branches are opposite, the lower spreading, the upper somewhat declining, and gradually diminishing in length, as they ascend, so as to form a pyramidal summit, which is covered with green foliage throughout the year. The leaves are opposite, upon short footstalks, oblong-ovate, acuminate, entire, wavy, four or five inches long, smooth and shining, of a dark green color on their upper surface, paler beneath, and accompanied with a pair of small pointed stipules. The flowers are white, with an odor not unlike that of the jasmine, and stand in groups in the axils of the upper leaves. The calyx is very small, the corolla salver-form, with a nearly cylindrical

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tube, and a flat border divided into five lanceolate, pointed segments. The stamens project above the tube. The fruit, which is inferior, is a roundish berry, umbilicate at top, at first green, then red, and ultimately dark purple. It is about as large as a cherry, and contains two seeds surrounded by a paper-like membrane, and enclosed in a yellowish purple matter. These seeds, divested of their coverings, constitute coffee.

This tree is a native of Southern Arabia and Abyssinia, and probably pervades Africa about the same parallel of latitude, as it is found growing wild in Liberia, on the western coast of the continent. It is cultivated in various parts of the world where the temperature is sufficiently elevated and uniform. Considerable attention has long been paid to its culture in its native country, particularly in Yemen, in the vicinity of Mocha, from which the demands of commerce were at first almost exclusively supplied. About the year 1690, it was introduced by the Dutch into Java, and in 1718, into their colony of Surinam. Soon after this latter period, the French succeeded in introducing it into their West India Islands, Cayenne, and the Isles of France and Bourbon; and it has subsequently made its way into the other West India Islands, various parts of tropical America, Hindostan, and Ceylon.

The tree is raised from the seeds, which are sown in a soil properly prepared, and, germinating in less than a month, produce plants which, at the end of the year, are large enough to be transplanted. These are then set out in rows at suitable distances, and in three or four years begin to bear fruit. It is customary to top the trees at this age, in order to prevent their attaining an inconvenient height, and to increase the number of the fruit-bearing branches. It is said that they continue productive for 30 or 40 years. Though almost always covered with flowers and fruit, they yield most largely at two seasons, and thus afford two harvests during the year. Various methods are employed for freeing the seeds from their coverings; but that considered the best is, by means of machinery, to remove the fleshy portion of the fruit, leaving the seeds surrounded only by their papyraceous envelope, from which they are, after drying, separated by peeling and winnowing mills.

The character of coffee varies considerably with the climate and mode of culture. Consequently, several varieties exist in commerce, named usually from the sources from which they are derived. The *Mocha Coffee*, which is in small roundish grains, takes precedence of all others. The *Java Coffee* is highly esteemed in this country; but our chief supplies are derived from the West Indies and South America. Some good coffee has been brought from Liberia. Coffee improves by age, losing a portion of its strength, and acquiring a more agreeable flavor. It is said to be much better when allowed to ripen perfectly on the tree, than as usually collected. The grains should be hard, and should readily sink in water. When soft, light, black or dark colored, or musty, they are inferior.

Properties. Coffee has a faint, peculiar odor, and a slightly sweetish, somewhat austere taste. An analysis by M. Payen gives for its constituents, in 100 parts, 34 of cellulose, 12 of hygroscopic water, 10 to 13 of fatty matter, 15·5 of glucose, with dextrin and a vegetable acid, 10 of legumin, 3·5 of *chlorogenate of potassium and caffeine*, 3 of a nitrogenous body, 0·8 of free caffeine (see article *Caffeina*) 0·001 of concrete volatile oil, 0·002 of fluid volatile oil, and 6·697 of mineral substances. (*Journ. de Pharm.*, 3e sér., x. 266.) Pfaff recognized, in the precipitate produced by acetate of lead with the decoction of coffee, two peculiar principles, one resembling tannin, called *caffeo-tannic acid*, and the other an acid, called by him *caffeic acid*. The latter is thought to be identical with the chlorogenic acid of Payen. When strongly heated, it emits the odor of roasted coffee, and is supposed to be the principle to which the flavor of coffee as a drink is owing. A remarkable property of caffeic acid is that, when acted on by sulphuric acid and manganese dioxide, it is converted into quinone, being in this respect analogous to quinic acid. The *sugar* of coffee is probably neither glucose as supposed by Payen, nor cane-sugar as stated by Rochleder, but peculiar; for, when the coffee is roasted, it does not answer to Trommer's test for glucose. (*P. J. Tr.*, xvi. 526–8.) Caffeotannic acid has been ascertained by Hlasiwetz to be a glucoside, resolvable into glucose and a peculiar crystallizable acid, $C_9H_8O_4$, named by him caffeic acid (*Journ.*

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de Pharm., 1867, p. 307), and which may be obtained from coffee, by boiling a solution of the extract with caustic potassa, treating the resulting liquid with sulphuric acid in excess, and extracting the caffeic acid with ether, which yields it somewhat impure by evaporation. (*Ibid.*, January, 1868, p. 75.) Another acid, named *viridic acid* (now generally regarded as an alteration product of caffeo-tannic acid) has been obtained by M. Cech from coffee, by bruising the grains, removing the fat by boiling etherized alcohol, and exposing the residue, moistened from time to time, to the air. In a few days the matter assumes a green color from the formation of *viridate of calcium*, which will yield the acid to alcohol mixed with acetic acid. (*Ibid.*, 1867, p. 318.)

Coffee undergoes considerable change during the roasting process. It swells up very much, acquiring almost double its original volume, while it loses from 15 to 20 per cent. of its weight. (*Pharm. Centralblatt*, 1850, p. 687.) It acquires, at the same time, a peculiar odor entirely different from that of the unroasted grains, and a decidedly bitter taste. An active empyreumatic oil is developed during the process, probably at the expense of a portion of the caffeine. Much of the alkaloid, however, escapes change, and a portion of it is volatilized. The excellence of the flavor of roasted coffee depends much upon the manner in which the process is conducted, and the extent to which it is carried. It should be performed in a covered vessel, over a moderate fire, and the grains should be kept in constant motion. When they have acquired a chestnut brown color, the process should cease. If too long continued, it renders the coffee bitter and acrid, or, by reducing it to charcoal, deprives it entirely of flavor. During a severe roasting it loses a portion of caffeine, which sublimes; while in a slight roasting it loses none: yet ordinary coffee for drinking, prepared by percolation, contains rather more caffeine when prepared from strongly roasted than from slightly roasted coffee, because the caffeine is more easily extracted from the former. (Herman Aubert. See *A. J. P.*, 1873, p. 121.) The coffee should not be burnt long before it is used, and should not be kept in the ground state.

Medical and Economical Uses. More attention has been paid to the effects of coffee on the system in the roasted than in the crude state. Unroasted coffee has been employed in intermittent fever; but it is much inferior to quinine. It has been given in powder, in the dose of a scruple every hour; in decoction, prepared by boiling an ounce with eighteen ounces of water down to six; or in extract, in the dose of from four to eight grains.

The action of coffee is directed chiefly to the nervous system. When swallowed it produces a warming cordial impression on the stomach, quickly followed by a diffused agreeable nervous excitement, which extends itself to the cerebral functions, giving rise to increased vigor of imagination and intellect, without any subsequent confusion or stupor such as characterizes the action of narcotic medicines. Indeed, one of its most extraordinary effects is a disposition to wakefulness, which continues for several hours after it has been taken. It is even capable of resisting, to a certain extent, the intoxicating and soporific influence of alcohol and opium, and may sometimes be advantageously employed for this purpose. It also moderately excites the circulatory system, and stimulates the digestive function. A cup of coffee, taken after a hearty meal, will often relieve the sense of oppression so apt to be experienced, and enable the stomach to perform its office with comparative facility. The exhilarating effects of coffee, united with its delicious flavor when suitably qualified by cream and sugar, have given rise to its habitual employment as an article of diet. Its use for this purpose has prevailed from time immemorial in Persia and Arabia. In 1517 it was introduced by the Turks into Constantinople, whence it was carried to France and England about the middle of the succeeding century, and has since gradually made its way into almost universal use. It cannot be supposed that a substance, capable of acting so energetically upon the system, should be entirely destitute of deleterious properties. Accordingly, if taken in large quantities, it leaves, after its first effects, a degree of nervous derangement or depression equivalent to the previous excitement; and its habitual immoderate employment is well known very greatly to injure the tone of the stomach, and frequently to occasion troublesome dyspeptic and nervous affections. This result is peculiarly apt to take place in indi-

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viduals of susceptible nervous systems, and in those of sedentary habits. We have repeatedly known patients, who have long suffered with headache and vertigo, to get rid of them by abstaining from coffee.

In the treatment of disease, coffee has been less employed than might have been expected from its effect upon the system. There can be no doubt that it may be advantageously used in various nervous disorders. In a tendency to stupor or lethargy dependent on deficient energy of the brain, without congestion or inflammation, it would be found useful by stimulating the cerebral functions. In light nervous headaches, and even in sick headache not caused by the presence of offending matter in the stomach, it often proves temporarily useful. It has acquired much reputation as a palliative in the paroxysms of spasmodic asthma, and has been recommended in hooping-cough, and in hysterical affections. The Egyptians are said to have formerly employed it as a remedy in amenorrhœa. Hayne informs us that in a case of violent spasmodic disease, attended with short breath, palpitation of the heart, and a pulse so much increased in frequency that it could scarcely be counted, immediate relief was obtained from a cup of coffee, after the most powerful antispasmodics had been used in vain for several hours. By the late Dr. Dewees it was highly recommended in cholera infantum, and it has even been used with asserted advantage in cholera. It is said also to have been used successfully in obstinate chronic diarrhœa, and the late Dr. Chapman, of Philadelphia, found it highly useful in calculous nephritis. Under the impression of its diuretic powers, it has been recommended in dropsy. A very concentrated infusion of coffee is serviceable in opium poisoning, but the alkaloid caffeine is probably preferable.

Roasted coffee is said to have the effect of destroying offensive and noxious effluvia from decomposing animal and vegetable substances, and therefore to be capable of beneficial application as a disinfecting and deodorizing agent. The powder of the grains should be roasted until it becomes dark brown, and then sprinkled, or placed in plates, in the infected place.

Coffee is usually prepared in this country by boiling the roasted grains, previously ground into a coarse powder, in water for a short time, and then clarifying by the white of an egg. Some prefer the infusion, made by a process similar to that of percolation. It has more of the aroma of the coffee than the decoction, with less of its bitterness. The proper proportion for forming the infusion for medical use is an ounce to a pint of boiling water, of which a cupful may be given warm for a dose, and repeated, if necessary. A *syrup of coffee* is prepared by Dorvault in the following manner. Treat a pound of ground roasted coffee by percolation with boiling water until two pints have passed. Evaporate eight pounds of simple syrup to six, add the infusion, and strain. Two tablespoonfuls of this syrup may be added to a cup of hot water or milk. It is also used with carbonic acid water.

Coffee depends for its physiological activity upon caffeine and the empyreumatic oil formed during the roasting, probably at the expense of the caffeine. There is much reason for believing that coffee and tea when taken internally lessen the waste of tissue and the elimination of urea. The experiments of Prof. Lehmann seem to show that in this action the empyreumatic oil is at least as active as is caffeine.

The *leaves* of the coffee plant possess properties analogous to those of the fruit, and are extensively used, in the form of infusion, as a beverage, in the vicinity of Padang, in the island of Sumatra. An account of their employment was published in the *Singapore Free Press* by Mr. N. M. Ward, of Padang. Previously to this, Dr. John Gardener, of London, had proposed to introduce them into use in Europe, and is stated to have taken out a patent for the mode of preparing them. A specimen examined by Dr. Stenhouse has been found to contain caffeine in larger proportion than the coffee-bean, and also caffeic acid. Mr. Ward states that, in Sumatra, the leaves are prepared for use by moderately roasting them, and then powdering them coarsely by rubbing in the hands. The powder is made into an infusion like common tea. The taste is said to be like that of tea and coffee combined. (*P. J. Tr.*, xii. 443, and xiii. 207 and 382.)

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CAFFEINA. *U. S. Caffeine.*

$C_8 H_{10} N_4 O_2 . H_2 O$; 212. (CĂF'FĘ-Ī'NĄ.) $C_{16} H_{10} N_4 O_4 . 2HO$; 212.

"A proximate principle of feebly alkaloidal power, generally prepared from the dried leaves of Camellia Thea, Link (*Nat. Ord.* Ternstrœmiaceæ), or from the dried seeds of Coffea Arabica, Linné (*Nat. Ord.* Rubiaceæ); or from Guarana, and occurring also in other plants." *U. S.*

Caffeine (*Caffeia*) was first discovered by Runge, and afterwards by Robiquet. According to Payen, it exists in coffee partly free, partly as a double salt, consisting of *chlorogenic acid* (caffeo-tannic acid), combined with potassa and caffeine.* It may be obtained in the following manner. Exhaust bruised coffee by two successive portions of boiling water, unite the infusions, add acetate of lead in order to precipitate various principles accompanying the caffeine, filter, decompose the excess of acetate of lead in the filtered liquor by sulphuretted hydrogen, concentrate by evaporation, and neutralize with ammonia. The caffeine is deposited in crystals upon cooling, and may be purified by redissolving in water, treating with animal charcoal, and evaporating. H. J. Versmann, of Lubeck, recommends the following process as more economical. Powdered coffee, mixed with one-fifth of its weight of slaked lime, is exhausted, by means of percolation, with alcohol of 0·863; the tincture is distilled to separate the alcohol; the residue is rinsed out of the still with warm water, and the supernatant oil separated; the liquid is evaporated so as to solidify on cooling; and the crystalline mass thus obtained, having been expressed and dried by pressure in bibulous paper, is purified by solution in water with animal charcoal, and recrystallization. (*Chem. Gaz.*, 1852, p. 67.) H. Leuchsenring obtains caffeine by availing himself of its property of subliming unchanged by heat. He precipitates a concentrated decoction of coffee by a weak solution of acetate of lead, filters, evaporates to dryness, mixes the residue with sand, and sublimes as in Mohr's process for procuring benzoic acid. (*A. J. P.*, xxxii. 25.) Still another method, proposed by Vogel, is to treat coffee, ground to powder, with benzin, which dissolves the caffeine and an oily substance, to separate the benzin by distillation, to treat the residue with boiling water which dissolves the caffeine, and deposits it in a crystalline form, after filtration and concentration. (*Journ. de Pharm.*, 3e sér., xxxv. 436.) Caffeine is in "colorless, soft and flexible crystals, generally quite long, and of a silky lustre, permanent in the air, odorless, having a bitter taste and a neutral reaction. Soluble in 75 parts of water and in 35 parts of alcohol at 15° C. (59° F.); in 9·5 parts of boiling water and very soluble in boiling alcohol; also soluble in about 6 parts of chloroform, but very slightly soluble in ether or in disulphide of carbon. When heated to 100° C. (212° F.), the crystals lose 8·49 per cent. in weight (of water of crystallization); and, when heated on platinum foil, they are completely volatilized without carbonizing. On heating Caffeine with chlorine water, or treating it with concentrated nitric acid, it is decomposed; on evaporating afterward at a gentle heat, a yellow mass is left, which, when moistened with water of ammonia, assumes a purplish color. Sulphuric or nitric acid should dissolve it without color, and its aqueous solution should not be precipitated by test-solution of iodide of mercury and potassium (abs. of other alkaloids)." *U. S.* It is precipitated from its aqueous solution by no reagent except tannic acid and solution of iodide of potassium and mercury. When this solution, made by saturating iodide of potassium with red oxide of mercury, is added to a solution of caffeine, a precipitate is produced, which soon takes the form of white, shining, acicular crystals. This reaction is proposed as a test of

* In a recent examination of 25 varieties of coffee, Dragendorff found a variation in the amount of caffeine of 0·6 to 2·2 per cent. The most important varieties were as follows:

Brown Preang	0·71 per cent.	First native Ceylon	0·87 per cent.
Finest Mocha	0·64 "	Second " "	1·54 "
Yellow Menado	1·22 "	Third " "	1·59 "
Finest plantation Jamaica	1·43 "	Costa Rica	1·18 "
First Surinam	1·78 "	West Indian	1·22 "
Pearl plantation Ceylon	0·78 "	Rio	1·14 "
Yellow Java	0·88 "	Jamaica	0·67 "
Gray Java	2·21 "	Santos	1·46 "

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caffeine by Prof. Dellfs; for, though the same solution will precipitate the other alkaloids, the product is always amorphous. (*Chem. Gaz.*, Feb. 15, 1855.) Caffeine is remarkable for containing a larger proportion of nitrogen than almost any other proximate vegetable principle, in this respect equalling some of the most highly animalized products.

Medical Properties. The alkaloid caffeine, given in large dose to the lower animals, produces hurried respiration, restlessness, slightly lowered followed by markedly elevated temperature, tetanic and clonic convulsions, progressive paralysis, and finally death from paralytic arrest of respiration. The cause of the convulsions in mammals is not determined, but in the frog the alkaloid certainly acts as a muscle poison. It would seem, also, that the cardiac muscle was influenced directly by it, although Leven affirms that in the beginning of the toxæmia the arterial pressure is increased. The symptoms produced by ordinary doses in man are not marked, but we have seen very decided cardiac depression, with much shortness of breath, produced by 5 grains of it. There is also frequently increased diuresis, probably produced by the effort of elimination. In doses of from eight to twelve grains it is said to produce great restlessness, tremulousness, anxiety, excited mental action, passing even into delirium, excessive urination, etc. It is almost certain that if in sufficient amount it is capable of causing toxic symptoms in man similar to those which it produces in the lower animals, the cerebral disturbance of course being more prominent. What little knowledge we have in regard to the empyeumatic oil of coffee indicates that it is a powerful cerebral stimulant. The usual dose of caffeine is 5 grains (0·33 Gm.); but, as already stated, we have seen this quantity produce unpleasant symptoms in the adult female. On the other hand, abroad it seems to be used more freely; at least it is affirmed that in France (*A. J. P.*, 1878, p. 297) the commencing dose is usually 7 grains (0·46 Gm.), rapidly increased to 60 grains (3·9 Gm.). In the form of *citrate of caffeine*, made by dissolving caffeine in a solution of citric acid with a gentle heat, and evaporating carefully, it has been recommended, as a remedy and preventive in sick headache (migraine), in the dose of a grain (0·065 Gm.) every hour, before and during the paroxysm. Two or three grains (0·13–0·20 Gm.) during the twenty-four hours is recommended under ordinary circumstances. (*Botkin.*) The *arseniate* has been given as an antiperiodic; but the arsenic is no doubt the main therapeutic agent in this case.

CALAMUS. *U. S.* *Calamus.* [*Sweet Flag.*]

(CĂL'Ą-MŬS.)

"The rhizome of Acorus Calamus. Linné. (*Nat. Ord.* Araceæ.)" *U. S.*

Rhizoma Calami, *P.G.*; Radix Calami Aromatici, Radix Acori; Acore vrai, Acore odorant, *Fr.*; Kalmuswurzel, *G.*; Calamo Aromatico, *It., Sp.*

Gen. Ch. Spadix cylindrical, covered with florets. *Corolla* six-petalled, naked. *Style* none. *Capsule* three-celled. *Willd.*

Acorus Calamus. Willd. *Sp. Plant.* ii. 199; Barton, *Med. Bot.* ii. 63; *B. and T.* 279. The sweet flag, or calamus, has a perennial, horizontal, jointed, somewhat compressed root (rhizome), from half an inch to an inch thick, sometimes several feet in length, sending off numerous round and yellowish or whitish radicles from its base, and bunches of brown fibres resembling coarse hair from its joints, internally white and spongy, externally whitish with a tinge of green, variegated with triangular stains of light brown and rose color. The leaves are all radical, sheathing at the base, long, sword-shaped, smooth, green above, but, near their origin from the root, of a red color variegated with green and white. The scape or flower-stem resembles the leaves, but is longer, and from one side, near the middle of its length, sends out a cylindrical spadix, tapering at each end, about two inches in length, and crowded with greenish yellow flowers. These are without calyx, and have six small, concave, membranous, truncated petals. The fruit is an oblong capsule, divided into three cells, and containing numerous oval seeds.

This is an indigenous plant, growing throughout the United States, in low, wet, swampy places, and along the sides of ditches and streams, and flowering in May and June. It is also a native of Europe and Western Asia; and a variety is found

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in India. The European plant differs slightly from the American. The leaves as well as the root have an aromatic odor; but the latter only is employed. It should be collected late in the autumn, or in the spring. After removal from the ground, the rhizomes are washed, freed from their fibres, and dried with a moderate heat. By drying they lose nearly one-half their diameter, but are improved in odor and taste.

Properties. The roots, as kept in the shops, are "in sections of various lengths, unpeeled, about three-quarters of an inch (2 cm.) broad, subcylindrical, longitudinally wrinkled; on the lower surface marked with the circular scars of the rootlets in wavy lines, externally reddish brown, somewhat annulate from remnants of leaf sheaths; internally whitish, of a spongy texture, breaking with a short, corky fracture, showing numerous oil-cells and scattered wood-bundles, the latter crowded within the subcircular nucleus-sheath. It has an aromatic odor, and a strongly pungent taste." *U. S.* Their texture is light and spongy, their color internally whitish or yellowish white, and their fracture short and rough. A variety imported from Germany consists exclusively of the interior portion of the root. The pieces are usually long, slender, irregularly quadrangular, and of a grayish white color.

The odor of calamus is strong and fragrant; its taste warm, bitterish, pungent, and aromatic. Its active principles are taken up by boiling water. From 100 parts of the fresh root of the European plant, Trommsdorff obtained 0·1 of volatile oil, 2·3 of soft resin, 3·3 of extractive with a little chloride of potassium, 5·5 of gum with some phosphate of potassium, 1·6 of starch analogous to inulin, 21·5 of lignin, and 65·7 of water. Sixteen ounces of the dried root afforded to Neumann about two scruples of volatile oil. The oil is at first yellow, but ultimately becomes red, and has the smell and taste of calamus. Kurbatow (*Annal. d. Chemie*, vol. 173, p. 4) examined oil of calamus, and found that the portion boiling below 170° C. (338° F.) yielded after treatment with sodium a terpene, $C_{10}H_{16}$, having sp. gr. ·8793 at 0° C. (32° F.); and having a boiling point of 158° C. (316·4° F.). The extractive matter has an acrid and sweetish taste. The root is sometimes attacked by worms, and deteriorates by keeping. The India variety is more slender than the European, and has a stronger and more pleasant flavor.

Medical Properties and Uses. Calamus is a feeble aromatic, which may be used with advantage in pain or uneasiness of the stomach or bowels arising from flatulence, and as an adjuvant to tonic or purgative medicines. It was probably known to the ancients, and is supposed to have been the ἄκορον of the Greeks; but the *calamus aromaticus* of Dioscorides was a different product, having been derived, according to Dr. Royle, from a species of *Andropogon*. The medicine is at present not much used. The dose in substance is from a scruple to a drachm (1·3–3·9 Gm.). An infusion, made in the proportion of an ounce of the root to a pint of boiling water, is sometimes given in the dose of a wineglassful (60 C.c.) or more.

Off. Prep. Extractum Calami Fluidum.

CALCIUM. *Calcium.*

Ca; 40. (CĂL'CĮ-ŬM.) Ca; 40.

This is the metal characteristic of lime, and consequently of all calcareous substances. It was obtained by Dr. Matthiessen, in 1855, in masses of the size of a pea, by the electrolysis of chloride of calcium with a Bunsen battery. It is a pale yellow metal, remarkably glittering when freshly filed. Its fracture is jagged, becoming granular. It is malleable and very ductile. In a dry air it remains unaltered; but it soon tarnishes in a moist one. It melts at a red heat, and afterwards burns with splendor, forming lime, or calcium oxide. (*Chem. Gaz.*, June 15, 1855.)

Calcium is a very abundant element in nature, existing in the mineral kingdom chiefly as a carbonate, in the form of limestone, marble, chalk, and calcareous spar; and as a phosphate and carbonate in the bones and shells of animals.

CALCII BROMIDUM. *U. S. Bromide of Calcium.*

$CaBr_2$; 199·6. (CĂL'CĮ-Ī BRŌ-MĪ'DŬM.) Ca Br; 99·8.

Calcium Bromatum, Bromure de Calcium, Bromure de Chaux, *Fr.*; Brom calcium, *G.*

"Bromide of Calcium should be preserved in well-stopped bottles." *U.S.* Although

this salt has been largely used, it has never been officinal until the present revision. It is prepared by M. Boedecker by first forming a bromide of sulphur, by the addition of 20 parts of the flowers of sulphur to 240 parts of bromine; this is added to a milk of lime containing 140 parts of fresh lime. The sulphate and bromide of calcium are formed and are readily separated. (*Journ. de Pharm.*, 4e sér., viii. 463.) Mr. Jas. R. Mercein puts five ounces of bromine and two and a half pints of water in a half gallon specie jar, passes a stream of sulphuretted hydrogen through the bromine until it is all taken up, filters, drives off excess of sulphuretted hydrogen by heat, distils the solution of hydrobromic acid thus obtained until four-fifths have passed over, saturates this with excess of precipitated carbonate of calcium, filters and evaporates. (*A. J. P.*, xliv. 100.) Mr. Macdonald (*Ibid.*, 1873) employs the following method. Dissolve 4 ounces of bromide of ammonium in a pint of water. Put in a flask and bring to the boiling point. Keep boiling, and add milk of lime (made from *pure* calcined lime) in small quantities, until ammoniacal vapors cease to be evolved. The operator can easily tell when this point has been reached, by the sense of smell. Filter the solution, evaporate to a syrupy consistency, remove from the fire, and stir until cold.

Properties. "A white, granular salt, very deliquescent, odorless, having a pungent, saline and bitter taste and a neutral reaction. Soluble in 0·7 part of water and in 1 part of alcohol at 15° C. (59° F.); very soluble in boiling water and in boiling alcohol. At a dull red heat the salt fuses without losing anything but moisture. At a higher temperature it is partially decomposed. An aqueous solution of the salt yields, with test-solution of oxalate of ammonium, a white precipitate soluble in hydrochloric, but insoluble in acetic acid. If disulphide of carbon be poured into a solution of the salt, then chlorine water added drop by drop, and the whole agitated, the disulphide will acquire a yellow or yellowish brown color without a violet tint." *U. S.*

Tests. "If diluted sulphuric acid be dropped upon the salt, the latter should not at once assume a yellow color (abs. of bromate). If 1 Gm. of the salt be dissolved in 10 C.c. of water, some gelatinized starch added and then a few drops of chlorine water carefully poured on top, no blue zone should make its appearance at the line of contact of the two liquids (iodide). On adding to 1 Gm. of the salt dissolved in 20 C c. of water, 5 or 6 drops of test-solution of nitrate of barium, no immediate cloudiness or precipitate should make its appearance (sulphate). If a solution of the salt be precipitated with an excess of nitrate of silver, the washed precipitate for some time shaken with a cold, saturated solution of carbonate of ammonium, and the decanted and filtered liquid supersaturated with nitric acid, not more than a faint cloudiness, insufficient to produce a precipitate, should appear (limit of chloride). On adding to the aqueous solution, first, chloride of ammonium, then test-solution of carbonate of ammonium and water of ammonia in slight excess, and gently warming, the filtrate separated from the resulting precipitate should not be rendered more than faintly turbid by test-solution of phosphate of sodium (limit of magnesium). 1 Gm. of the dry salt, when completely precipitated by nitrate of silver, yields, if perfectly pure, 1·878 Gm. of dry bromide of silver." *U. S.*

Medical Properties and Uses. Bromide of calcium was proposed by Dr. Hammond, in 1871, as a substitute for the corresponding salt of potash. It has failed to gain much support from the medical profession, but is sometimes employed as an adjuvant in epilepsy and hysteria. Its action upon the lower animals has been partially investigated by Guttmann (*Phila. Med. Times*, iv. 361), who finds that it acts as a sedative to the nerve-centres, but lacks the depressant cardiac action of the bromide of potassium. The dose is half to two drachms (0·95–7·8 Gm.).

CALCII CARBONAS PRÆCIPITATUS. *U. S.* *Precipitated Carbonate of Calcium.*

$CaCO_3$; 100. (KĂL'SĮ-Ī KĂR-BŌ'NĂS PRĒ-SĬP-Į-TĀ'TŬS.) Ca O, CO_2; 50.

Calcis Carbonas Præcipitata, *Br.;* Calcaria Carbonica Præcipitata, *P. G.;* Carbonas Calcicus Præcipitatus, Creta Præcipitata; Carbonate de Chaux précipité, Craie précipitée, *Fr.;* Präcipitirter kohlensauer Kalk, *G.*

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A formula for this preparation is found in the Pharmacopœia of 1870.*

"Take of Chloride of Calcium *five ounces* [avoirdupois]; Carbonate of Soda *thirteen ounces* [avoird.]; Boiling Distilled Water *a sufficiency*. Dissolve the Chloride of Calcium and the Carbonate of Soda each in two pints [Imperial measure] of the Water; mix the two Solutions; and allow the precipitate to subside. Collect this on a calico filter, wash it with boiling Distilled Water until the washings cease to give a precipitate with nitrate of silver, and dry the product at the temperature of 212°." *Br.*

The processes do not essentially differ. In each a mutual interchange of principles takes place, resulting in the production of chloride of sodium which remains in solution, and carbonate of calcium which is deposited, $CaCl_2 + Na_2CO_3 = CaCO_3 + 2NaCl$. Any peculiar advantage of the preparation must depend on the minute division of its particles. According to Dr. Bridges, this effect is best obtained by employing the solutions at the boiling temperature, a precaution which is observed in most processes now. (*A. J. P.*, xvi. 163.) When properly made, it is "a very fine, white, impalpable powder, permanent in the air, odorless and tasteless, and insoluble in water or alcohol. Wholly soluble in hydrochloric, nitric, or acetic acid with copious effervescence. By exposure to a red heat the salt loses carbonic acid gas, and the residue has an alkaline reaction. A neutral solution of the salt in acetic acid yields, with test-solution of oxalate of ammonium, a white precipitate soluble in hydrochloric, but insoluble in acetic acid. On adding to another portion of the same solution, first, chloride of ammonium, then test-solution of carbonate of ammonium and water of ammonia in slight excess, and gently warming, the filtrate separated from the resulting precipitate should not be rendered more than faintly turbid by test-solution of phosphate of sodium (limit of magnesium). A solution of the salt in hydrochloric acid, freed from carbonic acid gas by heat, should not be rendered turbid, when supersaturated with water of ammonia (abs. of aluminium, iron, or phosphate)." *U. S.*

Medical Properties and Uses. For ordinary use, it probably has no such superiority over prepared chalk as to counterbalance its greater expensiveness, but it is preferred by some in the preparation of tooth-powders. The dose is from 10 to 40 grains (0·65–2·6 Gm.) or more.

Off. Prep. Trochisci Bismuthi, *Br.*

CALCII CHLORIDUM. *U.S., Br.* *Chloride of Calcium.*

$CaCl_2$; 110·8. (KĂL'KĮ-Ī KHLŌ'RĮ-DŬM.) Ca Cl; 55·4.

"Chloride of Calcium, deprived of its water by fusion at a low red heat. It should be preserved in well-stopped bottles." *U. S.*

Calcaria Muriatica, Chloridum Calcicum; Muriate of Lime, Hydrochlorate of Lime; Chlorure de Calcium, Hydrochlorate de Chaux, *Fr.*; Chlorcalcium, Salzsaures Kalk, *G.*

Chloride of calcium consists of chlorine, united with calcium, the metallic radical of lime. It may be readily formed by saturating hydrochloric acid with chalk or marble, evaporating to dryness, and heating to redness. The hydrochloric acid, by reacting with the lime, forms chloride of calcium and water, the latter of which is dissipated at a red heat, $CaCO_3 + 2HCl = CaCl_2 + CO_2 + H_2O$. The Br. Pharmacopœia, after neutralizing the acid with carbonate of calcium, adds a little solution of chlorinated lime and slaked lime, filters, evaporates till the chloride becomes solid, and, instead of igniting the residue, dries it at about 205° C. (400° F.).

Properties. Chloride of calcium is in "colorless, slightly translucent, hard and friable masses, very deliquescent, odorless, having a hot, sharp, saline taste, and a neutral or faintly alkaline reaction. Soluble in 1·5 parts of water and 8 parts of alcohol at 15° C. (59° F.); very soluble in boiling water, and soluble in 1·5 parts of boiling alcohol. At a low red heat the salt fuses to an oily liquid which, on

* "Take of Solution of Chloride of Calcium *five pints and a half*; Carbonate of Sodium *seventy-two troyounces*; Distilled Water *a sufficient quantity*. Dissolve the Carbonate of Sodium in six pints of Distilled Water. Heat this solution and the Solution of Chloride of Calcium, separately, to the boiling point, and mix them. After the precipitate has subsided, separate it from the supernatant liquid by decantation, and wash it with boiling Distilled Water until the washings cease to be affected by a solution of nitrate of silver. Lastly, dry the precipitate on bibulous paper." *U. S.* 1870.

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cooling, solidifies to a mass of the original appearance, entirely soluble in water. The aqueous solution yields, with test-solution of oxalate of ammonium, a white precipitate, soluble in hydrochloric but insoluble in acetic acid. With test-solution of nitrate of silver, it yields a white precipitate soluble in ammonia. The dilute aqueous solution should not be precipitated by water of ammonia (aluminium, iron, etc.), nor by test-solution of chloride of barium (sulphate). On adding to the aqueous solution, first, chloride of ammonium, then test-solution of carbonate of ammonium and water of ammonia in slight excess, and gently warming, the filtrate separated from the resulting precipitate should not be rendered more than faintly turbid by test-solution of phosphate of sodium (limit of magnesium)." *U. S.* On account of its avidity for water, the fused salt is used for drying gases. The crystallized salt is also very deliquescent, and has the form of colorless, transparent, striated, six-sided prisms. The crystals, on exposure to heat, first dissolve in their water of crystallization, and after this has evaporated, undergo the igneous fusion. With ice or snow they form a powerful frigorific mixture. "The salt evolves no chlorine or hypochlorous acid on the addition of hydrochloric acid, is entirely soluble in twice its weight of water, and is not precipitated by lime-water." *Br.* Chloride of calcium exists in the water of the ocean and of many springs. It is usually associated with common salt and chloride of magnesium, from which it is separated with difficulty. When crystallized it contains six molecules of water.

Chloride of calcium is used medicinally in solution only.*

Pharm. Uses. In preparing Acidum Tartaricum, *Br.;* Æther, *Br.;* Æther Purus, *Br.;* Chloroformum, *Br.;* Ferrum Redactum, *Br.*

Off. Prep. Calcis Carbonas Præcipitata, *Br.;* Morphiæ Hydrochloras, *Br.*

CALCII HYPOPHOSPHIS. *U. S.* *Hypophosphite of Calcium.*

$Ca H_4 (PO_2)_2$; 170. (KĂL'CĮ-Ī HŸ-PŌ-PHŌS'PHĮS.) CaO, 2HO, PO; 85.

Calcis Hypophosphis; Hypophosphite of Lime; Calcaria Hypophosphorosa, Hypophosphis Calcicus; Hypophosphite de Chaux, *Fr.;* Unterphosphorigsaurer Kalk, *G.*

Attention has been called to the hypophosphites as a class of salts, in consequence of their recommendation by Dr. Churchill, of Paris, in the treatment of phthisis, in which they are thought to be useful by furnishing phosphorus to the tissues. One of the first papers on their mode of preparation and qualities was communicated by Prof. Procter. (See *A. J. P.*, xxx. 118.) Hypophosphorous acid consists of one atom of phosphorus, two of oxygen, and three of hydrogen, of which latter, however, only one is replaceable by metal. It is, therefore, a monobasic acid. It has a strong affinity for oxygen, and acts as a powerful deoxidizing or reducing agent, which property it is supposed to owe to the presence of the unreplaceable hydrogen atoms, sometimes termed "aldehydic" hydrogen. When heated, it is resolved into phosphuretted hydrogen and phosphoric acid. Its salts are generally soluble in water and deliquescent, and many of them are soluble in alcohol. They are converted into phosphates by heat, with the escape of phosphuretted hydrogen; and some of them are explosive.

Hypophosphite of calcium has attracted most attention, and would meet the views of those who wish to supply phosphate of calcium to the system, as the hypophosphorous acid is converted into the phosphoric by its deoxidizing power. To prepare it Prof. Procter gave the following formula. Slake 4 lbs. avoird. of lime with a gallon of water, add it, in a deep boiler, to 4 gallons of boiling water, and mix thoroughly. To the mixture add a pound (avoird.) of phosphorus, and continue the boiling, adding hot water from time to time to keep up the measure, until the combination is complete, and phosphuretted hydrogen is no longer evolved. It is necessary that provision should be made for the escape of the gas, which takes fire spontaneously in contact with the air. There are formed in the liquid, phosphate and hypophosphite of calcium, the phosphorus having become oxidized at the expense of the water, the hydrogen of which has escaped in combination with another

* *Liquor Calcii Chloridi* was officinal in Pharm. 1870. A convenient method of making this preparation is to dissolve 228 grains of fused chloride of calcium in 1 fluidounce of distilled water and filter if necessary.

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portion of phosphorus, which is therefore lost. The liquid is filtered to separate the insoluble phosphate and residuary lime, then concentrated, and refiltered to separate the carbonate of calcium formed by the action of the air on a little lime held in solution, and lastly evaporated till a pellicle appears; after which the salt may be allowed to crystallize by setting the liquid aside, or may be obtained in the granular form by continuing the heat, and stirring. The salt should be introduced into bottles.

Hypophosphite of calcium is "in colorless or white, six-sided prisms, or thin, flexible scales, of a pearly lustre, permanent in dry air, odorless, having a nauseous, bitter taste and a neutral reaction. Soluble in 6·8 parts of water at 15° C. (59° F.), and in 6 parts of boiling water; insoluble in alcohol. When heated in a dry test-tube, the salt decrepitates, gives off water, then evolves spontaneously-inflammable phosphoretted hydrogen, leaving a reddish residue which amounts to about 80 per cent. The aqueous solution yields, with test-solution of oxalate of ammonium, a white precipitate soluble in hydrochloric, but insoluble in acetic acid. Acidified with hydrochloric acid and added to excess of test-solution of mercuric chloride, it produces a white precipitate of mercurous chloride, and, on further addition, metallic mercury separates.

"When dissolved in water, the salt should leave no insoluble residue (insoluble salts of calcium). The aqueous solution should yield no precipitate with test-solution of acetate of lead (soluble phosphate), nor, after being acidulated with nitric acid, with test-solution of chloride of barium (soluble sulphate). On adding to the aqueous solution, first, chloride of ammonium, then test-solution of carbonate of ammonium and water of ammonia in slight excess, and gently warming, the filtrate separated from the resulting precipitate should not be rendered more than faintly turbid by test-solution of phosphate of sodium (limit of magnesium)." *U. S.*

The solubility of hypophosphite of calcium is increased by the addition of hypophosphorous acid. For a method of purifying alkaline hypophosphites, see *Journ. de Ph. d'Anvers*, 1879, p. 57; *N. R.*, 1879, p. 142.

As the soluble salts of mercury, copper, and silver are reduced by the hypophosphites, they are of course incompatible with it in prescriptions. With the hypophosphite of calcium, all the soluble sulphates and carbonates produce precipitates. As the hypophosphites are insoluble in cod-liver oil, they should be dissolved in syrup before being added to the oil. (See *Syrupus Calcii Hypophosphitis.*)

Medical Properties and Uses. The hypophosphite of calcium has been with the other hypophosphites strongly recommended in chronic phthisis, and is still much used; but the weight of testimony appears to be opposed to the first favorable impressions; and, though some cases may have seemed to be benefited, yet great care must be taken not to allow a reliance on the hypophosphites to interfere with the use of remedies known to be efficient, as cod-liver oil, and supporting measures generally. The remedy has also been highly commended in scrofulous diseases and in cases of defective nutrition of the nerve centres; but in most of these latter cases some direct preparation of phosphorus is probably superior, as it is not proven and not probable that the hypophosphites can yield up their phosphorus to the nerve centres. The dose of either of the hypophosphites is from ten to thirty grains (0·65–1·95 Gm.), three times a day.

Off. Prep. Syrupus Hypophosphitum.

CALCII PHOSPHAS PRÆCIPITATUS. *U.S.* *Precipitated Phosphate of Calcium.*

$Ca_3(PO_4)_2$; 310. (KĂL'CĮ-Ī PHŌS'PHĂS PRÆ-CĪP-Į-TĀ'TŪS.) 3CaO, PO_5; 155.

Calcis Phosphas, *Br.;* Phosphate of Calcium; Calcaria Phosphorica, *P. G.;* Phosphas Calcicus Præcipitatus; Precipitated Phosphate of Lime; Phosphate de Chaux hydraté, *Fr.;* Phosphorsaurer Kalk, *G.*

A formula for this preparation was given in the U. S. Pharmacopœia of 1870.*

* "Take of Bone, calcined to whiteness, and in fine powder, *four troyounces;* Muriatic Acid *eight troyounces;* Water of Ammonia *twelve fluidounces*, or *a sufficient quantity;* Distilled Water *a sufficient quantity*. Macerate the Bone in the Acid, diluted with a pint of Distilled Water, until

"Take of Bone Ash *four ounces* [avoirdupois]; Hydrochloric Acid *six fluidounces* [Imperial measure]; Water *two pints* [Imp. meas.]; Solution of Ammonia *twelve fluidounces*, or *a sufficiency;* Distilled Water *a sufficiency*. Digest the Bone Ash in the Hydrochloric Acid diluted with a pint of Water, until it is dissolved. Filter the solution, if necessary; add the remainder of the Water, and afterwards the Solution of Ammonia, until the mixture acquires an alkaline reaction; and, having collected the precipitate on a calico filter, wash it with boiling Distilled Water as long as the liquid which passes through occasions a precipitate, when dropped into solution of nitrate of silver acidulated with nitric acid. Dry the washed product at a temperature not exceeding 212°." *Br.**

This preparation, whatever opinion may be entertained of its real powers, has been very properly retained in the U. S. Pharmacopœia, as it is considerably used, and is by some much esteemed. One of its more recent uses was to replace carbonate of magnesium in the process for medicated waters. Experience has shown, however, that its insolubility is not as great as supposed, and cotton has been substituted

The hydrochloric acid dissolves the phosphate of calcium of the bones, and lets it fall, on the addition of ammonia, in a state of minute division. The ablution is intended to free it from adhering chloride of ammonium. The salt thus obtained is, for the sake of distinction, called *bone phosphate of calcium*. It is "a light, white, amorphous powder, permanent in the air, odorless, tasteless, and insoluble in water or alcohol. Wholly soluble in nitric or in hydrochloric acid without effervescence (abs. of carbonate). At an intense heat it is fusible without decomposition. A solution of the salt in diluted nitric acid, after being mixed with an excess of acetate of sodium, yields a white precipitate with test-solution of oxalate of ammonium, and a lemon yellow precipitate with test-solution of ammonio-nitrate of silver. On dissolving 1 Gm. of the salt in hydrochloric acid, and subsequently adding water of ammonia, the salt is precipitated unaltered. The precipitate should yield nothing to a boiling solution of potassa (abs. of aluminium), and, when washed and dried, should weigh 1 Gm." *U. S.*

"Ten grains dissolve perfectly and without effervescence in diluted hydrochloric acid, and the solution yields with ammonia a white precipitate, insoluble in boiling solution of potash, and weighing ten grains when washed and dried." *Br.*

Medical Uses. In the form of burnt hartshorn, phosphate of calcium formerly enjoyed a brief popularity in the treatment of rickets and mollities ossium, in which its use seemed to be indicated upon obvious chemical grounds. In 1851, Benecke suggested that, as it is essential in animals as well as plants to the formation of cells, it might be found useful in certain pathological states of the system characterized by defective nutrition, such as the scrofulous affections, and from that time its use has gradually become more frequent, and, in connection with other phosphates, as those of iron, sodium, and potassium, it has acquired no little reputation in different forms of scrofula, mollities ossium, rickets, and even chronic phthisis. It is also thought to have proved useful by hastening the union of fractured bones; and M. Alphonse Milne-Edwards is said to have shown, by experiments upon dogs and rabbits, that, in these animals, the callus in fractured bones forms more quickly under its use than without it. (*Med. Times and Gaz.*, May, 1856, p. 489.) Though insoluble in water, it is probably in general dissolved by the gastric liquids, in consequence of the acid present in them; but it is best administered in acid solution, and is at present very extensively used dissolved in lactic acid and emulsified with cod-liver oil. The dose is from ten to thirty grains (0·65–1·95 Gm.).

Off. Prep. Syrupus Calcii Lactophosphatis. *U. S.*

it is dissolved, and filter the solution. Add another pint of Distilled Water, and then, gradually, Water of Ammonia, until the liquid acquires an alkaline reaction. Mix the precipitate obtained, while yet in the state of magma, with twice its bulk of boiling Distilled Water, and pour the whole upon a strainer. Wash the precipitate with boiling Distilled Water until the washings cease to be affected by a solution of nitrate of silver, acidulated with nitric acid. Lastly, dry the precipitate with a gentle heat." *U. S.*

* For an apparatus for preparing *phosphate of calcium* on a large scale, see *Journ. de Pharm.*, Sept. 1, 1875, p. 193.

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CALENDULA. *U. S. Calendula.* [*Marigold.*]

(CĄ-LĔN'DŬ-LĄ.)

"The fresh, flowering herb of Calendula officinalis. Linné. (*Nat. Ord.* Compositæ.)" *U. S.*

Fleurs de Tous les mois, Souci, *Fr.;* Ringelblume, *G.*

Gen. Ch. Flower-head heterogamous, rayed, with the female flowers of the ray fertile, in one or two rows, the hermaphrodite of the disk sterile. *Involucre* broad, with linear, acuminate, subequal, often scarious bracts in one or two rows. *Receptacle* flat, naked. *Corolla* of female flowers ligulate, with the lamina entire or three dentate. Hermaphrodite flowers, regular, tubular, with an enlarged limb shortly five cut at the apex. *Anthers* sagittate, with the auricles setaceous-mucronate or caudate. *Style* of the hermaphrodite flower undivided. *Achenia* bare; those of the ray incurved, 2-3 serrate, heteromorphous usually upon the back, or everywhere muricate; the outer often elongate, linear, sometimes empty; the intermediate broader, often alate; the interior shorter, more incurved; those of the disk thin, smooth, empty. (Bentham & Hooker, *Genera Plantarum*, ii. 454.)

Calendula officinalis. L. The common marigold of the gardens is too well known to need description, other than that of the Pharmacopœia.

Properties. "Stem somewhat angular, rough; leaves alternate, thickish, hairy, spatulate or oblanceolate, slightly toothed, the upper ones sessile; flower-heads nearly two inches (5 cm.) broad, the yellow strap-shaped ray-florets in one or several rows, fertile, the achenes incurved and muricate; odor slightly narcotic; taste bitter and saline." *U. S.* The odor is much stronger in the fresh than in the dry herb, and, on exposure to the sun, the yellow color fades into whitish. Among its constituents is a peculiar principle, called *calendulin*, discovered by Geiger most abundantly in the flowers, and considered by Berzelius as analogous to bassorin, though soluble in alcohol. *French* or *African Marigold*, so called, is very frequently substituted for the officinal drug. It is the *Tagetes patula L.* and *T. erecta*, Lin., both of Mexico. The flowers are readily distinguished by the scales of the involucre being united to form a tube, and by the slender, flattish achenes being crowned with a few chaffy or awned scales. The broadly strap-shaped ray-florets are toothed, and light or deep orange color sometimes striped with red.

Medical Properties and Uses. The medical properties of this new officinal are probably very feeble, if indeed they be not altogether apocryphal. In the days of therapeutic darkness the plant was thought to be antispasmodic, sudorific, deobstruent, and emmenagogue, and was given in low forms of fever, scrofula, jaundice, amenorrhœa, etc. Both the leaves and flowers were used; but the latter were preferred, and were usually administered in the recent state in the form of tea. An extract was also prepared, and employed in cancerous and other ulcers, sick stomach, etc. The tincture has been used to a considerable extent as an embrocation in sprains, bruises, etc., and probably is of as much value as simple alcohol.

Off. Prep. Tinctura Calendulæ, *U.S.*

CALUMBA. *U. S. Calumba.* [*Columbo.*]

(CĄ-LŬM'BĄ.)

"The root of Jateorrhiza Calumba. Miers. (*Nat. Ord.* Menispermaceæ.)" *U. S.* "The root, cut transversely and dried, of Jateorrhiza Calumba, *Miers;* Cocculus palmatus, *non D. C.; Steph. and Church. Med. Bot.*, plate 160." *Br.*

Calumbæ Radix, *Br.;* Radix Colombo, *P. G.;* Radix Columbo; Colomba, *U. S.* 1850; Colombo, *Fr.;* Columbowurzel, *G.;* Columba, *It.;* Raiz de Columbo, *Sp.;* Kalumbo, *Port.;* Calumb, *Mozambique.*

The columbo plant was long but imperfectly known. Flowering specimens of a plant gathered by Commerson, about the year 1770, in the garden of M. Poivre in the Isle of France, and sent to Europe with that botanist's collection, were examined by Lamarck, and described under the name of *Menispermum palmatum.* But its original locality was unknown, and it was only conjectured to be the source of columbo. In the year 1805, M. Forten, while engaged in purchasing the drug in Mozambique, obtained possession of a living offset of the root, which, being taken

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to Madras, and planted in the garden of Dr. Anderson, produced a male plant, which was figured and described by Dr. Berry. From the drawing thus made, the plant was referred to the natural family of the Menispermaceæ; but, as the female flowers were wanting, some difficulty was experienced in fixing its precise botanical position. De Candolle, who probably had the opportunity of examining Commerson's specimens, gave its generic and specific character; but confessed that he was not acquainted with the structure of the female flower and fruit. This desideratum, however, was supplied by ample drawings sent to England by Mr. Telfair, of Mauritius, made from plants which were propagated from roots obtained by Captain Owen in 1825, while prosecuting his survey of the eastern coast of Africa. The plant was first placed in the genus Cocculus, which was separated by De Candolle from Menispermum. Subsequently, Mr. J. Miers established a new genus, which has been received by botanists, giving to it the name of Jateorrhiza. M. Miers also separated his plant specifically from *C. palmatus* of De Candolle, describing it under the name of *Jateorrhiza Calumba*. This species is now recognized by both the U. S. and Br. Pharmacopœias. But the very careful researches of Mr. Hanbury (*Pharmacographia*, 2d ed., p. 23) have led him to consider the specific differences as unimportant and inconstant. These differences are that in *J. palmata* "the lobes at the base of the leaf overlap, and the male inflorescence is nearly glabrous; while in *J. Calumba* the basal lobes are rounded, but do not overlap, and the male inflorescence is setose-hispid." The plants are probably only varieties of one species, and it is almost certain that columbo is derived from each of them.

Gen. Ch. *Sepals* 6, in two rows, somewhat unequal, thin. *Petals* 6, shorter than the sepals. Male flowers: *Stamens* 6, free, with the apex recurved-clavate. *Anthers* unilocular with the apex extrorse, dehiscent by a transverse cleft. Female flowers: *Carpels* 3, with lacerate, reflex stigmata. *Drupe* ovoid with a subterminal cicatrix of the style. *Putamen* somewhat concave in its inner face. *Seed* meniscoid; albumen fleshy, ruminate; embryo somewhat curved. *Cotyledons* laterally bivaricate." (Bentham and Hooker, *Genera Plantarum*, i. 34.)

"The plants of this genus, natives of intertropical Africa, are all climbers, distinguished by a very peculiar habit, having very large deeply-lobed leaves, upon very long petioles, and clothed with long strigose hairs; their inflorescence is in long slender racemes; the fruit is a drupe containing a putamen covered with a dense hairy coating imbedded in the fleshy mesoderm." (*Ann. Mag. Nat. Hist.*, Feb. 1864.)

Cocculus palmatus. De Cand. *Syst. Veg.* i. 523; Woodv. *Med. Bot.* 3d ed., v. 21; Hooker, *Curtis's Bot. Mag.*, Nos. 2970, 2971. *Jateorrhiza palmata.* Miers, *Annals and Mag. of Nat. Hist.*, Feb. 1864, p. 183. *B. & T.* 13. This is a climbing plant, with a perennial root, consisting of several fasciculated, fusiform, somewhat curved, and descending tubers, as thick as an infant's arm. The stems, of which one or two proceed from the same root, are twining, simple in the male plant, branched in the female, round, hairy, and about as thick as the little finger. The leaves, which stand on rounded, glandular hairy footstalks, are alternate, distant, cordate, with three, five, or seven entire, acuminate, wavy, somewhat hairy lobes, and as many nerves, each running into one of the lobes. The flowers are small and inconspicuous, and arranged in solitary axillary racemes, which, in the male plant, are compound, in the female, simple, and in both, shorter than the leaves.

Jateorrhiza Calumba. Miers. Br. Pharm.—*Cocculus palmatus.* Wallich, non De Cand.—*Menispermum Columba.* Roxb. *Flor. Ind.* This species is characterized by "rounded, angularly striate, roughly pilose branches; broadly orbicular, sinuously lobed leaves, with rounded sinuses; the lobes being 5 in number, broadly ovate, acute, mucronately acuminate; the basal deeply divaricate and hence broadly cordate; 7 to 9 nerved, opaque above, on both sides furnished with short, adpressed, somewhat curved, reddish hairs, beneath, pale, strongly reticulate with prominent nerves and veins; the petiole somewhat slender, striate, tortuous, and roughly glandular; the racemes axillary, solitary or many; the rachis greatly elongated, striate, bristly, with elongated, smooth, divaricate, almost capillary, subflexuous, few-flowered branches; the flowers sessile, and almost without bracts." (*Miers.*)

Both of these so-called species are natives of Mozambique, on the south-

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eastern coast of Africa, where they grow wild in great abundance in the thick forests extending from the sea many miles into the interior. They are not cultivated. The root is dug up in March, when dry weather prevails. From the base of the root numerous fusiform offsets proceed, less fibrous and woody than the parent stock. These offsets are separated and cut into transverse slices, which are dried in the shade. The old root is rejected.

Columbo is a staple export of the Portuguese from their dominions in the southeast of Africa. It is taken to India, and thence distributed. It was formerly supposed to be a product of Ceylon, and to have derived its name from Colombo, a city of that island, from which it was thought to be exported. It is possible that, when the Portuguese were in possession of Ceylon, Colombo may have been the entrepot for the drug brought from Africa, and thus have given origin to its name Some, however, consider a more probable derivation to be from the word *calumb*, which is said to be the Mozambique name for the root. Dr. Christison has been misinformed in relation to the cultivation of the true columbo plant in this country. (*Dispensatory*, Am. ed., p. 304.)

Properties. "In nearly circular disks, one and one-fifth to two and two-fifths inches (3 to 6 cm.) in diameter, yellowish gray, depressed in the centre, with two or three interrupted circles of projecting wood-bundles, distinctly radiate in the outer portion; fracture short, mealy; odor slight; taste mucilaginous, slightly aromatic, persistently bitter." *U. S.* Along with the disks are sometimes a few cylindrical pieces an inch or two in length. The cortical portion is thick, of a bright yellow, slightly greenish color internally, but covered with a brownish, wrinkled epidermis. The interior or medullary portion, which is readily distinguishable from the cortical, is light, spongy, yellowish, usually more or less shrunk, so that the pieces are thinnest in the centre; and is often marked with concentric circles and radiating lines. Those pieces are to be preferred which have the brightest color, are most compact and uniform, and least worm-eaten. The odor of columbo is slightly aromatic. The taste is very bitter, that of the cortical much more so than that of the central portion, which is somewhat mucilaginous. The root is easily pulverized. The powder is greenish, becoming browner with age, and deepening when moistened. As it attracts moisture from the air, and is apt to undergo decomposition, it should be prepared in small quantities.

M. Planche analyzed columbo in 1811, and found it to contain a nitrogenous substance, probably albumen, in large quantity, a bitter yellow substance not precipitated by metallic salts, and one-third of its weight of starch. He obtained also a small proportion of volatile oil, salts of lime and potassa, oxide of iron, and silica. Wittstock, of Berlin, afterwards isolated a principle, which he called *colombin*. This crystallizes in beautiful transparent quadrilateral prisms of the formula $C_{21}H_{22}O_7$, is without smell, and is extremely bitter. It is but very slightly soluble in water, alcohol, or ether, at ordinary temperatures, and yet imparts to these fluids a strongly bitter taste. It is more soluble in boiling alcohol, which deposits it upon cooling. The best solvent is dilute acetic acid. It is taken up by alkaline solutions, from which it is precipitated by acids. It has neither acid nor alkaline properties, and its alcoholic and acetic solutions are not affected by the metallic salts, or the infusion of galls. It is obtained by exhausting columbo by means of alcohol of the sp. gr. 0·835, distilling off three-quarters of the alcohol, allowing the residue to stand for some days till crystals are deposited, and lastly treating these crystals with alcohol and animal charcoal. The mother-waters still contain a considerable quantity of colombin, which may be separated by evaporating with coarsely powdered glass to dryness, exhausting the residue with ether, distilling off the ether, treating the residue with boiling acetic acid, and evaporating the solution to crystallization.

From the researches of Dr. Bödeker it appears that another bitter principle exists in columbo, which corresponds in composition and chemical relations with *berberine*, the active principle of *Berberis vulgaris*, and is assumed to be identical with that substance. It was obtained by exhausting columbo with alcohol of 0·889, distilling off the alcohol, allowing the residual liquor to stand for three days so as to deposit the columbin, evaporating the supernatant liquid together with the aque-

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ous washings of the colombin to dryness, exhausting the residue with boiling alcohol of 0·863, treating the solution thus obtained as the former one, submitting the residue to the action of the boiling water, filtering and adding hydrochloric acid, collecting the precipitate thus formed on a filter, drying it with bibulous paper, and finally, in order to separate adhering acid, dissolving it in alcohol, and precipitating with ether. The result was an imperfectly crystalline, bright yellow powder, of a disagreeable, bitter taste, supposed to be *berberine hydrochlorate*. It is stated that berberine is present in columbo in much larger proportion than columbin, and being freely soluble in hot water and alcohol, while columbin is but slightly so, is probably more largely extracted in the ordinary liquid preparations of the root. (*A. J. P.*, xx. 322.) A third constituent, *columbic acid*, was also discovered by Bödeker. It is yellow, amorphous, nearly insoluble in cold water, but dissolving in alcohol and in alkaline solutions. It tastes somewhat less bitter than *columbin*. Bödeker surmises that it may exist in combination with the berberine, and has pointed out a connection between the three bitter principles of columbo. If we suppose a molecule of ammonia, NH_3, to be added to two molecules of *columbin*, $C_{21}H_{22}O_7$, the complex molecule thence resulting will contain the elements of *berberine*, $C_{20}H_{17}NO_4$, *columbic acid*, $C_{22}H_{24}O_7$, and water, $3H_2O$. (*Pharmacographia*, p. 25.)

There can be little doubt that both columbin and berberine contribute to the remedial effects of columbo. The virtues of the root are extracted by boiling water and by alcohol. Precipitates are produced with the infusion and tincture by infusion of galls, and solutions of acetate and subacetate of lead; but the bitterness is not affected.

Adulterations. It is said that the root of *white bryony*, tinged yellow with the tincture of columbo, has sometimes been fraudulently substituted for the genuine root; but the adulteration is too gross to deceive those acquainted with the characters of either of these drugs. American columbo, which is the root of *Frasera Walteri*, is said to have been sold in some parts of Europe for the genuine. Independently of the sensible differences between the two roots (see *Frasera*), M. Stolze, of Halle, states that, while the tincture of columbo remains unaffected by the sulphate or sesquichloride of iron, and gives a dirty-gray precipitate with tincture of galls, the tincture of frasera acquires a dark green color with the former reagent, and is not affected by the latter. (*Duncan.*) Under the name of *columbo wood*, or *false columbo*, the wood of *Cocculus fenestratum*, a plant of the family of Menispermaceæ, growing in Ceylon, has been imported into England, and offered for sale in the drug market. (*P. J. Tr.*, x. 321, and xii. 185.)

Medical Properties and Uses. Columbo is among the most useful of the mild tonics. Without astringency, with very little stimulating power, and generally acceptable to the stomach, it answers admirably as a remedy in simple dyspepsia, and in the debility of convalescence, especially when the alimentary canal is left enfeebled. Hence, it is often prescribed in the declining stages of remittent fever, dysentery, diarrhœa, cholera morbus, and cholera infantum. The absence of irritating properties renders it also an appropriate tonic in the hectic fever of phthisis, and kindred affections. It has been highly recommended in vomiting, unconnected with inflammation of the stomach, as in the sickness of pregnant women. It is frequently administered in combination with other tonics, aromatics, mild cathartics, and antacids. A favorite remedy of Dr. Geo. B. Wood for the permanent cure of a disposition to the accumulation of flatus in the bowels, was an infusion made with half an ounce of columbo, half an ounce of ginger, a drachm of senna, and a pint of boiling water, and given in the dose of a wineglassful three times a day. Columbo is much used by the natives of Mozambique in dysentery and other diseases. (*Berry.*) It was first introduced to the notice of the profession in Europe by François Redi, in the year 1685. It is most commonly prescribed in the state of infusion. (See *Infusum Calumbæ.*) The dose of the powder is from ten to thirty grains (0·65–1·95 Gm.), and may be repeated three or four times a day. It is frequently combined with powdered ginger, subcarbonate of iron, and rhubarb.

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Off. Prep. Extractum Calumbæ, *Br.;* Extract. Calumbæ Fluidum, *U. S.;* Infusum Calumbæ; Mistura Ferri Aromatica, *Br.;* Tinctura Calumbæ.

CALX. *U. S., Br. Lime.*

Ca O; 56. (CĂLX.) Ca, O; 28.

"An alkaline earth, CaO, with some impurities, obtained by calcining chalk or limestone so as to expel carbonic acid." *Br.*

Calcaria Usta, *P.G.;* Calcaria, Calx Viva, Calx Usta, Oxydum Calcicum; Burned Lime; Quicklime; Chaux, Chaux vive, *Fr.;* Kalk, Gebrannter Kalk, *G.;* Calce, *It.;* Calviva, *Sp.*

Lime, which is ranked among the alkaline earths, is a very important pharmaceutical agent, and forms the principal ingredient in several standard preparations. It is a very abundant natural production. It is never found pure, but mostly combined with acids; as with carbonic acid in chalk, marble, calcareous spar, limestone, and shells; with sulphuric acid in the different kinds of gypsum, with phosphoric acid in the bones of animals; and with silica in a great variety of minerals.

Preparation. Lime is prepared by calcining, by a strong heat, some form of the native carbonate. The carbonic acid is thus expelled, and the lime remains. When the lime is intended for nice chemical operations, it should be obtained from pure white marble or oyster shells. For the purpose of the arts it is procured from common limestone, by calcining it in kilns of peculiar construction. When obtained in this way it is generally impure, being of a grayish color, and containing alumina, silica, sesquioxide of iron, and occasionally a little magnesia and oxide of manganese.

The officinal lime of the United States and British Pharmacopœias is the lime of commerce, and therefore impure. It may be obtained purer by exposing pure white marble, broken into small fragments, in a covered crucible, to a full red heat for three hours, or till the residuum, when slaked and suspended in water, no longer effervesces on the addition of hydrochloric acid.

Properties. Lime is in "hard, white or grayish white masses, gradually attracting moisture and carbonic acid gas on exposure to air and falling to a white powder, odorless, having a sharp, caustic taste and an alkaline reaction. Soluble in 750 parts of water at 15° C. (59° F.) and in 1300 parts of boiling water; insoluble in alcohol. When heated to a white heat, lime is neither fused nor altered. Brought in contact with about half its weight of water, it absorbs the latter, becomes heated and is gradually converted into a white powder (slaked lime). Lime mixed with water to a thin milk, should be dissolved by nitric acid with but little effervescence (limit of carbonate), and without leaving more than a slight residue of insoluble matter. Lime should be preserved in well-closed vessels, in a dry place. Distilled water agitated with slaked lime should give the reactions mentioned under *Liquor Calcis.*" *U. S.*

Lime is the oxide of calcium, and consists of one atom of calcium 40, and one of oxygen 16. Its sp. gr. is 3·08, whilst the hydrate has the sp. gr. 2·078. (*Filhol.*) Its solubility in water is greatly increased by the addition of sugar or glycerin. (See *Syrupus Calcis.*) It is distinguished from the other alkaline earths by forming a very deliquescent salt (*chloride of calcium*) by reaction with hydrochloric acid, and a sparingly soluble one with sulphuric acid. All acids, acidulous, ammoniacal, and metallic salts, borates, alkaline carbonates, and astringent vegetable infusions are incompatible with it.

Medical Properties. Lime acts externally as an escharotic, and was formerly applied to ill-conditioned ulcers. The *lime ointment* of Spender is made by incorporating four parts of washed slaked lime with one part of fresh lard and three parts of olive oil, previously warmed together. Mixed with potassa, lime forms an officinal caustic. (See *Potassa cum Calce.*) As an internal remedy, it is always administered in solution. (See *Liquor Calcis.*)

Pharm. Uses. Liquor Potassæ, *U. S.;* Liquor Sodæ, *U. S.*

Off. Prep. Calcis Hydras, *Br.;* Liquor Calcis, *U. S.;* Potassa cum Calce, *U. S.;* Syrupus Calcis, *U. S.*

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CALX CHLORATA. *U. S., Br. Chlorinated Lime.*

(CĂLX CHLŌ-RĀ'TĄ.)

CALX CHLORINATA, *Pharm.* 1870. CHLORIDE OF LIME. "A compound resulting from the action of Chlorine upon Hydrate of Calcium, and containing at least 25 per cent. of available Chlorine." *U. S.* "A product obtained by exposing slaked lime to the action of chlorine gas so long as the latter is absorbed." *Br.*

"Chloride of Lime should be preserved in well-closed vessels, in a cool and dry place." *U. S.*

Hypochlorite of Lime or Calcium, Oxymuriate of Lime or Calcium, Bleaching Powder; Calcaria Chlorata, *P.G.;* Chloris Calcicus, Chloruretum Calcis, Calcis Chloridum, Calcii Hypochloris, *Lat.;* Chlorure de Chaux, Poudre de Tennant ou de Knox, *Fr.;* Chlorkalk, Bleichkalk, *G.;* Cloruro di Calce, *It.*

This compound was originally prepared and brought into notice as a bleaching agent, in 1798, by Tennant, of Glasgow. Subsequently it was found to have valuable properties as a medicine and disinfectant; and, accordingly, it has been introduced into the United States and British Pharmacopœias.

The following is an outline of the process for preparing chlorinated lime on the large scale. A rectangular chamber is constructed, generally of silicious sandstone, the joints being secured by a cement of pitch, rosin, and dry gypsum. At one end it is furnished with an air-tight door, and on each side with a glass window, to enable the operator to inspect the process during its progress. The slaked or hydrated lime is sifted, and placed on wooden trays eight or ten feet long, two broad, and one inch deep. These are piled within the chamber to a height of five or six feet on cross-bars, by which they are kept about an inch asunder, in order to favor the circulation of the gas over the lime. The chlorine is generated in a leaden vessel nearly spherical, the lower portion of which is surrounded with an iron case, leaving an interstice two inches wide, intended to receive the steam for the purpose of producing the requisite heat. In the leaden vessel are five apertures. The first is in the centre of the top, and receives a tube which descends nearly to the bottom, and through which a vertical stirrer passes, intended to mix the materials, and furnished, at the lower end, with horizontal cross-bars of iron, or of wood sheathed with lead. The second is for the introduction of the common salt and manganese. The third admits a siphon-shaped funnel, through which the sulphuric acid is introduced. The fourth is connected with a pipe to lead off the chlorine. The fifth, which is near the bottom, receives a discharge-pipe, passing through the iron case, and intended for drawing off the residuum of the operation. The pipe leading off the chlorine terminates, under water, in a leaden chest or cylinder, where the gas is washed from hydrochloric acid. From this intermediate vessel the chlorine finally passes, by means of a pretty large leaden pipe, through the ceiling of the chamber containing the lime. The process of impregnation generally lasts four days, this time being necessary to form a good bleaching powder. If it be hastened, heat will be generated, which will favor the production of chloride of calcium, with a proportional diminution of chloride of lime.

The proportions of the materials generally adopted are 10 cwt. of common salt, mixed with from 10 to 14 cwt. of manganese dioxide: to which are added, in successive portions, from 12 to 14 cwt. of strong sulphuric acid, diluted before being used until its sp. gr. is about 1·65, which is accomplished by adding about one-third of its weight of water. In factories in which sulphuric acid is also made, the acid intended for this process is brought to the sp. gr. 1·65 only, whereby the expense of further concentration is saved.

Properties. Chlorinated lime is "a white or grayish white, dry, or but slightly damp powder, or friable lumps, becoming moist and gradually decomposing on exposure to air, having a feeble, chlorine-like odor, and a disagreeable, saline taste. It is partially soluble in water and in alcohol. On dissolving Chlorinated Lime in diluted hydrochloric acid, chlorine gas is given off, and there should not remain more than a trifling amount of insoluble matter. Its solution in diluted acetic acid yields, with test-solution of oxalate of ammonium, a white precipitate soluble in hydrochloric acid. The aqueous solution quickly destroys the color of a dilute solution

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of litmus or of indigo." *U.S.* When perfectly saturated with chlorine it dissolves almost entirely in water. When exposed to heat, it gives off oxygen, and some chlorine, and is converted into chloride of calcium. It is incompatible with the mineral acids, carbonic acids, and the alkaline carbonates. The acids evolve chlorine copiously, and the alkaline carbonates cause a precipitate of carbonate of calcium. (See *Liquor Sodæ Chlorinatæ.*)*

Chlorinated lime is an oxidizing agent, the oxygen being derived from water, the hydrogen of which unites with the chlorine to form hydrochloric acid. It has a powerful action on organic matter, converting sugar, starch, cotton, linen, and similar substances into formic acid, which unites with the lime. (*W. Bastick.*) It also acts energetically on the volatile oils, including oil of turpentine, producing chloroform. (J. Chautart, *Journ. de Pharm.*, Mars, 1855.)

Composition. The composition of bleaching powder is represented by the formula $CaOCl_2$, and it was formerly supposed to be a direct compound of lime with chlorine. This view, however, is not consistent with its reactions, for when distilled with dilute nitric acid it readily yields a distillate of aqueous hypochlorous acid, and when treated with water it is resolved into chloride and hypochlorite of calcium, the latter of which may be separated in crystals by exposing the filtered solution to a freezing mixture, or by evaporating it in a vacuum over oil of vitriol, and leaving the dense frozen mass to thaw upon a filter. A solution of calcium chloride mixed with hypochlorite then passes through, and feathery crystals remain on the filter, very unstable, but consisting, when recently prepared, of hydrated calcium hypochlorite, $Ca(OCl)_2 4H_2O$. These results seem at first sight to show that the bleaching powder is a mixture of chloride and hypochlorite of calcium, formed according to the equation $2CaO + Cl_4 = CaCl_2 + Ca(ClO)_2$; but if this were its true constitution, the powder when digested with alcohol ought to yield a solution of calcium chloride containing half the chlorine of the original compound, which is not the case. Its constitution is, therefore, better represented by the formula $Ca\begin{cases} Cl \\ OCl \end{cases}$, suggested by Dr. Odling, this molecule being decomposed by water into chloride and hypochlorite in the manner just explained, and yielding with dilute nitric acid or sulphuric acid a distillate containing hydrochloric and hypochlorous acids, $CaCl(OCl) + 2HNO_3 = Ca(NO_3)_2 + HCl + HClO$. (*Fowne*, 12th ed., p. 337.)

These results have also been confirmed recently by Lunge (*A. J. P.*, Dec. 1881, p. 608.)

Impurities and Tests. Chlorinated lime may contain a great excess of lime, from imperfect impregnation with the gas. This defect will be shown by the large proportion insoluble in water. If it contain much chloride of calcium, it will be quite moist, which is always a sign of inferior quality. When long and insecurely kept, it deteriorates from the gradual formation of chloride of calcium and carbonate of calcium. Several methods have been proposed for determining its bleaching power, which depends solely on the proportion of loosely combined chlorine. Walter proposed to add a solution of the bleaching powder to a standard solution

* Chlorinated lime is constantly becoming weaker on exposure, giving off chlorine or hypochlorous acid, probably through the influence of the atmospheric carbonic acid, which sets them free by combining with the lime. But it would seem that, even when closely confined, it sometimes at least gives off gaseous matter, as we have an account of a well-stopped bottle containing it having been broken by a violent explosion, without any peculiar exposure to heat. (See *A. J. P.*, 1861, p. 72.) M. Barreswil has found that the subjection of chlorinated lime to strong pressure greatly diminishes the tendency to decomposition. It is rendered in this way as hard as a stone, and may be kept long without undergoing change. (*Chem. News*, No. 58, p. 33.)

Under the following conditions, it is stated by C. Schrader that good chlorinated lime may be prepared which will long retain its strength. 1. The lime used must be free from iron and alumina; but the hydrate may contain from 6 to 12 per cent. of moisture without injury. 2. The chlorine must be brought slowly in contact with the hydrate. 3. When the hydrate of lime is oversaturated with chlorine, decomposition speedily ensues. Hence the hydrate and the hydrochloric acid employed must be in due proportion, to be determined by practice. 4. To insure complete saturation, there should be free chlorine in the apparatus at the close of the process. By attending to these precautions, it is said that a product may be obtained, with from 33 to 35 per cent. of chlorine, and losing its strength only at the rate of 3 or 4 per cent. a year. (*Ibid.*, 1863, p. 78.)

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of sulphate of indigo, in order to ascertain its decolorizing power; but the objection to this test is that the indigo of commerce is very variable in its amount of coloring matter. Dalton recommended, as a test, to add a solution of the bleaching powder to one of the sulphate of iron, slightly acidulated with hydrochloric or sulphuric acid, until the odor of chlorine is perceived. According to Wittstein and Claude, the test of sulphate of iron, which was formerly officinal, is not reliable. The present volumetric method, which is based upon that of the British Pharmacopœia, is preferred. "If 0·71 Gm. of Chlorinated Lime be mixed with a solution of 1·25 Gm. of iodide of potassium in 120 C.c. of water, and 9 Gm. of diluted hydrochloric acid be then added, the red-brown liquid should require for complete decoloration not less than 50 C.c. of the volumetric solution of hyposulphite of sodium." *U. S.*

The following is the test given in the British Pharmacopœia. "Ten grains mixed with thirty grains of iodide of potassium, and dissolved in four fluidounces of water, produce, when acidulated with two fluidrachms of hydrochloric acid, a reddish solution, which requires for the discharge of its color at least 850 grain-measures of the volumetric solution of hyposulphite of soda, corresponding to 30 per cent. of chlorine liberated by hydrochloric acid." In this process iodine is separated by the chlorine in equivalent quantity, and imparts color to the liquid, which is removed by the hyposulphite of sodium, by forming colorless compounds with the iodine; and the quantity required for this purpose measures the quantity of iodine, and consequently that of the chlorine present in the chlorinated solution. (See *Sodii Hyposulphis.*)

Medical Properties and Uses. Chlorinated lime, externally applied, is a desiccant and disinfectant, and has been used with advantage in solution, as an application to ill-conditioned ulcers, burns, chilblains, and cutaneous eruptions, especially itch; as a gargle in putrid sore throat; and as a wash for the mouth to disinfect the breath, and for ulcerated gums. Internally, it is stimulant and alterative. It has been used to some extent internally, in adynamic dysentery, typhus fever, and various other low diseases: it may be considered as therapeutically equivalent to chlorine. The dose internally is from three to six grains (0·2–0·4 Gm.), dissolved in one or two fluidounces (30–60 C.c.) of water, filtered and sweetened with syrup. It should never be given in pills. As it occurs of variable quality, and must be used in solution more or less dilute, according to the particular purpose to which it is to be applied, it is impossible to give any very precise directions for its strength as an external remedy. From one to four drachms of the powder added to a pint of water, and the solution filtered, will form a liquid within the limits of strength ordinarily required. For the cure of itch, M. Derheims has recommended a much stronger solution—three ounces of the chloride to a pint of water, the solution being filtered, and applied several times a day as a lotion, or constantly by wet cloths. When applied to ulcers, their surface may be covered with lint dipped in the solution. When used as an ointment, to be rubbed upon scrofulous enlargements of the lymphatic glands, this may be made of a drachm of the chloride to an ounce of lard. Chlorinated lime is less eligible for some purposes than the solution of chlorinated soda. (See *Liquor Sodæ Chlorinatæ.*)

In consequence of its powers as a disinfectant, chlorinated lime is a very important compound in its application to medical police. It possesses the property of preventing or arresting animal and vegetable putrefaction, and, perhaps, of destroying pestilential and infectious miasms. It may be used with advantage for preserving bodies from exhaling an unpleasant odor, before interment, in the summer season. In juridical exhumations its use is indispensable; as it effectually removes the disgusting and insupportable fetor of the corpse. The mode in which it is applied, in these cases, is to envelop the body with a sheet completely wet with a solution, made by adding about a pound of the chloride to a bucketful of water. It is employed also for disinfecting dissecting rooms, privies, common sewers, docks, and other places with offensive effluvia. In destroying contagion and infection, it appears to be highly useful; and hospitals, almshouses, jails, ships, etc., may be purified by it. In short, all places deemed infectious from having been the receptacle of disease, may be more

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or less disinfected by its use, after having undergone thorough cleansing. It should be carefully kept from contact with the air and organic substances, which cause rapid loss of chlorine, and the modern method of putting it up for ordinary use in hermetically sealed pasteboard boxes is a great convenience.

Chlorinated lime acts exclusively by its chlorine, which, being loosely combined, is disengaged by the slightest affinities. All acids, even the carbonic, disengage it; and, as this acid is a product of animal and vegetable decomposition, noxious effluvia furnish the means, to a certain extent, of their own disinfection. But the stronger acids disengage the chlorine far more readily, and among these, sulphuric acid is the most convenient. Accordingly, the powder may be dissolved in a very dilute solution of this acid; or a small quantity of the acid may be added to an aqueous solution ready formed, if a more copious evolution of chlorine be desired than that which takes place from the mere action of the carbonic acid of the atmosphere.

Chlorinated lime may be advantageously applied to the purpose of purifying offensive water, a property which makes it invaluable on long voyages. When used for this purpose, from one to two ounces of the chloride may be mixed with about sixty-five gallons of the water. The water must afterwards be exposed for some time to the air, and allowed to settle, before it is fit to drink.

Strong insecticide properties have been ascribed to chlorinated lime. Hence it is recommended to sprinkle it on vegetables, flowers, fruit-trees, etc., which are apt to be attacked by worms and insects.

Off. Prep. Chloroformum, *Br.;* Liquor Calcis Chloratæ, *Br.;* Liquor Sodæ Chloratæ, *U. S.;* Vapor Chlori, *Br.*

CALX SULPHURATA. *U. S.* *Sulphurated Lime.*

(CĂLX SŬL-PHŪ-RĀ'TĄ.)

"A mixture (commonly misnamed Sulphide of Calcium) consisting chiefly of Sulphide of Calcium [**CaS**; **72.**—CaS; 36] and Sulphate of Calcium [**$CaSO_4$**; **136.**—CaO,SO_3; 68], in varying proportions, but containing not less than 36 per cent. of absolute Sulphide of Calcium." *U. S.*

"Lime, in very fine powder, *one hundred parts;* Precipitated Sulphur, *ninety parts.* Mix the Lime and Sulphur intimately, pack the mixture with gentle pressure in a crucible so as to nearly fill it, and having luted down the cover, expose the crucible for one hour to a low red heat, by means of a charcoal fire so arranged that the upper part of the crucible shall be heated first. Then remove the crucible, allow it to cool, rub its contents to powder, and at once transfer the latter to small, glass-stoppered vials." *U. S.*

It may also be made by decomposing a mixture of three parts of sulphate of calcium and one part of charcoal, heated in a crucible to a red heat; carbonic oxide is formed, which combines with the oxygen of calcium sulphate, and calcium sulphide is produced, $CaSO_4 + 4CO = CaS + 4CO_2$. A less convenient method is to pass sulphuretted hydrogen over red hot lime, although if the lime be pure a better product is insured. This preparation, which is introduced in the U. S. Pharmacopœia for the first time, is of doubtful utility, particularly in the form in which it is produced when made by the officinal process. The amount of sulphide of calcium present must vary considerably according to circumstances. The medicinal activity is alone measured by the quantity of sulphide in the finished preparation, sulphate of calcium, the other constituent, being inert. It is to be regretted that a method of purification was not appended.

Properties. Sulphurated lime is "a grayish white or yellowish white powder, gradually altered by exposure to air, exhaling a faint odor of hydrosulphuric acid, having an offensive, alkaline taste and an alkaline reaction. Very slightly soluble in water and insoluble in alcohol. On dissolving Sulphurated Lime with the aid of acetic acid, hydrosulphuric acid is abundantly given off, and a white precipitate (sulphate of calcium) is thrown down. The filtrate yields, with test-solution of oxalate of ammonium, a white precipitate soluble in hydrochloric, but insoluble in acetic acid." *U. S.*

Test. "If 1 Gm. of Sulphurated Lime be gradually added to a boiling solution

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of 1·25 Gm. of sulphate of copper in 50 C.c. of water, the mixture digested on a water-bath for fifteen minutes, and filtered when cold, no color should be imparted to the filtrate by 1 drop of test-solution of ferrocyanide of potassium (presence of at least 36 per cent. of real sulphide of calcium)." *U. S.*

Sulphydrate of calcium is formed when sulphuretted hydrogen is passed into milk of lime as long as it is absorbed. It is in the form of a paste of a greenish gray color, and exhales a strong odor of sulphuretted hydrogen.

Medical Properties. It is used as a *depilatory*, and is applied in a layer on the part which is to be deprived of hair. At the end of fifteen minutes it is removed with a wet sponge, which at the same time detaches the hairs. On account of this preparation giving out sulphuretted hydrogen, it should not be applied near the mouth or nose. An impure aqueous solution of sulphide of calcium, necessarily containing hyposulphite of calcium from the manner of its preparation, is used with great success, in Belgium, in itch, the cure of which it effects in a few hours. It is made by boiling together one part of sublimed sulphur, two of lime, and ten of water. The liquid is allowed to cool, and the clear part poured off, and kept in well-stopped bottles. For an explanation of the reaction which takes place, see *Sulphur Præcipitatum*. The patient, after having been well washed with soap and tepid water in a bath, is rubbed over with the liquid, which is allowed to dry on the skin for a quarter of an hour. A second bath is then taken, which completes the cure. The preparation, when it dries, leaves on the skin a thin layer of the sulphur compound, which destroys the itch insect and its eggs. *Sulphide of calcium* has been strongly recommended by Ringer, Duhring, and other authorities as a remedy for furuncular eruptions. It is given in doses of from one-tenth to one-half grain.

CAMBOGIA. *U. S., Br.* *Gamboge.*

(KĂM-BŌ'JĬ-Ą.)

"A gum-resin obtained from Garcinia Hanburii. Hooker filius. (*Nat. Ord.* Guttiferæ.)" *U. S.* "A gum-resin obtained from Garcinia Morella (*Desrous.*), *var.* pedicellata." *Br.*

Gambogia, *Pharm.* 1870; Gomme gutte, *Fr.;* Gummigutt, *G.;* Gomma-gotta, *It.;* Gutta gamba, *Sp.*

Several plants belonging to the natural family of Guttiferæ, growing in the equatorial regions, yield on incision a yellow opaque juice, which hardens on exposure, and bears a close resemblance to gamboge; but it is only from a particular tree, growing in Siam, that the officinal gum-resin is procured.* Formerly the United States and all the British Pharmacopœias ascribed it to *Stalagmitis Cambogioides*. This genus and species were established by Murray, of Göttingen, in 1788, from dried specimens belonging to König, procured in Ceylon; and, from information derived from the same source, it was conjectured by Murray that the tree yielded not only the gamboge of Ceylon, but that also collected in Siam. On this authority the British Colleges made the references alluded to. But it was ascertained by Dr. Graham, of Edinburgh, that there is no such plant as *Stalagmitis Cambogioides;* the description of Murray having been drawn up from accidentally conjoined specimens of two trees belonging to different genera; one being the *Xanthochymus ovalifolius* of Roxburgh, and the other, the *Hebradendron Cambogioides* of Graham. By several botanists the gum-resin has been ascribed to *Garcinia Cambogia*, also a tree of Ceylon belonging to the Guttiferæ, and yielding a yellowish concrete juice; but a specimen of this juice, sent to Edinburgh, was found by Dr. Christison to differ from gamboge both in composition and appearance, being of a pale lemon-yellow color. Thus it appears that neither of these references is correct; and, besides, the fact seems to have been overlooked that commercial gamboge is never obtained from Ceylon, but exclusively from Siam and Cochin-China. A gum-resin from Ceylon having been found similar in composition to the gamboge of commerce, and the tree which produced it having been referred by Dr. Graham to a new genus, and named by him

* According to observations of Messrs. Baildon and Jamie, gamboge is obtained exclusively from the province of Cambodia; the plant being found in no other part of Siam or in Cochin-China. (*Journ. de Pharm.*, Juillet, 1874, p. 65.)

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Hebradendron Cambogioides, the Edinburgh College, in the last edition of its Pharmacopœia, was induced to adopt this Ceylon gamboge as officinal, and to recognize the name proposed by Dr. Graham for the tree producing it. But, as this variety is never found in western commerce, and exists only in cabinets, or the bazaars of India, it scarcely merited a place in an officinal catalogue; moreover the genus Hebradendron is not acknowledged by botanists. The *H. Cambogioides* is the *Garcinia pictoria* of Roxburgh (*Flor. Ind.*, ii. 627), which Sir Joseph Hooker considers to be a variety of the *G. Morella* (Desrous.); though Beddome keeps it distinct on account of its having the fertile flower bearing "the staminodes in bundles, and the stigma very small and 4-lobed." Several years since, Dr. Christison received from Singapore specimens of the gamboge plant cultivated in that island, and derived from Siam, which proved to be a Garcinia, differing from the *G. elliptica* of Wallich chiefly in having its male flower upon pedicels. More recently Mr. Hanbury obtained from the same source numerous specimens of the same plant, and was enabled to confirm the statement of Dr. Christison; but he also found that the plant approached very near to the *Garcinia Morella* of Desrousseaux, from which it could be distinguished only by its pedicellate flowers. These specimens were afterwards submitted to the inspection of Mr. Thwaites in Ceylon, who is perfectly familiar with the Garcinias of that island, and were pronounced by him to belong to a variety of *G. Morella*, scarcely differing from the Ceylon plant, except in having pedicelled instead of sessile flowers. Hence, in the existing editions of the British Pharmacopœias, the true Siam gamboge plant is recognized as the *Garcinia Morella*, var. *pedicellata*; while the Ceylon product, which never enters English or American commerce, must be derived from the other variety, having sessile flowers, and hence designated as *Garcinia Morella*, var. *sessile*. Sir Joseph Hooker, however, after a careful examination of the subject, concludes (*Journ. Linn. Soc.*, xiv. 485) that the var. *pedicellata* is a distinct species, differing from *G. Morella* not only in having its flowers pedicellate, but also its leaves more ovate and much larger, and its fruit larger, and has consequently given it a specific name, selecting very properly that of the late Mr. Hanbury to commemorate his contributions to pharmaceutical science, and his connection with the history of the present plant.

Gamboge is said to be procured in Siam by breaking off the leaves and shoots of the tree, the juice, which is contained in ducts or latex vessels in the bark, issuing in drops, and, being received in suitable vessels, it gradually thickens, and at length becomes solid. Dr. Jamie, of Singapore, states that incising the trunk and larger branches is often practised. The juice is frequently received into the hollow joints of the bamboo, and the water expelled by mild continuous heat. In this way the so-called pipe gamboge is formed, the contraction during drying causing the cylinders to be hollow. The name *gummi gutta*, by which it is generally known on the continent of Europe, probably originated from the circumstance that the juice escapes from the plant by drops. The officinal title was undoubtedly derived from the province of Cambodia, in which the gum-resin is collected. It was first brought to Europe by the Dutch about the middle of the seventeenth century. We import gamboge from Canton and Calcutta, whither it is carried by the native or resident merchants. There is no difference in the appearance or character of the drug as brought from these two ports; an evidence that it is originally derived from the same place.

Varieties. The best gamboge is in cylindrical rolls, from one to three inches in diameter, sometimes hollow in the centre, sometimes flattened, often folded double, or agglutinated in masses so that the original form is not always easily distinguishable. The pieces sometimes appear as if rolled, but are in general striated longitudinally from the impression made by the inner surface of the bamboo. They are externally of a dull orange color, which is occasionally displaced by greenish stains, or concealed by the bright yellow powder of the drug, slightly adhering to the surface. In this form the drug is sometimes called *pipe gamboge*. Another variety is imported under the name of *cake* or *lump gamboge*. It is in irregular masses of two or three pounds or more, often mixed with sticks and other impurities, containing many air cells, less dense, less uniform in texture, and less brittle than the former variety, and breaking with a dull and splintery instead of a shining and conchoidal fracture. The worst

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specimens of this variety, as well as of the cylindrical, are sometimes called by the druggists *coarse gamboge*. They differ, however, from the preceding, only in containing a greater amount of impurities. Indeed, it would appear, from the experiments of Christison, that all the commercial varieties of this drug have a common origin, and that cake or lump gamboge differs from the cylindrical, only in the circumstance that the latter is the pure concrete juice; while to the former, farinaceous matter and other impurities have been added for the purpose of adulteration. The inferior kinds of gamboge may be known by their greater hardness and coarser fracture; by the brownish or grayish color of their broken surface, which is often marked with black spots; by their obvious impurities; and by the green color which their decoction, after having been cooled, gives with tincture of iodine. When pure, the gum-resin is completely dissolved by the successive action of ether and water.*

Properties. The officinal description is as follows. "In cylindrical pieces, sometimes hollow in the centre, one to two inches (25 to 50 mm.) in diameter, longitudinally striate on the surface; fracture flattish-conchoidal, smooth, of a waxy lustre; orange red, or in powder, bright yellow; inodorous; taste very acrid; the powder sternutatory. Gamboge is partly soluble in alcohol and in ether; when triturated with water, it yields a yellow emulsion, and forms, with solution of potassa, an orange red solution, from which, on the addition of hydrochloric acid, yellow resin is precipitated. Boiled with water, Gamboge yields a liquid which, after cooling, does not become green with test-solution of iodine (abs. of starch)." *U. S.* From the brilliancy of its color, gamboge is highly esteemed as a pigment. It has no smell and little taste; but, after remaining a short time in the mouth, produces an acrid sensation in the fauces. Its sp. gr. is 1·221. Exposed to heat, it burns with a white flame, emitting much smoke, and leaving a light spongy charcoal. It is a gum-resin, without volatile oil. Christison has shown that the proportion of gum and resin varies in different specimens even of the purest drug. In one experiment, out of 100·8 parts he obtained 74·2 of resin, 21·8 of gum, and 4·8 of water. The gum is quite soluble in water, and of the variety denominated arabin. Flückiger, however, says that the gum is not identical with gum arabic, as its solution does not redden litmus, and is not precipitated by neutral acetate of lead, nor by ferric chloride, nor by silicate or biborate of sodium. By fusing purified gamboge resin with potash, Hlasiwetz and Barth (*Ann. Ch. und Pharm.*, 138, p. 61) obtained acetic and other acids of the same series, together with *phloroglucin*, $C_6H_3(OH)_3$, *pyrotartaric acid*, $C_5H_8O_4$, and *isuvitinic acid*, $C_6H_3.CH_3(COOH)_2$. Gamboge is readily and entirely diffusible in water, forming a yellow opaque emulsion, from which the resin is very slowly deposited. It yields its resinous ingredient to alcohol, forming a golden yellow tincture, which is rendered opaque and bright yellow by the addition of water. Its solution in ammoniated alcohol is not disturbed by water. Ether dissolves about four-fifths of it, taking up only the resin. It is wholly taken up by alkaline solutions, from which it is partially precipitated by the acids. The strong acids dissolve it; the solution when diluted deposits a yellow sediment. The color, acrimony, and medicinal power of gamboge are thought to reside in the resin.

Medical Properties and Uses. Gamboge is a powerful, drastic, hydragogue cathartic, so very apt to produce nausea and vomiting and much griping when given in the full dose that it is almost never employed except in combination with other cathartics. In large quantities it is capable of causing fatal effects, and death has resulted from a drachm. The full dose is from two to six grains (0·13–0·4 Gm.), which in cases of tænia has been raised to ten or fifteen grains. It may be given in pill or emulsion, or dissolved in an alkaline solution. In the dose of five grains the resin is said to produce copious watery stools, with little or no uneasiness. If

* *Ceylon gamboge*, derived from the *Hebradendron Cambogioides* of Graham (*Cambogia gutta*, Linn., *Garcinia Morella*, De Cand., *G. pictoria*, Roxb.), is procured by incisions, or by cutting away a portion of the bark, and scraping off the juice which exudes. The specimens sent to Dr. Christison were in flattish or round masses, eight or nine inches in diameter, apparently composed of aggregated irregular tears, with cavities which are lined with a grayish and brownish powdery incrustation. It resembled coarse gamboge, and was identical in composition. In Ceylon it is used as a pigment and purgative. (*Christison.*)

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this be the case, it is probable that, as it exists in the gum-resin, its purgative property is somewhat modified by the other ingredients.

Off. Prep. Pilulæ Catharticæ Compositæ, *U. S.;* Pilula Cambogiæ Comp., *Br.*

CAMPHORA. *U. S., Br. Camphor.*

$C_{10}H_{16}O$; 152. (CĂM'PHO-RA.) $C_{20}H_{16}O_2$; 152.

"A stearopten derived from Cinnamomum Camphora, F. Nees et Ebermaier (*Nat. Ord.* Lauraceæ), and purified by sublimation." *U. S.* "A concrete volatile oil, obtained from the wood of Camphora officinarum; imported in the crude state from China and Japan, and purified by sublimation." *Br.*

Camphre, *Fr.;* Kampher, Kampfer, *G.;* Canfora, *It.;* Alcanfor, *Sp.*

The name of camphor has been applied to various concrete, white, odorous, volatile products, found in different aromatic plants, and resulting probably from chemical change in their volatile oil. But commercial camphor is derived exclusively from two plants, the *Camphora officinarum* of Nees or *Laurus Camphora* of Linnæus, and the *Dryobalanops Camphora;* the former of which yields our officinal camphor, the latter a product much valued in the East, but unknown in the commerce of this country and of Europe. A considerable quantity of camphor, said to be identical with the officinal, was a few years since obtained upon the Tenasserim Coast, in Farther India, by subliming the tops of an annual plant, abundant in that region, and thought to be a species of Blumia. This product, however, does not occur in general commerce. (*A. J. P.*, xvi. 56.) The Rev. Mr. Mason, an American missionary in Burmah, states that the Chinese settlers informed him that the same plant abounds in China, and that camphor is procured from it there. (*Proc. Acad. Nat. Sci. Phila.*, 1851, p. 201.) The following observations apply to the officinal camphor.

Gen. Ch. For characters of genus Cinnamon, see *Cinnamomum.* The genus Camphora as separated by Nees departs from the characters there given, in the segments of the perianth being completely deciduous, and falling off completely, leaving the berry resting upon the somewhat enlarged cup-shaped or disk-shaped, entire, or slightly serrate base or tube.

Camphora officinarum. Nees, *Laurin.* 88; Carson, *Illust. of Med. Bot.* ii. 29, pl. xxiv.—*Laurus Camphora.* Willd. *Sp. Plant.* ii. 478.—*Cinnamomum Camphora. B. & T.* 222. The camphor-tree is an evergreen of considerable size, having the aspect of the linden, with a trunk straight below, but divided above into many branches, which are covered with a smooth, greenish bark. Its leaves, which stand alternately upon long footstalks, are ovate-lanceolate, entire, smooth and shining, ribbed, of a bright yellowish green color on their upper surface, paler on the under, and two or three inches in length. The flowers are small, white, pedicelled, and collected in clusters, which are supported by long axillary peduncles. The fruit is a red berry, resembling that of the cinnamon. The tree is a native of China, Japan, and other parts of eastern Asia. It has been introduced into the botanical gardens of Europe, and is occasionally met with in our own conservatories.*

The leaves have when bruised the odor of camphor, which is diffused through all parts of the plant, and is obtained from the root, trunk, and branches by sublimation. The process is not precisely the same in all places. The following is said to be the one pursued in Japan. The parts mentioned, particularly the roots and smaller branches, are cut into chips, which are placed with a little water in large iron vessels, surmounted by earthen capitals, furnished with a lining of rice-straw. A moderate heat is then applied, and the camphor, volatilized by the steam, rises into the capital, where it is condensed upon the straw. In China the comminuted plant is said to be first boiled with water until the camphor adheres to the stick used

* The camphor-tree sometimes attains a great age and an enormous size. A tree seen by Kämpfer, in Japan, in 1691, with a trunk 36 feet in circumference, was in the year 1826 described by Siebold as having a circumference of 50 feet. (*Japan as it was and is*, by R. Hildreth. Boston, 1855, p. 337.) Dr. Geo. B. Wood saw a large tree growing in the open air at Naples, and had no doubt that it might be readily and perhaps profitably cultivated in the southern parts of our own country, and especially in California.

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in stirring, when the strained liquor is allowed to cool; and the camphor which concretes, being alternated with layers of earth, is submitted to sublimation. In the island of Formosa, where the camphor-tree abounds, the chips are heated in a rough still. This is usually composed of a furnace surmounted with a trough or similar rude vessel, which is protected by clay. In this reservoir the chips are placed, with water upon them, and a perforated board luted upon the top; on this are set earthen pots. A fire having been lighted, steam rises through the chips and carries the camphor with it to deposit it in the pots. The crude camphor is taken to the towns in baskets and then put into large vats, with holes in the bottom, through which an oil escapes called *camphor-oil*, much used by the Chinese for medical purposes. It is said that of recent years hydraulic pressure is largely substituted for drainage, and that the camphor, thus drained, is packed in bags and exported. (*P. J. Tr.*, Dec. 1863, p. 280.)

Commercial History. Camphor, in the *crude* state, is brought to this country chiefly from Canton. It comes also from Batavia, Singapore, Calcutta, and frequently from London. All of it is probably derived originally from China and Japan. Two commercial varieties are found in the market. The cheapest and most abundant is the *Chinese camphor*, most of which is produced in the island of Formosa, and thence taken to Canton. It comes in chests lined with lead, each containing about 130 pounds. It is in small grains or granular masses, of a dirty-white color, and frequently mixed with impurities. It has occurred in commerce adulterated with chloride of ammonium. The other variety is variously called *Japan*, *Dutch*, or *tub* camphor, the first name being derived from the place of its origin, the second from the people through whom it was introduced into commerce, and the third from the recipient in which it is often contained. It has usually come from Batavia, to which port it was taken from Japan. Like the former variety, it is in grains or granular masses; but the grains are larger and of a pinkish color, and there are fewer impurities, so that it yields a larger product when refined.

Crude camphor, as brought from the East, is never found in the shop of the apothecary. It must be refined before it can be used for medicinal purposes. The process for refining camphor was first practised in Europe by the Venetians, who probably derived it from the Chinese. It was afterwards transferred to the Dutch, who long enjoyed a monopoly of this business; and it is only within a few years that the process has been generally known. It is now practised largely in this country, and the camphor refined in our domestic establishments is equal to any formerly imported. Crude camphor is mixed with about one-fiftieth of quicklime, and exposed, in an iron vessel placed in a sand-bath, to a gradually increasing heat, by which it is melted, and ultimately converted into vapor, which condenses in a suitable recipient.* Refined in this manner, it is usually in the form of large circular cakes, one or two inches thick, slightly convex on one side and concave on the other, and perforated in the centre.

Properties. "In white, translucent masses of a tough consistence and crystalline structure, readily pulverizable in the presence of a little alcohol, ether, or chloroform. It has the sp. gr. 0·990–0·995, melts at 175° C. (347° F.), boils at 205° C. (401° F.), sublimes without residue, and burns with a luminous, smoky flame. It has a penetrating odor, and a pungent taste, dissolves readily in alcohol, ether, chloroform, disulphide of carbon, benzin, fixed and volatile oils, and is sparingly soluble in

* We are informed that the process is conducted in the following manner in some of the laboratories of Philadelphia. The vessels in which the camphor is put are of cast-iron, circular, from 12 to 15 inches or more in diameter, and 4 inches deep, with perpendicular sides, and a ledge at top, on which the cover rests. This consists of sheet-iron, with a hole through the centre about an inch in diameter, over which a small hollow cone of sheet-iron is placed loosely. The crude camphor mixed with the lime, the object of which is said to be to combine with the moisture present, which interferes with the due solidification of the camphor vapor, is placed in the iron vessels described, of which from 20 to 50 are arranged in a long sand-bath. Heat is then applied until the camphor melts, after which it is kept as nearly uniform as possible, so that the vaporation may take place regularly, without violent ebullition. The vapor condenses on the lower surface of the lid; and care is taken, by the occasional removal of the iron cone, and clearing of the opening by means of a knife, to allow the escape of any accidental excess of the vapor. They who desire to see minute details as to the mode of refining camphor practised in France, are referred to an article by M. Emile Perret, pharmacian at Moret, in the *Journ de. Pharm. et de Chimie* (Fév. 1868, p. 124).

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water." *U. S.* Camphor has a peculiar, strong, penetrating, fragrant odor; and a bitter, pungent taste, with a slight sense of coolness. It is beautifully white and pellucid, somewhat unctuous to the touch, brittle, and yet possessed of a tenacity which renders its reduction to a fine powder very difficult, unless its cohesion be overcome by the addition of a minute proportion of alcohol, ether, chloroform, glycerin, essential or fatty oil, or other volatile liquid for which it has an affinity. It may be obtained in powder by pulverizing with an equal weight of sugar, by precipitating the tincture with water, or by grating and afterwards sifting it,* or better yet, by sublimation. The fracture of camphor is shining, and its texture crystalline. Its sp. gr. varies from 0·9857 to 0·996. When thrown in small fragments upon water, it assumes singular circulatory movements, which cease upon the addition of a drop of oil; and this property has been applied to the detection of grease in liquids, a very small proportion of which is sufficient to prevent the movements. Its volatility is so great that, even at ordinary temperatures, it is wholly dissipated if left exposed to the air. When it is confined in bottles, the vapor condenses on the inner surface, and, in large bottles partially filled, sometimes forms, after long standing, large and beautiful crystals. It melts at 175° C. (347° F.), boils at 204° C. (399·2° F.), and, in close vessels, sublimes unchanged. When allowed to concrete slowly from the state of vapor, it assumes the form of hexagonal plates. It is not altered by air and light. It readily takes fire, burning with a brilliant flame, with much smoke, and without residue. Water triturated with camphor dissolves, according to Berzelius, not more than 1000th part; which, however, is sufficient to impart a decided odor and taste to the solvent. By the intervention of sugar or magnesia, a much larger proportion is dissolved. (See *Aqua Camphoræ.*) Carbonic acid increases the solvent power of water, as also does the spirit of nitrous ether. Ordinary alcohol will take up 75 per cent. of its weight of camphor, which is precipitated upon the addition of water. Berzelius states that 100 parts of alcohol, of the sp. gr. 0·806, dissolve 120 parts at 10° C. (50° F.). It is soluble without change in ether, the volatile and fixed oils, strong acetic acid, and diluted mineral acids, and is extremely soluble in chloroform. Nitric acid on prolonged boiling with camphor oxidizes it into *camphoric acid*, $C_{10}H_{16}O_4$, and *camphoronic acid*, $C_9H_{12}O_5$. Schwanert's *camphresinic acid*, $C_{10}H_{14}O_{12}$, is, according to Kachler, a mixture of these two. Sulphuric acid in the proportion of ten parts to one gives, when heated with camphor, an oil isomeric with camphor, boiling at 200° C. (392° F.), and yielding a solid camphor when distilled repeatedly over solid caustic potash. Sulphuric acid in the proportion of four to one gives with camphor, according to Chautard, a volatile product which he calls *camphrene*, and to which Schwanert gives the formula $C_9H_{14}O$. Kachler (*Ann. Ch. und Pharm.*, 164, p. 90) considers, however, that camphrene is only *phorone* (a condensation product of acetone) with slight impurities. Alcoholic potash solution heated with camphor gives a derivative called *campholic acid*, $C_{10}H_{18}O_2$, a white solid, fusing at 95° C. (203° F.), and boiling at 250° C. (482° F.). Resins unite with it, forming a soft tenacious mass, in which the odor of the camphor is sometimes almost extinguished, and frequently diminished; and a similar softening effect results when it is triturated with the concrete oils.† Ex-

* But the powder thus formed is apt to aggregate on keeping. To obviate this it is recommended to rub it up with a minute proportion of carbonate of magnesium, from 10 to 20 grains to the ounce; or, as suggested by the late Mr. Henry F. Fish, of New York, by pouring an alcoholic solution of camphor into water in which carbonate of magnesium is suspended; the proportion employed being 16 ounces of camphor to a drachm of the carbonate, suspended in a gallon of water. The powder is allowed to settle on a filter. (*A. J. P.*, Nov. 1870, p. 506.) Another method of accomplishing the same object, proposed by Mr. John C. Lowd, is to sublime camphor from a retort into a large chamber, and collect the powder. (*Ibid.*, March, 1872, p. 112.)

William F. Simes, of Philadelphia, sublimes camphor on a considerable scale as a preliminary process in making compressed camphor. His apparatus consists of a retort, which is connected with a large cooling chamber, in which are board partitions with openings alternately above and below, for the purpose of compelling the camphor vapor to pass over a circuitous route and come in contact with the cool air, which condenses it in very small particles. These collect upon the bottom and sides, and it forms, after sifting, a very uniform powder.

† As this property of camphor may have a bearing, injuriously or otherwise, on pharmaceutical processes, it is desirable that the operator, as well as prescriber, should be aware of the degree of effect produced by different resinous substances which may be mixed with it. M. Planche has found that mixtures, formed by triturating powdered camphor with powdered *dragon's blood*,

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posed to a strong heat, in close vessels, camphor is resolved into carbonic acid gas and hydrocarbons, among which cymol is especially to be recognized.

Camphor, $C_{10}H_{16}O$, and borneol, $C_{10}H_{18}O$,* are classified together as belonging to the group called in general *camphors*, and which occur with the *terpenes* or essential oils, $C_{10}H_{16}$, and are to be considered as oxidation products of these latter.

Borneol is an alcohol, yielding compound ethers when heated to about 200° C.

guaiac, asafetida, and *galbanum,* assume, and preserve indefinitely the pilular consistence; with *benzoin, tolu, ammoniac,* and *mastic,* though at first of a pilular consistence, afterwards become soft by exposure to the air; with *sagapenum* and *animé,* assume a permanently semi-liquid form; with *olibanum, opopanax, gamboge, euphorbium, bdellium, myrrh,* and *amber,* remain pulverulent though somewhat grumous; and with *tacamahac, resin of jalap, sandarac,* and *resinoid matter of cinchona,* preserve the form of powder indefinitely. The same experimenter observed that camphor loses its odor entirely when mixed with *asafetida, galbanum, sagapenum, animé,* and *tolu;* retains a feeble odor with *dragon's blood, olibanum, mastic, benzoin, opopanax, tacamahac, guaiac,* and *ammoniac;* while with the other resinous substances above mentioned, it either has its odor increased, or retains it without material change. (*Journ. de Pharm.*, xxiv. 226.)

In mixing camphor with other substances in the form of powder, it is best to first pulverize the camphor with the aid of a little alcohol, then to pulverize the other substances together, and lastly to mix the two powders gently; much rubbing with the pestle having the effect of consolidating the granules of the camphor. (*Procter.*)

* *Sumatra Camphor. Borneo Camphor. Dryobalanops Camphor. Borneol.* It has long been known that a variety of camphor is produced in the islands of Sumatra and Borneo, by a forest tree, which remained until a recent period undetermined. It was at length, however, described by Colebrook, and is now recognized in systematic works as *Dryobalanops Camphora*, or *D. aromatica*. It is a very large tree, often exceeding one hundred feet in height, with a trunk six or seven feet in diameter, and ranking among the tallest and largest trees in India.* It is found in Sumatra and Borneo, and is abundant on the north-west coast of the former island. The camphor exists in concrete masses, which occupy longitudinal cavities or fissures in the heart of the tree, from a foot to a foot and a half long, at certain distances apart. The younger trees are generally less productive than the old. The only method of ascertaining whether a tree contains camphor is by incision. A party proceed through the forest, wounding the trees, till they find one which will answer their purpose; and hundreds may be examined before this object is attained. When discovered, the tree is felled and cut into logs, which are then split, and the camphor removed by means of sharp-pointed instruments. It is stated that the masses are sometimes as thick as a man's arm; and that the product of a middling-sized tree is nearly eleven pounds; of a large one double that quantity. The trees which have been wounded and left standing often produce camphor seven or eight years afterwards. Mrs. Ida Pfeiffer states, in her *Second Journey round the World* (Am. ed., p. 183), that the camphor is also found in a concrete state under the bark, and is swept down with long brooms. The Dryobalanops yields also a fragrant straw-colored liquid, called in the East Indies *oil of camphor*, and highly valued as an external application in rheumatism and other painful affections. It is said to be found in trees too young to produce camphor, and is supposed to constitute the first stage in the development of this substance; as it occupies the cavities in the trunk which are afterwards filled with the camphor. It has been stated to hold a large portion of this principle in solution; and to yield an inferior variety by artificial concretion; but this was not true of a specimen in the possession of Dr. Christison. A specimen examined by Professor Procter deposited a small quantity of the camphor at a temperature near the zero of Fahrenheit. By the action of nitric acid, it may be combined with oxygen, and converted into camphor of the same character as that deposited by refrigeration. The whole tree is pervaded more or less by the camphor or the oil. The wood retains a fragrant smell, and, being on this account less liable to the attacks of insects, is highly esteemed for carpenter's work. The camphor-wood chests, occasionally brought to this country from the East Indies, are probably made out of the wood of the Dryobalanops.

It has been supposed that this variety of camphor is occasionally brought into the markets of Europe and America; but this is a mistake; as the whole produce of the islands is engrossed by the Chinese, by whom it is so highly valued that it commands at Canton, according to Mr. Crawford, seventy-eight times, according to Mr. Reeves, one hundred times the price of ordinary camphor. A specimen which was sent to the late Prof. Joseph Carson from Canton as a curiosity, is in tabular plates of the size of a finger nail or smaller, of a foliaceous crystalline texture, white, somewhat translucent, of an odor analogous to that of common camphor, and yet decidedly distinct, and less agreeable. It has also a camphorous taste. It is more compact and brittle than ordinary camphor; and, though the pieces will often float for a time when thrown on water, yet they sink when thoroughly moistened, and deprived of adhering air. According to Dr. Christison, its sp. gr. is 1·009. It is easily pulverized without the addition of alcohol. It is, moreover, much less disposed to rise in vapor, and to condense on the inside of the bottle containing it; indeed, its value in China is largely dependent upon its being less volatile than the ordinary camphor, and hence preferable for embalming purposes. Like ordinary camphor, it is fusible, very slightly soluble in water, and freely soluble in alcohol and in ether. Its formula is $C_{10}H_{18}O$.

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* For a particular description of this tree, see a paper by Dr. W. H. De Vriese, of Leyden, in the *A. J. P.* (xxiv. 329), taken from Hooker's Journal of Botany. In this paper it is stated on the authority of Dr. Junghuhn, who witnessed the process of collection, that the camphor is deposited in very small quantities, in minute fissures between the fibres, from which it is scraped off by small splinters of wood, or by the nail; and the thickest and oldest trees seldom yield more than two ounces. This account as to the productiveness of the tree differs greatly from that of Colebrook, as stated in the note above.

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(392° F.) with organic acids. It is a secondary alcohol, and therefore contains the group CH.OH linked to a more complex group. Secondary alcohols by oxidation yield *ketones*, by the change of the CH.OH group to CO. Common camphor bears this relation to borneol, and is therefore considered as a ketone, although not capable of being formed directly from borneol. The action of metallic sodium, however, upon common camphor, $C_{10}H_{16}O$, gives us borneol, $C_{10}H_{18}O$.

Genuine camphor is said to be sometimes adulterated with the artificial, which may be detected by the action of ammonia upon its alcoholic solution, causing a flocculent precipitate, which does not redissolve, and the quantity of which is proportionate to that of the artificial product in any mixture of the two. (*A. J. P.*, xxxiv. 189.) As a means of distinguishing from the artificial camphor resulting from the reaction between the oil of turpentine and hydrochloric acid, Mr. J. W. Bailey recommends that a drop of alcohol, holding a little of the camphor to be tested in solution, be allowed to evaporate on the slide of a microscope. The crystals then formed produced with polarized light beautiful colors, if of natural camphor, but not if of the artificial. (*Neues Repertorium*, xvi. 763, 1867.)

Medical Properties and Uses. Camphor does not seem to have been known to the ancient Greeks and Romans. Europe probably derived it from the Arabians, by whom it was employed as a refrigerant. Much difference of opinion has prevailed as to its mode of action; some maintaining its immediate sedative influence, others considering it as a direct and decided stimulant. Its operation appears to be primarily and chiefly directed to the cerebral and nervous systems; and the circulation, though usually affected to a greater or less extent, is probably involved, for the most part, through the brain. It acts, also, to a certain extent, as a direct irritant of the mucous membranes with which it is brought into contact, and may thus in some measure secondarily excite the pulse. The effects of the medicine vary with the quantity administered. In moderate doses it produces, in health, mental exhilaration, increased heat of skin, and occasional diaphoresis. The pulse is usually increased in fulness, but little, if at all, in force or frequency. According to the experiments of certain Italian physicians, it has a tendency to the urinary and genital organs, producing a burning sensation along the urethra, and exciting voluptuous dreams (*N. Am. Med. and Surg. Journ.*, ix. 442); and these experiments have been confirmed by the observations of Dr. Reynolds in a case of poisoning by camphor (*Brit. Am. Journ. of Med.*, June, 1846). Cullen, however, states that he has employed it fifty times, even in large doses, without having ever observed any effect upon the urinary passages. By many it is believed to calm irritation of the urinary and genital apparatus, and to possess antaphrodisiac properties. In its primary operation it allays nervous disorder, quiets restlessness, and produces a general placidity of feeling, and is thus highly useful in certain forms of disease attended with derangement of the nervous functions. In larger doses, it displays a more decided action on the brain, producing more or less giddiness and mental confusion, with a disposition to sleep; and in morbid states of the system, relieving pain, and allaying spasmodic action. In immoderate doses it occasions nausea, vomiting, anxiety, faintness, vertigo, delirium, insensibility, coma, and convulsions, which may end in death. The pulse, under these circumstances, is at first reduced in frequency and force (Alexander, *Experimental Essays*, p. 227); but, as the action advances, it sometimes happens that symptoms of strong sanguineous determination to the head become evident in the flushed countenance, inflamed and fiery eyes, and highly excited pulse. (*Quarin.*) In three cases of poisoning by camphor, reported by Schaaf, of Strasburg, the symptoms produced were violent and incessant convulsions, paleness and coolness of the surface, vomiting and frequent micturition, and finally stupor or coma. The patients were children, and the youngest, a girl of about eighteen months, died from the effects of the poison, of which she took about ten grains. (*Monthly Journ. of Med. Sci.*, Oct. 1850, p. 377.) There can be no doubt that camphor is absorbed; as its odor is observed in the breath and perspiration, and according to Dr. Reynolds, in the urine also, though the contrary has been asserted.

By its moderately stimulating powers, its diaphoretic tendency, and its influence

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over the nervous system, camphor is adapted to the treatment of diseases of a typhoid character, which combine, with the enfeebled condition of the system, a frequent irritated pulse, a dry skin, and much nervous derangement, indicated by restlessness, watchfulness, tremors, subsultus, and low muttering delirium. It is not, however, at present much used in serious disease, but is very extensively employed in various functional nervous disorders, such as hysteria, dysmenorrhœa, general nervousness, and even in nymphomania. It is much used in diarrhœa, in flatulence, spasmodic colic, etc., as a local stimulant to the alimentary canal. In some of these cases, advantage may be derived from combining it with opium. Camphor has also been employed internally to allay the strangury produced by cantharides.

It is much used locally as an anodyne, dissolved in alcohol, oil, or acetic acid, and frequently combined with laudanum.* In rheumatic and gouty affections, and various internal spasmodic and inflammatory complaints, it often yields relief in this way. The ardor urinæ of gonorrhœa may be alleviated by injecting an oleaginous solution of camphor into the urethra; and the tenesmus from ascarides and dysentery, by administering the same solution in the form of enema. Twenty or thirty grains of camphor, added to a poultice, and applied to the perineum, allay the chordee which is a painful attendant upon gonorrhœa. Its vapor has been inhaled into the lungs with benefit in asthma and spasmodic cough; and a lump of it held to the nose is said to relieve coryza. It has been employed for the same purpose, and for nervous headache, in the form of powder snuffed up the nostrils. It enters into the composition of certain tooth-powders.

Camphor may be given in substance, in the form of bolus or pill, or diffused in water by trituration with various substances. The form of pill is objectionable; as in this state the camphor is with difficulty dissolved in the gastric liquor, and, floating on the top, is apt to excite nausea, or pain and uneasiness at the upper orifice of the stomach. Orfila states that, when given in the solid form, it is capable of producing ulceration in the gastric mucous membrane.† The emulsion is almost always preferred. This is made by rubbing up the camphor with loaf sugar, gum arabic, and water; and the suspension will be rendered more complete and permanent by the addition of a little myrrh. Milk is sometimes used as a vehicle, but is objectionable, from its liability to become speedily sour. The aqueous solution is often employed where only a slight impression is desired. For this purpose, the *Aqua Camphoræ* of the U. S. Pharmacopœia is preferable to the solution made by simply pouring boiling water upon a lump of camphor, which is sometimes prescribed under the name of *camphor tea*. When chloroform is not inadmissible, an elegant preparation may be made by dissolving camphor in that liquid, in the proportion of two drachms of the former to a fluidrachm of the latter, and then mixing the solution with water by the intervention of the yolk of an egg.

The medium dose of camphor is from five to ten grains (0·33–0·65 Gm.); but, to meet various indications, it may be diminished to a single grain (0·065 Gm.) or increased to a scruple (1·3 Gm.). The injurious effects of an overdose are said to be best counteracted, after clearing out the stomach, by the use of opium.

Off. Prep. Aqua Camphoræ; Ceratum Plumbi Subacetatis, *U. S.;* Linimentum Aconiti, *Br.;* Linimentum Belladonnæ, *Br.;* Linimentum Camphoræ; Linimentum Camphoræ Comp., *Br.;* Linimentum Iodi, *Br.;* Linimentum Saponis; Linimentum Sinapis Comp., *Br.;* Linimentum Terebinthinæ, *Br.;* Mistura Chloroformi, *U. S.;* Spiritus Camphoræ; Tinctura Camphoræ Composita, *Br.;* Tinct. Opii Camphorata, *U. S.;* Unguentum Hydrargyri Comp., *Br.;* Unguentum Plumbi Subacetatis Comp., *Br.*

* An *ointment of camphor* may be made by heating three parts, in powder, by means of a water-bath, with twelve parts of prepared lard, and stirring the solution thoroughly when it begins to thicken on cooling. (*P. J. Tr.*, July, 1860, p. 41.) M. Parisel recommends, as affording a better product, that the powdered camphor and the lard should be mixed, at ordinary temperatures, in a thin well-glazed earthen vessel, and allowed to stand for twelve hours, with occasional agitation. The solution of the camphor is effected without apparent liquefaction, each molecule being dissolved in the surrounding molecules of the lard. (*Journ. de Pharm.*, Mai, 1860, p. 362.)

† There is some difficulty in making a good pilular mass with powdered camphor. Mr. W. H. Githens states that this difficulty may be obviated by using soap and honey as excipients. (*A. J. P.*, xxxiii. 206.)

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CAMPHORA MONOBROMATA. *U. S.* *Monobromated Camphor.*

$C_{10}H_{15}BrO$; 230·8. (KĂM'PHŌ-RĄ MŌN-Ō-BRŌ-MĀ'TĄ.) $C_{20}H_{15}BrO_2$; 230·8.

Bromated Camphor, Brominated Camphor, Brom-camphor; Camphre monobromé, *Fr.*; Monobrom Camphor, *G.*

This substance was discovered in 1861 by Th. Swarts, who prepared it by heating bibromide of camphor in a sealed tube to 100° C. It may also be made by heating for three hours in a sealed tube, with the water-bath, bromine and camphor in the proper chemical proportions. The crystalline mass is washed with water, recrystallized from alcohol after treatment with animal charcoal, washed with an alcoholic solution of potassa, then with much water, and finally recrystallized from a mixture of alcohol and ether. It is very easy to prepare the monobromide on a small scale in this way. There is, however, at all times a very great pressure upon the inside of the tube, and the attempt to practise the method upon a large scale is very apt to result in shattering the tubes. This has led to numerous experiments as to the best method of preparing it. Prof. Maisch (*A. J. P.*, 1872, p. 339) introduces 4 oz bromine gradually into a retort, in which 13 oz. camphor have been previously placed. In 15 or 20 minutes a brisk reaction will commence. When this subsides, 8 or 9 oz. more bromine are to be poured in, in four portions, waiting after each addition until the reaction ceases. The liquid in the retort is now to be heated to about 132° C. (270° F.), then cooled, and sufficient petroleum benzin added to dissolve the crystalline mass. The crystals which are formed on cooling may be purified by recrystallization from benzin or hot alcohol. Various modifications of this process have been proposed. Prof. J. U. Lloyd (*A. J. P.*, April, 1875) directs the addition of water to the camphor and bromine in the retort, and boils the mixture for two hours, or until all of the water is evaporated. Then the contents are poured into a dish and treated with warm alcohol, and allowed to crystallize, the mother-liquor drained off and recrystallized from hot alcohol. C. C. Keller (*Schweiz. Wochensch. f. Pharm.*, 1880, p. 50) uses chloroform (instead of water, as proposed by Prof. Lloyd) with the camphor and bromine, and washes the crystals with absolute alcohol, crystallizing them finally from an ethereal solution. 300 parts of camphor yield 340 parts monobromated camphor.

Properties. "Colorless, prismatic needles or scales, permanent in the air and unaffected by light, having a mild, camphoraceous odor and taste, and a neutral reaction. Almost insoluble in water; freely soluble in alcohol, ether, chloroform, hot benzin, and fixed oils; slightly soluble in glycerin. When heated, Monobromated Camphor slowly volatilizes; at 65° C. (149° F.) it melts, and may be sublimed at a slightly higher temperature. At 274° C. (525° F.) it boils and is completely volatilized with partial decomposition. If boiled with test-solution of nitrate of silver, it is decomposed and yields bromide of silver, amounting to 81·2 per cent. of the weight of Monobromated Camphor taken. It is soluble, without decomposition, in cold, concentrated sulphuric acid, and will again separate unaltered, if the solution be poured into water." *U. S.*

Medical Properties. It was first proposed as a medicine by Professor Deneffe, and has been used by various practitioners as a nervous sedative in delirium tremens, hysteria, convulsive irritation of teething, sleeplessness, etc. According to the experiments of Dr. Bourneville (*Le Progrès Médical*, 1874) and of Dr. Lawson (*The Practitioner*, Aug. 1874), it produces in mammals muscular weakness, passing into paralysis, very decided progressive reduction of temperature, decrease in the respiration rate, sleep passing into stupor, and finally death. Dr. Bourneville states that the vessels of the ear and eyelids in the rabbit are contracted. Its therapeutic action resembles, but is not identical with, that of other bromides; in the experience of Dr. H. C. Wood, it has seemed to be of especial value in spermatorrhœa. It is not safe to give it too freely, as in some cases its ingestion has been followed by epileptiform convulsions. The dose of it is 5 grains (·33 Gm.),* given in pill or emul-

* *Elixir of Monobromated Camphor* is proposed by Munday (*P. J. Tr.*, March 3, 1877). Monobromated camphor 3 parts, alcohol (90 per cent.) 120 parts, orange-flower water 80 parts, glycerin 100 parts. Mix the alcohol and glycerin; dissolve the monobromated camphor by the use of a gentle heat, and add the orange-flower water. This solution contains 1 per cent of monobromated camphor.

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sion, and repeated every hour for 2 or 3 doses if necessary. The emulsion may be made by dissolving it in six times its weight of expressed oil of almonds, and then forming an emulsion with gum and water in the usual manner.

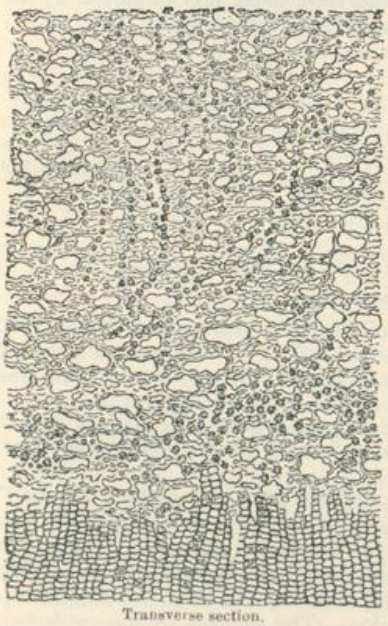
CANELLÆ ALBÆ CORTEX. *Br. Canella Alba Bark.*

(CĄ-NĔL'LÆ ĂL'BÆ CÖR'TĔX.)

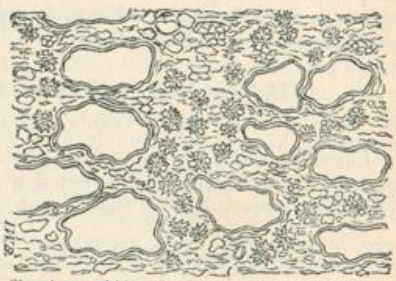
Canella, *U. S.*, 1870. Canelle blanche, *Fr.;* Weisser Zimmt, Canell, Weisser Canel, *G.;* Canella bianca, *It.;* Canela blanca, *Sp.*

Gen. Ch. *Calyx* three-lobed. *Petals* five. *Anthers* sixteen, adhering to an urceolate nectary. *Berry* one-celled with two or four seeds. *Willd.* (*Nat. Ord.* Canellaceæ.)

Canella alba. Willd. *Sp. Plant.* ii. 851; Carson, *Illust. of Med. Bot.* i. 24, pl. 16; *B. and T.* 26. This is the only species of the genus. It is an erect tree,



Transverse section.



Showing raphides of calcium oxalate in the liber

rising sometimes to the height of fifty feet, branching only at the top, and covered with a whitish bark, by which it is easily distinguished from other trees in the woods where it grows. The leaves are alternate, petiolate, oblong, obtuse, entire, of a dark green color, thick and shining like those of the laurel, and of a similar odor. The flowers are small, of a violet color, and grow in clusters upon divided footstalks, at the extremities of the branches. The fruit is an oblong berry, containing one, two, or three black, shining seeds.

Canella alba is a native of Florida, the Bahama Islands, and also of Jamaica and other West India islands. The bark of the branches, which is the part employed in medicine, is loosened and deprived of its epidermis by beating. After removal from the tree it is dried in the shade. It comes to us in pieces partially or completely quilled, occasionally somewhat twisted, of various sizes, from a few inches to two feet in length, from half a line to two or even three lines in thickness, and, in the quill, from half an inch to an inch and a half in diameter. It enters commerce solely from the Bahamas, where it is known as cinnamon bark, or as white wood bark.

Properties. Canella is of a pale orange yellow color externally, yellowish white on the inner surface, with an aromatic odor somewhat resembling that of cloves, and a warm, bitterish, very pungent taste It is brittle, breaking with a short fracture, and yielding, when pulverized, a yellowish white powder. Boiling water extracts nearly one-fourth of its weight; but the infusion, though bitter, has comparatively little of the warmth and pungency of the bark. It yields all its virtues to alcohol, forming a bright yellow tincture, which is rendered milky by the addition of water. By distillation with water it affords a large proportion of a yellow or reddish, fragrant, and very acrid volatile oil. It contains, moreover, according to the analysis of MM. Petroz and Robinet, mannite, a peculiar very bitter extractive,

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resin, gum, starch, albumen, and various saline substances. Meyers and Reiche obtained twelve drachms of the volatile oil from ten pounds of the bark. They found it to consist of four different oils, the first being identical with the eugenol or eugenic acid of oil of cloves; the second is closely allied to the chief constituent of cajeput oil; the other oils require further examination. The bark yielded to Flückiger 0·74 per cent. of oil. Meyers and Reiche also obtained 8 per cent. of mannite and 6 per cent. of ash, chiefly calcium carbonate. (*Pharmacograph.*, 2d ed., p. 75.) Canella has been sometimes confounded with Winter's bark, from which, however, it differs both in sensible properties and composition. (See *Wintera.*)

Medical Properties and Uses. Canella is possessed of the ordinary properties of the aromatics, acting as a local stimulant and gentle tonic, and producing upon the stomach a warming cordial effect, which renders it useful as an addition to tonic or purgative medicines, in debilitated states of the digestive organs. It is scarcely ever prescribed except in combination. In the West Indies it is employed by the negroes as a condiment, and has some reputation as an antiscorbutic.

Off. Prep. Vinum Rhei, *Br.*

CANNABIS AMERICANA. *American Cannabis.*

(CĂN'NȦ-BĪS Ȧ-MĔR-Ī-CĀ'NȦ.)

"Cannabis sativa, Linné (*Nat. Ord.* Urticaceæ, Cannabineæ), grown in the Southern United States, and collected while flowering." *U. S.*

American Hemp, *U. S.* 1870; Chanvre américain, *Fr.*; Amerikanischer Hanf, *G.*

CANNABIS INDICA. *U. S., Br. Indian Cannabis.*

(CĂN'NȦ-BĪS ĬN'DĮ-CȦ.)

"The flowering tops of the female plant of Cannabis sativa, Linné (*Nat. Ord.* Urticaceæ, Cannabineæ), grown in the East Indies." *U. S.* "The dried flowering tops of the female plants of Cannabis sativa. That which is grown in India, and from which the resin has not been removed, is alone to be employed." *Br.*

Hemp, Indian Hemp; Herba Cannabis Indicæ, *P. G.*; Chanvre Indien, *Fr.*; Indischer Hanf, *G.*

Gen. Ch. MALE. *Calyx* five-parted. *Stamens* five. FEMALE. *Calyx* one-leaved, rolled up. *Styles* two. *Lindley.*

Cannabis sativa. Linn. *Sp. Plant.* 1457; Griffith, *Med. Bot.* p. 572; *B. and T.* 231. Hemp is an annual plant, from four to eight feet or more in height, with an erect, branching, angular stem. The leaves are alternate or opposite, on long, lax footstalks, roughish, and digitate, with linear-lanceolate, serrated segments. The stipules are subulate. The flowers are axillary; the male in long, branched, drooping racemes; the female in erect, simple spikes. The stamens are five, with long pendulous anthers; the pistils two, with long, filiform, glandular stigmas. The fruit is ovate and one-seeded. The whole plant is covered with a fine pubescence, scarcely visible to the naked eye, and is somewhat viscid to the touch. The hemp plant of India, from which the drug is derived, has been considered by some as a distinct species, and named *Cannabis Indica;* but the most observant botanists, upon comparing it with our cultivated plant, have been unable to discover any specific difference. It is now, therefore, regarded merely as a variety, and is distinguished by the epithet *Indica.* Dr. Pereira states that, in the female plant, the flowers are somewhat more crowded than in the common hemp; but that the male plants in the two varieties are in all respects the same. It is unfortunate that the name of *Indian hemp* has been attached to the medicinal product; as, in the United States, the same name has long been appropriated to *Apocynum cannabinum*, and some confusion has hence arisen.

The American and true Indian hemp are respectively described as follows in the present edition U. S. P.

"Stem about six feet (2 m.) high, rough; leaves opposite below, alternate above, petiolate, digitate; the leaflets linear-lanceolate, serrate; dicœcious, the staminate flowers in pedunculate clusters forming compound racemes; the pistillate flowers axillary, sessile and bracteate; odor heavy; taste bitter, slightly acrid." *U. S.*

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"Branching, compressed, brittle, about two inches (5 cm.) long, with a few digitate leaves, having linear-lanceolate leaflets, and numerous, sheathing, pointed bracts, each containing two small, pistillate flowers, sometimes with the nearly ripe fruit, the whole more or less agglutinated with a resinous exudation. It has a brownish color, a peculiar, narcotic odor, and a slightly acrid taste." *U. S.*

C. sativa is a native of the Caucasus, Persia, and the hilly regions in the north of India. It is cultivated in many parts of Europe and Asia, and largely in our Western States. It is from the Indian variety exclusively that the medicine was formerly obtained; the heat of the climate in Hindostan apparently favoring the development of its active principle.* Dr. H. C. Wood having obtained a parcel of the male plant from Kentucky, made an alcoholic extract of the leaves and tops, and, upon trying it on the system, found it effective in less than a grain, and, having inadvertently taken too large a dose, experienced effects which left no doubt of the powers of the medicine, and of the identity of its influence with that of the Indian plant. How far the female tops might have the same effect is left uncertain; but, if we are to judge from analogy with the Indian plant, they would be preferable to the male. (*Proc. Am. Philos. Soc.*, vol. xi. p. 226.) The results obtained by Dr. Wood were so decisive that, at the 1870 revision of our Pharmacopœia, the American plant and an extract were introduced into the materia medica catalogue; but none of the extract has been made for commercial purposes, and in the present Pharmacopœia, Extractum Cannabis Americanæ has been dropped.

The seeds, though not now officinal, have been used in medicine. They are about the eighth of an inch long, roundish-ovate, somewhat compressed, of a shining ash-gray color, and of a disagreeable, oily, sweetish taste. They yield by expression about 20 per cent. of a fixed oil, which has the drying property, and is used in the arts. They contain also uncrystallizable sugar and albumen, and when rubbed with water form an emulsion, which may be used advantageously in inflammations of the mucous membranes, though without narcotic properties. They are much used as food for birds, which are fond of them. They are generally believed to be in no degree poisonous; but M. Michaud relates the case of a child, in which serious symptoms of narcotic poisoning occurred after taking a certain quantity of them. It is probable that some of the fruit eaten by the child was unripe; as, in this state, it would be more likely to partake of the peculiar qualities of the plant itself. (*Annuaire de Thérap.*, 1860, p. 159.)

In Hindostan, Persia, and other parts of the East, hemp has long been habitually employed as an intoxicating agent. The parts used are the tops of the plant, and a resinous product obtained from it. The plant is cut after flowering, and formed into bundles from two to four feet long by three inches in diameter, which are sold in the bazaars under the name of *gunjah*. The *hashish* of the Arabs is essentially the same. The name *bang* is given to a mixture of the larger leaves and capsules without the stems. There is on the surface of the plant a resinous exudation to which it owes its clammy feel. Men clothed in leather run through the hemp fields, brushing forcibly against the plants, and thus separating the resin, which is subsequently scraped from their dress, and formed into balls. These are called *churrus*. In these different states of preparation, the hemp is smoked like tobacco, with which

* On a visit to the botanical garden of Edinburgh, in the autumn of 1860, Dr. George B. Wood saw a full-grown specimen of *Cannabis sativa*, and was surprised to find that it was only about four feet high, had little or no odor, and was scarcely adhesive when handled. If this is the general character of the hemp plant in the north of Europe, it is not surprising that it should be destitute of the medicinal properties of the Indian plant. In Philadelphia, the plant attains a height usually of six or eight feet, has a decided narcotic odor, and exudes so much of its peculiar resin as to be very adhesive to the fingers. It is highly probable, therefore, that the hemp plant grown in this country might be advantageously used in medicine. On this occasion Dr. Christison informed Dr. Geo. B. Wood, from information he had received from India, that the plant there cultivated in the hot plains does not yield hashish satisfactorily; but that this product is chiefly if not exclusively obtained from it in the hilly regions. He said, moreover, that the story of the natives running through the hemp fields and collecting the resin on their clothing, from which it is afterwards scraped, is, if not quite untrue, at least apocryphal. He had been informed that the real mode of gathering it is to rub the hemp-tops between the hands, and, when the palms and fingers are sufficiently loaded with the resin, to scrape it off. It is possible, however, that different methods may be followed in different localities.

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it is said to be frequently mixed. An infusion or decoction of the plant is also sometimes used as an exhilarating drink.

The imported *medicinal resin or extract of hemp*, directed by the U. S. Pharmacopœia of 1860, is made by evaporating a tincture of the dried tops. Dr. O'Shaughnessy directs it to be prepared by boiling the tops of the gunjah in alcohol until all the resin is dissolved, and evaporating to dryness by means of a water-bath. Mr. Robertson, of the Calcutta Medical College, prepares it by passing the vapor of boiling alcohol from the boiler of a still into the dried plant contained in a convenient receptacle, and evaporating the condensed liquor by a heat not exceeding 65·6° C. (150° F.). The Messrs. Smith, of Edinburgh, obtained a purer resin by the following process. Bruised gunjah is digested, first in successive portions of warm water, till the expressed liquid comes away colorless; and afterwards, for two days with a moderate heat, in a solution of carbonate of sodium, containing one part of the salt for two of the dried herb. It is then expressed, washed, dried, and exhausted by percolation with alcohol. The tincture, after being agitated with milk of lime containing one part of the earth for twelve of the gunjah used, is filtered; the lime is precipitated by sulphuric acid; the filtered liquor is agitated with animal charcoal, and again filtered; most of the alcohol is distilled off, and to the residue twice its weight of water is added; the liquor is then allowed to evaporate gradually; and, finally, the resin is washed with fresh water until it ceases to impart a sour or bitter taste to the liquid, and is then dried in thin layers. Thus obtained, it retains the odor and taste of the gunjah, of which 100 pounds yield 6 or 7 of the extract. Much of the commercial extract is very impure, and is but partially soluble in alcohol.

Under the name of *Extractum Cannabis Purificatum*, the U. S. Pharmacopœia of 1860 directed a preparation made by evaporating a tincture of the crude extract, which, from its greater uniformity of strength, was preferable for prescription. The British Pharmacopœia directs the Extract of Indian Hemp to be prepared by macerating an avoirdupois pound of the dried tops of the hemp, in coarse powder, in four Imperial pints of rectified spirit, for seven days, then expressing, and evaporating to the proper consistence. From this a tincture is ordered to be prepared.

Properties. Fresh hemp has a peculiar narcotic odor, which is said to be capable of producing vertigo, headache, and a species of intoxication. It is much less in the dried tops, which have a feeble bitterish taste. According to Dr. Royle, *churrus* is when pure of a blackish gray, blackish green, or dirty olive color, of a fragrant and narcotic odor, and a slightly warm, bitterish, and acrid taste. Schlesinger found in the leaves a bitter substance, chlorophyll, green resinous extractive, coloring matter, gummy extract, extractive, albumen, lignin, and salts. The plant also contains volatile oil in very small proportion, which probably has narcotic properties. The resin obtained by T. & H. Smith, of Edinburgh, in 1846, is probably the active principle, and has received the name of *cannabin*. It is neutral, soluble in alcohol and ether, and separable from the alcoholic solution by water as a white precipitate. Martino (*N. Rep. Pharm.*, 4, p. 529) obtained a resin fusing at 68° C. (154·4° F.), easily soluble in alcohol, ether, and volatile oils, difficultly soluble in aqueous alkalies and acids. By oxidation with nitric acid a product is formed, *oxycannabin*, $C_{20}H_{20}H_2O_7$, which, after purifying, is white and crystalline. Preobraschensky (*Pharm. Zeit. f. Russl.*, 1876, p. 705) believes that cannabis Indica contains the alkaloid nicotine; this has, however, not been confirmed, and is hardly probable, because the physiological actions of the two drugs differ very greatly. The taste of *cannabin* is warm, bitterish, acrid, somewhat balsamic, and its odor fragrant, especially when heated. From the effects on the system of the exhalations from fresh hemp, it was a very probable supposition that the plant owed its medical properties, in part at least, to a volatile principle. By repeated distillation of the same portion of water from relatively large quantities of hemp renewed at each distillation, M. J. Personne obtained a volatile oil, of a stupefying odor, and an action on the system such as to dispose him to think that it was the active principle of the plant. As the water distilled was strongly alkaline, he supposed that this volatile principle might be a new alkaloid; but the alkaline reaction was found to depend on ammonia; and the liquid obtained proved to be a volatile oil, lighter than water, of a deep amber color, a strong

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smell of hemp, and composed of two distinct oils, one colorless, with the formula $C_{18}H_{20}$, the other a hydride of the first, $C_{18}H_{22}$, which was solid, and separates from alcohol in plate-like crystals. For the former M. Personne proposes the name of *cannabene*. When this is inhaled, or taken into the stomach, a singular excitement is felt throughout the system, followed by a depression, sometimes amounting to syncope, with hallucinations which are generally disagreeable, but an action on the whole slighter and more fugitive than that of the resin.

Medical Properties. Extract of hemp is a powerful narcotic, causing exhilaration, intoxication, delirious hallucinations, and, in its subsequent action, drowsiness and stupor, with little effect upon the circulation. It is asserted also to act as a decided aphrodisiac, to increase the appetite, and occasionally to induce the cataleptic state. In overdoses it may produce poisonous effects. In morbid states of the system, it has been found to cause sleep, to allay spasm, to compose nervous disquietude, and to relieve pain. In these respects it resembles opium; but it differs from that narcotic in not diminishing the appetite, checking the secretions, or constipating the bowels. It is much less certain in its effects; but may sometimes be preferably employed, when opium is contraindicated by its nauseating or constipating effects, or its disposition to produce headache, and to check the bronchial secretion. The complaints in which it has been specially recommended are neuralgia, gout, rheumatism, tetanus, hydrophobia, epidemic cholera, convulsions, chorea, hysteria, mental depression, delirium tremens, insanity, and uterine hemorrhage. It has been found to cure obstinate intermittent fever, given before the paroxysm. Dr. Alexander Christison, of Edinburgh, affirms that it has the property of hastening and increasing the contractions of the uterus in delivery, and has employed it with advantage for this purpose. It acts very quickly, and without anæsthetic effect. It appears, however, to exert this influence only in a certain proportion of cases. (*Ed. Month. Journ. of Med. Sci.*, xiii. 117, and xv. 124.) The strength of the extract varies much as found in commerce, and therefore no definite dose can be fixed. When it is of good quality, half a grain or a grain (0·03–0·065 Gm.) will affect the system. The Messrs. Smith found two-thirds of a grain (0·04 Gm.) of their extract to produce powerful narcotic effects. In some instances it will be necessary to give as much as ten or twelve grains (0·65–0·80 Gm.) of the imported extract; and half an ounce (15·5 Gm.) of it has been taken without sensible effect. The proper plan is to begin with one-quarter or half a grain (0·016–0·03 Gm.), repeated at intervals of two, three, or four hours, and gradually increased until its influence is felt, and the strength of the parcel employed is thus ascertained. Afterwards the dose will be regulated by the ascertained strength; but, should a new parcel be employed, the same caution must be observed as to the commencing dose. A tincture is prepared by dissolving an ounce of the extract in a pint (Imp. meas.) of alcohol. A dose of this, equivalent to a grain of the extract, is about twenty minims (1·25 C.c.), or forty drops. Dr. O'Shaughnessy gave ten drops (0·6 C.c.) every half hour in cholera, and a fluidrachm (3·75 C.c.) every half hour in tetanus As the resin is precipitated by water, the tincture should be administered in mucilage or sweetened water. Alarming effects have been produced by overdoses.

Off. Prep. Extractum Cannabis Indicæ, *U. S.;* Tinctura Cannabis Indicæ, *U. S., Br.;* Extractum Cannabis Indicæ Fluidum, *U. S.*

CANTHARIS. *U. S., Br. Cantharides.* [*Spanish Flies.*]

(KĂN'THĄ-RĪS.)

"Cantharis vesicatoria. De Geer. (*Class*, Insecta; *Order*, Coleoptera.) Cantharides should be kept in well-closed vessels, containing a little camphor." *U. S.*
"Cantharis vesicatoria." *Br.*

Cantharides, *P.G.:* Muscæ Hispanicæ; Cantharides, Cantharide, *Fr.:* Spanische Fliege, Kantharide, Canthariden, *G.:* Cantarelie, *It.:* Cantharidas, *Sp.*

The term *Cantharis* was employed by the ancient Greek writers to designate many coleopterous insects or beetles. Linnæus gave the title to a genus not including the officinal blistering insect, and placed this in the genus *Meloë*, which, however, has

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been since divided into several genera. Geoffrey made the Spanish fly (beetle)* the prototype of a new one called *Cantharis*, substituting *Cicindela* as the title of the Linnæan genus. Fabricius altered the arrangement of Geoffrey, and substituted *Lytta* for *Cantharis* as the generic name. The former was adopted by the London College, and at one time was in extensive use; but the latter, having been restored by Latreille, is now recognized in the British and American Pharmacopœias, and is universally employed. By this naturalist the vesicating insects were grouped in a small tribe, corresponding very nearly with the Linnæan genus Meloë, and distinguished by the title *Cantharidæ*. This tribe he divided into eleven genera, among which is Cantharis. Two others of these genera, *Meloë* properly so called, and *Mylabris*, have been employed as vesicatories. *Mylabris cichorii* is thought to be one of the insects described by Pliny and Dioscorides under the name of cantharides, and is to this day employed in Italy, Greece, the Levant, and Egypt; and another species, *M. pustulata*, is used for the same purpose in China. Mr. W. R. Warner has found 500 parts of *M. cichorii* to yield 2·13 parts of cantharidin, which somewhat exceeds the yield of Spanish flies (*A. J. P.*, xxviii. 195); and R. Wolff has obtained by ethereal extraction more than 4 parts of cantharidin in 500 of the *Lytta aspersa* of Buenos Ayres. The *M. cichorii* has been recently imported to some extent under the name of *Chinese blistering fly*. It is black, with the powder blackish gray and free from shining particles. *Meloë proscarabæus* and *M. majalis* have been occasionally substituted for cantharides in Europe, and *M. trianthemæ* is used in the upper provinces of Hindostan. Several species of Cantharis, closely analogous in medical properties, are found in various parts of the world; but *C. vesicatoria* is the only one recognized as officinal in the United States, Great Britain, and France. A second species, *C. vittata*, was introduced into our national Pharmacopœia, but has been discarded. Of this, and some other indigenous species, notice will be taken at the end of this article. At present we shall confine our observations to *C. vesicatoria*.†

CANTHARIS. *Class* Insecta. *Order* Coleoptera. *Linn.*—*Family* Trachelides. *Tribe* Cantharidæ. *Latreille.*

Gen. Ch. Tarsi entire; *nails* bifid; *head* not produced into a rostrum; *elytra* flexible, covering the whole abdomen, linear, semicylindric; *wings* perfect; *maxillæ* with two membranous *laciniæ*, the external one acute within, subuncinate; *antennæ* longer than the head and thorax, rectilinear; first joint largest, the second transverse, very short; *maxillary palpi* larger at tip. (*Say.*)

Cantharis vesicatoria. Latreille, *Gen. Crust. et Insect.*, ii. p. 220. This beetle is from six to ten lines in length, by two or three in breadth, and of a beautiful, shining, golden green color. The head is large and heart-shaped, bearing two thread-like, black, jointed feelers; the thorax short and quadrilateral; the wing-sheaths long and flexible, covering brownish membranous wings. When alive, the Spanish flies have a strong, penetrating, fetid odor, compared to that of mice, by which swarms of them may be detected at a considerable distance. They attach themselves preferably to certain trees and shrubs, such as the white poplar, privet, ash, elder, and lilac, upon the leaves of which they feed. They abound most in Spain, Italy, and the south of France, but are found also in all the temperate parts of Europe, and in the west of Asia. According to the researches of Lichtenstein, the eggs are laid by the female in the latter part of June in small cylindrical holes made in the ground. A week later the larvæ hatch out. They are a millimetre long, with two long caudal threads, and of a brown color. After many efforts, M. Lichtenstein succeeded in getting them to feed on the honey contained in the stomach of bees. In a few days they changed into milk-white larvæ, and about a month after this buried themselves in the ground, to assume the chrysalis stage and to hatch out the following spring as perfected beetles. In the wild state the larvæ are said to mount up flowers and attach themselves to bees or other hymenopterous insects; carried by the bee

* A *beetle* is to be distinguished from a *fly* by its having the first pair of wings converted into elytra, or wing-cases—*i.e.*, thickened and hardened for protection.

† Those who wish to investigate the subject of vesicating insects generally are referred to the *P. J. Tr.* (Aug. 2, 1871), also *Proc. A. P. A.* (1876, p. 507).

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to the hive, the larvæ feed upon the young bees and the honey and bee bread stored up for use. The beetles usually make their appearance in swarms upon the trees in May and June, when they are collected. The time preferred for the purpose is in the morning at sunrise, when they are torpid from the cold of the night, and easily let go their hold. Persons with their faces protected by masks, and their hands with gloves, shake the trees, or beat them with poles; and the insects are received as they fall upon linen cloths spread underneath. They are then plunged into vinegar diluted with water, or exposed in sieves to the vapor of boiling vinegar, and, having been thus deprived of life, are dried either in the sun, or in apartments heated by stoves. This mode of killing the flies by the steam of vinegar is as ancient as the times of Dioscorides and Pliny. In some places they are gathered by smoking the trees with burning brimstone. It has been proposed by M. Lutrand to destroy them by the vapor of chloroform. When perfectly dry, they are introduced into casks or boxes, lined with paper and carefully closed, so as to exclude as much as possible the atmospheric moisture. According to M. Neutwich, the young fly has no vesicating power; and even those half-grown are equally destitute of it. (*P. J. Tr.*, Nov. and Dec., 1870, p. 355.)

Cantharides come chiefly from Spain, Italy, Sicily, and other parts of the Mediterranean. Considerable quantities are also brought from St. Petersburg, derived originally, in all probability, from the southern provinces of Russia, where the insect is very abundant. The Russian flies are most esteemed. They may be distinguished by their greater size, and their color approaching to that of copper.

In the United States are several species of Cantharis, which have been employed as substitutes for *C. vesicatoria*, and found equally efficient; but none of them are now recognized by our national Pharmacopœia; even *C. vittata*, which was at one time officinal, having been discarded. This we regret, as it seems to us that the native products of our country should always be encouraged when shown to be useful. We shall briefly notice all that have been submitted to experiment, and found to possess vesicating powers.

1. *Cantharis vittata.* Latreille, *Gen. Crust. et Insect.;* Durand, *Journ. of the Phil. Col. of Pharm.*, ii. 274, fig. 4. The *potato fly* * is rather smaller than *C. vesicatoria*, which it resembles in shape. Its length is about six lines. The head is light red, with dark spots upon the top; the feelers are black; the elytra or wing-cases are black, with a yellow longitudinal stripe in the centre, and with a yellow margin; the thorax is also black, with three yellow lines; and the abdomen and legs, which have the same color, are covered with a cinereous down. It inhabits chiefly the potato vine, and appears about the end of July or beginning of August, in some seasons very abundantly. It is found on the plant in the morning and evening, but during the heat of the day descends into the soil. The insects are collected by shaking them from the plant into hot water; and are afterwards carefully dried in the sun. They are natives of the Middle and Southern States. This species of Cantharis was first described by Fabricius in the year 1781, and was introduced to the notice of the profession by Dr. Isaac Chapman, of Bucks County, Pennsylvania, who found it equal if not superior to the Spanish fly as a vesicatory. The testimony of Dr. Chapman has been corroborated by that of many other practitioners. It may be applied to the same purposes, treated in the same manner, and given in the same dose as the foreign insect. Mr. W. R. Warner obtained 1·99 parts of cantharidin from 500 parts of this beetle, but by improved methods Mr. Fahnestock procured 1¼ per cent. of the active principle. (*A. J. P.*, xxviii. 195; li. 298.) Professor Leidy, of the University of Pennsylvania, ascertained, by experiment, that the vesicating property of this insect resides in the blood, the eggs, and a peculiar fatty matter of certain accessory glands of the generative apparatus. (*Am. Journ. of Med. Sci.*, Jan. 1860, p. 60.)

2. *Cantharis cinerea.* Latreille, *Gen. Crust. et Insect.;* Durand, *Journ. of the Phil. Col. of Pharm.*, ii. 274, fig. 5. The *ash-colored cantharis* closely resembles the preceding species in figure and size; but differs from it in color. The elytra and body are black, without the yellow stripes that characterize *C. vittata*, and are

* According to the researches of L. Dembinski, the Colorado potato-beetle (*Doryphora decemlineata*) contains no cantharidin. (*A. J. P.*, 1877, p. 550.)

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entirely covered with a short and dense ash-colored down, which conceals the proper color of the insect. The feelers are black, and the first and second joints are very large in the male. This species also inhabits the potato plant, and is occasionally found on other plants, as the English bean and wild indigo. It is a native of the Northern and Middle States. Illiger in 1801 discovered its vesicating properties; but Dr. Gorham was first to call public attention particularly to the subject, and to the fact of its equality in all respects with the potato fly, in a communication addressed, in the year 1808, to the Medical Society of Massachusetts.

3. *Cantharis marginata.* Latreille, *Gen. Crust. et Insect.;* Durand, *Journ. of the Phil. Col. of Pharm.*, ii. 274, fig. 6. This is somewhat larger than *C. vittata*, and of a different shape. The elytra are black, with the suture and margin ash-colored. The head, thorax, and abdomen are black, but nearly covered with an ash-colored down; and, on the upper part of the abdomen, under the wings, are two longitudinal lines of a bright clay color. The insect is usually found, in the latter part of summer, upon different species of Clematis, and frequents especially the lower branches which trail along the ground. Professor Woodhouse, of Philadelphia, first ascertained its vesicating properties; but it had previously been described by Fabricius as a native of the Cape of Good Hope. Dr. Harris, of Massachusetts, found it as efficient as any other species.

4. *Cantharis atrata.* Latreille, *Gen. Crust. et Insect.;* Durand, *Journ. of the Phil. Col. of Pharm.*, ii. 274, fig. 7. The *black cantharis* is smaller than the indigenous species already described; but resembles *C. marginata* in figure. Its length is only four or five lines. It is distinguished by its size, and its uniform black color. It frequents more especially the different species of Aster and Solidago, though it is found also on *Prunella vulgaris*, *Ambrosia trifida*, and some other plants. Mr. Durand met with considerable numbers of this insect near Philadelphia, in the month of September; and they continued to appear till the middle of October. They are common in the Northern and Middle States, but are not confined exclusively to this country, being found also in Barbary. Drs. Oswood and Harris, of New England, satisfactorily ascertained their vesicating powers. They are probably identical with the insect noticed as vesicatory by Prof. Woodhouse, under the name of *Meloë niger*.

5. *Cantharis Vulnerata.* Harrison Allen, *Medical Zoology*, 1st ed., p. 150. Dr. Geo. H. Horn states that this is so abundant upon the Pacific coast that he has often seen bushels of it covering the ground. It has a black body, an orange-colored head, sometimes with a broad black stripe down the middle, and black wing-cases. Dr. Horn found it medicinally very active, as was also the less plentiful *C. Melæna*.

Several other species have been discovered in the United States, but not yet practically employed. Among these are *C. æneas*, a native of Pennsylvania, discovered by Mr. Say; *C. politus* and *C. aszelianus*, inhabiting the Southern States; *C. Nuttalli*, a large and beautiful insect of Missouri, first noticed by Mr. Nuttall, and said to surpass the Spanish fly in magnitude and splendor; and *C. albida*, another large species, found by Mr. Say near the Rocky Mountains. Of these, *C. Nuttalli* (*Lytta Nuttalli*, Say, *Am. Entomol.*, i. 9) bids fair, at some future period, to be an object of importance in the western section of this country. The head is of a deep greenish color, with a red spot in front; the thorax is of a golden green; the elytra red or golden purple and somewhat rugose on their outer surface, green and polished beneath; the feet black; the thighs blue or purplish. The exploring party under Colonel Long ascertained the vesicating powers of this insect. It was found in the plains of the Missouri, feeding on a scanty grass. In one spot it was so numerous as to be swept away by bushels, in order that a place might be cleared for encamping. There are also a number of beetles found in the United States which are plentiful enough to be capable of affording a commercial article, and which are so closely allied to the genus Cantharis as to render it probable that they possess blistering properties. For an account of the more important, see *Proc. A. P. A.*, 1876, p. 506.

Properties. "About one inch (25 mm.) long, and a quarter of an inch (6 mm.) broad; with filiform antennæ, black in the upper part, and ample, membranous, transparent, brownish wings; elsewhere of a shining, coppery-green color;

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the powder is grayish brown and contains green, shining particles; odor strong and disagreeable." *U. S.* Dried Spanish flies preserve the form and color, and, to a certain extent, the disagreeable odor of the living insect. They have an acrid, burning, and urinous taste. Their powder is of a grayish brown color, interspersed with shining green particles, which are the fragments of the feet, head, and wing-cases. If kept perfectly dry, in well-stopped glass bottles, they retain their activity for a great length of time. A portion which had been preserved by Van Swieten for thirty years, in a glass vessel, was found still to possess vesicating properties. But, exposed to a damp air, they quickly undergo putrefaction; and this change takes place more speedily in the powder. Hence the insects should either be kept whole, and powdered as they are wanted for use, or, if kept in powder, should be well dried immediately after pulverization, and preserved in air-tight vessels. They should never be purchased in powder, as, independently of the consideration just mentioned, they may in this state be more easily adulterated. But, however carefully managed, cantharides are apt to be attacked by mites, which feed on the interior soft parts of the body, reducing them to powder, while the hard exterior parts are not affected. An idea was at one time prevalent that the vesicating property of the insect was not injured by the worm, which was supposed to devour only the inactive portion. But this has been proved to be a mistake. M. Farines, an apothecary of Perpignan, has satisfactorily shown that, though the hard parts left by these mites possess some vesicating power, and the powder produced by them still more, yet the sound flies are much stronger than either. Camphor, which has been recommended as a preservative, does not prevent the destructive agency of the worm.* It is stated by M. Farines that, when the flies are destroyed by the vapor of pyroligneous acid, instead of common vinegar, they acquire an odor which contributes to their preservation. Cantharides will bear a very considerable heat without losing the brilliant color of their elytra; nor is this color extracted by water, alcohol, ether, or the oils; so that the powder might be deprived of all its active principle, and yet retain the exterior characters unaltered. The wing-cases resist putrefaction for a long time, and the shining particles have been detected in the human stomach months after interment.

So early as 1778, Thouvenel attempted to analyze cantharides, and the attempt was repeated by Dr. Beaupoil in 1803; but no very interesting or valuable result was obtained till 1810, when Robiquet discovered in them a crystalline substance, which proved to be the vesicating principle of the insect, and received the name of *cantharidin*. The constituents, according to Robiquet, are—1, a green oil, insoluble in water, soluble in alcohol, and inert as a vesicatory; 2, a black matter, soluble in water, insoluble in alcohol, and inert; 3, a yellow viscid matter, soluble in water and alcohol, and without vesicating powers; 4, cantharidin; 5, a fatty matter, insoluble in alcohol; 6, phosphates of calcium and magnesium, acetic acid, and in the fresh insect, a small quantity of uric acid. Orfila afterwards discovered a volatile principle, upon which the fetid odor of the fly depends. It is separable by distillation with water. Prof. Dragendorff has found a volatile principle which acts on the system in the same manner as cantharidin. When powdered flies are moistened with water and distilled, the part which passes over, at or below 100° C. (212° F.), contains this principle. (*Chem. News*, May 31, 1867.) That the green coloring matter is chlorophyll seems to be shown by the experiments of Pocklington, who

* It appears from the experiments of M. Nivet that, though camphor does not preserve the entire fly from the attacks of the larvæ of the *Anthrenus*, it actually destroys the mites of the Cantharis so often found in the powder, and may, therefore, be introduced with advantage, in small lumps, into bottles containing powdered cantharides. (*Journ. de Pharm.*, xix. 604.) Carbonate of ammonium has also been recommended as a preservative. Pereira has found that a few drops of strong acetic acid, added to the flies, are very effectual. Among the best means of preserving them, whether whole or in powder, is the application of the process of Apert, which consists in exposing them, for half an hour, confined in glass bottles, to the heat of boiling water, which destroys the eggs of the insect, without impairing the virtues of the flies. (*Ibid.*, xxii. 246.) Of course the access of water to the flies should be carefully avoided. Lutrand recommends chloroform as the best preservative that he has tried. (*Journ. de Pharm.*, xviii. 214.) We have little doubt that exposure, in a confined vessel, to the vapor of carbolic acid, would be a perfect protection against all forms of insect life.

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(*P. J. Tr.*, [3] iii. p. 681) found that when cantharides was treated with alcohol, ether, and bisulphide of carbon, the solutions yielded absorption spectra agreeing with that of chlorophyll.

Cantharidin is a white substance, in the form of crystalline scales, of a shining micaceous appearance, inodorous, tasteless, almost insoluble in water and in cold alcohol, but soluble in ether, chloroform, benzol, the oils, and in hot alcohol and acetic acid, which deposit it upon cooling.* It fuses at 210° C. (410° F.), and is volatilizable by heat without decomposition, and its vapor condenses in acicular crystals. As determined by the experiments of Mr. Wm. A. Guy, the subliming heat of isolated cantharidin is 100° C. (212° F.), or the temperature of boiling water. (*P. J. Tr.*, Feb. 1868, p. 373.) According to MM. Masing and Dragendorff, cantharidin, with the composition $C_{10}H_{12}O_4$, is capable of combining with water, and thus becomes cantharidic acid, $2(C_5H_6O_2.H_2O)$, or $C_{10}H_{14}O_5$, and in this state forms definite compounds with bases, such as $2(C_5H_6O_2.KHO) + H_2O$, and $2(C_5H_6O_2.NaHO) + H_2O$, which are crystallizable. These may be obtained by heating cantharidin with an alkaline solution. (*Journ. de Pharm. et de Chim.*, Janv. 1868, p. 79.) Cantharidin itself has been found to combine like an acid with the salifiable and earthy bases, forming soluble compounds with potassium, sodium, and lithium hydrates, salts of very sparing solubility, with baryta, strontia, and lime, and, with magnesia a salt, which, though feebly soluble in water (100 parts of water dissolving only 0·24 of the salt) (see *P. J. Tr.*, March 13, 1880), is much more largely dissolved in cold than in hot water, and in cold than hot alcohol. (For further details concerning the relations of cantharidin with bases, and the preparation of its salts, see *P. J. Tr.*, Oct. 1873, p. 282.) The most satisfactory test of cantharidin is its vesicating property. Notwithstanding the insolubility of this principle in water and cold alcohol, the decoction and tincture of cantharides have the medicinal properties of the insect; and Lewis ascertained that both the aqueous and alcoholic extracts acted as effectually in exciting vesication as the flies themselves, while the residue was in each case inert. Cantharidin consequently exists in the insect, so combined with the yellow matter as to be rendered soluble in water and cold alcohol. H. G. Greenish calls attention to the fact that much loss of cantharidin takes place in making the various pharmaceutical preparations through insufficient exhaustion by the use of the ordinary solvents. He obtained 0·822 per cent. of cantharidin from exhausted residues. M. Ferrer found cantharidin in all parts of the fly, but somewhat more largely in the soft than the hard parts. (*Journ. de Pharm.*, Oct. 1859, p. 279.)

Adulterations. These are not common. Occasionally other insects are added, purposely, or through carelessness. These may be readily distinguished by their different shape or color. Flies exhausted of their cantharidin by ether are said to have been substituted for the genuine. An account has been published of considerable quantities of variously colored glass beads having been found in a parcel of the drug; but this would be too coarse a fraud to be extensively practised. Pereira states that powdered flies are sometimes adulterated with euphorbium. According to the researches of Mr. Fahnestock (*A. J. P.*, 1879, p. 298), age destroys the activity of the drug without of necessity impairing its physical appearance.

The percentage of cantharidin found in cantharides furnishes the best test of their virtues. Professor Procter succeeded, by means of chloroform, in isolating can-

* The solubilities of cantharidin were examined with great care by Professor Procter, with the following results. It is insoluble in water. Cold alcohol dissolves it slightly, hot alcohol freely. It is more soluble in ether, which also dissolves it more freely hot than cold. Chloroform, cold or hot, is its best solvent; and acetone ranks next to it in this respect. Olive oil, at 250° F., dissolves one-twentieth of its weight, and oil of turpentine, boiling hot, one-seventieth; and both deposit the greater portion on cooling. The olive oil solution after deposition vesicates, the terebinthinate does not. Strong acetic, sulphuric, and nitric acid dissolve it, with the aid of heat, and deposit it unchanged on cooling. It is also dissolved by solutions of potassa and soda, and to a small extent by a strong solution of ammonia. (*A. J. P.*, xxiv. 296.)

Somewhat different results in relation to the solubility of cantharidin have been obtained by M. E. Rowan. Careful examination with distilled water showed that, when agitated for eight days at ordinary temperatures with pure cantharidin, it was capable of dissolving 0·0266 per cent. of that principle; boiling water dissolves 0·297 per cent.; alcohol (boiling at 99 Tralles.) 2·168 per cent. (*Journ. de Pharm.*, Mai, 1873, p. 409.)

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tharidin with great facility. He treated the flies with chloroform by percolation, displacing the last portion by means of alcohol, and allowing the resulting solution to evaporate spontaneously. Cantharidin is thus obtained in crystals mixed with the green oil, the greater portion of which may be removed by bibulous paper. The residuary crystals are dissolved in a mixture of ether and alcohol, which, by the spontaneous evaporation of the ether, yield the cantharidin nearly pure. M. Mortreux, having ascertained that cantharidin is insoluble in bisulphide of carbon, proposed to use this fluid for removing the fatty matter associated with the cantharidin crystals obtained by the use of chloroform. He employed the same liquid in estimating the proportion of cantharidin, which he found to be about 20 centigrammes for 40 grammes of the flies, or half of one per cent. (*Journ. de Pharm. et de Chem.*, 3e sér., xlvi. 33, 1864.) Wittstein obtains it by digesting coarsely powdered flies repeatedly with water, straining through linen and expressing, allowing the liquid to settle for a day, separating the supernatant oil, adding a little wood charcoal, evaporating to dryness, treating the residue with ether so long as the solution affords a laminated substance on evaporation, evaporating the ethereal solution, treating the residue with cold alcohol of 80 per cent. for one day with frequent shaking, and finally drying the scales. (See *A. J. P.*, xxviii. 231.) Mr. Williams has obtained it by means of benzol. (*Ibid.*, xxvi. 340.)

Medical Properties and Uses. Internally administered, cantharides is a powerful irritant, with a peculiar direction to the urinary and genital organs. In moderate doses, this medicine sometimes acts as a diuretic, and generally excites some irritation in the urinary passages, which, if its use be persevered in, or the dose increased, often amounts to violent strangury, attended with excruciating pain, and the discharge of bloody urine. In still larger quantities, it produces, in addition to these effects, obstinate and painful priapism, vomiting, bloody stools, severe pains in the whole abdominal region, excessive salivation with a fetid cadaverous breath, hurried respiration, a hard and frequent pulse, burning thirst, exceeding difficulty of deglutition, sometimes a dread of liquids, frightful convulsions, tetanus, delirium, and death. Orfila has known twenty-four grains of the powder to prove fatal. Dissection reveals inflammation and ulceration of the mucous coat of the whole intestinal canal. According to M. Poumet, if the intestines be inflated, dried, cut into pieces, and examined in the sun between two pieces of glass, they will exhibit small shining yellow or green points, strongly contrasting with the matter around them. (*Journ. de Pharm.*, 3e sér., iii. 167.)* The poisonous effects are to be counteracted by emetics, cathartics, and opiates by the stomach and rectum. Dr. Mulock, of Dublin, recommends the officinal solution of potassa as an antidote, having found thirty drops given every hour an effectual remedy in strangury from blisters. (*Dub. Quart. Journ. of Med. Sci.*, N. S., vi. 222.) From the experiments of Schroff it seems that oils somewhat accelerate the poisonous action, probably by dissolving the cantharidin. (See *A. J. P.*, xxviii. 365.) By experiments upon dogs, M. Thouery, a French apothecary, has satisfied himself that animal charcoal possesses a real antidotal power. (*Journ. de Pharm.*, 1858, p. 65.) Notwithstanding their exceeding violence, cantharides have been long and beneficially used in medicine. Either these or other vesicating insects appear to have been given by Hippocrates in dropsy and amenorrhœa, in the latter of which complaints, when properly prescribed, they are a highly valuable remedy. In dropsy they sometimes prove useful when the system is in an atonic state, and the vessels of the kidneys feeble. They are also useful in obstinate gleet, leucorrhœa, and seminal weakness, and afford one of the most certain means of relief in incontinence of urine arising from debility or partial paralysis of the sphincter of the bladder. A case of diabetes is recorded in the *N. Am. Archives* (vol. ii. p. 175), in which recovery took place under the tincture of cantharides. They are used also in certain cutaneous eruptions, especially those of

* Cantharidin may be detected in the body after death from poisoning. M. Dragendorff, contrary to the opinion that cantharidin is so rapidly decomposed in a case of poisoning as to render search for it futile, states that he has succeeded in finding it in the dead body of a cat three months after it had been taken, and is convinced that it might be discovered in the human corpse six months after burial. (*Journ. de Pharm.*, 1873, p. 443.)

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a scaly character, and in chronic eczema. Dr. Erven has employed them in scurvy (*Ann. de Thérap.*, 1845); and they have been found useful, internally administered, in obstinate ulcers. Their unpleasant effects upon the urinary passages are best obviated by the free use of diluent drinks, and, when not consequent upon great abuse of the medicine, may almost always be relieved by an anodyne injection, composed of laudanum with a small quantity of mucilaginous fluid. The dose of Spanish flies is one or two grains (0·065–0·13 Gm.) of the powder, which may be given twice a day, in the form of pill. The tincture, however, is more frequently employed.

Externally applied, cantharides excites inflammation in the skin, which terminates in a copious secretion of serum under the cuticle. Even thus employed, it not unfrequently gives rise to strangury or tenesmus; and this is one of the most troublesome attendants upon its operation. It results from the absorption of the active principle of the fly. For various methods employed for obviating strangury from blisters, see *Ceratum Cantharidis.*

The blistering fly may be used either as a rubefacient, or to produce a blister. In the former capacity it is seldom employed, except in low states of disease, where external stimulation is required to support the system; but as an epispastic it is preferred to all other substances.

Blisters are calculated to answer numerous indications. Their local effect is attended with a general excitement, which renders them valuable auxiliaries to internal stimulants in low conditions of disease; and they may sometimes be safely resorted to with this view, when the latter remedies are inadmissible. The powerful impression they make on the system is sufficient, in many instances, to subvert morbid associations, and thus to allow the re-establishment of healthy action. Hence their application to the cure of remittent and intermittent fevers, in which they often prove effectual, when so employed as to be in full operation at the period for the recurrence of the paroxysm. On the principle of revulsion, they are useful in a vast variety of complaints. Drawing both the nervous energy and the circulating fluid to the seat of their immediate action, they relieve irritations and inflammations of internal parts, and are employed for this purpose in every disease attended with these derangements. In such cases, however, arterial excitement should be reduced before the remedy is resorted to. Blisters are also capable of substituting their own action for one of a morbid nature, existing in the part to which they are directly applied. Hence their use in tinea capitis, obstinate herpes, and various cutaneous eruptions. Their local stimulation renders them useful in some cases of threatened gangrene, and in partial paralysis. From the serous discharge they occasion, much good results in erysipelas and various other local inflammations, in the immediate vicinity of which their action can be established; and the effects of an issue may be obtained by the continued application of irritants to the blistered surface. Perhaps the pain produced by blisters may be useful in some cases of nervous excitement or derangement, in which it is desirable to withdraw the attention of the patient from subjects of agitating reflection. On some constitutions they produce a poisonous impression, attended with frequent pulse, dryness of the mouth and fauces, heat of skin, subsultus tendinum, and even convulsions. What is the precise condition of system in which these effects result, it is impossible to determine. They probably arise from the absorption of the active principle, and depend on individual peculiarities of constitution. In this respect Spanish flies are analogous to mercury; and any argument drawn from this source against the use of the one would equally apply to the other. The general good resulting from their use far overbalances any partial and uncertain evil. For some rules relative to the application of blisters, the reader is referred to the article *Ceratum Cantharidis*, where also will be noticed other blistering preparations from cantharides.

Off. Prep. Acetum Cantharidis, *Br.;* Ceratum Cantharidis, *U. S.;* Ceratum Extracti Cantharidis, *U. S.;* Charta Cantharidis, *U. S.;* Charta Epispastica, *Br.;* Collodium cum Cantharide, *U. S.;* Emplastrum Calefaciens, *Br.;* Emplastrum Cantharidis, *Br.;* Extractum Cantharidis; Linimentum Cantharidis, *U. S.;* Liquor Epispasticus, *Br.;* Tinctura Cantharidis; Unguentum Cantharidis, *Br.*

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CAPSICUM. *U.S.* *Capsicum.*

(CĂP'SĮ-CŬM.)

"The fruit of Capsicum fastigiatum. Blume. (*Nat. Ord.* Solanaceæ.)" *U.S.* "The dried fruit of Capsicum fastigiatum. Imported from Zanzibar, and distinguished in commerce as Guinea Pepper and Pod Pepper." *Br.*

Capsici Fructus, *Br.;* Cayenne Pepper, African Pepper; Fructus capsici, *P.G.;* Piper Hispanicum; Pod Pepper, *E.;* Capsique, Piment des Jardins, Piment rouge, Poivre de Cayenne, Poivre de Guinée, Poivre d'Inde, *Fr.;* Spanischer Pfeffer, *G.;* Pepperone, *It.;* Pimiento, *Sp.*

Gen. Ch. Corolla wheel-shaped. *Berry* without juice. *Willd.*

Numerous species of Capsicum, inhabiting the East Indies and tropical America, are enumerated by botanists, the fruit of which, differing simply in the degree of pungency, may be indiscriminately used. *C. baccatum*, or bird pepper, and *C. frutescens*, are said to yield most of the Cayenne pepper brought from the West Indies and South America; and Ainslie informs us that the latter is chiefly employed in the East Indies. Both Pharmacopœias now recognize, as the source of capsicum, *C. fastigiatum*, a species growing in the East Indies, and on the coast of Guinea. The one most extensively cultivated in Europe and this country is *C. annuum*. The first three are shrubby plants, the last is annual and herbaceous.

Capsicum annuum. Willd. *Sp. Plant.* i. 1052; *B. & T.* 189. The stem of the annual capsicum is thick, roundish, smooth, and branching; rises two or three feet in height; and supports ovate, pointed, smooth, entire leaves, which are placed without regular order on long footstalks. The flowers are solitary, white, and stand on long peduncles at the axils of the leaves. The calyx is persistent, tubular, and five-cleft; the corolla, monopetalous and wheel-shaped, with the limb divided into five spreading, pointed, and plaited segments; the filaments, short, tapering, and furnished with oblong anthers; the germen, ovate, supporting a slender style which is longer than the filaments, and terminates in a blunt stigma. The fruit is a pendulous, pod-like berry, of various shape and size, light, smooth, and shining, of a bright scarlet, orange, or sometimes yellow color, with two or three cells, containing a dry, loose pulp, and numerous flat, kidney-shaped, whitish seeds.

Capsicum fastigiatum. Blume. *B. & T.* 188. This species resembles closely *C. annuum*, but is distinguished by the lobes of the corolla being more acute, and especially by the fruit and seeds. The latter are smaller than those of *C. annuum*, and the erect, narrowly ovoid, oblong pod is nearly cylindrical, one-half to three-quarters of an inch long, and of a bright orange scarlet color when ripe.

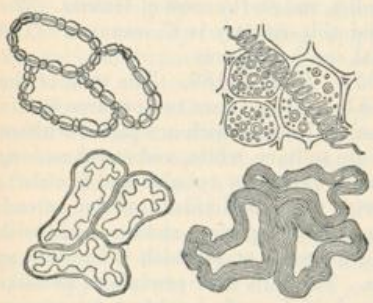
These plants are natives of the warmer regions of Asia and America, and are cultivated in almost all parts of the world both for culinary and medicinal purposes. *C. annuum* is chiefly grown in this country; its flowers appear in July and August, and the fruit ripens in October. The several varieties of it differ in the shape of the fruit. The most abundant is probably that with a large irregularly ovate berry, depressed at the extremity, which is much used in the green state for pickling. The medicinal variety is that with long, conical, generally pointed, recurved fruit, usually not thicker than the finger. Sometimes we meet with small, spherical, slightly compressed berries, not greatly exceeding a large cherry in size. When perfectly ripe and dry, the fruit is ground into powder, and brought into market under the name of *red* or *Cayenne* pepper. Our markets are also partly supplied from the West Indies. A variety of capsicum, consisting of very small, conical, pointed, exceedingly pungent berries, less than an inch, is imported from Liberia. It is probably the *Capsicum fastigiatum*. In England the fruit of *C. annuum* is frequently called *chillies*. The officinal description of the fruit of *C. fastigiatum* is as follows: "Conical, from half to three-quarters of an inch (12 to 18 mm.) long, supported by a flattish, cup-shaped, five-toothed calyx, with a red, shining, membranous and translucent pericarp enclosing two cells, and containing flat, reniform, yellowish seeds attached to a thick, central placenta. It has a peculiar odor, and an intensely hot taste." *U.S.*

Powdered capsicum is usually of a more or less bright red color, which fades upon exposure to light, and ultimately disappears. The color of the Liberia or African pepper, in powder, is a light brownish yellow. The odor is peculiar and

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somewhat aromatic, stronger in the recent than in the dried fruit. The taste is bitterish, acrid, and burning, producing a fiery sensation in the mouth, which continues for a long time. The pungency appears to depend on a peculiar principle, which was obtained, though not in a perfectly isolated state, by Braconnot, and named *capsicin*. It is obtained as a thick yellowish red liquid, but slightly soluble in water. When gently heated it becomes very fluid, and at a higher temperature is dissipated in fumes, which are extremely irritating to the respiration. It is evidently a mixed substance, consisting of resinous and fatty matters.

In 1876, Thresh isolated, however, a well-defined highly active principle, *capsaicin*, from the extract, which he obtained by exhausting Cayenne pepper with petroleum. From the red liquor dilute caustic alkali removes capsaicin, which is to be precipitated in minute crystals by passing carbonic acid through the alkaline solution. The crystals may be purified by recrystallizing them from either alcohol, ether, benzin, glacial acetic acid, or hot bisulphide of carbon; in petroleum capsaicin is but sparingly soluble, yet dissolves abundantly on addition of fatty oil. The latter being present in the pericarp is the reason capsaicin can be extracted by the above process. The crystals of capsaicin are colorless, and answer to the formula $C_9H_{14}O_2$; they melt at 59° C. (138·2° F.), and begin to volatilize at 115° C. (239° F.), but decomposition can only be avoided with great care. The vapors of capsaicin are of the most dreadful acridity, and even the ordinary manipulation of that substance requires much precaution. Felletar (*Journ. de Pharm.*, Avril, 1870, p. 347) first obtained from capsicum fruits a volatile alkaloid, which resembles conine in odor, but is distinguished by the different shape of its hydrochlorate crystals. Red oxide of lead is sometimes added to the powdered capsicum sold in Europe. It may be detected by digesting in diluted nitric acid, and precipitating the lead by sulphate of sodium. Capsicum is said to be sometimes adulterated with colored sawdust; to be recognized by the microscope. The cut represents the characteristic cells of capsicum. It is occasionally attacked by insects.



Medical Properties and Uses. Cayenne pepper is a powerful stimulant, producing when swallowed a sense of heat in the stomach, and a general glow over the body, without any narcotic effect. Its influence upon the circulation, though considerable, is not in proportion to its local action. It is much employed as a condiment, and proves highly useful in correcting the flatulent tendency of certain vegetables, and aiding their digestion. Hence the advantage derived from it by the natives of tropical climates, who live chiefly on vegetable food. In the East Indies it has been used from time immemorial. From a passage in the works of Pliny, it appears to have been known to the Romans. As a medicine it is useful in cases of enfeebled and languid stomach, and is occasionally prescribed in dyspepsia and atonic gout, particularly when attended with much flatulence, or occurring in persons of intemperate habits. It has also been given as a stimulant in palsy and certain lethargic affections. To the sulphate of quinine it forms an excellent addition in some cases of intermittents, in which there is a great want of gastric susceptibility. Upon the same principle of rousing the susceptibility of the stomach, it may prove useful in low forms of fever, as an adjuvant to tonic or stimulant medicines. Its most important application, however, is to the treatment of malignant sore throat and scarlet fever, in which it is used both internally and as a gargle. The following formula was employed in malignant scarlatina, with great advantage, in the West Indies, where this application of the remedy originated. Two tablespoonfuls (31·1 Gm.) of the powdered pepper, with a teaspoonful (3·9 Gm.) of common salt, are infused for an hour in a pint of boiling liquid, composed of equal parts of water and vinegar. This is strained when cool through a fine linen cloth, and given in the dose of a tablespoonful (15 C.c.) every half hour. The same preparation is also

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used as a gargle. It is, however, only to the worst cases that the remedy is applied so energetically. In milder cases of scarlatina, with inflamed or ulcerated throat, much relief and positive advantage often follow the employment of the pepper in a more diluted state. Capsicum has been advantageously used in sea-sickness, in the dose of a teaspoonful (3·9 Gm.), given in some convenient vehicle on the first occurrence of nausea. It is thought also to have been beneficial in hemorrhoidal affections. It has long been used as a stomachic stimulant in the enfeebled digestion of drunkards, and has been recommended in delirium tremens, in which, when taken early, it is said sometimes to produce sleep, and thus to cut short the disease. (Dr. Lyons, *Med. Press and Circ.*, April 18, 1866.)

Applied externally, Cayenne pepper is a powerful rubefacient, very useful in local rheumatism, and in low forms of disease, where a stimulant impression upon the surface is demanded. It has the advantage of acting speedily without endangering vesication. It may be applied in the form of cataplasm, or more conveniently and efficiently as a lotion, mixed with heated spirit. The powder or tincture, brought into contact with a relaxed uvula, often acts very beneficially. The tincture has also been used advantageously in chilblain. The ethereal extract (*Oleoresina Capsici, U. S.*) is powerfully rubefacient.

The dose of the powder is from five to ten grains (0·33–0·65 Gm.), which is most conveniently given in the form of pill. Of an infusion prepared by adding two drachms to half a pint of boiling water, the dose is half a fluidounce (15 C.c.). A gargle may be prepared by infusing half a drachm of the powder in a pint of boiling water, or by adding half a fluidounce of the tincture to eight fluidounces of rose-water.

Off. Prep. Extractum Capsici Fluidum; Infusum Capsici, *U. S.;* Oleoresina Capsici, *U. S.;* Tinctura Capsici.

CARBO. *Carbon.*

C; 12. (CÄR'BŌ.) C; 6.

Pure Charcoal; Carbone, *Fr., It.;* Kohlenstoff, *G.;* Carbon, *Sp.*

Carbon is an element of great importance, and very extensively diffused in nature. It exists in large quantity in the mineral kingdom, and is the most abundant constituent of animal and vegetable matter. In the crystallized state it constitutes the diamond; and, more or less pure, it forms the substances called graphite, or black lead, plumbago, anthracite and bituminous coal, coke, animal charcoal, and vegetable charcoal. Combined with oxygen it forms *carbon dioxide*, or *carbonic acid gas*, which is a constituent of the atmosphere, and present in many natural waters, especially those which have an effervescing quality. United with oxygen and a base it forms the carbonates, among others *carbonate of calcium*, which is one of the most abundant minerals. There are three allotropic conditions of carbon, represented respectively by the diamond, graphite, and charcoal.

The *diamond* is found principally in India, Brazil, and Cape Colony, South Africa. Several diamonds have been found in the gold regions of Georgia and North Carolina. This gem is perfectly transparent, and the hardest and most brilliant substance in nature. Its sp. gr. is about 3·5. It is fixed and unalterable in the fire, provided air be excluded; but is combustible in air or oxygen, the product being the same as when charcoal is burned, namely, carbon dioxide.

Next to diamond, graphite or plumbago is the purest natural form of carbon. Graphite is the substance of which black-lead crucibles and pencils are made. It is found in greatest purity in the mine of Borrowdale, in England; but it also occurs very pure in this country, and in extensive deposits at Ticonderoga, N. Y., Stourbridge, Mass., and in Canada. In physical characters it is utterly different from the diamond; it crystallizes in hexagonal plates, is very soft and unctuous, of 2 to 2·5 sp. gr., and generally contains a little ash. It was formerly supposed to be a carbide of iron; but, in very pure specimens, it is nearly free from iron, which must, therefore, be deemed an accidental impurity. *Anthracite*, the purest variety of natural coal, occurs in different parts of the world, but particularly in the State of Pennsylvania. It contains from 90 to 95 per cent. of carbon, and several per

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cent. of ash. *Bituminous coal* is another variety, containing, besides the fixed or free carbon, some 10 to 15 per cent. of volatile hydrocarbons or gas-making material. When this is driven off by the process of charring, as in the manufacture of coal gas, a kind of mineral charcoal, called *coke*, is obtained, very useful in the arts as a fuel. When peat is charred, it is converted into *peat charcoal*, which forms a cheap disinfectant and deodorizer, applicable to the purification of hospitals, dissecting rooms, factories, privies, etc.

Carbon may be obtained in a state approaching to purity by several processes. One method is to expose lampblack to a full red heat in a close vessel. It may also be obtained, in a very pure state, by passing the vapor of volatile oils through an ignited porcelain tube; whereby the hydrogen and oxygen of the oil will be dissipated, and the charcoal left in the tube. A pure charcoal is procured by burning sugar, or other vegetable substances which leave no ashes, in close vessels.

Properties. Carbon, in its uncrystallized state, is an insoluble, infusible solid, generally of a black color, and without taste or smell. It burns when sufficiently heated, uniting with the oxygen of the air, and generating carbonic acid gas. Its sp. gr. in the solid state, apart from its pores when in mass, is 3·5; but with the air of the pores included, it is only 0·44. It is a very unalterable and indestructible substance, and has great power in resisting and correcting putrefaction in other bodies. When properly prepared, it possesses the property of absorbing the coloring and odorous principles of most liquids. (See *Carbo Animalis.*) Its other physical properties differ according to its source, and peculiar state of aggregation. As a chemical element it enjoys a very extensive range of combination. It forms two compounds with oxygen, *carbon dioxide* (carbonic acid gas) and *carbon monoxide* (carbonous oxide). With hydrogen it forms a number of compounds, called *hydrocarbons*, of which the most interesting, excluding hypothetical radicals, are light carburetted hydrogen or marsh-gas, olefiant gas, the light and concrete oils of wine, the hydrocarbons constituting petroleum, and the various essential oils. With nitrogen it constitutes cyanogen, the compound radical of hydrocyanic or prussic acid; and united in minute proportion with iron it forms steel.

To notice all the forms of the carbonaceous principle would be out of place in this work. We shall, therefore, restrict ourselves to the consideration of those which are officinal, namely, *animal charcoal* and *wood charcoal.*

CARBO ANIMALIS. *U.S., Br.* *Animal Charcoal.*

(CÄR'BŌ ĂN-Ĭ-MĀ'LĬS.)

"Animal [*sic*] charcoal prepared from bone." *U.S.* "The residue of bones, which have been exposed to a red heat without access of the air." *Br.*

Bone Black, Ivory Black, *Br.;* Charbon animal, Noir d'Os, *Fr.;* Thierische Kohle, Knochen Kohle, Beinschwarz, Thierkohle, *G.;* Carbone animale, *It.;* Carbon animal, *Sp.*

The animal charcoal employed in pharmacy and the arts is usually obtained from bones, by subjecting them to a red heat in close vessels. The residue of the ignition is a black matter, which, when reduced to powder, forms *bone-black*, sometimes incorrectly called *ivory-black.* Ivory by carbonization will furnish a black, which, on account of its fineness and intensely black color, is more esteemed than the ordinary bone-black; but it is much more expensive.

In manufacturing bone-black, the bones, first boiled in water to separate the fat, are subjected to destructive distillation in iron cylinders, connected with vessels which receive the ammoniacal liquor, called *bone-spirit*, together with a dark tarry liquid (*bone-oil*), this being a secondary product of the operation. When the bone-spirit ceases to come over, the residue is charred bone, or bone-black. Bone consists of animal matter with phosphate and carbonate of calcium. In consequence of the decomposition of the animal matter involved in this destructive distillation, the nitrogen and hydrogen, united as ammonia, and a part of the charcoal, in the form of carbonic acid gas, distil over; while the remainder of the charcoal is left in the cylinder, intermingled with the calcareous salts. M. Deiss, of Paris, proposes bisulphide of carbon as a solvent for the fat of bones; as it furnishes a larger and better product of fat, and renders the bones fitter for producing a good bone-black.

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(*Chem. Gaz.*, April 1, 1856.) This form of animal charcoal necessarily contains phosphate and carbonate of calcium.

Properties. Animal charcoal is in the form of "dull black, granular fragments, or a dull black powder, odorless and nearly tasteless, and insoluble in water or alcohol. When ignited, it leaves a white ash, amounting to at least 86 per cent. of the original weight, which should be completely soluble in hydrochloric acid, with the aid of heat." *U. S.* It is, however, more dense and less combustible than vegetable charcoal; from which, moreover, it may be distinguished by burning a small portion of it on a red-hot iron, when it will leave a residuum imperfectly acted on by sulphuric acid; whereas the ashes from vegetable charcoal readily dissolve in this acid, forming a bitterish solution.

Animal charcoal by no means necessarily possesses the decolorizing property; as this depends upon its peculiar state of aggregation. If a piece of pure animal matter is carbonized, it usually enters into fusion, and from the gaseous matter which is extricated, becomes porous and cellular. The charcoal formed has generally a metallic lustre, and a color resembling that of black lead. It has, however, little or no decolorizing power, even though finely pulverized.

The decolorizing power of vegetable charcoal was first noticed by Lowitz, of St. Petersburg; and that of animal charcoal by Figuier, of Montpellier, in 1811. In 1822 the subject was ably investigated by Bussy, Payen, and Desfosses. The power is generally communicated to charcoal by igniting it in close vessels, but not always. The kind of charcoal, for example, obtained from substances which undergo fusion during carbonization scarcely possesses the property, even though it may be afterwards finely pulverized. The property in question is possessed to a certain extent by wood charcoal;* but is developed in it in a much greater degree by burning it with some chemical substance, which may have the effect of reducing it to an extreme degree of fineness. The most powerful of all the charcoals for discharging colors are those obtained from certain animal matters, such as dried blood, hair, etc., by first carbonizing them in connection with carbonate of potassium, and then washing the product with water. Charcoal, thus prepared, seems to be reduced to a state of extremely minute division, and is, therefore, very porous. The next most powerful decolorizing charcoal is *bone-black*, in which the separation of the carbonaceous particles is effected by the phosphate of calcium present in the bone. Vegetable substances also may be made to yield a good charcoal for destroying color, provided, before carbonization, they be well comminuted, and mixed with pumice stone, chalk, flint, or other similar substance in a pulverized state.

The following table, abridged from one drawn up by Bussy, denotes the relative decolorizing power of different charcoals.

KINDS OF CHARCOAL.	Decolorizing power on Syrup.	Decolorizing power on Indigo.
Bone-black	1	1
Bone charcoal treated with an acid	1·6	1·8
Lampblack, not ignited	3·3	4
Charcoal, from acetate of potassium	4·4	5·6
Blood ignited with phosphate of calcium	10	12
Lampblack ignited with carbonate of potassium	10·6	12·2
Blood ignited with chalk	11	18
White of egg ignited with carbonate of potassium	15·5	34
Glue ignited with carbonate of potassium	15·5	36
Bone charcoal, formed from bone deprived of phosphate of calcium by an acid, and subsequently ignited with carbonate of potassium	20	45
Blood ignited with carbonate of potassium	20	50

* Dr. Stenhouse divides decolorizing charcoals into three classes. First, pure charcoals, which, being in a state of minute division, decolorize by their porosity alone. Second, those which, like aluminized charcoal and artificial bone-black, decolorize solely by the bases they contain, acting as mordants. Third, those which, like bone-black, decolorize, partly by the mineral matter, and partly by the minutely divided charcoal they contain. (*P. J. Tr.*, Jan. 1857, p. 366.)

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In order to determine the commercial value of animal charcoal, M. Corenwinder has proposed to ascertain its power of absorbing lime from a solution of saccharate of lime of determinate strength. The value is in proportion to the absorbing power of the charcoal. A given weight of the charcoal to be tested is left in contact, for an hour, with a given volume of the solution of the saccharate, taken in excess. The liquid is then filtered, and a small measure of it saturated with dilute sulphuric acid of known strength. The less the acid necessary for this purpose, the greater the amount of lime absorbed, and the better the animal charcoal. (See *Chem. Gaz.*, 1854, p. 16; see also *Scientific American*, April 22, 1876. F. L. Bartlett.)

Spent animal charcoal, which has been used by the sugar refiners, may have its decolorizing power restored by calcination, which destroys the organic matters that have become fixed in it; and it is stated that it may be submitted to this process twenty times before becoming unfit for use. According to Pelouze, the same object may be accomplished by subjecting it to a weak solution of carbonate of potassium or of sodium. In removing the coloring matter, the alkaline solution becomes yellow. After its action the animal charcoal must be carefully washed, first with boiling water, and afterwards with acidulated water. But a process devised by MM. Leplay and Cuisinier is probably more effectual. The charcoal, without being removed from the cylinders, is thoroughly washed, treated by steam to remove viscous substances, and then percolated successively, 1, by a weak alkaline solution, which removes salts and some coloring matters; 2, by weak hydrochloric acid, which, in removing a certain amount of salts of lime, liberates coloring matter; 3, again with a weak alkaline solution to carry off the remaining coloring matter; and 4, lastly by a solution of biphosphate of calcium, by which the decolorizing power of the charcoal is restored. (Dr. F. C. Calvert, *A. J. P.*, 1865, p. 263.)

Animal charcoal is capable of taking the bitter principles from infusions and tinctures, and iodine from liquids which contain it in solution. Its power, however, of acting on solutions and chemical compounds is much more decided in its purified state, as shown by both Warington and Weppen. (See *Carbo Animalis Purificatus.*)

Bone-black consists of about 90 per cent. of phosphate and carbonate of calcium, and 10 per cent. of charcoal.

Pharm. Uses. Animal charcoal is used in pharmacy for decolorizing vegetable principles, such as gallic acid, quinine, morphine, veratrine, etc., and in the arts, principally for clarifying syrups in sugar refining, for depriving spirits distilled from grain of the peculiar volatile oil, called *fusel oil*, which imparts to them an unpleasant smell and taste, as first distilled, and for the filtration of petroleum residuums in the manufacture of petrolatum and petroleum jellies. (See *Petrolatum.*) The manner in which it is used as a decolorizer is to mix it with the substance to be decolorized, and to allow the mixture to stand for some time. The charcoal unites with the coloring matter, and the solution by filtration is obtained white and transparent. Its use, however, in decolorizing the organic alkalies and other vegetable principles, no doubt causes a loss by absorption; since it has been shown by the experiments of M. Lebourdais, mentioned under the head of purified animal charcoal, that several of these principles may be obtained by the sole action of charcoal. For most pharmaceutical operations, and for use as an antidote, animal charcoal must be purified by hydrochloric acid from phosphate and carbonate of calcium. (See *Carbo Animalis Purificatus.*) According to Guthe, a German chemist, bone charcoal, without purification, is to be preferred as a decolorizer, in all cases in which the calcareous salts exert no injurious effect.

Off. Prep. Carbo Animalis Purificatus.

CARBO ANIMALIS PURIFICATUS. *U.S., Br. Purified Animal Charcoal.*

(CĂR'BŌ ĂN-Ị-MĀ'LĪS PŪ-RĮ-FĮ-CĀ'TŪS.)

Charbon animal purifié, *Fr.*; Gereinigte Knochen Kohle, *G.*

"Animal Charcoal, in No. 60 powder, *two parts*; Hydrochloric Acid, *three parts*; Water, *a sufficient quantity*. Pour the Hydrochloric Acid, previously mixed with

fifteen (15) *parts* of Water, upon the Animal Charcoal, and digest the mixture on a water-bath, for twenty-four hours, occasionally stirring. Pour off the supernatant liquid, and digest the undissolved portion with *fifteen* (15) *parts* of Water for two hours. Transfer the mixture to a strainer, and, when the liquid portion has run off, wash the residue with Water until the washings cease to be affected by test-solution of nitrate of silver. Dry the product, heat it to dull redness in a closely covered crucible, and, when cool, keep it in well-stopped bottles." *U. S.*

"Take of Bone Black, in powder, *sixteen ounces* [avoirdupois]; Hydrochloric Acid *ten fluidounces;* Distilled Water *a sufficiency.* Mix the Hydrochloric Acid with a pint of the Water, and add the Bone Black, stirring occasionally. Digest at a moderate heat for two days, agitating from time to time; collect the undissolved charcoal on a calico filter, and wash with Distilled Water till what passes through gives scarcely any precipitate with nitrate of silver. Dry the charcoal, and then heat it to redness in a covered crucible." *Br.*

Animal charcoal, as it is made by charring bones, necessarily contains bone-phosphate and carbonate of calcium, the presence of which does no harm in some decolorizing operations; but, in delicate chemical processes, these salts may be dissolved or decomposed, and thus become a source of impurity. It is on this account that animal charcoal requires to be purified from its calcareous salts; and this is accomplished by diluted hydrochloric acid, which dissolves the phosphate and decomposes the carbonate. According to Dr. Stenhouse, aluminized vegetable charcoal may be substituted for purified animal charcoal, and is equally efficacious as a decolorizer. (See page 357.)

Properties. Purified animal charcoal is "a dull black powder, odorless and tasteless, and insoluble in water, alcohol, or other solvents. When ignited at a high temperature with a little red oxide of mercury and with free access of air, it leaves at most only a trace of residue. If 1 part be digested with 2 parts of hydrochloric acid and 6 parts of water, the filtrate, after being supersaturated with water of ammonia, should remain unaffected by test-solution of magnesium (abs. of phosphate)." *U. S.*

It has been shown by Mr. Robert Warington that bitter vegetable substances, including the organic alkalies, are removed from solution by passing through purified animal charcoal, especially when the action is assisted by heat. M. Weppen finds that a similar effect is produced by it in removing resins from tinctures, tannic acid and bitter principles from astringent and bitter infusions, and certain metallic salts from their solutions. Purified animal charcoal, thus employed, has been resorted to by M. Lebourdais as an agent for obtaining the active principles of plants. A decoction or infusion of the plant is either boiled with or filtered through the charcoal, which takes up, more or less completely, the bitter and coloring principles. The charcoal, after having been washed and dried, is treated with boiling alcohol, which dissolves the principles taken up. Finally, the alcohol is distilled off, and the principles are obtained in a separate state. In this way digitalin, ilicin, scillitin, columbin, colocynthin, arnicine, strychnine, quinine, and other principles have been obtained by M. Lebourdais. (*Chem. Gaz.*, Nov. 15, 1848.) In relation to the method of M. Lebourdais, see a paper by Mr. J. S. Cobb. (*A. J. P.*, 1851.) Dr. A. B. Garrod has proposed purified animal charcoal as an antidote to vegetable and animal poisons, with which it appears to combine. According to his experiments, common bone-black has not one-fifth of the powder possessed by the purified substance; and vegetable charcoal and lampblack are nearly or quite useless. The amount of the antidote proposed by Dr. Garrod is half an ounce for each grain of a vegetable organic alkali. Dr. Alfred Taylor deems the results of Dr. Garrod inconclusive. Prof. B. H. Rand, of this city, made some interesting observations in relation to the antidotal powers of purified animal charcoal, and proved that poisonous doses of the strongest vegetable poisons may be swallowed with impunity, if mixed with that substance. (*Med. Exam.*, Sept. 1848.) It has also been recommended as an antidote for phosphorus (*N. Y. Med. Record*, 1874, p. 68), but its value is very doubtful.

In using animal charcoal for decolorizing active vegetable principles, great caution should be observed, as much loss is often incurred by the absorption of those principles by the charcoal.

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Pharm. Uses. Atropia, *Br.;* Digitalinum; Morphiæ Hydrochloras, *Br.;* Santoninum, *Br.*

CARBO LIGNI. *U.S., Br.* *Charcoal.*

(CÄR'BŌ LĬG'NĪ.)

"Charcoal prepared from soft wood." *U. S.* "Wood charred by exposure to a red heat without access of air." *Br.*

Wood Charcoal, Vegetable Charcoal; Carbo Pulveratus, *P.G.;* Carbo Præparatus, Carbo e Ligno; Charbon végétal, Charbon de Bois, *Fr.;* Holzkohle, Präparirte Kohle, *G.;* Carbone di Legno, *It.;* Carbon de Lena, *Sp.*

Preparation on the Large Scale. Billets of wood are piled in a conical form, and covered with earth and sod to prevent the free access of air; several holes being left at the bottom, and one at the top of the pile, in order to produce a draught to commence the combustion. The wood is then kindled from the bottom. In a little while the hole at the top is closed, and, after the ignition is found to have pervaded the whole pile, those at the bottom are stopped also. The combustion taking place with a smothered flame, the volatile portions of the wood, consisting of hydrogen and oxygen, are dissipated; while the carbon, in the form of charcoal, is left.

In this process for the carbonization of wood, all the volatile products are dissipated; and a portion of the charcoal itself is lost by combustion. Wood, thus carbonized, yields not more than 17 or 18 per cent. of charcoal. A better method is to char the wood in iron cylinders, when it yields from 22 to 23 parts in 100 of excellent charcoal; and, at the same time, the means are afforded for collecting the volatile products, consisting of pyroligneous acid, empyreumatic oil, and tar. This process for obtaining charcoal has been described under another head. (See *Acidum Aceticum*.) A method of preparing charcoal by subjecting wood to over-heated steam has been invented by M. Violette. When the temperature of the steam is 300° C. (572° F.), the wood is converted into a peculiar charcoal, called *red charcoal*, which is intermediate in its qualities between wood and ordinary charcoal. When the temperature is lower, the carbonization is incomplete; when higher, the product is black charcoal. The steam process yields a uniform charcoal for a given temperature, which may be easily regulated, and a product about double that obtained in closed cylinders. Charcoal, prepared in closed cylinders, yields ten times as much ash as that ordinarily made. Charcoal contains *carbon*, in proportion to the temperature at which it is formed; varying from 65 per cent. when made at 250° C. (482° F.), to 80 per cent. at 400° C. (752° F.). The gaseous matter present is always inversely as the temperature of carbonization. Thus, for charcoal made at 300° C. (572° F.), it is one-third of its weight; at 350° C. (662° F.), one-fourth. (*Journ. de Pharm.*, 1851, p. 35.)

Mr. E. C. C. Stanford has called attention to a variety of vegetable charcoal, obtained by charring a species of sea-weed, *Laminaria digitata*, gathered on the shores of the Hebrides, which, although, on account of the large proportion of carbonate of calcium contained in it (20 per cent.), unfit for use in refining sugar, possesses more of the deodorizing and decolorizing power than animal charcoal itself, which, with the exception referred to, it closely resembles in chemical composition. (*P. J. Tr.*, 1867, p. 186.)

Preparation for Medicinal Use. M. Belloc recommends charcoal for this purpose to be obtained from poplar shoots, cut at the time the sap rises, and deprived of their bark. The carbonization should be performed in cast-iron vessels at a red-white heat. The product is a light and brilliant charcoal, which must be purified by being macerated for three or four days in water, frequently renewed. It is then dried, powdered, and placed in bottles, which should be well stopped. The charcoal most esteemed in Philadelphia, for medicinal purposes, is that prepared by the Messrs. Dupont, near Wilmington, Delaware, for the manufacture of gunpowder. It is made from young willow shoots of two or three years' growth.

Properties. Charcoal is a black, shining, brittle, porous substance, tasteless and inodorous and insoluble in water. It is a good conductor of electricity, but a bad one of heat. It possesses the remarkable property of absorbing many times its own bulk of certain gases. When exposed to the air after ignition, it increases rapidly

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in weight, absorbing from 12 to 14 per cent. of moisture. As ordinarily prepared, it contains the incombustible part of the wood amounting to 1 or 2 per cent., which is left as ashes when the charcoal is burned. These may be removed by digesting the charcoal in diluted hydrochloric acid, and afterwards washing it thoroughly with boiling water.

Medical Properties, etc. Powdered charcoal is disinfectant and absorbent. It is employed with advantage in diarrhœa as an absorbent, and in dyspepsia with fetid breath and eructations. It was given in dysentery by the late Dr. Robert Jackson, who found it to have the effect of soothing the patient, and improving the character and consistence of the stools. It is also useful, in the form of injection, in putrid discharges from the uterus. M. Belloc recommends it strongly in gastralgia, and especially pyrosis, in which, if it fails to remove the disease, it abates the pain, nausea, and vomiting; and his observations have been confirmed by a committee of the French Academy of Medicine. As a remedy in obstinate constipation, Dr. Daniel, of Savannah, speaks of it in high terms. He also found it useful in nausea and constipation of pregnancy. On the other hand, some practitioners have found charcoal to confine the bowels. Dr. Wilson, of New Zealand, speaks highly of it in the diarrhœa of measles, and in epidemic cholera. Dr. Newman recommends it as a dressing to wounds and ulcers. Mr. Wormald, of St. Bartholomew's Hospital, has made a useful application of the disinfecting power of dry charcoal, in what he calls the *charcoal quilt*. This consists of two sheets of cotton wadding, quilted together in small segments, with a tolerably thick layer of powdered charcoal between them. The quilts, thus prepared, may be of any size, so as to fit a gangrenous sore or stump. Its use as an ingredient of poultices is noticed under *Cataplasma Carbonis*. Several of its varieties are used as tooth-powder. Those generally preferred are the charcoals of the cocoa-nut shell and of bread. It is said that charcoal proves useful in preserving the teeth by absorbing the acid sometimes morbidly present in the mucus of the mouth. The dose of charcoal varies from one to four teaspoonfuls (3·9–15·5 Gm.) or more. Dr. Daniel gave it in his case of constipation in doses of a tablespoonful (15·5 Gm.), repeated every half hour. *Charcoal biscuits* have been prepared, containing 15 or 20 per cent. of charcoal in fine powder, whilst *charcoal lozenges*, either with charcoal alone or associated with bismuth, have been employed with asserted good results in certain forms of gastric disturbances.

For internal use charcoal is preferred by some in the *granular form*. Mr. W. Lascelles Scott employs the following method of preparing it. He prefers the wood of the box, willow, or linden, which, after being charred, should be allowed to cool out of contact with air, then boiled for some time in diluted hydrochloric acid, and afterwards, having been thoroughly washed with pure water, in a little weak ammonia. The fragments are again ignited, and then quickly powdered, and passed through a sieve of 80 or 100 apertures to the inch. Nine pounds of this powder are mixed with one pound of pure sugar passed through a 30 sieve, and 4 ounces of gum arabic in impalpable powder. The whole is then moistened with a few ounces of warm distilled water, to which have been added an ounce and a quarter of tincture of benzoin, and a little mucilage. The mass is now granulated on flat steam pans, in the usual manner, at a temperature of 101·6°–107·2° C. (215° or 225° F.). When perfectly dry it is sifted, and secured in well-stopped bottles. (*Chem. News*, 1867, p. 204.)

Charcoal has been employed with good effect, as a deodorizer, in dissecting-rooms, placed in open pans through the room. It has the advantage over the chlorides that it has no smell. When it loses its effect, it may be recalcined. Water for long voyages is kept sweet by having a little powdered charcoal added to each cask.

Dr. Stenhouse has devised a process for combining alumina with common vegetable charcoal, forming what he calls *aluminized charcoal*, which is an economical substitute for purified animal charcoal, and equally efficacious as a decolorizer. It is prepared by digesting finely powdered charcoal with sufficient of the solution of sulphate of aluminium to give an impregnation of 7·5 per cent. of alumina. The whole is evaporated to dryness, and ignited in a covered Hessian crucible, until the

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water and acid have been dissipated. Aluminized charcoal is perfectly black, though thoroughly impregnated with anhydrous alumina, and only requires to be carefully pulverized to be ready for use. (*P. J. Tr.*, 1857, p. 364.) On similar principles, Dr. Stenhouse prepares his *artificial bone-black*, by impregnating powdered wood charcoal with 7·5 per cent. of phosphate of calcium, by digesting it in a solution of this salt in hydrochloric acid, evaporating to dryness, and igniting in covered vessels. This charcoal decolorizes well, but can be used only for neutral solutions.

Charcoal may act either as an oxidizer or deoxidizer; and these contrary powers seem to depend upon its having for oxygen a medium affinity, which enables it to take that element from some bodies, and to yield it to others, or at least by its porosity to facilitate atmospheric oxidation. Thus, it is known to reduce several oxides; while, on the other hand, it aids powerfully in the oxidation of animal matter. The bodies of two dogs having been laid in an open box on a bed of charcoal, a few inches deep, and covered by the same material, were kept by Mr. John Turnbull, of Glasgow, for six months in his laboratory, without emitting any perceptible effluvium; and, when they were examined at the end of this time, scarcely anything remained but the bones. Dr. Stenhouse, who relates this experiment, has confirmed it by observations of his own, and believes that the animal matter thus treated, undergoes putrefaction; though the products, by their rapid oxidation and absorption, are prevented from contaminating the air. He, therefore, considers charcoal not to be antiseptic, but the very opposite. (*Chem. Gaz.*, 1854, p. 132.)

The study of the absorbent and oxidizing properties of charcoal led Dr. Stenhouse to apply it to the purpose of preventing the access of noxious effluvia to the lungs in respiration. This object he proposed to effect by covering the nose and mouth with what he called the *charcoal respirator*. The instrument consists of a layer of coarsely powdered charcoal, a quarter of an inch thick, between two sheets of silvered wire gauze, covered with thin woollen cloth, by means of which the temperature of the inspired air is greatly increased. The frame is made of thin sheet-copper; but the edges of lead padded and lined with velvet so as to fit the lower part of the face. Dr. Stenhouse considered his respirator to act as an air filter, and to be peculiarly adapted to protect the wearer against infectious diseases. (*P. J. T.*, 1855, p. 328.) This instrument must not be confounded with Jeffrey's wire ventilator, which is intended solely to warm the air before entering the lungs.

Pharm. Uses. In the preparation of Acidum Sulphurosum; Potassii Bromidum, *Br.*; Potassii Iodidum.

Off. Prep. Cataplasma Carbonis, *Br.*

CARBONEI BISULPHIDUM. *U. S.* *Bisulphide of Carbon.* [*Disulphide of Carbon.*]

CS_2; 76. (CAR-BŌ'NĒ-Ī BĪ-SŬL'PHĪ-DŬM.) CS_2; 38.

"Bisulphide of Carbon should be kept in well-stopped bottles, in a cool place, remote from lights or fire." *U. S.*

Carboneum Sulfuratum, Alcohol Sulfuris, *P.G.*; Carbonii Bisulphidum; Carbon Sulphide, Sulfure de Carbone, *Fr.*; Schwefelkohlenstoff, *G.*

This compound, corresponding to carbon dioxide (carbonic acid gas), CO_2, is prepared by the direct combination of carbon and sulphur at a moderate red heat. To effect this, charcoal is heated to redness in a vertical cylinder, while sulphur is admitted through a lateral tubulure near the bottom. As the sulphur melts and vaporizes, it combines with the carbon, and the carbon disulphide formed distils over through a series of condensing tubes, which, while they serve to collect the crude carbon disulphide, allow of the escape of the hydrogen sulphide formed at the same time. The crude product is then rectified, first over a solution of chlorinated lime to break up any hydrogen sulphide gas remaining, and then repeatedly either over mercury or mercuric chloride, or over a pure fatty oil, which withdraws from it all free sulphur and bad-smelling sulphur compounds.

The manufacture of carbon disulphide has within late years assumed large proportions. In the works of Deiss at Pantin, near Marseilles, France, 500 kilogrammes

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are turned out daily, and their annual production in 1880 exceeded 1,200,000 kilogrammes.

It is used in the arts for the extraction of oils from different oil-seeds, for the extraction of sulphur from some varieties of sulphur ores, for the cleansing of wool and recovering the fat, in the manufacture of india-rubber goods as a solvent for the caoutchouc, for the extraction of perfumes, and latterly on an enormous scale in France as a remedy against the *phylloxera*, or grape pest, using it either directly or to produce the alkaline xanthogenates (sulphocarbonates).

Properties. "A clear, colorless, highly refractive liquid, very diffusive, having a strong, characteristic odor, a sharp, aromatic taste, and a neutral reaction. It is insoluble in water; soluble in alcohol, ether, chloroform, and fixed or volatile oils. Sp. gr. 1·272. It vaporizes abundantly at ordinary temperatures, is highly inflammable, boils at 46° C. (114·8° F.), and, when ignited, burns with a blue flame, producing carbonic and sulphurous acids. It should not affect the color of blue litmus paper moistened with water (abs. of sulphurous acid). A portion evaporated spontaneously in a glass vessel should leave no residue (sulphur). Test-solution of acetate of lead agitated with it should not be blackened (abs. of hydrosulphuric acid)." *U. S.*

Medical Properties. Bisulphide of carbon is a powerful poison, but is not used as an internal remedy. According to M. Delpech, the workmen exposed to the fumes of the bisulphide are affected with headache, vertigo, and over-excitement of the nervous system, as evinced by voluble talking, incoherent singing, or immoderate laughter, or sometimes by weeping; and a continuance of the exposure is apt to cause at length a state of cachexia, characterized by general weakness, loss of sexual appetite, dulness of sight and hearing, and impairment of memory. M. S. Cloëz has made with it experiments on some of the smaller animals, as rats and rabbits, which were confined under a bell-glass with some cotton saturated with the bisulphide. In a few moments the animal exhibited signs of its action in great excitement, followed by retarded movements, with some convulsive shocks, then fell on its side and died in five minutes from the beginning. Congestion of the lungs and of the cavities of the heart, without any cerebral lesion, while the right auricle continued to contract two hours after apparent death, were the phenomena observed on dissection. (*Lancet*, Sept. 1866, p. 267.)

Externally, the bisulphide has been used as a counter-irritant and local anæsthetic. In enlarged lymphatic glands, Dr. Turnbull has used it with asserted good success. He applies it by means of a bottle with a proper sized mouth, containing a fluidrachm of the bisulphide, imbibed by a piece of sponge. The skin over the gland is first well moistened with water. He employed the vapor also with benefit in deafness, when dependent on want of nervous energy, and a deficiency of wax. For this purpose, the bottle containing the bisulphide is made with a neck to fit the meatus, and, being applied to the ear, is held there until considerable warmth is produced. The remedy has been used often with very good results, in a similar manner, in facial and other neuralgias and various local pains. It causes a good deal of smarting, but its excessive odor is the chief objection to it.

CARDAMOMUM. *U. S., Br.* *Cardamom.*

(KĂR-DĄ-MŌ'MŬM.)

"The fruit of Elettaria Cardamomum. Maton. (*Nat. Ord.* Zingiberaceæ.)" *U. S.*

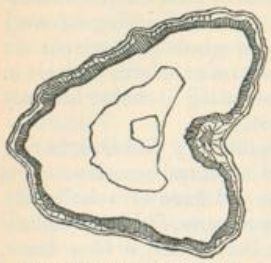
"The dried capsules of the Malabar Cardamom, Elettaria Cardamomum. The seeds are best kept in their pericarps, from which they should be separated when required for use, the pericarpial coats being rejected." *Br.*

Cardamoms, *Br.;* Fructus (Semen) Cardamomi Minoris, *P.G.;* Cardamomum Minus, Cardomomum Malabariam; Malabar Cardamoms; Cardamomes, Petit Cardamome, *Fr.;* Cardamomen, Kleine Cardamomen, *G.;* Cardamomo minore, *It.;* Cardamomo menor, *Sp.;* Ebil, *Arab.;* Kakelah seghar, *Pers.;* Capalaga, *Malay;* Gujaratii elachi, *Hindoost.*

The subject of Cardamom has been involved in some confusion and uncertainty, both in its commercial and botanical relations. The name has been applied to the aromatic capsules of various Indian plants belonging to the family of Scitamineæ.

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Three varieties have long been designated by the several titles of the *lesser*, *middle*, and *larger*—*cardamomum minus*, *medium*, and *majus*; but these terms have been used differently by different writers, so that their precise signification remains doubtful. To the late Dr. Pereira we are mainly indebted for the clearing up of this confusion. It is well known that the *lesser cardamom* of most writers is the variety recognized by the Pharmacopœias, and generally kept in the shops. The other varieties, though circulating to a greater or less extent in European and Indian commerce, are little known in this country.* The following remarks have reference exclusively to the genuine Malabar, or officinal cardamom.



Transverse section of seed of cardamom.

Linnæus confounded, under the name of *Amomum Cardamomum*, two different vegetables—the genuine

* The following is a sketch of the non-officinal cardamoms, compiled chiefly from the publications of Pereira and of Flückiger and Hanbury.

1. *Ceylon Cardamom.* This has been denominated variously *cardamomum medium*, *cardamomum majus*, and *cardamomum longum*, and is sometimes termed in English commerce *wild cardamom*. It is the *large cardamom* of Guibourt. In the East it is sometimes called *grains of Paradise*; but it is distinct from the product known with us by that name. It is derived from a plant cultivated in Candy, in the island of Ceylon, and also growing wild in the forests of the interior, which was designated by Sir James Edward Smith *Elletaria major*, but is now generally acknowledged to be only a variety of the officinal plant. This plant was described by Pereira in *P. J. Tr.* (ii. 388). The fruit is a lanceolate-oblong, acutely triangular capsule, somewhat curved, about an inch and a half long and four lines broad, with flat and ribbed sides, tough and coriaceous, brownish or yellow ash-colored, having frequently at one end the long, cylindrical, three-lobed calyx, and at the other the fruit-stalk. It is three-celled, and contains angular, rugged, yellowish red seeds, of a peculiar fragrant odor and spicy taste. Its effects are analogous to those of the officinal cardamom.

2. *Round Cardamom.* This is probably the Ἀμωμον of Dioscorides, and the *Amomi uva* of Pliny, and is believed to be the fruit of *Amomum Cardamomum* (Willd.), growing in Sumatra, Java, and other East India islands. The capsules are usually smaller than a cherry, roundish or somewhat ovate, with three convex sides, more or less striated longitudinally, yellowish or brownish white, and sometimes reddish, with brown, angular, cuneiform, shrivelled seeds, which have a spicy camphorous flavor. They are sometimes, though rarely, met with connected in their native clusters, constituting the *amomum racemosum*, or *amome en grappes* of the French. They are similar in medicinal properties to the officinal, but are seldom used except in the southern parts of Europe.

3. *Java Cardamom.* The plant producing this variety is supposed to be the *Amomum maximum* of Roxburgh, growing in Java and other Malay islands in the East. The capsules are oval, or oval-oblong, often somewhat ovate, from eight to fifteen lines long, and from four to eight broad, usually flattened on one side and convex on the other, sometimes curved, three-valved, and occasionally imperfectly three-lobed, of a dirty grayish brown color, and coarse fibrous appearance. When soaked in water, they exhibit as their distinguishing character from nine to thirteen ragged membranous wings along their whole length, which distinguish them from all other varieties. The seeds have a feebly aromatic taste and smell. This variety of cardamom affords but a very small proportion of volatile oil, is altogether of inferior quality, and, when imported into London, is usually sent to the continent.

4. *Madagascar Cardamom.* This is the *Cardamomum majus* of Geiger and some others, and is thought to be the fruit of *Amomum angustifolium* of Sonnerat, growing in marshy grounds in Madagascar. The capsule is ovate, pointed, flattened on one side, striated, with a broad circular scar at the bottom, surrounded by an elevated, notched, corrugated margin. The seeds have an aromatic flavor analogous to that of officinal cardamom.

5. *Bengal Cardamom.* The fruit of *Amomum subulatum*, Roxb., sometimes known by the name of Winged Bengal Cardamom. *Morung elachi*, or *Buro elachi*, is about an inch in length, obscurely three-sided, ovoid or somewhat obconic, with nine narrow, jagged ridges or wings (best seen after soaking in water) upon its distal end, which terminates in a truncate bristly nipple. The pericarp is coarsely striated, of a deep brown, splitting into three valves, disclosing a three-lobed mass of seeds, 60 to 80 in number, agglutinated by their viscid saccharine anthers.

6. *Nepaul Cardamom* is produced by an Amomum of undetermined species, and resembles the Bengal cardamom, except in having a long tubular calyx on its summit, and in being usually attached to a stalk.

7. *Grains of Paradise. Grana Paradisi.* Under this name and that of *Guinea grains*, and *Malegueta*, or *Mallaguetta pepper*, are found in commerce small seeds of a round or ovate form, often angular, and somewhat cuneiform, minutely rough, brown externally, white within, of a feebly aromatic odor when rubbed between the fingers, and of a strongly hot and peppery taste. Two kinds of them are known in the English market, one larger, plumper, and more warty, with a short conical projecting tuft of pale fibres on the umbilicus; the other smaller and smoother, and without the fibrous tuft. The latter are the most common. It is probable that one of the varieties is produced by *Amomum Grana Paradisi* of Sir J. E. Smith, and the other by Roscoe's *Amomum Meleguета*. (Pereira's *Mat. Med.*, 3d ed., p. 1134.) Dr. W. F. Daniell, who has published (*P. J. Tr.*, xiv. 312 and 356) an elaborate paper on the Amoma of Western Africa, states that the true Malla-

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plant of Malabar, and another growing in Java. These were separated by Willdenow, who conferred on the former Sonnerat's title of *Amomum repens*, while he retained the original name for the latter, though not the true cardamom plant. In the tenth volume of the Linnæan Transactions, 1811, Mr. White, a British Army Surgeon in India, published a very minute description of the Malabar plant, which he had enjoyed frequent opportunities of examining in its native state. From this description, Dr. Maton inferred that the plant, according to Roscoe's arrangement of the Scitamineæ, could not be considered an *Amomum;* and, as he was unable to attach it to any other known genus, he proposed to construct a new one with the name of *Elettaria*, derived from *elettari* or *elatari*, the Malabar name of this vegetable. Sir James Smith afterwards suggested the propriety of naming the new genus *Matonia*, in honor of Dr. Maton; and the latter title, having been adopted by Roscoe, obtained a place in former editions of the London and U. S. Pharmacopœias. The celebrated Dr. Roxburgh described the Malabar cardamom plant as an *Alpinia*, with the specific name *Cardamomum*. As doubts were entertained of the necessity for the new genus proposed by Maton, Roxburgh was followed in the London and U. S. Pharmacopœias, and the fruit was referred to *Alpinia Cardamomum*. This decision, however, has been revised in the later editions of the U. S. and British Pharmacopœias. Finally Roscoe has arranged it with the abandoned genus *Renealmia* of Linnæus, which he has restored.

Gen. Ch. Corolla with the tube filiform and the inner limb one-lipped. *Anther* naked. *Capsule* often berried, three-celled, three-valved. *Seeds* numerous, arillate. *Blume.*

Elettaria Cardamomum. Maton; *B. & T.*, 267.—*Alpinia Cardamomum.* Roxburgh.—*Amomum Repens.* Sonnerat; Willd. *Sp. Plant.* i. 9.—*Renealmia Cardamomum.* Roscoe, *Monandrous Plants.* Figured in *Linn. Trans.* x. 248, and Carson's *Illust. of Med. Bot.* ii. 55. The cardamom plant has a tuberous horizontal root or rhizome, furnished with numerous fibres, and sending up from eight to twenty erect, simple, smooth, green and shining, perennial stems, which rise from six to twelve feet in height, and bear alternate sheathing leaves. These are from nine inches to two feet long, from one to five inches broad, elliptical-lanceolate, pointed, entire, smooth, and dark green on the upper surface, glossy and pale sea-green beneath, with strong midribs, and short footstalks. The flower-stalk proceeds from the base of the stem, and lies upon the ground, with the flowers arranged in a panicle. The calyx is monophyllous, tubular, and toothed at the margin; the corolla monophyllous and funnel-shaped, with the inferior border unilabiate, three-lobed, and spurred at the base. The fruit is a three-celled capsule, containing many seeds.

This valuable plant is a native of the mountains of Malabar, where it springs up spontaneously in the forests after the removal of the undergrowth, and is very extensively cultivated by the natives. The curious reader may find a detailed account of the method of culture in the *A. J. P.*, 1877, p. 605. The plant begins to yield fruit at the end of the fourth year, and continues to bear for several years afterwards. The capsules when ripe are picked from the fruit stems, dried over a gentle fire, and separated by rubbing with the hands from the footstalks and adhering calyx.

Thus prepared, they are ovate-oblong, from three to ten lines long, from two to four thick, three-sided with rounded angles, obtusely pointed at both ends, longitudinally wrinkled, and of a yellowish white color. The seeds which they contain

guetta pepper is obtained exclusively from varieties of the same species, to which belong the *Amomum Grana Paradisi* of Afzelius, and the *A. Melegueta* of Roscoe; while the *A. Grana Paradisi* of Sir J. E. Smith is a different plant, and yields a different product. These grains are imported from Guinea, and other parts of the western coast of Africa. Similar grains are taken to England from Demerara, where they are obtained from a plant cultivated by the negroes, supposed to have been brought from Africa, and believed by Dr. Pereira to be the *Amomum Melegueta* of Roscoe. (*Ibid.*, vi. 412.) At the international exhibition of 1862, at London, Dr. Geo. B. Wood noticed a specimen of similar grains, under the name of grains of Paradise, sent from the island of Trinidad. Their effects on the system are analogous to those of pepper; but they are seldom used except in veterinary practice, and to give artificial strength to spirits, wine, beer, and vinegar. In the same journal (ii. 443), Dr. Pereira points out seven distinct scitamineous fruits, to which the name of grains of Paradise has been applied by different authors.

Other products of different Scitamineæ, which have received the name of cardamom, are described; but the above are all that are known in commerce, or likely to be brought into our drug markets.

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are small, angular, irregular, rough as if embossed upon their surface, of a brown color, easily reduced to powder, and thus separable from the capsular covering, which, though slightly aromatic, is much less so than the seeds, and should be rejected when the medicine is administered. The seeds constitute about 74 parts per cent. by weight. According to Pereira, three varieties are distinguished in commerce:—1, the *shorts*, from three to six lines long, from two to three broad, browner and more coarsely ribbed, and more highly esteemed than the others; 2, the *long-longs*, from seven lines to an inch in length by two or three lines in breadth, elongated, and somewhat acuminate; and 3, the *short-longs*, which are somewhat shorter and less pointed than the second variety. The odor of cardamom is fragrant, the taste warm, slightly pungent, and highly aromatic. "Ovoid or oblong, from two-fifths to four-fifths of an inch (1 to 2 cm.) long, obtusely triangular, rounded at the base, beaked, longitudinally striate; of a pale buff color, three-celled, with a thin, leathery, nearly tasteless pericarp and a central placenta. The seeds are reddish brown, angular, transversely rugose, depressed at the hilum, surrounded by a thin, membranous arillus, and have an agreeable odor and a pungent aromatic taste." *U. S.* Cardamom yields its virtues to water and alcohol, but more readily to the latter. The seeds contain 4·6 per cent. of volatile oil, 10·4 of fixed oil, 2·5 of a salt of potassa mixed with a coloring principle, 3·0 of starch, 1·8 of azotized mucilage, 0·4 of yellow coloring matter, and 77·3 of ligneous fibre. (Trommsdorff.) The volatile oil is colorless, of an agreeable and very penetrating odor, and of a strong aromatic, burning, camphorous, and bitterish taste. It is dextrogyrate, and consists essentially of a terpene, $C_{10}H_{16}$. From old specimens of oil Dumas and Peligot claim to have obtained crystals of *terpin*, $C_{10}H_{16} + 3H_2O$, while Flückiger has obtained a crystalline deposit from Ceylon oil which he considers identical with common camphor. The sp. gr. of the oil is between 0·92 and 0·94. It cannot be kept long without undergoing change, and finally, even though excluded from the air, loses its peculiar odor and taste. If ether be made to percolate through the powdered seeds, and the liquor obtained be deprived of the ether, a light greenish brown fluid remains, consisting almost exclusively of the volatile and fixed oils. It has the odor of cardamom, and keeps better than the oil obtained by distillation. (*A. J. P.*, xxi. 116.) The seeds should be powdered only when wanted for use; as they retain their aromatic properties best while in the capsules.

Cardamoms are not often adulterated; but an instance has been mentioned by Mr. G. W. Kennedy, as having occurred under his own observation, in which orange seeds and unroasted grains of coffee were mixed with the cardamoms to the extent of nearly 4 per cent. (*A. J. P.*, 1872, p. 389.)

Medical Properties and Uses. Cardamom is a warm and grateful aromatic, less heating and stimulating than some others belonging to the class, and very useful as an adjuvant or corrective of cordial, tonic, and purgative medicines. Throughout the East Indies it is largely consumed as a condiment. It was known to the ancients, and derived its name from the Greek language. In this country it is employed chiefly as an ingredient in compound preparations.

Off. Prep. Extractum Colocynthidis Compositum; Pulvus Aromaticus, *U. S.;* Pulvis Cinnamomi Comp., *Br.;* Pulvis Cretæ Aromaticus, *Br.;* Tinctura Cardamomi, *U. S.;* Tinct. Cardamomi Comp.; Tinct. Gentianæ Comp.; Tinct. Rhei; Vinum Aloës.

CARUM. *U. S., Br.* *Caraway.*

(CĀ'RŬM.)

"The fruit of Carum Carvi. Linné. (*Nat. Ord.* Umbelliferæ, Orthospermæ.)" *U. S.* "The dried fruit of Carum Carui." *Br.*

Carui Fructis, *Br.;* Caraway Fruit; Fructus Carvi, *P.G.;* Cumin des Près, Carvi, *Fr., It.;* Gemeiner Kümmel, Kümmel, *G.;* Alcaravea, *Sp.*

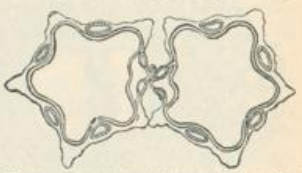
Gen. Ch. Fruit ovate-oblong, striated. *Involucre* one-leafed. *Petals* keeled, inflexed-emarginate. *Willd.*

Carum Carui. Willd. *Sp. Plant.* i. 1470; *B. & T.* 121. This plant is biennial and umbelliferous, with a spindle-shaped, fleshy, whitish root, and an erect stem, about two feet in height, branching above, and furnished with doubly pinnate, deeply

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incised leaves, the segments of which are linear and pointed. The flowers are small and white, and in erect terminal umbels, which are accompanied with an involucre, consisting sometimes of three or four leaflets, sometimes of one only, and are destitute of partial involucre.

The caraway plant is a native of Europe, growing wild in meadows and pastures, and cultivated in many places. It has been introduced into this country. The flowers appear in May and June, and the seeds, which are not perfected till the second year, ripen in August. The root, when improved by culture, resembles the parsnep, and is used as food in the north of Europe. The seeds are the part used in medicine. They are collected by cutting down the plant, and threshing it on a cloth. Our markets are supplied partly from Europe, partly from our own gardens. The American seeds are usually rather smaller than the German. Under the name of *Ajowan*, the fruit of the *Carum Ajowan*, Bentham & Hooker (*Ammi Copticum*, Linn.) are largely used in India. They are $\frac{1}{10}$ to $\frac{1}{16}$ of an inch long, and resemble the fruits of common parsley, but are distinguished by their odor, and their surface being very rough from numerous, very minute tubercles. They contain about 4 per cent. of a volatile oil, which has the odor of the oil of thyme, and contains thymol.



Transverse section of caraway, showing oil-tubes.

Caraway seeds (half-fruits) are about two lines in length, slightly curved, with five longitudinal ridges, which are of a light yellowish color, while the intervening spaces are dark brown. "Oblong, laterally compressed, about one-sixth of an inch (4 mm.) long, usually separated into the two mericarps, and these curved, narrower at both ends, brown, with five yellowish, filiform ribs, and with six oil-tubes." *U. S.* They have an agreeable aromatic smell, and a sweetish, warm, spicy taste. These properties depend on an essential oil, which they afford largely by distillation. (See *Oleum Cari.*) The residue is insipid. They yield their virtues readily to alcohol, and more slowly to water.

Medical Properties and Uses. Caraway is a pleasant stomachic and carminative, occasionally used in flatulent colic, and as an adjuvant or corrective of other medicines. The dose in substance is from a scruple to a drachm (1·3–3·9 Gm.). An infusion may be prepared by adding two drachms of the seeds to a pint of boiling water. The volatile oil, however, is most employed. (See *Oleum Cari.*) The seeds are baked in cakes, to which they communicate an agreeable flavor, while they stimulate the digestive organs.

Off. Prep. Aqua Carui, *Br.;* Confectio Piperis, *Br.;* Oleum Cari, *U. S.;* Oleum Carui, *Br.;* Pulvis Opii Compositus, *Br.;* Tinctura Cardamomi Composita; Tinct. Sennæ, *Br.*

CARYOPHYLLUS. *U. S., Br.* *Cloves.*

(CĂR-Y-O-PHĬL'LUS.)

"The unexpanded flowers of Eugenia caryophyllata. Thunberg. (*Nat. Ord.* Myrtaceæ.)" *U. S.* "The dried unexpanded flower-buds of Caryophyllus aromaticus." *Br.*

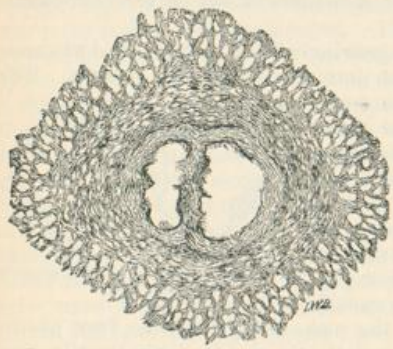
Caryophyllum, *Br.;* Caryophilli, *P. G.;* Caryophylli Aromatici; Girofle, Clous aromatiques, Clous de Girofles, *Fr.;* Gewurznelken, Nägelein, *G.;* Garofani, *It.;* Clavos de Espicia, *Sp.;* Cravo da India, *Portug.;* Kruidnagel, *Dutch;* Kerunfel, *Arab.*

Gen. Ch. Tube of the *calyx* cylindrical; limb, four-parted. *Petals* four, adhering by their ends in a sort of calyptra. *Stamens* distinct, arranged in four parcels in a quadrangular fleshy hollow, near the teeth of the calyx. *Ovary* two-celled, with about twenty ovules in each cell. *Berry* one or two celled, one or two seeded. *Seeds* cylindrical or half-ovate. *Cotyledons* thick, fleshy, convex externally, sinuous in various ways internally. *Lindley. De Cand.*

Eugenia caryophyllata. Willd. *Sp. Plant.* ii. 965; *B. & T.* 112.—*Caryophyllus aromaticus.* Linn. *Sp. Plant.*, 735; De Cand. *Prodrom.* iii. 262; Carson, *Illust. of Med. Bot.* i. 43, pl. 37. This small tree is one of the most elegant of those inhabiting the islands of India. It has a pyramidal form, is always green, and is

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adorned throughout the year with a succession of beautiful rosy flowers. The stem is of hard wood, and covered with a smooth, grayish bark. The leaves are about four inches in length by two in breadth, obovate-oblong, acuminate at both ends, entire, sinuated, with many parallel veins on each side of the midrib, supported on long footstalks, and opposite. They have a firm consistence, and a shining green color, and when bruised are highly fragrant. The flowers are disposed in terminal corymbose panicles, and exhale a strong, penetrating, and grateful odor.



Transverse section of calyx-tube of clove.

The natural geographical range of the clove is extremely limited. It was formerly confined to the Molucca Islands, in most of which it grew abundantly before their conquest by the Dutch. By the monopolizing policy of that commercial people, the trees were extirpated in nearly all the islands except Amboyna and Ternate, which were under their immediate inspection. Notwithstanding, however, their jealous vigilance, a French governor of the Isles of France and Bourbon, named Poivre, succeeded, in the year 1770, in obtaining plants from the Moluccas, and introducing them into the colonies under his control. Five years afterwards, the clove-tree was introduced into Cayenne and the West Indies, in 1803 into Sumatra, and in 1818 into Zanzibar. It is now cultivated largely in these and other places; and commerce has ceased to depend on the Moluccas for supplies of this spice.*

The unexpanded flower-buds are the part of the plant employed under the ordinary name of cloves.† They are first gathered when the tree is about six years old. The fruit has similar aromatic properties, but much weaker. The buds are at first white, then become green, and then bright red, when they must be at once collected, which is done sometimes by hand-picking, sometimes by beating the trees with bamboos, and catching the falling buds. In the Moluccas they are said to be sometimes immersed in boiling water, and afterwards exposed to smoke and artificial heat, before being spread out in the sun. In Zanzibar, Cayenne, and the West Indies, they are dried simply by solar heat.

Cloves appear to have been unknown to the ancients. They were introduced into Europe by the Arabians, and were distributed by the Venetians. After the discovery of the southern passage to India, the trade in this spice passed into the hands of the Portuguese; but was subsequently wrested from them by the Dutch, by whom it was long monopolized. Within a few years, however, the extended culture of the plant has thrown open the commerce in cloves to all nations. The United States derive much of their supply from the West Indies and Guiana; but the great source of cloves have been recently the islands of Zanzibar and Pemba, on the east coast of Africa. In 1872 the clove orchards in Zanzibar were nearly destroyed by a hurricane, but it is said that they have been replanted. The Molucca cloves are said to be thicker, darker, heavier, more oily, and more highly aromatic than those cultivated elsewhere. They are known by the name of *Amboyna cloves*. The *Bencoolen cloves*, from Sumatra, are deemed equal if not superior by the English druggists.

Properties. Cloves in shape resemble a nail, with a round head with four spreading points beneath it. "About half an inch (12 mm.) long, dark brown, consisting of a subcylindrical, solid and glandular calyx-tube, terminated by four teeth,

* Cloves from Cayenne, and from various West India islands, as Martinique, Guadaloupe, and Trinidad, have been for several years circulating in commerce. Dr. Geo. B. Wood saw a specimen from Para, in Brazil, at the international exhibition at London (1862). They were lighter colored than those from the East Indies.

† The peduncles of the flowers have been sometimes employed. They possess the odor and taste of the cloves, though in a less degree, and furnish a considerable quantity of essential oil. The French call them *griffes de girofles*.

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and surmounted by a globular head, formed by four petals, which cover numerous, curved stamens and one style." *U. S.* Their color is externally deep brown, internally reddish; their odor strong and fragrant; their taste hot, pungent, aromatic, and very permanent. The best cloves are large, heavy, brittle, and exude a small quantity of oil on being pressed or scraped with the nail. When light, soft, wrinkled, pale, and of feeble taste and smell, they are inferior. Those from which the essential oil has been distilled are sometimes fraudulently mixed with the genuine. In powdered cloves this fraud appears to be extensively practised, and its detection is almost impossible.

Trommsdorff obtained from 1000 parts of cloves 180 of volatile oil, 170 of a peculiar tannin, 130 of gum, 60 of resin, 280 of vegetable fibre, and 180 of water. M. Lodibert afterwards discovered a fixed oil, aromatic and of a green color, and a white resinous substance which crystallizes in fasciculi, composed of very fine diverging silky needles, without taste or smell, soluble in ether and boiling alcohol, and exhibiting neither alkaline nor acid reaction. This substance, called by M. Bonastre *caryophyllin*, was found in the cloves of the Moluccas, of Bourbon, and of Barbadoes, but not in those of Cayenne, from which, however, it has since been procured. To obtain it, the ethereal extract of cloves is treated with water, and the white substance thrown down is separated by filtration, and treated repeatedly with ammonia to deprive it of impurities. The most recent determination of its formula by Mylius (*D. Chem. Ges.*, 1873, p. 1053) makes it $C_{20}H_{32}O_2$. Dr. Theod. Martius obtains it cheaply by exposing cloves, previously deprived as far as possible of oil by distillation with water, to distillation at a higher temperature, redistilling the brown liquid obtained until the distillate nearly ceases to have the taste or smell of cloves, and then purifying the residue by washing with water, and treating it with boiling alcohol and animal charcoal repeatedly, until the caryophyllin, which is deposited by the alcohol on cooling, is perfectly white. (See *A. J. P.*, xxxii. 65.) M. Dumas has discovered another crystalline principle, which forms in the water distilled from cloves, and is gradually deposited. Like caryophyllin, it is soluble in alcohol and ether, but differs from that substance in becoming red when touched with nitric acid. M. Bonastre proposes for it the name of *eugenin*. (*Journ. de Pharm.*, xx. 565.) It has the formula $C_{10}H_{12}O_2$, and is isomeric with eugenol or eugenic acid, a constituent of oil of cloves. Water extracts the odor of cloves with comparatively little of their taste. All their sensible properties are imparted to alcohol; and the tincture when evaporated leaves an excessively fiery extract, which becomes insipid if deprived of the oil by distillation with water, while the oil which comes over is mild. Hence it has been inferred that the pungency of this aromatic depends on a union of the essential oil with the resin. *Caryophyllic acid*, $C_{20}H_{32}O_6$, is obtained by gradually adding caryophyllin to fuming nitric acid, kept cool by immersing the vessel in water until crystals begin to separate; these are purified by dissolving them in ammonia, precipitating with hydrochloric acid, and redissolving in alcohol and crystallizing. For an account of the oil and its constituents, see *Oleum Caryophylli*. The infusion and oil of cloves are reddened by nitric acid, and rendered blue by tincture of chloride of iron; facts of some interest, as morphine gives the same reactions.

Medical Properties and Uses. Cloves are among the most stimulant of the aromatics, but, like others of this class, act less upon the system at large than on the part to which they are immediately applied. They are sometimes administered in substance or infusion to relieve nausea and vomiting, correct flatulence, and excite languid digestion; but their chief use is to assist or modify the action of other medicines. They enter into several officinal preparations. Their dose in substance is from five to ten grains (0·33–0·65 Gm.).

The French Codex directs a *tincture of cloves* to be prepared by digesting for six days, and afterwards filtering, a mixture of four ounces of powdered cloves and sixteen of alcohol of 31° Cartier. Three ounces to the pint of alcohol is a sufficiently near approximation.

Off. Prep. Infusum Aurantii Compositum, *Br.;* Infusum Caryophylli; Mistura Ferri Aromatica, *Br.;* Oleum Caryophylli; Pulvis Cretæ Aromaticus, *Br.;* Tinctura Lavandulæ Compositus, *U. S.;* Syrupus Rhei Aromaticus, *U. S.;* Vinum Opii.

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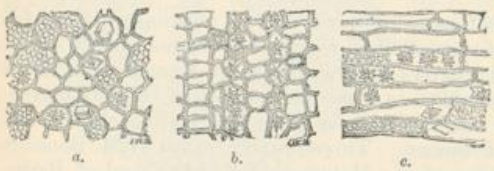
CASCARILLA. *U.S., Br.* *Cascarilla.*

(CĂS-CĄ-RĬL'LĄ.)

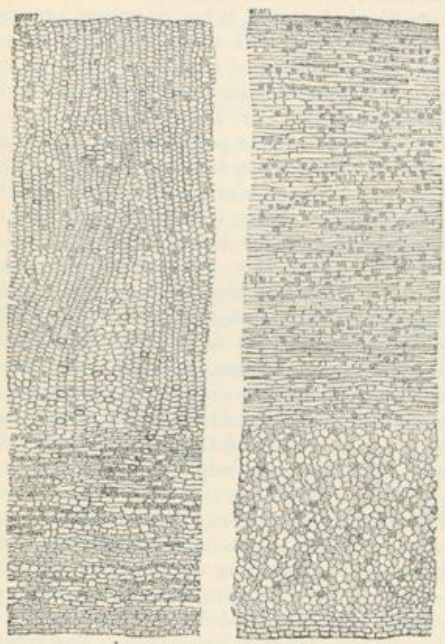
"The bark of Croton Eluteria. Bennett. (*Nat. Ord.* Euphorbiaceæ.)" *U.S.*
"The bark of Croton Eluteria." *Br.*

Cascarillæ Cortex. *Br.;* Cascarilla Bark; Cortex Cascarillæ, *P.G.;* Cortex Eluteriæ, Cortex Thuris; Chacrille, Écorce éleuthérienne, Cascarille, *Fr.;* Cascarillrinde, Cascarilla, Kaskarillrinde, *G.;* Cascariglia, *It.;* Chacarila, *Sp.*

Gen. Ch. MALE. *Calyx* cylindrical, five-toothed. *Corolla* five-petalled. *Stamens* ten to fifteen. FEMALE. *Calyx* many-leaved. *Corolla* none. *Styles* three, bifid. *Capsule* three-celled. *Seed* one. *Willd.*



a. *b.* *c.*



d. *e.*

Figs. *a*, *c*, highly magnified sections, showing raphides and starch granules and a bast cell; *b*, longitudinal section highly magnified, showing raphides and starch granules; *d*, transverse section moderately magnified; *e*, longitudinal section.

There has been much confusion in relation to the different species of Croton growing in the West Indies, and as to which of them the Cascarilla of the shops is to be ascribed. At present, however, it is generally admitted that this bark, which is brought exclusively from the Bahama Islands, is the product of *Croton Eluteria;* and, though it is probable that the proper *C. Cascarilla* may at one time have yielded a portion of its bark to commerce, at present little or none is derived from that species. The London College committed the error, which it afterwards corrected, of recognizing *C. Cascarilla* of Don as the source of it. This botanist mistook the *Copalchi bark* of Mexico, which is produced by *Croton Pseudo-China* of Schiede, and somewhat resembles cascarilla, for the genuine bark, and hence proposed to transfer the specific name of Cascarilla to the Mexican plant.*

Croton Eluteria. Bennett, *Journ. of the Linn Soc.* iv. 29; Daniell, *P. J. Tr.* 2d ser., iv. 145, figured at p. 150; *B. & T.* 238. —*Clutia Eluteria.* Woodv. *Med. Bot.* 3d ed., iv. 633, t. 223. As described by Dr. W. F. Daniell, who resided in the Bahama Islands, this, though commonly a shrub of from three to five feet high, sometimes appears in the form

* *Copalchi bark* has been mistaken not only for cascarilla, but also for a variety of cinchona. Portions of it, having been taken to Europe, attracted the attention both of pharmacologists and physicians. Two kinds were noticed; one, in small slender quills, of an ash color, bearing some resemblance to a variety of pale cinchona, but having the flavor of cascarilla, and burning with a similar odor; the other in larger quills, with a thick cork-like epidermis, very bitter, and yielding an aromatic odor when burnt. The former is the product of *Croton Pseudo-China;* the latter is of unknown origin, but conjecturally referred to *C. suberosum.* Mr. J. E. Howard states that the quilled copalchi bark contains a bitter alkaloid, soluble in ether, and precipitable as a white hydrate from its acid solution. (*P. J. Tr.*, xiv. 319.) Copalchi bark is an aromatic tonic, employed in Mexico in intermittents, and capable of useful application in all cases requiring a mild aromatic bitter. Dr. Stark has employed it advantageously in feeble states of digestion with irritable bowels, and found it, in one or two cases, to exhibit antiperiodic properties. It may be given in infusion,

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of a small tree with a stem from four to eight inches in diameter.* The stem is straight, and marked at intervals with white or grayish stains. The leaves are petiolate, from two to three inches in length by an inch or more in breadth, often somewhat cordate at the base, obtusely acuminate, pale or grayish green above, and densely covered beneath with shining silvery scales, appearing white at a distance. They are smaller and narrower in the plants of arborescent growth. The flowers, which have a delicious odor, are monœcious, small, white, petiolate, and closely set in simple terminal or axillary spikes. The shrub is a native of the Bahamas, scarce at present in the island of New Providence, but still abundant in Andros, Long, and Eleutheria islands, from the latter of which it derived its botanical title. Daniell calls the plant *sweet-wood*. The name of *seaside balsam* belongs to another species, *C. Balsamiferum* of Linnæus, which grows in the Bahamas and other West India islands, and owes its name to the exudation of a balsamic juice from its young branches when wounded.

Croton Cascarilla. Bennett, *Journ. of the Linn. Soc.* iv. 30.—*Clutia Cascarilla.* Linn. *Sp. Plant.* ed. 1, p. 1042.—*Ricinoides elæagnifolia.* Catesby, *Hist. Carolin.* ii. t. 46. As described by Daniell, this is a shrub of from four to six feet, much branched, with a pale grayish green stem, without the white stains of the former species. The leaves are petiolate, long, narrow, lanceolate, tapering towards each end, pointed, with flat, or somewhat undular margins, above smooth and green, beneath pale and very hairy. The flowers are monœcious, in simple terminal spikes, with small white petals tinged with yellow. They are very fragrant. The plant is a native of the Bahamas, and is said also to grow in Hayti. In the Bahamas it is much scarcer than formerly, and is said by Dr. Daniell to yield at present none of the cascarilla of commerce, of which much was formerly derived from it. This species seems to have been confounded by some with *Croton lineare* of Jacquin, which grows in the Bahamas and most of the West India islands, where it is known by the name of *wild rosemary*, owing probably in part to its fragrant smell, but still more to its narrow linear leaves with reflected margins.

Cascarilla is brought to this market from the West Indies, and chiefly, as we have been informed, from the Bahamas. It comes in bags or casks. We have observed it in the shops in two forms, so distinct as to merit the titles of varieties. In one, the bark is in rolled pieces of every size, from three or four inches in length and half an inch in diameter to the smallest fragments, covered externally with a dull whitish or grayish white epidermis, which in many portions is partially, sometimes wholly removed, leaving a dark brown surface, while the inner surface has a chocolate color, and the fracture is a reddish brown. The small pieces are sometimes curled, but have a distinct abrupt edge as if broken from the branches. The second variety consists entirely of very small pieces, not more than an inch or two in length, very thin, without the white epidermis, not regularly quilled, but curved more or less in the direction of their length, often having a small portion of woody fibre attached to their inner surface, and appearing precisely as if shaved by a knife from the stem or branches. Whether these two varieties are derived from distinct species, or differ only from the mode of collection, it is difficult to determine. The officinal description of cascarilla is as follows. "In quills or curved pieces, about one-twelfth of an inch (2 mm.) thick, having a grayish, somewhat fissured, easily detached, corky layer, the remaining tissue being dull brown, and the inner surface smooth. It breaks with a short fracture, having a resinous and radially striate

made with half an ounce of the bark to a pint of water, in the dose of one or two fluidounces three times a day. (*Ed. Med. and Surg. Journ.*, April. 1849, p. 410.)

* The plant referred to in very early editions of this work, as having been seen by Dr. Wright in Jamaica, and called by him *C. Eluteria*, is, according to Mr. Bennett, a distinct species, *C. Sloanei*, which was confounded by Linnæus with the genuine cascarilla plant, under the name of *Clutia Eluteria*. The genuine plant was first described by him in his *Hortus Cliffortianus* (pp. 486–7), from a specimen in Cliffort's herbarium in the British Museum, and afterwards apparently confused with a Jamaica specimen sent to him by Patrick Brown, from the latter of which the description of his *Clutia Eluteria* was drawn up, which is quite inapplicable to the original plant. It is the *C. Sloanei* also that was described by Schwartz in his *Flora Indiæ Occidentalis* (p. 1183), under the name of *Croton Eluteria*, and probably the same that was figured by Dr. Carson in his *Illust. of Med. Bot.* ii. 34, pl. 78. (See *P. J. Tr.*, 1859, pp. 132–3.)

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appearance; when burned, it emits a strong, aromatic odor; its taste is warm and very bitter." *U. S.*

Properties. Cascarilla has an aromatic odor, rendered much more distinct by friction, and a warm, spicy, bitter taste. It is brittle, breaking with a short fracture. When burnt it emits a pleasant odor, closely resembling that of musk, but weaker and more agreeable. This property serves to distinguish it from other barks. It was analyzed by Trommsdorff, and more recently by M. Duval, of Liseux, in France. The constituents found by the latter were albumen, a peculiar kind of tannin, a bitter crystallizable principle called *cascarillin*, a red coloring matter, fatty matter of a nauseous odor, wax, gum, volatile oil, resin, starch, pectic acid, chloride of potassium, a salt of lime, and lignin. The oil, according to Trommsdorff, constitutes 1·6 per cent., is of a greenish yellow color, a penetrating odor analogous to that of the bark, and of the sp. gr. 0·938. It is probably a mixture of two oils, one of which is oxygenated. Gladstone (*Jahresbr. der Pharm.*, 1872, p. 450) gives to the hydrocarbon of cascarilla oil the composition of oil of turpentine. To obtain cascarillin, M. Duval treated the powdered bark with water, added acetate of lead to the solution, separated the lead by sulphuretted hydrogen, filtered, evaporated with the addition of animal charcoal, filtered again, evaporated at a low temperature to a syrupy consistence, and, having allowed the semi-liquid substance thus obtained to harden by cooling, purified it by twice successively treating it, first with a little cool alcohol, to separate the coloring and fatty matters, and afterwards with boiling alcohol and animal charcoal. The last alcoholic solution was allowed to evaporate spontaneously. Thus obtained, cascarillin is white, crystalline, inodorous, bitter, very slightly soluble in water, soluble in alcohol and ether. (*Journ. de Pharm.*, 3e sér., viii. 96.) It melts at 205° C. (401° F.), is not volatile nor a glucoside. Its composition answers to the formula $C_{12}H_{18}O_4$. Either alcohol or water will partially extract the active matters of cascarilla; but diluted alcohol is the proper menstruum.

Medical Properties and Uses. This bark is aromatic and tonic. It was known in Germany so early as the year 1690, and was much used as a substitute for Peruvian bark by those who were prejudiced against that febrifuge in the treatment of remittent and intermittent fevers. It has, however, lost much of its reputation, and is now employed only where a pleasant and gently stimulant tonic is desirable; as in dyspepsia, chronic diarrhœa and dysentery, flatulent colic, and other cases of debility of the stomach or bowels. It is said to promote the flow of milk in the lower animals, and has been proposed with a view to the same effect in the human subject. It is sometimes advantageously combined with the more powerful bitters. It may be given in powder or infusion. The dose of the former is from a scruple to half a drachm (1·3–1·95 Gm.), which may be repeated several times a day. Prof. Procter published a formula for a fluid extract, which contains the virtues of a troyounce of the bark in a fluidounce. (*A. J. P.*, 1863, p. 113.) In consequence of its pleasant odor when burnt, some smokers mix it in small quantity with their tobacco; but it is said, when thus employed, to occasion vertigo and intoxication.

Off. Prep. Infusum Cascarillæ; Tinctura Cascarillæ, *Br.*

CASSIA FISTULA. *U. S., Br.* *Cassia Fistula.* [*Purging Cassia.*]

(KĂS'SI-Ą FĬS'TŪ-LĄ.)

"The fruit of Cassia Fistula. Linné. (*Nat. Ord.* Leguminosæ, Cæsalpinieæ.)" *U. S.* "The pulp obtained from the pods of the Purging Cassia, Cassia Fistula." *Br.*

Cassiæ Pulpa, *Br.;* Cassia Pulp; Fructus Cassiæ Fistulæ; Casse officinale, Casse en Batons, Pulpe de Casse, Casse mondée, Casse, *Fr.;* Rohrenkassie, Purgiercassie, Fistelkassie, *G.;* Cassia, *It.;* Cana Fistula, *Sp.*

Gen. Ch. Calyx five-leaved. *Petals* five. *Anthers,* three upper sterile, three lower beaked. *Lomentum. Willd.*

The tree which yields the purging cassia is ranked by some botanists as a distinct genus, separated from the Cassia, and denominated *Cathartocarpus.* (See *Lindley's Flor. Med.*, 262.)

Cassia Fistula. Willd. *Sp. Plant.* ii. 518; Carson, *Illust. of Med. Bot.* i. 24, pl. 26.; *B. & T.* 87.—*Cathartocarpus Fistula.* Persoon, *Synops.* i. 459. This

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is a large tree, rising to the height of forty or fifty feet, with a trunk of hard, heavy wood, dividing towards the top into numerous spreading branches, and covered with a smooth ash-colored bark. The leaves are commonly composed of five or six pairs of opposite leaflets, which are ovate, pointed, undulated, smooth, of a pale green color, from three to five inches long, and supported upon short petioles. The flowers are large, of a golden yellow color, and arranged in long, pendent, axillary racemes. The fruit consists of long, cylindrical, woody, dark brown, pendulous pods, which, when agitated by the wind, strike against each other, and produce a sound that may be heard at a considerable distance.

This species of Cassia is a native of Upper Egypt and India, whence it is generally supposed to have been transplanted to other parts of the world. It is at present very extensively diffused through the tropical regions of the old and new continents, being found in Insular and Continental India, Cochin-China, Egypt, Nubia, the West Indies, and the warmer parts of the continent of America. The fruit is the officinal portion of the plant. It is imported from the East and West Indies, chiefly the latter, and from South America.

Properties. Cassia pods are a foot or more in length, straight, or but slightly curved, cylindrical, less than an inch in diameter, with a woody shell, externally of a dark brown color, and marked with three longitudinal shining bands, extending from one end to the other, two of which are in close proximity, appearing to constitute a single band, and the third is on the opposite side of the pod. These bands mark the place of junction of the valves of the legume, and are represented as sometimes excavated in the form of furrows. There are also circular depressions at unequal distances. The officinal description is as follows. "Cylindrical, eighteen to twenty-four inches (45 to 60 cm.) long, nearly one inch (25 mm.) in diameter, blackish brown, somewhat veined, the sutures smooth, forming two longitudinal bands; indehiscent, internally divided transversely into numerous cells, each containing a glossy seed imbedded in a blackish brown, sweet pulp." *U. S.* The pods brought from the East Indies are smaller, smoother, have a blacker pulp, and are more esteemed than those from the West Indies.

We have seen a quantity of pods in this market sold as cassia pods, which were an inch and a half in diameter, flattened on the sides, exceedingly rough on the outer surface, and marked by three longitudinal very elevated ridges, corresponding to the bands or furrows of the common cassia. The pulp was rather nauseous, but in other respects seemed to have the properties of the officinal purging cassia. They correspond exactly with a specimen of the fruit of *Cassia Brasiliana* brought from the West Indies, and were probably derived from that plant.

The heaviest pods, and those which do not make a rattling noise when shaken, are to be preferred; as they contain a larger portion of the pulp, which is the part employed. This should be black and shining, and have a sweet taste. It is apt to become sour if long exposed to the air, or mouldy if kept in a damp place. The pulp is extracted from the pods by first bruising them, then boiling them in water, and afterwards evaporating the decoction; or, when the pods are fresh, by opening them at the sutures, and removing the pulp by a spatula.

Cassia pulp has a slight rather sickly odor, and a sweet mucilaginous taste. From the analysis of M. Henry it appears to contain sugar, gum, a substance analogous to tannin, a coloring matter soluble in ether, traces of a principle resembling gluten, and a small quantity of water.

Medical Properties and Uses. Cassia pulp is laxative, and may be advantageously given in small doses in cases of habitual costiveness. In quantities sufficient to purge, it occasions nausea, flatulence, and griping. In this country it is rarely prescribed, except as an ingredient in the confection of senna, which is a pleasant and useful laxative preparation. The dose of the pulp as a laxative is one or two drachms (3·9–7·8 Gm.), as a purge one or two ounces (31·1–62·2 Gm.).

Off. Prep. Confectio Sennæ.

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CASTANEA. *U. S. Castanea.* [*Chestnut.*]

(CĂS-TĀ'NĘ-Ą.)

"The leaves of Castanea vesca, Linné (*Nat. Ord.* Cupuliferæ), collected in September or October, while still green." *U. S.*

Folia Castaneæ; Feuilles de Châtaignier, Feuilles de Marronier, Châtaigne, *Fr.;* Kastanie, Kastanienblätter, *G.;* Castagna, *It.;* Castaña, *Sp.*

Gen. Ch. MALE. *Ament* naked. *Calyx* none. *Corolla* five-petalled. *Stamens* ten to twenty. FEMALE. *Calyx* five or six-leaved, muricate. *Corolla* none. *Germs* three. Stigma pencil-formed. *Nuts* three, included in an echinated calyx. *Willd.*

This is a very small genus, separated from the original Fagus of Linn., including only two or three recognized species; the *Castanea vesca* of Europe and North America, and *C. pumila* of the United States, which will be found described in Part II. of the present work. The European and American chestnut-trees are known under the same botanical title; as no points of difference can be found between them, which botanists in general are willing to recognize as authorizing distinct specific designations. The late Dr. Geo. B. Wood, however, believed, for reasons given below, that they are distinct trees, differing in origin, and as much entitled to distinct names as the European and American white oaks, or indeed any other analogous species of the two continents. Thus, the general aspect of the two trees is such that the accustomed eye will at a glance recognize the difference, though it might be difficult to say in what exactly the difference consists. The much greater size and somewhat peculiar shape of the fruit of the European, or, as it is commonly called, in this country, the Spanish Chestnut, is another very striking distinction, and, if permanent, should, we think, be admitted as a sufficient specific character. Besides, the European tree does not lose its distinctive character, under complete change of circumstances. Transplanted into North America, and propagated by the seed, it has retained, through a succession of generations, the original superiority in the size of its fruit, which, had the tree been of the same species as the American, would have almost certainly more or less deteriorated.

Castanea vesca. Willd.; Michaux, *N. American Sylva*, iii. 9. *Castanea Americana.* Persoon. (See *Mérat and De Lens.*) The American chestnut is, under favorable circumstances, one of our largest and most magnificent native trees. Michaux states that he had measured several trees, the trunks of which, at six feet from the ground, were fifteen or sixteen feet in circumference, and their stature equal to that of the loftiest trees of the forest. So great a size, however, is rare. Its leaves, which are the officinal portion, serve also at once to distinguish the tree. They are from four to ten inches long by about two in breadth, oblong-elliptical, sharp at the end, strongly and somewhat unequally serrated, with prominent parallel nerves beneath, of a brilliant color, and firm consistence. The only leaves that are liable to be confounded with them are those of the chestnut-oak, which have a very similar form and structure, but are at once distinguishable by the rounded crenate projections on the edge, instead of the sharp serratures of the chestnut. The male flowers are whitish, and disposed on axillary peduncles, four or five inches long; the fertile aments similarly disposed, but less conspicuous. The fruit is a spherical burr, an inch or two in diameter, and very prickly, containing two or three brown nuts, the appearance of which is too well known to require description here. When perfectly ripe, it opens and lets fall the seeds. The bark is very peculiar and characteristic in its appearance, with a longitudinal arrangement of its fibres. The wood is firm and elastic, though not compact, with a remarkable power of resisting decomposition from the weather, and therefore very valuable for posts and rails in fencing. It is not well fitted for fuel, in consequence of a great disposition to snap in the fire, and to throw off burning particles to a considerable distance.

The American chestnut is spread largely through the eastern portions of the United States, from New Hampshire to the mountainous districts of Virginia, North and South Carolina, Georgia, and Tennessee, where it abounds; as also in the Middle States of New Jersey and Pennsylvania, though rare in the maritime parts of Virginia and the other Southern States. The leaves should be collected after perfect maturity, and before beginning to decay in autumn.

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The European species is distributed in the south of Europe very much as the American is with us, preferring hilly regions, and abounding in Spain, the south and west of France, Switzerland, and Italy. It sometimes attains an enormous magnitude, and Michaux describes one, growing at Sancerre in France, which at six feet from the ground is thirty feet in circumference, and six hundred years ago was known as the *Great Chestnut*. Though supposed to be more than one thousand years old, its trunk is perfectly sound, and its branches are annually loaded with fruit. Much larger than this is the celebrated chestnut of Mount Etna, of which the trunk is said to be one hundred and sixty feet in circumference, though hollow in the centre, so that the tree lives by its bark. (*Mérat and De Lens.*) In Europe the young chestnut is much used for making hoops, for which it is preferred to all other wood on account of resisting the effects of air and moisture. For this purpose it is much cultivated in Europe, and cut when large enough. But the tree is still more valuable on account of its large nuts, which are much used as food, being a favorite on the table of the rich, and often the main dependence of the poor peasant, who considers himself well-off when possessed of a few healthy chestnut-trees. Whole provinces are said to be supported by this fruit. Though cultivated in small numbers in this country, they have not been so extensively introduced as they ought to be, chiefly, in all probability, from their difficulty of propagation. The inner bark of the chestnut has been vaunted in Europe as a remedy in dysentery. (*Mérat and De Lens.*)

Properties. The leaves, which have already been described, are so flexible and tenacious that it is difficult to powder them. In preparing them for the action of a solvent, they must be comminuted by cutting and bruising them in a mortar. They are not, therefore, well fitted for percolation. (*Maisch.*) They have little smell, and a slightly astringent, and scarcely bitterish taste, so that they are not offensive to children. They yield their virtues freely to water, and, probably, less so to alcohol. John B. Turner found in chestnut leaves chlorophyll, tannin, gallic acid, gum, and albumen. (*A. J. P.*, 1879, p. 542.) In addition to these constituents, L. J. Steltzer found carbonates, chlorides, and phosphates of potassium, calcium, magnesium, and iron, and a trace of resin and fat. (*A. J. P.*, 1880, p. 294.)

Medical Uses. The only remedial use of the leaves, so far as we have learned, has been in the treatment of hooping-cough. Their effects on the system do not appear to have been carefully studied; but their sensible properties do not indicate the possession of any extraordinary physiological power. A communication from Mr. G. C. Close, of Brooklyn, N. Y., calling attention to their efficacy in hooping-cough, made to the American Pharmaceutical Association, at the meeting of 1862, was the first intimation that has come to our notice of their claims to consideration as a medicine. Enough of favorable reports have been since published to indicate that the leaves have some control over the disease, but their use has not become general in the profession.

The leaves may be administered in infusion or fluid extract. Dr. Unzicker prepared an infusion with three or four drachms of the leaves and a pint of boiling water, and gave of it, well sweetened, as much as the child would drink.

Off. Prep. Extractum Castaneæ Fluidum, *U. S.*

CASTOREUM. *Br.* *Castor.*

(CĂS-TŌ'RĒ-ŪM.)

"The dried preputial follicles and their secretion, obtained from the Beaver, Castor Fiber, and separated from the somewhat shorter and smaller oil-sacs which are frequently attached to them." *Br.*

Castoreum, *Fr.*; Bibergeil, *G.*; Castoro, *It.*; Castoreo, *Sp.*

In the beaver, *Castor fiber* of naturalists, between the anus and external genitals of both sexes, are two pairs of membranous follicles, of which the lower and larger are pear-shaped, and contain an oily, viscid, highly odorous substance, secreted by glands which lie externally to the sac. This substance is called castor. After the death of the animal, the follicles containing it are removed, and dried either by smoke or in the sun; and in this state are brought into the market.

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This drug is derived either from the northern and north-western parts of America, or from Russia, and is distinguished, according to its source, into the Canadian or American and Russian castor. It is supposed by some that the American and Russian beavers are distinct species, the former being a building, the latter a burrowing animal; and additional ground for the supposition is afforded by the fact that the products of the two differ considerably. Of the Russian but a very small portion reaches this country. That which is brought to Philadelphia is derived chiefly from Missouri; but large quantities are collected in the north-western regions of British America.*

Castor comes to us in the form of solid unctuous masses, contained in sacs about two inches in length, larger at one end than at the other, much flattened and wrinkled, of a brown or blackish color externally, and united in pairs by the excretory ducts which connect them in the living animal. In each pair one sac is generally larger than the other. They are divided internally into numerous cells, containing the castor, which, when the sacs are cut or torn open, is exhibited of a brown or reddish brown color, intermingled more or less with the whitish membrane forming the cells. Those brought from Russia are larger, fuller, heavier, and less tenacious than the American; and their contents, which are of a rusty or liver color, have a stronger taste and smell, and are considered more valuable as a medicine. A variety of Russian castor, described by Pereira under the name of *chalky Russian castor*,† is in smaller and rounder sacs than the American, has a peculiar empyreumatic odor very different from that of the other varieties, breaks like starch under the teeth, and is characterized by effervescing with dilute hydrochloric acid. In a specimen examined by Müller, 40·646 per cent. of carbonate of calcium was found. In the castor from Missouri, the contents of the sac are sometimes almost white, and evidently inferior. According to Jannarch, castor varies with the time of year at which it is collected, being lighter colored, more fluid, and less copious in the follicles from February to July than in the remainder of the year. (*Pharm. Centralb.*, Mai, 1847, p. 318.) It is said by M. Kohli that the Canadian castor, treated with distilled water and ammonia, affords an orange precipitate, while the matter thrown down from the Russian under similar treatment is white.

Properties. Good castor has a strong, fetid, peculiar odor; a bitter, acrid, and nauseous taste; and a color more or less tinged with red. It is of a softer or harder consistence, according as it is more or less thoroughly dried. When perfectly desiccated, though still somewhat unctuous, it is hard, brittle, and of a resinous fracture. Its chemical constituents, according to Brandes, are volatile oil; a resinous matter; albumen; a substance resembling *osmazome;* mucus; urate, carbonate, benzoate, phosphate, and sulphate of calcium; acetate and chloride of sodium; chloride, sulphate, and benzoate of potassium; carbonate of ammonium; membranous matter; and a peculiar proximate principle discovered by M. Bizio, an Italian chemist, and called by him *castorin*. This principle crystallizes in long, diaphanous, fasciculated prisms, has the smell of castor, and a copperish taste. It is insoluble in cold water and cold alcohol: but is dissolved by 100 parts of the latter liquid at the boiling temperature, and by the essential oils. It possesses neither alkaline nor acid properties. It may be obtained by treating castor, minutely divided, with six times

* The statement in the text, that the lower of the two pairs of sacs is the one containing the castor, was made on the authority of Cuvier. In an appendix by Dr. W. W. Ely, to a treatise recently published on the "American Beaver and his Works," by Lewis H. Morgan, it is stated by Dr. Ely, who appears to have thoroughly studied the anatomy of the animal, at least in reference to this particular subject, that the upper pair are the real castor sacs, the lower containing an oily secretion, with very little dark-colored castor.

In the same communication by Dr. Ely, the question is discussed as to the identity of the Russian and American beavers; and the conclusion arrived at, that, though there are striking differences between the skulls of the two, as also in some respects in the contents of the castor sacs, yet these are nothing more than can be accounted for by the different circumstances in which they are placed, and by their long separation on the two continents; and consequently the Russian and American beavers should be considered merely as varieties of the same species.

† The normal proportion of carbonate of calcium is said by Dr. Godfrey (*Proc. A. P. A.*, xxvii. 289) to be about 3 per cent., but the proportion often far exceeds this, as much as 85 per cent. having been noted. This excess is believed to be due to disease in the animal, and unfits castor for use as medicine.

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its weight of boiling alcohol, filtering the liquor while hot, and allowing it to cool. The *castorin* is slowly deposited, and may be purified by means of cold alcohol. M. Valenciennes, who could not obtain the crystals white and pure by simple treatment with alcohol, succeeded by first boiling a mixture of equal parts of castor and hydrated lime with water, and acting upon the residue, separated and dried, with boiling alcohol of the sp. gr. 0·823. The product exceeded 1 per cent. (*P. J. Tr.*, Dec. 1861, p. 329.) It has been thought to be the active principle; but its claims are doubtful. The *volatile oil* may be obtained by repeated distillation with the same portion of water. It is pale yellow, and has the smell and taste of castor.

F. Wöhler ascertained the existence of salicin in a specimen of castor; also that it contained a small quantity of *carbolic acid*, to which he ascribes its odor. (See *Chem. Gaz.*, Jan. 1, 1849.) Dr. Pereira found that a portion of water distilled from American castor gradually lost its peculiar odor, and acquired that of the flowers of *Spiræa ulmaria*, and afterwards presented no trace of the presence of oil of castor. Upon testing it, he ascertained the existence in it of *salicylic aldehyde* (*oil of Spiræa ulmaria*), and concluded that the oil of castor had been converted into that principle. He further inferred that the oil is probably a volatile product of the salicin of the castor, and ascribes the carbolic acid, found by Wöhler, to the same source. (*P. J. Tr.*, xi. 200.) The salicin of the castor probably proceeds from the willow and poplar on which the beaver feeds.

Alcohol and ether extract the virtues of castor. An infusion made with boiling water has its sensible properties in a slight degree; but the odorous principle of the drug is dissipated by decoction.

The virtues of castor are impaired by age. Warmth, and especially moisture, promotes its decomposition. In a dry cool place it may be kept for a long time without material deterioration. When quite black, with little taste or smell, it is unfit for use. The castor follicles are sometimes partly deprived of the castor, and its place supplied with sawdust. A factitious preparation has been sold, consisting of a mixture of various drugs, scented with genuine castor, intermingled with membrane, and stuffed into the scrotum of a goat. The fraud may be detected by the comparatively feeble odor, the absence of other characteristic sensible properties, and the want of the smaller follicles containing fatty matter, often attached to the bags of castor.

Medical Properties and Uses. Castor is moderately stimulant and antispasmodic. The experiments of Thouvenel prove that, in large doses, it quickens the pulse, increases the heat of the skin, and produces other symptoms of general excitement; but its force is directed chiefly to the nervous system, and in small doses it scarcely disturbs the circulation. It has also enjoyed a high reputation as an emmenagogue. It was employed by the ancients. Pliny and Dioscorides speak of it as useful in hysteria and amenorrhœa. In Europe, especially on the continent, it is still frequently prescribed in low forms of fever attended with nervous symptoms, in spasmodic diseases, such as hysteria and epilepsy, in many anomalous nervous affections, and in diseases dependent on or connected with suppression or retention of the menses. It is less used in this country. The dose in substance is from ten to thirty grains (0·65–1·95 Gm.), which may be given in bolus or emulsion. The tincture is sometimes employed.

CATAPLASMATA. *Cataplasms.*

(CĂT-Ą-PLĂȘ'MĄ-TĄ.)

Poultices, *E.;* Cataplasmes, *Fr.;* Umschläge, Breiumschläge, *G.*

Cataplasms or *poultices** are moist substances intended for external application, of such a consistence as to accommodate themselves accurately to the surface to which they are applied, without being so liquid as to spread over the neighboring parts,

* *Spongio Piline* is a thick cloth into which sponge in very small pieces has been felted, and a layer of rubber applied upon the surface. It is used as a substitute for a poultice by simply soaking a piece of the desired size in warm or hot water, and, after wiping the rubber side dry, applying at once, using a bandage to keep it in place if necessary. Moisture is retained a long time, evaporation being prevented by the rubber coating. If desired, Fluid Extract of Belladonna, Conium, or any similar preparation, may be added in proper quantity to the warm water.

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or so tenacious as to adhere firmly to the skin. As they are in this country seldom made by the apothecary, they were not deemed by the compilers of the U. S. Pharmacopœia proper objects for officinal direction. The ounce used in the following processes is the avoirdupois.

CATAPLASMA CARBONIS. *Br.* *Charcoal Poultice.*

(CĂT-Ą-PLĂS'MĄ CĂR-BŌ'NĪS.)

Cataplasme au Charbon, *Fr.;* Kohlenumschlag, *G.*

"Take of Wood Charcoal, in powder, *half an ounce;* Crumb of Bread *two ounces;* Linseed Meal *one ounce and a half;* Boiling Water *ten fluidounces.* Macerate the Bread in the Water for ten minutes near the fire, then mix, and add the Linseed Meal gradually, stirring the ingredients, so that a soft poultice may be formed. Mix with this half the charcoal, and sprinkle the remainder on the surface of the poultice." *Br.*

Charcoal, recently prepared, has the property of absorbing those principles upon which the offensive odor of putrefying animal substances depends. In the form of poultice, it is an excellent application to foul and gangrenous ulcers, correcting their fetor, and improving the condition of the sore. It should be frequently renewed.

CATAPLASMA CONII. *Br.* *Hemlock Poultice.*

(CĂT-Ą-PLĂS'MĄ CŌ-NĪ'Ī.)

Cataplasme avec la Ciguë, *Fr.;* Schierling-Umschlag, *G.*

"Take of Hemlock Leaf, in powder, *one ounce;* Linseed Meal *three ounces;* Boiling Water *ten fluidounces.* Mix the Hemlock and Linseed Meal, and add them to the Water gradually, with constant stirring." *Br.*

This cataplasm may be advantageously employed as an anodyne application to cancerous, scrofulous, syphilitic, and other painful ulcers; but its liability to produce narcotic effects, in consequence of the absorption of the active principle of the hemlock, should not be overlooked. (See *A. J. P.*, 1873, p. 177.)

CATAPLASMA FERMENTI. *Br.* *Yeast Poultice.*

(CĂT-Ą-PLĂS'MĄ FĘR-MĔN'TĪ.)

Cataplasme avec le Levûre de Bière, *Fr.;* Hefenumschlag, *G.*

"Take of Beer Yeast *six fluidounces;* Wheaten Flour *fourteen ounces;* Water, heated to 100° F., *six fluidounces.* Mix the Yeast with the Water, and stir in the Flour. Place the mass near the fire till it rises." *Br.*

By exposing a mixture of yeast and flour to a gentle heat, fermentation takes place, and carbonic acid gas is extricated, which causes the mixture to swell, and is the source of its peculiar virtues. The yeast cataplasm is gently stimulant, and is sometimes applied with benefit to foul and gangrenous ulcers, the fetor of which it corrects, while it hastens the separation of the slough.

CATAPLASMA LINI. *Br.* *Linseed Poultice.*

(CĂT-Ą-PLĂS'MĄ LĪ'NĪ.)

Cataplasma Emolliens, s. Communis; Flaxseed Poultice; Cataplasme de Farine de Lin, Cataplasme simple (commun), *Fr.;* Leinsamen-Umschlag, *G.*

"Take of Linseed Meal *four ounces;* Olive Oil *half a fluidounce;* Boiling Water *ten fluidounces.* Mix the Linseed Meal gradually with the Water, then add the Oil with constant stirring." *Br.*

The flaxseed meal which remains after the expression of the oil is here employed; but that which has not been submitted to pressure is decidedly preferable, and answers an excellent purpose when mixed with boiling water, without other addition. Fresh lard or olive oil, spread upon the surface of the poultice, serves to prevent its adhesion to the skin, and to preserve its softness.

The use of this and other emollient cataplasms is to relieve inflammation, or to promote suppuration. They act mainly by the sedative influence of their moisture, and by excluding the air. The one most extensively employed, perhaps because its materials are always at hand, is that prepared by heating together milk and the crumb

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of bread. The milk should be quite sweet, and fresh lard should be incorporated with the poultice. Mush made with the meal of Indian corn also forms an excellent emollient cataplasm.*

CATAPLASMA SINAPIS. *Br.* *Mustard Poultice.*

(KĂT-Ą-PLĂṢ'MĄ SĮ-NĀ'PĬS.)

Sinapismus, *P.G.;* Cataplasma Rubefaciens; Sinapisme, Cataplasme de Moutarde, Cataplasme rubéfiant, *Fr.;* Senfteig, *G.*

"Take of Mustard, in powder, Linseed Meal, each, *two ounces and a half;* Boiling Water *ten fluidounces.* Mix the Linseed Meal gradually with the Water, and add the Mustard, with constant stirring." *Br.*

The simplest and most effectual mode of preparing a mustard poultice. is to mix the powdered mustard of the shops with a sufficient quantity of warm water to give it a due consistence. When a weaker preparation is required, an equal portion or more of rye or wheat flour should be added. Vinegar never increases its efficiency, and, in the case of the black mustard seed, has been ascertained by MM. Trousseau and Blanc to diminish its rubefacient power. The same may be said of alcohol. A boiling temperature is also injurious by interfering with the development of the volatile oil or acrid principle. (See *Sinapis.*)

These poultices are frequently called *sinapisms.* They are powerfully rubefacient, exciting a sense of warmth in a few minutes, and usually becoming insupportably painful in less than an hour. When removed they leave the surface intensely red and burning; and the inflammation frequently terminates in desquamation, or even blistering if the application be too long continued. Obstinate ulcers and gangrene also sometimes result from the protracted action of mustard. especially on parts possessed of little vitality. As a general rule, the poultice should be removed when the patient complains much of pain; and in cases of insensibility should not, unless greatly diluted, be allowed to remain longer than one, or at most two hours; as violent inflammation, followed by obstinate ulceration, is apt to take place upon the occurrence of reaction. In children particular care is necessary to avoid this result. The poultice should be thickly spread on linen, and may be covered with gauze or unsized paper in order to prevent its adhesion to the skin. If hairs are present they should be removed by the razor. Sinapisms may be employed in all cases in which it is desirable to produce a speedy rubefacient impression. (See *Charta Sinapis.*)

CATAPLASMA SODÆ CHLORATÆ. *Br.* *Chlorine Poultice.*

(KĂT-Ą-PLĂṢ'MĄ SŌ'DÆ ĊHLŌ-RĀ'TÆ.)

"Take of Solution of Chlorinated Soda *two fluidounces;* Linseed Meal *four ounces;* Boiling Water *eight fluidounces.* Mix the Linseed Meal gradually with the Water, and add the Solution of Chlorinated Soda, with constant stirring." *Br.*

This is an excellent application to sloughing and other fetid ulcers, to correct the smell, and afford a moderate stimulation.

CATECHU. *U.S.* *Catechu.*

(KĂT'Ę-ĊHŪ—kăt'ę-kū.)

"An extract prepared from the wood of Acacia Catechu. Willdenow. (*Nat. Ord.* Leguminosæ, Mimoseæ.)" *U. S.*

Cutch, Terra Japonica, Catechu Nigrum; Cachou, *Fr.;* Catechu, Katechu, Pegu Catechu, *G.;* Catecu, Catciu, Catto, *It.;* Catecu, *Sp.;* Cutt, *Hindostanee.*

CATECHU PALLIDUM. *Br.* *Pale Catechu.*

(KĂT'Ę-ĊHŪ PĂL'LĮ-DŬM.)

"An extract of the leaves and young shoots of Uncaria Gambir (Nauclea Gambir)." *Br.*

* A substitute for linseed meal poultices has been prepared by saturating a piece of thick felt paper with a decoction of linseed and drying. When intended to be used, the prepared paper is dipped in hot water. It swells considerably, and is applied to the desired part, covered with waxed paper, rubber tissue, or oiled silk, fastened with bandages, and allowed to remain 12 hours. (Volkhausen, *Pharm. Ztg.,* 1879, p. 95.)

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The British Pharmacopœia has entirely rejected the proper catechu, which, in the former edition, was recognized under the inappropriate name of Catechu Nigrum, retaining, by the name of Catechu Pallidum, a product which, though analogous to catechu, is entirely distinct, being derived from a different plant, and known commonly by a different name, that, namely, of gambir. We treat in the text of the proper catechu, and, in a note, of gambir among the catechus not recognized by the U. S. Pharmacopœia.

Acacia Catechu. Willd. *Sp. Plant.* iv. 1079; Carson, *Illust. of Med. Bot.* i. 32, pl. 24; *B. & T.* 95. According to Mr. Kerr, whose description has been followed by most subsequent writers, *Acacia Catechu* is a small tree, seldom more than twelve feet in height, with a trunk one foot in diameter, dividing towards the top into many close branches, and covered with a thick, rough, brown bark. The leaves, which stand alternately upon the younger branches, are composed of from fifteen to thirty pairs of pinnæ nearly two inches long, each of which is furnished with about forty pairs of linear leaflets, beset with short hairs. At the base of each pair of pinnæ is a small gland upon the common footstalk. Two short recurved spines are attached to the stem at the base of each leaf. The flowers are in close spikes, which arise from the axils of the leaves, and are about four or five inches long. The fruit is a lanceolate, compressed, smooth, brown pod, with an undulated thin margin, and contains six or eight roundish flattened seeds, which when chewed emit a nauseous odor.

This species of Acacia is a native of the East Indies, growing abundantly in various provinces of Hindostan, and in the Burmese Empire. Pereira says that it is now common in Jamaica. Like most others of the same genus, it abounds in astringent matter, which may be extracted by decoction. Catechu is an extract from the wood of the tree.

This drug had been long known before its source was discovered. It was at first called *terra Japonica*, under the erroneous impression that it was an earthy substance derived from Japan. When ascertained by analysis to be of vegetable origin, it was generally considered by writers on the Materia Medica to be an extract of the *betel nut*, which is the fruit of a species of palm, denominated *Areca Catechu*. Its true origin was made known by Mr. Kerr, assistant surgeon of the civil hospital in Bengal, who had an opportunity of examining the tree from which it was obtained, and observing the process of extraction. According to Mr. Kerr, the manufacturer, having cut off the exterior white part of the wood, reduces the interior brown or reddish-colored portion into chips, which he then boils in water in unglazed earthen vessels, till all the soluble matter is dissolved. The decoction thus obtained is evaporated first by artificial heat, and afterwards in the sun, till it has assumed a thick consistence, when it is spread out to dry upon a mat or cloth, being, while yet soft, divided by means of a string into square or quadrangular pieces. The account subsequently given by Dr. Royle, of the preparation of the extract in Northern India, is essentially the same. The process, as he observed it, was completed by the pouring of the extract into quadrangular earthen moulds. Our countryman, the Rev. Howard Malcom, states, in his "Travels in South-Eastern Asia," that catechu is largely prepared from the wood of *Acacia Catechu* near Prome, in Burmah. Two kinds, he observes, are prepared from the same tree; one *black*, which is preferred in China, and the other *red*, which is most esteemed in Bengal. It is said that the unripe fruit and leaves are also sometimes submitted to decoction.

The name *catechu* in the native language signifies the *juice of a tree*, and appears to have been applied to astringent extracts obtained from various plants. According to the U. S. Pharmacopœia, however, the term is properly restricted to the extract of *Acacia Catechu;* as it was not intended to recognize all the astringent products which are floating in Asiatic commerce; and those from other sources than the Acacia, though they may occasionally find their way into our shops, do so as an exception to the general rule. A minute account of the diversified forms and exterior characters which officinal catechu presents as produced in different localities, would rather tend to perplex the reader than to serve any good practical purpose. These characters are, moreover, frequently changing, as the drug is procured from new

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sources, or as slight variations may occur in the mode of its preparation. Commerce is chiefly supplied with catechu from Bahar, Northern India, and Nepaul through Calcutta, from Canara through Bombay, and from the Burmese dominions. We derive it directly from Calcutta, or by orders from London, and it is sold in our markets without reference to its origin. It is frequently called *cutch* by the English traders, a name derived, no doubt, from the Hindoostanee word *cutt*.*

* In order not to embarrass the text unnecessarily, we have thrown together, in the form of a note, the following observations upon the varieties of catechu; those being first considered which are probably derived from *Acacia Catechu*, and, therefore, recognized as officinal in the U. S. Pharmacopœia.

1. *Officinal Catechu. U. S.*

The following, so far as we have been able to distinguish them, are the varieties of officinal catechu to be found in the markets of Philadelphia.

1. *Plano-convex Catechu. Cake Catechu.* This is in the form of circular cakes, flat on one side, convex on the other, and usually somewhat rounded at the edge, as if the soft extract had been placed in saucers, or vessels of a similar shape, to harden. As found in the retail shops, it is generally in fragments, most of which, however, exhibit some evidences of the original form. The cakes are of various sizes, from two or three to six inches or more in diameter, and weighing from a few ounces to nearly two pounds. Their exterior is usually smooth and dark brown; but we have seen a specimen in which the flat surface exhibited impressions as if produced by coarse matting. The color internally is always brown, sometimes of a light yellowish brown or chocolate color, but more frequently dark reddish brown, and sometimes almost black. The cakes are almost always more or less cellular in their interior; but in this respect great diversity exists. Sometimes they are very porous, so as almost to present a spongy appearance, sometimes compact and nearly uniform; and this difference may be observed even in the same piece. The fracture is sometimes rough and dull, but in the more compact parts is usually smooth and somewhat shining; and occasionally a piece split in one direction will exhibit a spongy fracture, while in another it will be shining and resinous, indicating the consolidation of the extract in layers. This variety of catechu is often of good quality. It is common at present in our market, but we have been unable to trace its origin accurately. There can be little doubt, from its internal character, that it comes from the East Indies, and is the product of *A. Catechu:* but no accounts that we have seen of the preparation of the drug, in particular geographical sites, indicate this particular shape; and it is not impossible that portions of it may be formed out of other varieties of catechu by a new solution and evaporation.

2. *Pegu Catechu.* This is the product derived from the Burmese dominions, and named from that section of the country whence it is exported. It enters commerce, probably in general through Calcutta, in large masses, sometimes of one cwt., consisting of layers of flat cakes, each wrapped in leaves, said to be those of the *Nauclea Brunonis*. In this form, however, we do not see it in the shops; but almost always in angular, irregular fragments, in which portions of two layers sometimes cohere with leaves between them, indicating their origin. It is characterized by its compactness, shining fracture, and blackish brown or dark port-wine color, so that when finely broken it bears considerable resemblance to kino. This is an excellent variety of catechu, and is not unfrequent in the shops.

3. *Catechu in Quadrangular Cakes.* This is scarcely ever found in the shops in its complete form, and the fragments are often such that it would be impossible to infer from them the original shape of the cake. This is usually between two and three inches in length and breadth, and somewhat less in thickness, of a rusty brown color externally, and dark brown or brownish gray within, with a somewhat rough and dull fracture, but, when broken across the layers in which it is sometimes disposed, exhibiting a smoother and more shining surface. Guibourt speaks of the layers as being blackish externally and grayish within, and bearing some resemblance to the bark of a tree, a resemblance, however, which has not struck us in the specimens which have fallen under our notice. There is little doubt that this variety comes from the provinces of Bahar and Northern India, where the preparation of the drug was witnessed by Mr. Kerr and Dr. Royle, who both speak of it as being brought, when drying, into the quadrangular form. It has been called *Bengal Catechu*, because exported from that province.

Pale catechu, so far as the term is not applied to *gambir*, may be considered as belonging to this variety. A specimen with this name, which was sent from India to the great London exhibition, and which Dr. G. B. Wood had an opportunity of examining, was in oblong rectangular pieces, or fragments of such pieces, about three and a half inches long by an inch and a half in breadth, of a dirty yellowish color within, and an earthy fracture, quite free from gloss, and bearing a much stronger resemblance to gambir than to ordinary catechu.

4. *Catechu in Balls.* We have seen this in two forms—one consisting of globular balls about as large as an orange, very hard and heavy, of a ferruginous aspect externally, very rough when broken, and so full of sand as to be gritty under the teeth; the other in cakes, originally, in all probability, globular, and of about the same dimensions, but flattened and otherwise pressed out of shape before being perfectly dried, sometimes adhering two together, as happens with the lumps of Smyrna opium, and closely resembling in external and internal color, and in the character of their fracture, the quadrangular variety last described. The former kind is rare, and the specimens we have seen had been twenty years in the shop, and had very much the appearance of a factitious product. The latter is in all probability the kind known formerly as the *Bombay catechu;* as Dr. Hamilton, and, more recently, Major Mackintosh, in describing the mode of preparing catechu on the Malabar coast, of which Bombay is the entrepot, say that, while the extract is soft, it is shaped into balls about the size of an orange.

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Properties. Catechu, as it comes to us, is in masses of different shapes, some in balls more or less flattened, some in circular cakes, some saucer-shaped, others

2. *Catechus not recognized in the U. S. Pharmacopœia.*

1. **Catechu Pallidum,** *Br. Gambir. Terra Japonica. Pale Catechu.* An astringent extract is abundantly prepared in certain parts of the East Indies, under the name of *gambir* or *gambeer*, and imported into Europe and America under that of terra Japonica. The plant from which it is obtained, called by Mr. Hunter, who first minutely described it, *Nauclea Gambir*, but by Roxburgh, De Candolle, and others, *Uncaria Gambir*, is a climbing shrub of the natural order Rubiaceæ of Jussieu, Cinchonaceæ of Lindley. (*B. & T.* 139.) It is a native of Malacca, Sumatra, Cochin-China, and other parts of Eastern Asia, and is largely cultivated in the islands of Bintang, Singapore, and Prince of Wales. The gambir is prepared by boiling the leaves and young shoots in water, and evaporating the decoction either by artificial or solar heat. When of a proper consistence, it is spread out into flat cakes in moulds or otherwise, and then cut into small cubes, which are dried in the sun. Sometimes these cohere into a mass when packed before being quite dry.

Gambir is in cubes, with sides about an inch square, is light and porous, so that it floats when thrown in water, is deep yellowish, or reddish brown externally, but pale yellowish within, presents a dull earthy surface when broken, is inodorous, and has a strongly astringent, bitter, and subsequently sweetish taste. It softens and swells up when heated, and leaves a minute proportion of ashes when burnt. It is partially soluble in cold water, and almost wholly so in boiling water, which deposits a portion upon cooling. Duhamel, Ecky, and Procter dissolved 87·5 per cent. of it in cold water by means of percolation. (*A. J. P.*, xvi. 166.) Nees von Esenbeck found it to consist of from 36 to 40 per cent. of catechu-tannic acid, a peculiar principle called *catechuin*, *catechin*, or catechuic acid, gum or gummy extractive, a deposit like the cinchonic red, and 2·5 per cent. of lignin. *Catechuic acid*, when perfectly pure, is snow-white, of a silky appearance, crystallizable in fine needles, unalterable if dry in the air, fusible by heat, very slightly soluble in cold water with which it softens and swells up, soluble in boiling water which deposits it on cooling, and soluble also in alcohol and ether. It very slightly reddens litmus paper, and, though coloring the solution of chloride of iron green, and producing with it a grayish green precipitate, differs from tannic acid in not affecting a solution of gelatin. It bears considerable analogy to gallic acid in its relations to the metallic salts, but does not, according to Neubauer, bear the same relation to the tannic acid of catechu that gallic acid does to that of galls. On the contrary, instead of resulting from the oxidation of tannic acid, it is by heat converted into a substance analogous to tannin. (*A. J. P.*, xxviii. 329 and 331; from *Liebig's Annalen*, xcvi. 337.) The very great discordance of different authors as to its formula seems to be explained by some recent experiments of Etti (*Liebig's Ann.*, 186, p. 327), who shows that *catechin*, $C_{19}H_{18}O_8$, readily gives at 100° C. (212° F.), or even when kept for some time over sulphuric acid, an anhydride, $C_{38}H_{34}O_{15}$, and at 160° C. (320° F.) a second anhydride, $C_{38}H_{32}O_{14}$, which, mixed in varying proportions, explain the varying results. Gautier (*Journ. de Pharm. et de Chim.*, 1878, p. 368) assigns to catechin the formula $C_{21}H_{18}O_8$.

Several varieties of gambir are described. Sometimes it is in oblong instead of cubical pieces, without differing in other respects from the ordinary kind; sometimes in small circular cakes, or short cylindrical pieces, heavier than water, of a pale reddish yellow color, moderately astringent, gritty under the teeth, and quite impure; sometimes in very small cubes, distinguishable by the black color they afford with tincture of iodine, indicating the admixture of sago, or other amylaceous matter; and, finally, in circular cakes of the size of a small lozenge flat on one side, and somewhat convex on the other, of a pale pinkish yellowish white color, and a chalky feel. This is most highly esteemed by the natives in India. (*Pereira.*) None of these varieties occur to any extent in our commerce.

Gambir was probably the substance first brought from the East under the name of *terra Japonica*. It is largely consumed in the East by the betel-chewers. Great quantities are imported into Europe, where it is used for tanning, calico-printing, dyeing, etc. In this country it is also largely consumed by the calico-printer. It is a strong astringent, and applicable to the same purposes as the officinal catechu.

2. *Areca Catechu.* This is obtained from the *areca nut*, or *betel nut*, which is the seed of *Areca Catechu*, a palm cultivated in all parts of India. (See Part II.) It is prepared by boiling the nuts in water, and evaporating the decoction. There are two varieties; one of a black color, very astringent, mixed with paddy husks and other impurities, and obtained by evaporating the first decoction; the other, yellowish brown, of an earthy fracture, and pure, resulting from the evaporation of a decoction of the nuts which had been submitted to the previous boiling. The first is called *kassu*, the other *coury*. (Heyne, *Tracts, etc., on India.*) They are prepared in Mysore, and Ainslie states that both varieties are sold in the bazaars of Lower India, and used for the same purpose as the officinal catechu by the native and European practitioners. They are also much used for chewing by the natives. But they are seldom exported, and it is uncertain whether they find their way into European or American commerce. Pereira thought he had identified the *kassu* with a variety of catechu derived from Ceylon, where he had been informed that an extract of the areca nut is prepared. It was in circular flat cakes, from two to three inches in diameter, scarcely an inch thick, covered on one side with paddy husks, and internally blackish brown and shining, like Pegu catechu.

Guibourt and Pereira describe other varieties, which we have not met with, and which are probably rare. One of these is the *Siam catechu*, in conical masses shaped like a betel nut, and weighing about a pound and a half. Its fracture is shining and liver-colored, like that of hepatic aloes; in other respects it resembles Pegu catechu. Another is the *black mucilaginous catechu* of Guibourt, in parallelopipeds, an inch and a half in length by an inch in breadth. Internally it is black and shining, and its taste is mucilaginous and feebly astringent. A third is the *dull reddish catechu* of Guibourt, in somewhat flattened balls, weighing three or four ounces, of a dull reddish, wavy,

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cubical or oblong, or quite irregular, and of every grade in size, from small angular pieces, which are evidently fragments of the original cakes, to lumps which weigh one or two pounds. The color is externally of a rusty brown more or less dark, internally varying from a pale reddish or yellowish brown to a dark liver color. In some specimens it is almost black, in others somewhat like the color of port wine, and in others again, though rarely, dull red like annotta. The extract has been distinguished into the *pale* and *dark* varieties; but there does not appear to be sufficient ground for retaining this distinction, at least in relation to the proper catechu obtained from the wood of *A. Catechu*. Catechu is inodorous, with an astringent and bitter taste, followed by a sense of sweetness. It is brittle, and breaks with a fracture which is rough in some specimens, in others uniform, resinous, and shining. That which is preferred in our market is of a dark color, easily broken into small angular fragments, with a smooth glossy surface, bearing some resemblance to kino. Catechu is often mixed with sand, sticks, and other impurities. From 200 parts of Bombay catechu, Sir H. Davy obtained 109 parts of tannic acid, 68 of extractive, 13 of mucilage, and 10 of insoluble residue. The same quantity of Bengal catechu yielded 97 of tannic acid, 73 of extractive, 16 of mucilage, and 14 of insoluble residue. Other experimenters have obtained results somewhat different. The proportion of tannic acid, which may be considered the efficient principle, varies from about 30 to 55 per cent. in the different varieties of the drug. The portion designated by Davy as extractive is said to contain, if it does not chiefly consist of, a principle discovered by Buchner, and now called *catechin*, *catechuin*, or *catechuic acid*, $C_{19}H_{18}O_8$. (See preceding page.) To prepare pure catechin, Etti (*loc. cit.*) proceeds as follows. Catechu is dissolved in eight times its weight of boiling water, and the liquid, after being strained through a cloth, is left for some days until the insoluble catechin has subsided. The crude catechin is collected in a linen cloth and submitted to the action of a screw-press, then dissolved in a sufficient amount of dilute alcohol, and the filtered solution is shaken up with ether as long as any catechin is thereby dissolved; and after the ether has been removed by distillation the residue is taken up with distilled water, and the solution is left for a few days, when the catechin crystallizes out in an almost colorless state. After pressure in a cloth it is again dissolved in boiling water, when a yellowish white body remains behind, which appears to be *quercetin*. The deep red liquid remaining behind after the catechin has been dissolved out with ether contains *catechin red*. The *tannic acid* is of the variety which precipitates iron of a greenish black color, and differs from most of the other varieties in not yielding grape-sugar when digested with dilute sulphuric acid. It is not, therefore, a glucoside. It precipitates gelatin, but not tartar emetic (*Kane*), and is not, like the tannic acid of galls, converted into gallic acid by exposure to the air. It may be distinguished by the name of *catechu-tannic acid*. Catechu is almost wholly soluble in a large quantity of water, to which it imparts a brown color. The extractive or catechuic acid is much less soluble than the astringent principle, which may be almost entirely separated from it by the frequent application of small quantities of cold water. Boiling water dissolves it much more readily than cold, and deposits it of a reddish brown color upon cooling. Both principles are readily dissolved by alcohol or proof spirit, and also by ether. For the important reactions of catechu, see *Acidum Tannicum*.

M. de Meyer affirms that the best method of detecting adulteration of catechu is to treat the suspected drug with ether. Catechu of good quality, after repeated treatment with ether, loses 53 per cent. of its weight, and the dried residue weighs only 47 per cent. of the catechu employed. If this be exceeded, the drug must be proportionately impure. (*Journ. de Pharm.*, Juin, 1870, p. 479.) A. Jossart (*Journ. Pharm. d'Anvers*, 1881, p. 41) examined a catechu which was adulterated with 60 to 65 per cent. of ferrous carbonate.

Medical Properties and Uses. Catechu is a powerful astringent. The dark-

and often marbled fracture. Many years since an extract like this was brought to Philadelphia upon speculation by a merchant from Calcutta, but it is not now in the market. Lastly, there is a *pale* or *whitish* catechu, in small roundish or oval lumps, with an irregular surface, dark or blackish brown externally, very pale and dull internally, and of a bitter, astringent and sweetish taste, with a smoky flavor. It is unknown in commerce.

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colored is somewhat more powerful than the light, and is therefore usually preferred; but the light, being rather sweeter, is chosen by the Malays, Hindoos, and other East Indians, who consume vast quantities of this extract by chewing it, mixed with aromatics and a small proportion of lime, and wrapped in the leaf of the *Piper Betel*. Catechu may be advantageously used in most cases where astringents are indicated. The complaints to which it is best adapted are diarrhœa dependent on debility or relaxation of the intestinal mucous membrane, and passive hemorrhages, particularly that from the uterus. A small piece held in the mouth and allowed slowly to dissolve, is an excellent remedy in relaxation of the uvula, and the irritation of the fauces and troublesome cough which depend upon it. Applied to spongy gums, in the state of powder, it sometimes proves useful; and it has been recommended as a dentifrice in combination with powdered charcoal, Peruvian bark, myrrh, etc. Sprinkled upon the surface of indolent ulcers, it is occasionally beneficial, and is much used in India for the same purpose, in the form of an ointment. An infusion of catechu may be used as an injection in obstinate gonorrhœa, gleet, and leucorrhœa, and we have found it highly beneficial, when thrown up the nostrils, in arresting epistaxis. The dose is from ten grains to half a drachm (0·65–1·95 Gm.), which should be frequently repeated, and is best given with sugar, gum arabic, and water.*

Off. Prep. Tinctura Catechu Composita, *U. S.*

Off. Prep. of Pale Catechu (Gambir). Infusum Catechu, *Br.;* Pulvis Catechu Compositus, *Br.;* Tinctura Catechu, *Br.;* Trochisci Catechu, *Br.*

CAULOPHYLLUM. *U. S. Caulophyllum.* [*Blue Cohosh.*]

(CÂU-LŌ-PHĬL'LŬM.)

"The rhizome and rootlets of Caulophyllum thalictroides. Michaux. (*Nat. Ord.* Berberidaceæ.)" *U. S.*

Pappoose Root, Squaw Root, Blueberry Root.

Gen. Ch. Sepals 6, with three small bractlets at the base, ovate-oblong. *Petals* 6, thick and gland-like, somewhat kidney-shaped or hooded bodies, with short claws much smaller than the sepals, one at the base of each of them. *Stamens* 6: *anthers* oblong. *Pistil* gibbous, style short. *Stigma* minute and unilateral. *Ovary* bursting soon after flowering by the pressure of the two erect, enlarging seeds and withering away. The spherical *seeds* naked on their thick seed-stalks, looking like drupes; the fleshy integument turning blue; albumen of the texture of horn. (*Gray's Manual.*)

Caulophyllum thalictroides. Michaux. *Leontice thalictroides.* Linn. This is an indigenous, perennial, herbaceous plant, with matted, knotty rhizomes, from which rises a single smooth stem, about two feet high, naked till near the summit, where it sends out a large triternately compound leaf, and ending in a small raceme or panicle of greenish yellow flowers, at the base of which is often a smaller biternate leaf. The whole plant when young, as well as the seeds, which are about as large as peas, is glaucous. It is the only known species of the genus. It is found in most parts of the United States, growing in moist rich woods.

Properties. The root stock is the only part used. It has a sweetish, pungent taste, and yields its virtues to water and alcohol. It is officinally described as follows. "Rhizome about four inches (10 cm.) long, and about one-fourth to two-fifths of an inch (6 to 10 mm.) thick, bent; on the upper side with broad, concave stem-scars and short, knotty branches; externally gray brown, internally whitish, tough and woody. Rootlets numerous, matted, about four inches (10 cm.) long, and one twenty-fifth of an inch (1 mm.) thick, rather tough; nearly inodorous; taste sweetish, slightly bitter, and somewhat acrid." *U. S.*

Caulophyllum was examined by Mayer, who found it to contain *saponin*. (*A. J. P.*,

* *Fluid Extract of Catechu.* Prof. Procter suggested the following formula for a *fluid extract of catechu* based on the solvent power of glycerin over this extract. Eight *troyounces* of pure catechu, in moderately coarse powder, are mixed in a mortar with *four fluidounces* of glycerin so as to form a paste, to which enough diluted alcohol is added to make a pint. The liquid is poured into a bottle, shaken occasionally for twenty-four hours, and then strained through muslin. Each fluidrachm of the fluid extract represents thirty grains of catechu. (*Proc. A. P. A.*, 1863, p. 241.)

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1863, p. 99.) A. E. Ebert subsequently made an investigation of its constituents, and found albumen, gum, starch, phosphoric acid, extractive, two resins, coloring matter, and a body analogous to saponin. The *caulophyllin* of the eclectics is made in the usual way, by pouring a concentrated alcoholic tincture into water and collecting, washing, and drying the resinous precipitate.

Medical Properties. We have no positive evidence of the possession by this drug of any medical properties entitling it to entrance into the Pharmacopœia. It is deemed especially emmenagogue, and is thought also to act like ergot in promoting the contractions of the uterus, for which purpose it is much employed by the "eclectic" practitioners, who consider it also possessed of diaphoretic and various other remedial properties. It is given in decoction, infusion, or tincture, the first two being made in the proportion of an ounce to a pint of water, the last of four ounces to a pint of spirit. The dose of the decoction or infusion is one or two fluidounces, of the tincture one or two fluidrachms.

CERA ALBA. *U. S., Br. White Wax.*

(CĒ'RĄ ĂL'BĄ.)

"Yellow wax bleached." *U. S.* "Bleached by exposure to moisture, air, and light." *Br.*

Cire blanche, *Fr.;* Weisses Wachs, *G.;* Cera bianca, *It.* Cera blanca, *Sp.*

CERA FLAVA. *U. S., Br. Yellow Wax.*

(CĒ'RĄ FLĀ'VĄ.)

"A peculiar, concrete substance, prepared by Apis mellifica. Linné. (*Class*, Insecta; *Order*, Hymenoptera.)" *U. S.* "The prepared honeycomb of the Hive Bee, Apis mellifica." *Br.*

Cera Citrina; Beeswax; Cire jaune, *Fr.;* Gelbes Wachs, *G.;* Cera gialla, *It.;* Cera amarilla, *Sp.*

Wax is a product of the common bee, *Apis mellifica* of naturalists, which constructs with it the cells of the comb in which the honey and larvæ are deposited. It was at one time doubted whether the insect elaborated the wax by its own organs, or merely gathered it from vegetables. The question was set at rest by Huber, who fed a swarm of bees exclusively on honey and water, and found that they formed a comb consisting of wax. This, therefore, is a proper secretion of the insect. It is produced in the form of scales under the rings of the belly. But wax also exists in plants, bearing in this, as in other respects, a close analogy to the fixed oils. It is, however, the product of the bee only that is recognized by the Pharmacopœias.* This is directed in two forms: 1, that of *yellow wax* procured immediately from the comb;

* *China wax*, called *pe-la* by the Chinese, resembles spermaceti in whiteness and crystalline appearance, but is distinguished by greater hardness and friability, and a somewhat fibrous fracture. It melts at about 83° C. (181° F.), is very slightly soluble in alcohol or ether, is insoluble in cold oil of turpentine and rectified petroleum, but is dissolved by these fluids with the aid of heat. These solubilities distinguish it from spermaceti. (*P. J. Tr.*, xiv. 9.) It was formerly supposed to be of vegetable origin; but has been ascertained to be the product of an insect belonging to the genus Coccus, which fixes itself to the branches of a certain tree, and, investing them closely, becomes imbedded in a waxy material, which is scraped off with the insects, and constitutes the crude wax. It is purified by melting and straining. (Hanbury, *P. J. Tr.*, xii. 476.) The tree from which the wax is obtained has been ascertained to be the *Fraxinus Chinensis* of Roxburgh. (*Ibid.*, Sept. 1, 1859, p. 176.)

Mr. T. T. Cooper, in his "Travels of a Pioneer" in China, gives some interesting statements as to the production of this wax, which are the result of his own personal observations. It is chiefly the province of S'zchuan which is the seat of this industry: the cultivation of the China wax being a source of great wealth to this province, second only in importance to the silk culture. The "wax trees" are all cut down at the height of 8 feet, leaving no branches, the trunks being about as thick as a man's thigh, and sending forth shoots in the spring. The insects are cultivated in a different province, that of Yunnan, whence vast quantities of the eggs are sent annually to S'zchuan, where they are received in little balls of the size of a pea. These are suspended, enclosed in young leaves, to the shoots of the tree in March. In about two months the larvæ appear, and feeding on the leaves soon attain the size of small butterflies, which spread themselves in immense numbers over the branches, which are whitened by them, so as to seem covered with feathery snow. The grub, as it advances to the chrysalis form, buries itself in a white secretion by which all the branches are coated an inch in thickness. These are then cut off near the stem and divided into small pieces, which are tied in bundles, and put into large caldrons, where they are boiled in water till all the wax melts and rises to the surface. It is then skimmed off and run into moulds where it hardens. In the form thus produced, it is spread over the Empire, where it is used for candles and as medicine. (*P. J. Tr.*, 1872, p. 569.)

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and, 2, that of *white wax* prepared by bleaching the former. We shall consider these separately, and afterwards give an account of *vegetable wax*.

1. CERA FLAVA, or *Yellow Wax*. This is obtained by slicing the comb taken from the hive, draining and afterwards expressing the honey, and melting the residue in boiling water, which is kept hot for some time in order to allow the impurities to separate, and either subside or be dissolved by the water. When the liquid cools the wax concretes, and, having been removed and again melted in boiling water, is strained and poured into pans or other suitable vessels. It is usually brought to market in round flat cakes of considerable thickness. The druggists of Philadelphia are supplied chiefly from the Western States and North Carolina, especially the latter, and from Cuba. Some of inferior quality is imported from Africa.

Properties. Yellow wax is "a yellowish or brownish yellow solid, having an agreeable, honey-like odor, and a faint, balsamic taste. It is brittle when cold, but becomes plastic by the heat of the hand. It melts at 63°–64° C. (145·4°–147·2° F.), and congeals with a smooth and level surface. Sp. gr. 0·955 to 0·967. It is insoluble in water, but soluble in 35 parts of ether and in 11 parts of chloroform; also soluble in oil of turpentine, and in fixed or volatile oils. Cold alcohol dissolves it only partially, but it is almost completely soluble in boiling alcohol. If 1 Gm. of Wax be boiled, for half an hour, with 40 Gm. of solution of soda (sp. gr. 1·180), the volume being preserved by the occasional addition of water, the Wax should separate, on cooling, without rendering the liquid opaque, and no precipitate should be produced in the filtered liquid by hydrochloric acid (abs. of fats or fatty acids, Japan wax, resin), nor should the same reagent produce a precipitate in water which has been boiled with a portion of the Wax (abs. of soap). If 5 Gm. of Wax be heated in a flask, for fifteen minutes, with 25 Gm. of sulphuric acid to 160° C. (320° F.), and the mixture diluted with water, no solid, wax-like body should separate (abs. of paraffin)." *U. S.*

Various adulterations have been practised, most of which may be readily detected. Meal, earth, and other insoluble substances are at the same time discovered and separated by melting and straining the wax. When the fracture is smooth and shining instead of being granular, the presence of resin may be suspected. This is dissolved by cold alcohol, while the wax is left untouched. Yellow wax is frequently adulterated with a mixture of paraffin and rosin; such wax is usually translucent on the edges. Dr. A. W. Miller has observed that when a large quantity of paraffin is present the upper surface of the cake is concave, whilst pure yellow wax presents either a plane or slightly convex surface. For other adulterating substances used, and the modes of detecting them, see the remarks which follow on white wax.

Yellow wax is used chiefly as an ingredient of plasters and cerates.

2. CERA ALBA, *Bleached Yellow Wax*, or *White Wax*. The color of yellow wax is discharged by exposing it, with an extended surface, to the combined influence of air, light, and moisture. The process of bleaching is carried on to a considerable extent in this country. The wax, previously melted, is made to fall in streams upon a revolving cylinder, kept constantly wet, upon which it concretes, forming thin riband-like layers. These, having been removed, are spread upon linen cloths stretched on frames, and exposed to the air and light, care being taken to water and occasionally turn them. In a few days they are partially bleached; but, to deprive the wax completely of color, it is necessary to repeat the whole process once, if not oftener. When sufficiently white, it is melted and cast into small circular cakes. The color may also be discharged by chlorine; but the wax is said to be somewhat altered.* White wax sometimes contains one or more free fatty acids,

* The following process for purifying wax by steam has been patented by M. Cassgrand, in France, and is said to have been employed advantageously. Wax melted by steam is passed along with the steam through a coiled tube or worm, is received into a double bottom heated by steam, where it is washed with water, and is then raised by a pump into another pan, also heated by steam, where it is again washed with water; and the whole operation is repeated three or four times; the wax being allowed to rest for about four or five minutes in the upper pan after each operation, and, after the last one, an hour or two for the subsidence of impurities. The wax is then granulated by means of cold water, allowed to dry for two or three days, and then exposed to light and air. The whole process is completed in a few days. (See *A. J. P.*, xxvi. 525.)

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consequent probably upon the employment of alkalies in bleaching it, which render it an unfit ingredient in the unctuous preparations of certain salts. Of these acids it may be deprived by means of alcohol.

Perfectly pure wax is white, shining, diaphanous in thin layers, inodorous, insipid, harder and less unctuous to the touch than the yellow, soft and ductile at 35° C. (95° F.), and fusible at 65° C. (149° F.), retaining its fluidity at a lower temperature. According to Saussure, its sp. gr. in the solid state is 0·966. The U. S. Pharmacopœia describes it as "a yellowish white solid, generally in form of circular cakes, about four inches (10 cm.) in diameter, somewhat translucent in thin layers, having a slightly rancid odor and an insipid taste. It melts at about 65° C. (149° F.). Sp. gr. 0·965–0·975. In other respects it has the characteristics and answers to the tests mentioned under Yellow Wax (see *Cera Flava*)." *U. S.* By a great heat it is partly volatilized, partly decomposed; and, when flame is applied to its vapor, it takes fire and burns with a clear bright light. It is insoluble in water, and in cold alcohol or ether, but is slightly soluble in boiling alcohol and ether, which deposit it in a great measure upon cooling. The volatile and fixed oils dissolve it with facility, resin readily unites with it by fusion, and soaps are formed by the action of soda and potassa in solution. It is not affected by the acids at ordinary temperatures, but is converted into a black mass when boiled with concentrated sulphuric acid. Bleached wax contains, according to Lewy's analysis, 80·2 per cent. of carbon, 13·4 of hydrogen, and 6·4 of oxygen. It is a mixture of three different substances, which may be separated from one another by alcohol, viz.: 1, *myricin*, insoluble in boiling alcohol, and consisting chiefly of myricyl palmitate, $C_{16}H_{31}(C_{30}H_{61}O_2)$,—that is, a compound of *palmitic acid*, $C_{16}H_{31}O.OH$, and *myricyl alcohol*, $C_{30}H_{61}OH$; 2, *cerotic acid*, $C_{27}H_{54}O_2$ (formerly called *cerin* when obtained only in an impure state), which is dissolved by boiling alcohol, but crystallizes out on cooling; 3, *cerolein*, which remains dissolved in the cold alcoholic liquid. This latter is probably a mixture of fatty acids, as indicated by its acid reaction. It has not been investigated fully, however.

Wax has been variously adulterated. *White lead* sinks to the bottom of the vessel when the wax is melted. *Starch*, *meal*, and other *insoluble substances* remain behind when the wax is dissolved in oil of turpentine or benzin; and the starch is known by producing a blue color with iodine added to water in which the wax has been boiled. *Water*, which is said to be sometimes fraudulently incorporated with it, by agitation when partially melted, is driven off by heat. *Fatty substances* render lime-water turbid, when agitated with it and allowed to stand. For the detection of stearin and stearic acid, M. Lebel dissolves the suspected wax in two parts of oil, beats the cerate thus formed with its weight of pure water, and then adds a few drops of solution of subacetate of lead. If stearin is present, there is an immediate decomposition, and the mixture acquires an extraordinary solidity from the formation of stearate of lead. (*Journ. de Pharm.*, 3e sér., xv. 302.) Vogel proposes chloroform as a means of detecting the adulteration with fatty matters. That liquid dissolves only 25 per cent. of wax, but stearin and stearic acid completely. If, therefore, wax, treated with 6 or 8 parts of chloroform, loses more than one-quarter of its weight, it may be considered as impure. (*Ibid.*, xvii. 374.) Overbeck detects stearic acid by the abundant effervescence produced from the escape of carbonic acid, when a small portion of the suspected wax is boiled in a solution composed of one part of carbonate of sodium and fifty of distilled water. (*P. J. Tr.*, xi. 128.) Fehling detects *stearic acid* and *resin* by boiling one part of the wax in twenty of alcohol, filtering the solution when cold, and then adding water. If either of these substances be present, there will be a flocculent precipitate, whereas if the wax be pure there will scarcely be an observable turbidness. The natural fats, as *tallow*, *suet*, *lard*, etc., are not amenable to this test; but it may be applied by first saponifying them, and thus converting them into the fatty acids, as the stearic. But, as wax itself is somewhat liable to be affected, it is necessary to avoid too strong an alkaline solution, and too long boiling in the process. To obviate such a result, 30 grains of the wax are to be boiled with two or three fluidounces of water containing 6 grains of pure hydrate of soda, and the mass saturated with a very dilute

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acid, and heated. The wax is then to be separated, dried between folds of blotting-paper, and treated as above for stearic acid. (*Neues Repert. für Pharm.*, viii. 78.) For the detection of rosin cold alcohol is sufficient. It dissolves the rosin, and yields it on evaporation, attended with a very small portion of pure wax, which yields 2·4 per cent. to cold alcohol. (Ed. Davies, *A. J. P.*, 1870, p. 537.) F. Jean states that a few drops of sulphuric acid added to the melted wax, adulterated with rosin, cause a red color, or, if only 1 per cent. be present, a greenish tint. (*A. J. P.*, 1881, p. 307.) To detect *paraffin*, which is another adulteration said to be frequent, Prof. Landolt, of Bonn, heats the wax with fuming sulphuric acid (*Nordhausen*), which destroys the wax, converting it into a black jelly-like mass, while the paraffin is left as a transparent layer on the surface. (See *A. J. P.*, xxxiv. 35.) M. Lies Bodart detects the same impurity by a somewhat complex process, based on the etherification of the wax; the paraffin being left sufficiently pure to enable its proportion to be estimated. For the particulars of the process, the reader is referred to the *Journ. de Pharm. et de Chim.* (4e sér., iii. 287, 1866). A simpler method is that of M. Dullo, who treats the adulterated wax with ether. If this dissolves more than 50 per cent., the presence of paraffin is indicated. M. Payen resorts to the point of fusion as a means of detecting paraffin. This substance melts at a lower temperature than wax, and lowers the melting point of wax with which it is mixed. (*Ibid.*, 4e sér., ii. 233.) White wax should not melt below 65·5° C. (150° F.); yellow not below 60° C. (140° F.). (*Br.*) *Japan wax* is said also to be largely employed for adulterating beeswax; so that sometimes but little of the product of the bee is to be found in the mixture. To detect Japan wax, M. Dullo boils together for a minute 10 Gm. (150 grains) of wax, 120 Gm. of water, and 1 of soda. If there be Japan wax present, a soap will immediately form, which will slowly solidify on cooling. Beeswax does not saponify under these circumstances. (*Ibid.*, 4e sér., i. 448.) Ceresin, a principle obtained from ozokerit (see Part II.), is also employed as an adulterant, and is manufactured largely for that purpose in Vienna. It is only native paraffin, and of course answers to the tests for that substance. There are other less precise methods of detecting adulterations. Thus, spermaceti and lard render wax softer and less cohesive, of a smoother and less granular fracture, and of a different odor when heated. The melting point and specific gravity are lowered by tallow, suet, and lard. Legrip's cereometer is based upon the altered specific gravity of wax when adulterated. Any one may apply this principle by making such a mixture of alcohol and water that pure wax will neither sink nor rise in it, but remain wherever placed. Adulterated wax would either swim or sink in this liquid. Pereira says that pure wax is yellowish white; and that the white wax in circular cakes always contains spermaceti, added to improve its color.

Medical Properties and Uses. Wax has little effect upon the system. Under the impression that it sheathes the inflamed mucous membrane of the bowels, it has been occasionally prescribed in diarrhœa and dysentery; and it is mentioned by Dioscorides as a remedy in the latter complaint. By Pœrner it is highly recommended in excoriations of the bowels, attended with pain and obstinate diarrhœa. His mode of using it is to melt the wax with oil of almonds or olive oil, and, while the mixture is still hot, to incorporate it by means of the yolk of an egg with some mucilaginous fluid. The dose is half a drachm three or four times a day. Another method is to form an emulsion by means of soap; but it is evident that the soap would be the most energetic ingredient. Wax is also used to fill cavities in carious teeth. Its chief employment, however, is in the formation of ointments, cerates, plasters, and suppositories. It is an ingredient in almost all the officinal cerates, which owe to it their general title.

3. Vegetable Wax. Many vegetable products contain wax. It exists in the pollen of numerous plants, and forms the bloom or glaucous powder which covers certain fruits, and the coating of varnish with which leaves are sometimes supplied. In some plants it is so abundant as to be profitably extracted for use. Such is the *Ceroxylon Andicola*, a lofty palm growing in the South American Andes. Upon the trunk of this tree, in the rings left by the fall of the leaves, is a coating of wax-like

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matter, about one-sixth of an inch thick, which is removed by the natives, and employed in the manufacture of tapers. It contains, according to Vauquelin, two-thirds of a resinous substance, and one-third of pure wax. Two kinds of wax are collected in Brazil, one called *carnauba*,* from the leaves of the *Copernicus cerifera*, a palm, which forms large forests in the province of Ceara, the other *ocuba*, from the fruit of a shrub of the province of Para. (*Journ. de Pharm.*, 3e sér., v. 154.)† A form of vegetable wax sometimes seen in this country is that derived from *Myrica cerifera*, and commonly called *myrtle wax*. The *wax myrtle* is an aromatic shrub, from one to twelve feet high, growing in the United States, from New England to Louisiana, and flourishing especially on the sea-coast. The fruit, which grows in clusters closely attached to the stems and branches, is small, globular, and covered with a whitish coat of wax, which may be separated for use. Other parts of the plant are said to possess medical virtues. The bark of the root is acrid and astringent, and in large doses emetic, and has been popularly employed in jaundice. The process for collecting the wax is simple. The berries are boiled in water, and the wax, melting and floating on the surface, is either skimmed off and strained, or allowed to concrete as the liquor cools, and then removed. To render it pure, it is again melted and strained, and cast into large cakes. It is collected in New Jersey, North Carolina, and New England, and particularly in Rhode Island.

Myrtle wax is of a pale grayish green color, somewhat diaphanous, more brittle and unctuous to the touch than beeswax, of a feeble odor, and a slightly bitterish taste. It is about as heavy as water, and melts, according to Dr. G. E. Moore, at from 46·6° C.–48·8° C. (116° F.–120° F.). It is insoluble in water, scarcely soluble in cold alcohol, soluble, excepting about 13 per cent., in twenty parts of boiling alcohol, which deposits the greater portion on cooling, soluble also in boiling ether, and slightly so in oil of turpentine. It is readily saponifiable with the alkalies. By Dr. John it was found to consist, like beeswax, of cerin and myricin, containing 87 per cent. of the former and 13 of the latter; but a more accurate analysis by Dr. Moore gives as its constituents one part of palmitin and four of palmitic acid, with a little laurin or lauric acid. (*Am. Journ. of Sci. and Arts*, 1852, p. 319.) The green color and bitterness depend upon distinct principles, which may be separated by boiling with ether. On cooling, the wax is deposited colorless, while the ether remains green. The color is ascribed by Dr. Moore to chlorophyll.

* *Carnauba Wax* is collected by cutting out the leaf buds, drying and beating them, and melting the powder thus detached in water. According to Nevil Story Maskelyne, it consists chiefly of melissyl-alcohol, $C_{30}H_{62}O$, which saponifies, another alcohol, $C_{28}H_{48}O$, and small quantities of resin and a substance melting at 150° C. (221° F.). Berard believes it to be composed of free cerotic acid and melissyl ether. It is hard, brittle, and buff-colored, yellow, or greenish, resembling the resins more than wax, and melts at 89° C. (192° F.), which is much higher than the fusing point of other kinds of vegetable wax. "It takes a fine polish when rubbed with any soft material," does not receive impressions from the finger at the natural temperature of the hand, and is adapted for polishing furniture, either alone or mixed with wax. 2,000,000 pounds of it are said to be annually produced in Brazil, where it is largely used, mixed with tallow, in making candles, etc.

† *Japan Wax*. A substance under this name has been imported into Europe in considerable quantities, either directly from Japan, or through the Chinese ports. It is obtained from the berries of the *Rhus Succedaneum* of Linnæus, and in small amount from the *R. Sylvestris* and *R. Vernicifera*, or lacquer plant. The partially dried berries are crushed, winnowed, steamed, placed in hemp cloth bags, steamed again, and pressed in a wooden wedge press. They yield about 15 per cent. of a coarse greenish tallowy mass. It has come in two forms, the one, as originally distinguished by Mr. Hanbury, of circular cakes, about four inches in diameter, and an inch thick, flat on one side and somewhat convex on the other; the second, as brought directly from Japan, of large rectangular blocks, which are packed in chests. It bears a considerable resemblance to purified beeswax, but is not quite so white, having a slightly yellowish tint, is softer, more friable, and has a somewhat rancid smell and taste. Its melting point is below that of wax, varying from 49° C. (120° F.), as stated by Prof. Procter, to 52° C. (125° F.), and even 55° C. (131° F.), as observed in different specimens by Mr. Hanbury. Meyer noticed a sample melting at 42° C. (107° F.). It is much more soluble in alcohol than is beeswax, is saponifiable with the alkalies, and is said to contain palmitic acid. It has been employed in the preparation of candles, which yield as brilliant light as those made of common wax. It has been found useful in the preparation of cerates, etc.

From Roucher's experiments it appears that there are two melting points of this wax, one corresponding closely with Prof. Procter's results, while the same wax rapidly heated to a point above that of fusion and then allowed to cool, if plunged into water at 42° C., melts into a transparent liquid; consequently melting at a point 12° C. below its freezing point in its ordinary state, which was 54° C.; the two temperatures being about equivalent in Fahrenheit's scale to 107° and 129°. (*P. J. Tr.*, Aug. 1872, p. 122.)

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Medical Properties and Uses. This variety of wax has been popularly employed in the United States as a remedy for dysentery; and we are told by Dr. Fahnestock that he found great advantage from its use in numerous cases during an epidemic prevalence of that complaint. He gave the powdered wax in doses of a teaspoonful (3·75 C.c.) frequently repeated, mixed with mucilage or syrup. (*Am. Journ. of Med. Sci.*, ii. 313.) It is occasionally substituted by apothecaries for beeswax in the formation of plasters, and is used in the preparation of tapers and candles. It is somewhat fragrant when burning, but emits a less brilliant light than common lamp oil.

Off. Prep. of White Wax. Ceratum, *U. S.*

Off. Prep. of Yellow Wax. Ceratum Resinæ; Unguentum, *U. S.*

CERATA. *Cerates.*

(CĘ-RĀ'TĄ.)

Cérats, Céréotés, *Fr.;* Cerate, Wachssalben, *G.*

These are unctuous substances consisting of oil or lard, mixed with wax, spermaceti, or resin, to which various medicaments are frequently added. Their consistence, which is intermediate between that of ointments and of plasters, is such that they may be spread at ordinary temperatures upon linen or leather, by means of a spatula, and do not melt or run when applied to the skin. In preparing them, care should usually be taken to select the oil or lard perfectly free from rancidity. In reference to the wax, too, there would seem to be a choice, as experience has shown that cerates made with yellow wax keep longer unchanged than those made with white or bleached wax, probably because there is in yellow wax some principle which corrects the tendency of fatty matters to become rancid. (F. Bringhurst, *A. J. P.*, 1869, p. 59.) The liquefaction should be effected by a very gentle heat, which may be applied by means of a water-bath; and during the refrigeration the mixture should be well stirred, and the portions which solidify on the sides of the vessel should be made to mix again with the liquid portion, until the whole assumes the proper consistence, or, as some prefer, the melted cerate is allowed to cool quickly without stirring. When a large quantity is prepared, the mortar or other vessel into which the mixture may be poured for cooling, should be previously heated by means of boiling water. It has been proposed to substitute paraffin for wax in the preparation of the cerates, but the great tendency to produce granulations in the finished cerate has largely prevented its use. It is, we think, unfortunate that this class of preparations has been abandoned in the British Pharmacopœia; the several cerates having been rejected, or transferred to the class of Ointments. Independently of the connection between the name and one of the characteristic constituents of the cerates, there is a ground of difference between them and the ointments in their consistence; that of the cerates being such as to render them especially suitable for spreading on linen, while that of ointments is peculiarly adapted to inunction.*

CERATUM. *U. S. Cerate.*

(CĘ-RĀ'TŬM.)

Ceratum Adipis, *U. S.* 1860; Ceratum Simplex, *U. S.* 1850; Cérat simple, *Fr.;* Einfaches Cerat, Wachssalbe, *G.*

"White Wax, *thirty parts* [or three ounces av.]; Lard, *seventy parts* [or seven ounces av.], To make *one hundred parts* [or ten ounces av.]. Melt them together, and stir the mixture constantly until cool." *U. S.*

Cerate, or, as it is usually called, *simple cerate*, has been changed very slightly in the last revision; the proportion of wax has been slightly decreased; formerly it was 33·3 per cent., it is now 30 per cent. This change will be regarded by many as an improvement. In the preparation of this cerate, peculiar care should be taken

* Dr. W. H. Mielcke (*Pharm. Centralb.*, 1881, Nos. 20, 21) proposes a new class of preparations, to which he has given the name "*Steatins*," "*Steatinum*." These are about the consistence of cerates, of varied composition, and contain usually a considerable portion of tallow. The *Steatinum Iodoformi* offers a fair specimen of the class. "Take of mutton tallow 18 parts, expressed oil of nutmeg 2 parts, iodoform, in fine powder, 1 part. Melt the tallow and add the other ingredients." For other formulas, see *A. J. P.*, 1881, p. 404.

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that the oleaginous ingredient be entirely free from rancidity, and that the heat employed be not sufficient to produce the slightest decomposition; for the value of the preparation depends on its perfect blandness. To avoid change, it should be put up in small jars, and covered closely with tin foil so as to exclude the air. It is used for dressing blisters, wounds, etc., in all cases in which the object is to prevent the contact of air and preserve the moisture of the part, and at the same time to avoid all irritation. It is sometimes improperly employed as the vehicle of substances to be applied by inunction. For this purpose lard should be used in winter, and simple ointment in summer; the cerate having too firm a consistence.

The simple ointment, Unguentum Simplex, of the British Pharmacopœia is very nearly equivalent to this preparation, but contains some olive oil. It will be described among the ointments.

CERATUM CAMPHORÆ. *U. S.* *Camphor Cerate.*

(CĔ-RĀ'TŬM CĂM'PHŌ-RÆ.)

"Camphor Liniment, *three parts* [or fifteen minims]; Olive Oil, *twelve parts* [or one fluidrachm]; Cerate, *eighty-five parts* [or four hundred grains], To make *one hundred parts* [or about one ounce]. Mix the Camphor Liniment and the Olive Oil, and incorporate with the Cerate." *U. S.*

This is a new officinal preparation; it was introduced primarily for use in making cerate of subacetate of lead by the extemporaneous process. It will no doubt be found useful for its own sake as a slightly stimulating dressing.

CERATUM CANTHARIDIS. *U. S.* *Cantharides Cerate. Blistering Cerate.*

(CĔ-RĀ'TŬM CĂN-THĂR'Ĭ-DĬS.)

Emplastrum Cantharidis, *Br.:* Cantharides Plaster; Emplastrum Cantharidum (Vesicatorium) Ordinarium, *P.G.;* Emplastrum Epispasticum, s. Vesicatorium, s. Vesicans; Emplâtre de Cantharides, Emplâtre vésicatoire, *Fr.;* Spanischfliegen Pflaster, Blasenpflaster, *G.*

"Cantharides, in No. 60 powder, *thirty-five parts* [or seven ounces av.]; Yellow Wax, *twenty parts* [or four ounces av.]; Resin, *twenty parts* [or four ounces av.]; Lard, *twenty-five parts* [or five ounces av.], To make *one hundred parts* [or twenty ounces av.]. To the Wax, Resin, and Lard, previously melted together and strained through muslin, add the Cantharides, and, by means of a water-bath, keep the mixture in a liquid state, for half an hour, stirring occasionally. Then remove it from the water-bath, and stir constantly until cool." *U. S.*

The British Pharmacopœia directs of Cantharides, in powder, *twelve ounces* [avoirdupois]; Yellow Wax, and Prepared Suet, each, *seven ounces and a half;* Prepared Lard *six ounces;* and Resin *three ounces;* melts the Wax, Suet, and Lard together, by a water-bath, and adds the Resin previously melted; then introduces the Cantharides, mixes the whole thoroughly, and continues to stir the mixture while cooling.

This is the common well-known *blistering plaster.* As it can be readily spread without the aid of heat, it is properly a cerate, and is, therefore, correctly named in the U. S. Pharmacopœia. The process now officinal differs but slightly from that of the U. S. P. 1870. The quantity of lard is about 4 per cent. less, thus making the cerate a trifle stronger. It is essentially the same as prepared by the two processes; though the U. S. formula has a decided advantage over the British, in keeping the mixture of the flies and the other ingredients for some time at an elevated temperature, while in the latter they are allowed to cool after being mixed with the fatty matters. Care was formerly considered requisite, in making the cerate, not to injure the flies by heat. It was, therefore, recommended that they should not be added to the other ingredients until immediately before these begin to stiffen, after having been removed from the fire; and, though this direction has been omitted, no provision is made for the continued application of heat. From the experiments of Mr. Donovan (*Dublin Med. Press,* Aug. 1840), and those of Professor Procter (*A. J. P.,* xiii. 302, and xxiv. 296), it may be inferred that the vesicating principle of Spanish flies is not injured or dissipated by a heat under 148·8° C.

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(300° F.), and that an elevated temperature, instead of being hurtful, is positively advantageous in the preparation of the cerate. The cantharidin is thus more thoroughly dissolved by the oleaginous matter, and consequently brought more efficiently into contact with the skin, than when retained in the interior of the tissue of the fly. Another advantage, stated by Donovan, is that the moisture, usually existing to a certain extent in all the ingredients of the cerate, is thus dissipated, and the preparation is less apt to become mouldy, or otherwise to undergo decomposition. Instead, therefore, of waiting until the melted wax, resin, and lard begin to stiffen, it is better to add the powder before the vessel is removed from the fire. Mr. Donovan recommends that, as soon as the other ingredients are melted, the powdered flies should be added, and the mixture stirred until the heat is shown by a thermometer to have risen to 121·1° C. (250° F.), when the vessel is to be removed from the fire, and the mixture stirred constantly until cool. At the heat mentioned, ebullition takes place in consequence of the escape of the moisture contained in the materials. In the cerate thus prepared, the active matter has been dissolved by the lard, and the powder may be separated, if deemed advisable, by straining the mixture before it solidifies. Care should be taken that the temperature be not so high as to decompose the ingredients; and it would be better to keep it within 100° C. (212° F.), by means of a water-bath, as in the U. S. process, than to incur any risk from its excess. Violent irritation and even vesication of the face of the operator are stated to have resulted from exposure to the vapors of the liquid, at a temperature of 121·1° C. (250° F.). (*P. J. Tr.*, ii. 391.) From an experiment, however, of Professor Procter, it appears that, though cantharidin begins to volatilize slightly at 121·1° C. (250° F.), and rapidly rises in vapor and sublimes at from 205·5° C. to 211·1° C. (402° F. to 412° F.), yet it is not decomposed unless by increasing the heat considerably above the last-mentioned point. (*A. J. P.*, xxiv. 296 and 298.) It is desirable that the flies should be very finely pulverized. Coarsely-powdered cantharides should not be used, because of the imperfect and unequal distribution of the vesicating agent. Powdered euphorbium is said to be sometimes fraudulently added.

The cerate will always raise a blister in ordinary conditions of the system, if the flies are good, and not injured in the preparation. It should be spread on soft leather, though linen or even paper will answer the purpose when that is not to be had. An elegant mode of preparing it for use is to spread a piece of leather, of a proper size, first with adhesive plaster, and afterwards with the cerate, leaving a margin of the former uncovered, in order that it may adhere to the skin. Heat is not requisite, and should not be employed in spreading the cerate. Some sprinkle powdered flies upon the surface of the plaster, press them lightly with a roller, and then shake off the portion which has not adhered; but, if the flies originally employed were good, this addition is superfluous. The habit of applying over the surface with a brush an ethereal tincture of cantharides, which leaves a thin coating of extract, renders the preparation more certain.

Upon the application of the plaster, the skin should be moistened with warm vinegar or other liquid; and a good rule is to cover the surface of the plaster closely with very thin gauze or unsized paper, which prevents any of the cerate from adhering to the cuticle, and is thought by some to diminish its liability to occasion strangury, but it must at the same time be remembered that the plaster must come in contact with the skin or the cantharidin will not be absorbed, and thus vesication prevented. In adults, when the full action of the flies is desired, and the object is to produce a permanent effect, the application should be continued for twelve hours, and on the scalp for twenty-four hours. In very delicate persons, however, or those subject to strangury, or upon parts of a loose texture, or when the object is merely to produce a blister to be healed as quickly as possible, the plaster should remain no longer than is necessary for the production of full redness of the skin, which generally occurs in five or six hours, or even in a shorter time. It should then be removed, and followed by a bread and milk poultice, or some other emollient dressing, under which the cuticle rises, and a full blister is usually produced. By this management the patient will generally escape strangury, and the blister will very quickly heal after the discharge

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of the serum.* In young children, cantharides sometimes produce alarming and even fatal ulceration, if too long applied. From two to four hours are usually sufficient for any desirable purpose. When the head, or other very hairy part, is to be blistered, an interval of ten or twelve hours should, if possible, be allowed between the shaving of the part and the application of the plaster; so that the abrasions may heal, and some impediment be offered to the absorption of the flies. After the blister has been formed, it should be opened at the most depending parts, and, the cuticle being allowed to remain, should be dressed with simple cerate; but, if it be desirable to maintain the discharge for a short time, resin cerate should be used, and the cuticle removed if it can be done without inconvenience. When it is wished that the blistered surface should heal as soon as possible, and with the least inconvenience to the patient, Dr. Maclagan recommends a dressing of cotton wadding; an emollient poultice being first applied for two hours after the removal of the blistering cerate, the cuticle then cut, and the surface afterwards covered with the cotton, with its raw surface next the skin. Should the dressing become soaked, so much of the cotton may be removed as can be done without disturbing the cuticle, and a new batch applied. The cotton is to be allowed to remain until the old cuticle spontaneously separates. The effects of an issue may be obtained by employing savine ointment, or the ointment of Spanish flies, as a dressing. If much inflammation take place in the blistered surface, it may be relieved by emollient poultices, weak lead-water, or Goulard's cerate. When there is an obstinate indisposition to heal, we have found nothing so effectual as the cerate of subacetate of lead, mixed with an equal weight of simple cerate. When deep and extensive ulceration occurs in consequence of general debility, bark or sulphate of quinine should be used, with nutritious aliment.

Various preparations of cantharides have been proposed and employed as substitutes for the cerate. They consist for the most part of cantharidin, more or less pure, either dissolved in olive oil and applied to the skin by means of a piece of paper saturated with it, or incorporated with wax and spread in a very thin layer upon fine waxed cloth, silk, or paper, constituting the *blistering cloth*, *blistering paper*, *vesicating taffetas*, etc., of the shops. The advantages of these preparations are that they occupy less space, are more portable, and, being very pliable, are more easily adapted to irregularities of the surface. Absolutely pure cantharidin is expensive and not requisite;† as extracts of cantharides, made with ether, alcohol, or boiling water, will answer every purpose. Henry and Guibourt give the following formula. Digest powdered cantharides in ether, distil off the ether, evaporate the residue by means of a salt-water bath, until ebullition ceases, melt the mass which remains with twice its weight of wax, and spread the mixture upon waxed cloth. The *waxed cloth* may be prepared by spreading upon linen or muslin a mixture composed of 8 parts of white wax, 4 of olive oil, and 1 of turpentine, melted together. An extract of cantharides of a buttery consistence, said to act very efficiently when applied by means of paper greased with it, is prepared by digesting 4 parts of flies with one part of strong acetic acid, and 16 of alcohol, straining, filtering, and evaporating at a moderate heat. A preparation which received the favorable report of a committee of the Society of Pharmacy, at Paris, is the following, proposed by M. Dubuison. Four parts of a

* The late Dr. M. B. Smith, of Philadelphia, informed us that he had frequently employed uva ursi, as a preventive of strangury from blisters, and had never found it to fail. He gave a small wineglassful of the officinal decoction (see *Decoctum Uvæ Ursi*) every hour, commencing two hours after the application of the blister. Camphor is sometimes incorporated with the blistering cerate to prevent strangury, though with doubtful effect. A plan proposed by M. Vée is to spread over the surface of the plaster, when ready for delivery, by means of the finger, a saturated solution of camphor in ether. The ether evaporates, leaving a thin coating of camphor uniformly diffused. (*Journ. de Pharm.*, 3e sér., viii. 68.) Guyot Dannecy believes camphor to be useless in this connection, and recommends dusting the blister with bicarbonate of sodium and powdered cantharides in equal parts. The late Dr. Joseph Hartshorne, of Philadelphia, was in the habit, in cases where he apprehended strangury, of directing four grains of opium and twenty of camphor to be mixed with the cerate of a blister of large size, and experienced the happiest effects from the addition.

† Dragendorff (*A. J. P.* 1872, p. 273) recommends *cantharidate of sodium*. M. E. Delpech (*A. J. P.*, xlii. 240) proposes the use of *cantharidate of potassium* in substance or solution. He prepares it by dissolving two parts of cantharides in 150 parts of alcohol, and adding 1·6 parts of caustic potash dissolved in a very little water. The whole becomes a crystalline mass from which the alcohol may be separated by pressure. See also R. Rother, *Chicago Pharmacist*, Nov. 1872.

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hydro-alcoholic extract of the flies, made by maceration, are mixed with an aqueous solution of one part of pure gelatin, so as to obtain a solution of suitable consistence, which is then applied upon a piece of extended waxed cloth, care being taken that the brush should always have the same direction. When the first layer has dried, a second and a third are to be applied in the same manner. The gelatin renders the cloth more adhesive and less deliquescent. The hydro-alcoholic extract is preferred to the alcoholic, because it contains less of the green oil, which does not readily mix with the other ingredients. The committee, however, preferred the aqueous extract, as cheaper and more active. This taffeta has been tried, and found to raise blisters in four hours. (*Journ. de Pharm.*, 3e sér., viii. 67.) For very speedy vesication, an infusion of the flies in strong acetic acid is sometimes employed. None of these preparations are likely to supersede the cerate, but the demand for them has been met by introducing into the Pharmacopœia the Charta Cantharidis and the Collodium cum Cantharide.

Off. Prep. Emplastrum Picis cum Cantharide, *U. S.*

CERATUM CETACEI. *U. S.* *Spermaceti Cerate.*

(CḘ-RĀ'TŬM CḘ-TĀ'CḘ-Ī.)

Emplastrum Spermatis Ceti, Ceratum Labiale Album; Cérat de Blanc de Baleine, Onguent blanc. *Fr.;* Wallrath-Cerat, *G.*

"Spermaceti, *ten parts* [or one ounce av.]; White Wax, *thirty-five parts* [or three and a half ounces av.]; Olive Oil, *fifty-five parts* [or five and a half ounces av.], To make *one hundred parts* [or ten ounces av.]. Melt together the Spermaceti and Wax; then add the Olive Oil, previously heated, and stir the mixture constantly until cool." *U. S.*

The direction to heat the oil before adding it to the other ingredients is important. If added cold, it is apt to produce an irregular congelation of the wax and spermaceti, and thus to render the preparation lumpy. The cerate is employed as a dressing for blisters, excoriated surfaces, and wounds, and as the basis of more active preparations. When the ingredients are pure and sweet, it is perfectly free from irritating properties. The present formula contains a little less spermaceti than that of U. S. P. 1870. From experiments made by Mr. J. B. Barnes, it appears that this cerate keeps much better when made of unbleached materials, than when prepared with olive oil and wax previously bleached. (*P. J. Tr.*, 1861, p. 352.)

CERATUM EXTRACTI CANTHARIDIS. *U. S.* *Cerate of Extract of Cantharides.*

(CḘ-RĀ'TŬM ḖX-TRĂC'TĪ CĄN-THĂR'Į-DĪS.)

Cérat d'Extrait de Cantharides, *Fr.;* Cantharidenextract-Cerat, *G.*

"Cantharides, in No. 60 powder, *thirty parts* [or six ounces av.]; Resin, *fifteen parts* [or three ounces av.]; Yellow Wax, *thirty-five parts* [or seven ounces av.]; Lard, *thirty-five parts* [or seven ounces av.]; Alcohol, *a sufficient quantity.* Moisten the Cantharides with *eighteen parts* [or four fluidounces] of Alcohol, and pack firmly in a cylindrical percolator; then gradually pour on Alcohol, until *one hundred and eighty parts* [or two and a half pints] of percolate are obtained, or until the Cantharides are exhausted. Distil off the Alcohol by means of a water-bath, transfer the residue to a tared capsule and evaporate it, on a water-bath, until it weighs *fifteen parts* [or three ounces av.]. Add to this the Resin, Wax, and Lard, previously melted together, and keep the whole at a temperature of 100° C. (212° F.) for fifteen minutes. Lastly, strain the mixture through muslin, and stir it constantly until cool." *U. S.*

This preparation of the Pharmacopœia of 1860, adopted from a formula of Mr. Wm. R. Warner, published in the *A. J. P.*, 1860, p. 11, was intended as a substitute for the old Ceratum Cantharidis, from which it differs mainly in containing an alcoholic extract of the flies instead of the flies themselves. If the percolation be well conducted, so as to exhaust the cantharides, of which the active matter is soluble in alcohol, this cerate ought theoretically to be more effective than the old blistering cerate; as the active principles are separated from the inert matter of the

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flies which envelops them in the natural state, and must in some measure interfere with their action; and it is said that its superior efficacy has been practically ascertained. It is to be used in the same manner as the cerate of cantharides.

CERATUM PLUMBI SUBACETATIS. *U. S.* *Cerate of Subacetate of Lead.* [*Goulard's Cerate.*]

(CĘ-RĀ'TŬM PLŬM'BĪ SŬB-ĂÇ-Ę-TĀ'TĪS.)

Unguentum Plumbi Subacetatis Compositum, *Br.;* Compound Ointment of Subacetate of Lead; Unguentum Plumbi, *P.G.;* Ceratum cum Subacetate Plumbico; Cérat de Saturne, Saturné de Goulard, *Fr.;* Bleisalbe, Bleicerat, *G.*

"Solution of Subacetate of Lead, *twenty parts* [or one ounce av.]; Camphor Cerate, *eighty parts* [or four ounces av.], To make *one hundred parts* [or five ounces av.]. Mix them thoroughly. This Cerate should be freshly prepared, when wanted for use." *U. S.*

The British Pharmacopœia takes *six fluidounces* of the Solution of Subacetate of Lead, *eight ounces* [avoirdupois] of White Wax, *a pint* [Imperial measure] of Oil of Almonds, and *sixty grains* of Camphor. The wax and four-fifths of the oil are melted by means of a water-bath, and the solution of subacetate of lead added gradually, stirring as the mixture cools; the camphor dissolved in the remaining fifth of the oil is then added, and the whole mixed thoroughly.

The process now officinal differs from that of U. S. P. 1870, experience having shown the futility of all expedients to prevent rancidity. The camphor cerate keeps well with care, but it can be readily made extemporaneously, and thus dispensed in a fresh, non-irritating condition. This plan was proposed by Prof. Remington, and adopted by the Pharmacopœia committee of the Philadelphia College of Pharmacy.

This cerate received the name by which it is commonly known from M. Goulard, by whom it was employed and recommended. It immediately begins to assume a yellowish color, and after a short time becomes so rancid as to be scarcely fit for use. Hence it should be prepared in small quantities at once. The addition of a few drops of acetic acid prevents the yellow color from remaining permanent. The late Mr. Jacob Bell found it more satisfactory when made with yellow wax. (*P. J. Tr.*, 1859, p. 459.) Eggenfels, a German pharmaceutist, recommends the following method of proceeding to prevent its change of color. The wax and oil are melted in a water-bath; the solution of subacetate of lead, previously heated, is added in small portions successively, and the mixture well stirred, and digested for some time; a partial saponification takes place, and an emulsion afterwards; and the cerate retains its white color. (See *A. J. P.*, 1861, p. 408.) It is used chiefly in excoriations, burns, scalds, and chilblains, and in cutaneous eruptions. Wherever there is an acute active inflammation of the skin it is a most efficient remedy.

CERATUM RESINÆ. *U. S.* *Resin Cerate.* [*Basilicon Ointment.*]

(CĘ-RĀ'TŬM RĘ-ZĪ'NÆ.)

Unguentum Resinæ, *Br.;* Ointment of Resin, Unguentum Basilicum; Cérat de Résine anglais, *Fr.;* Harzcerat, *G.*

"Resin, *thirty-five parts* [or seven ounces av.]; Yellow Wax, *fifteen parts* [or three ounces av.]; Lard, *fifty parts* [or ten ounces av.], To make *one hundred parts* [or twenty ounces av.]. Melt them together at a moderate heat, strain the mixture through muslin, and allow it to cool without stirring." *U. S.*

"Take of Resin, in coarse powder, *eight ounces;* Yellow Wax *four ounces;* Simple Ointment *sixteen ounces.* Melt with a gentle heat, strain the mixture while hot through flannel, and stir constantly while it cools." *Br.*

This preparation does not differ greatly from that formerly officinal; it contains now about 1 per cent. less wax, and 6 per cent. less lard. An improvement has been made in the manipulation, however, in directing the ointment not to be stirred, a better consistence being secured by this change. The straining is directed in consequence of the impurities which resin often contains. Resin cerate, commonly called *basilicon ointment*, is much used as a gently stimulant application to blistered sur-

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faces, indolent ulcers, burns, scalds, and chilblains. We have found no application more effectual in disposing the ulcers which follow burns, to heal.*

Off. Prep. Ceratum Sabinæ, *U. S.;* Linimentum Terebinthinæ, *U. S., Br.*

CERATUM SABINÆ. *U. S.* *Savine Cerate.*

(CḘ-RĀ'TŬM SĄ-BĪ'NÆ.)

Unguentum Sabinæ, *Br.;* Ointment of Savine, Unguentum Sabinæ, *P.G.;* Cérat de Sabine, *Fr.;* Sadebaum Salbe, *G.*

"Fluid Extract of Savine, *twenty-five parts* [or five ounces av.]; Resin Cerate, *ninety parts* [or eighteen ounces av.]. Melt the Resin Cerate by means of a water-bath, add the Fluid Extract of Savine, and continue the heat until the alcohol has evaporated; then remove the heat, and stir constantly until cool." *U. S.*

"Take of Fresh Savine Tops, bruised, *eight ounces;* White Wax *three ounces;* Prepared Lard *sixteen ounces.* Melt the Lard and Wax together on a water-bath, add the Savine, and digest for twenty minutes. Then remove the mixture, and express through calico." *Br.* The U.S. preparation is identical with that formerly officinal.

As the savine used in this country is generally brought from Europe in the dried state, we are compelled to resort to a mode of preparing the cerate different from that usually employed in Europe. In the Pharmacopœia of 1850, the dried savine was simply mixed, in powder, with resin cerate previously softened; and the proportion used was one part of the powder to six parts of the cerate. Nor did we find the preparation thus made to be "intolerably acrid and almost caustic," as Dr. Duncan described it. On the contrary, it answered very well the purpose for which it was used, that of maintaining the discharge from blistered surfaces. The process, however, of the present edition of the Pharmacopœia is certainly more elegant than the former, and probably, if the fluid extract has been carefully made, yields a more effective product. A cerate, prepared in the same manner as the former cerate, from the leaves of the red cedar (*Juniperus Virginiana*), is sometimes substituted for that of savine, but is less efficient. Prepared according to the process of the British Pharmacopœia, savine cerate has a fine deep green color, and the odor of the leaves. It should be kept in closely-covered vessels.

Savine cerate is preferable to the ointment of Spanish flies as a dressing for perpetual blisters, from the circumstance that it has no tendency to produce strangury. The white coating which forms, during its use, upon the blistered surface should be occasionally removed, as it prevents the contact of the cerate. It is sometimes applied to seton cords, to increase the discharge.

CEREVISIÆ FERMENTUM. *Br.* *Beer Yeast.*

(CḔR-Ę-VĪS'Ī-Æ FĘR-MĔN'TŬM.)

"The ferment obtained in brewing beer." *Br.*

Fermentum, *U. S.* 1870; Levûre de Bière, Levûre, *Fr.;* Bierhefen, Oberhefe, *G.;* Fermento di Cervogia, *It.;* Espuma de Cerveza, *Sp.*

This is the substance which rises, in the form of froth, to the surface of beer, and subsides, during the process of fermentation. A similar substance is produced during the fermentation of other saccharine liquids.

It is flocculent, frothy, somewhat viscid, semifluid, of a dirty yellowish color, a sour vinous odor, and a bitter taste. At the temperature of 60° or 70° F., in a close vessel or damp atmosphere, it soon undergoes putrefaction. Exposed to a moderate heat it loses its liquid portion, becomes dry, hard, and brittle, and may in this state be preserved for a long time, though with the loss of much of its peculiar power.

* *Ceratum Resinæ Compositum, U. S.* 1870. *Compound Resin Cerate.* Deshler's Salve; Cérat de résine composé, *Fr.* "Take of Resin, Suet, Yellow Wax, each, *twelve troyounces;* Turpentine *six troyounces;* Flaxseed Oil *seven troyounces.* Melt them together, strain the mixture through muslin, and stir it constantly until cool." *U. S.* 1870. This is somewhat more stimulating than the Ceratum Resinæ, but is applicable to similar purposes, particularly to the treatment of indolent ulcers. Under the name of *Deshler's salve,* it is popularly employed in some parts of the United States. It should be kept well protected from the air, in consequence of its liability when exposed to acquire a tough consistence. It was officinal in 1870, but was dropped at the last revision.

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Yeast cakes are made by putting yeast into sacks, washing it with water, then submitting it to pressure, and ultimately drying it.

Yeast is insoluble in alcohol or water. Its ultimate composition, according to Schlossberger (*Ann. Chem. und Pharm.*, 51, p. 199), is carbon 49·9 per cent., hydrogen 6·6 per cent., nitrogen 12·1 per cent., and oxygen 31·4 per cent. Its proximate constituents are albuminoids, cellulose, fats, and resinous substances. Its bitterness is attributable to a principle derived from the hops The property for which it is chiefly valued is that of exciting the vinous fermentation in saccharine liquids, and in various farinaceous substances. This property it owes to its nitrogenous ingredient; for, if separated from this, it loses its powers as a ferment, and reacquires them upon its subsequent addition. It is also rendered ineffective by strong alcohol, by several of the acids, as sulphuric and concentrated acetic acids, by various other substances, and by a heat of 212°. At a high temperature the yeast is decomposed, affording products similar to those which result from the decomposition of animal matters. From experiments by Mr. Horace T. Brown, it would appear that the degree of atmospheric pressure has much influence upon the progress of the alcoholic fermentation, which is considerably retarded by a diminution of that pressure. (*P. J. Tr.*, Jan. 1874, p. 615.)

Besides alcohol and carbonic acid, which are the characteristic products of the vinous fermentation, various other substances are generated in smaller or larger proportions, and, among the rest, an organic alkaloid, which, according to M. Oser, is always produced when solutions of sugar ferment under the influence of yeast, and is always present in fermented liquors, either in the pure state, or that of saline combination. Its formula is $C_{26}H_{30}N_4$. Its hydrochlorate is in hygroscopic tables, which become brown on exposure to the air, and have a bitter taste. (*Journ. de Pharm.*, Oct. 1869, p. 305.)

The opacity of yeast is due to the presence of a microscopic fungus, first discovered in it by Leuwenhoek in 1680. As originally announced by Thénard in 1803, this yeast plant is the cause of the alcoholic fermentation. It consists of numerous cells, irregular, roundish, or cylindrical in shape, separate, joined into rows, or budding one from the other. During fermentation the yeast plant multiplies very rapidly: and when the fermentation is very active the plant rises to the surface, constituting the so-called *top yeast* of the brewer; when the process is restrained by cold the yeast settles and constitutes *bottom yeast*. Top and bottom yeast have a tendency to produce the form of fermentation by which they were developed. It is most probable that the yeast plant is the mycelium, or early vegetative stage, of more than one species of mucor or mould; and some authorities recognize various species of the yeast fungus. The name of *Torula*, or *Torula cerevisiæ*, was first given to the yeast plant, which was subsequently called *Mycoderma vini;* Dr. M. Reess, in his elaborate work (*Botan. Untersuch. Alkoholsgährungspilze*, Leipsic, 1870), makes a distinct genus of it, *Saccharomyces*, including many species.

There have been three theories in regard to fermentation: 1st, that it is a chemical process; 2d, that it is of galvanic origin; 3d, that it is the result of the vital actions of the yeast plant. The chemical theory founded by Trommsdorff and Meissner has been very ably advocated by Liebig, but, chiefly owing to the labors of Pasteur, the vital theory is now almost universally accepted.

Medical Properties. Yeast has been highly commended as a stimulant remedy in *typhoid*, *hectic*, and other similar fevers, but is at present very rarely used. In some of these cases it has been given with great asserted advantage in doses of a pint (472 C.c.) a day. It still continues to be employed to a considerable extent as a remedy against successive eruptions of boils, in doses of an ounce (30 C.c.) three times a day. Locally applied it is probably stimulant, although it may be the products of fermentation rather than the yeast which give the peculiar value to the "yeast poultice."

Pharm. Uses. In preparing Acidum Citricum, *Br.*

Off. Prep. Cataplasma Fermenti, *Br.*

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CERII OXALAS. *U. S., Br. Oxalate of Cerium.*

$Ce_2(C_2O_4)_3 . 9H_2O$; 708. (CĒ′RĮ-Ī ŎX′Ą-LĂS.) $Ce_2O_3, 3C_2O_3 . 9HO$; 354.

"A salt which may be obtained as a precipitate by adding solution of oxalate of ammonia to a soluble salt of cerium." *Br.*

Cerium Oxalicum, Oxalas Ciricus; Oxalate de Cérium, *Fr.;* Oxalsaures Ceroxydul, Cerium Oxalat, *G.*

Cerium is a metal, which was discovered in 1803 by Berzelius and Hisinger, and about the same time by Klaproth, who, however, described it as an earth. By the two former chemists it was recognized as a metal, and named cerium in honor of the goddess Ceres. It was obtained from a Swedish mineral, formerly from its great weight called *heavy stone of Bastnas* (Bastnas Schwerstein), but now named *cerite*, after the metal extracted from it. Besides cerite, it has been found in several other minerals, as *gadolinite*, *orthite*, etc., in the north of Europe, a number of different minerals from Greenland, and *allanite* near Bethlehem, in Pennsylvania. It is not easy to obtain it pure in the metallic state, as its oxides and salts are difficult of reduction. Berzelius describes it as in the form of pulverulent masses, of a deep chocolate-brown, which exhibit, however, under the burnisher a metallic appearance, and a dark gray color. Hildebrand and Norton have since prepared it in large quantity by the electrolysis of its chloride. It is a bad conductor of electricity. Heated in the air it takes fire before the point of ignition, and burns vividly, passing to the state of peroxide. At ordinary temperatures it is oxidized in a moist atmosphere, giving out a strong and disagreeable smell of hydrogen. In water, especially when moderately heated, it rapidly oxidizes with the evolution of hydrogen, and the water does not become alkaline. There are two oxides of cerium hitherto considered as the protoxide and sesquioxide. (According to more recent investigators, cerium forms a sesquioxide and a dioxide only, so that cerous oxalate, which is the officinal salt, is an oxalate of the sesquioxide, a fact recognized in the Pharmacopœia of 1880.) Sulphur and phosphorus combine with it. Of its compounds two only have been introduced into medicine, the nitrate and oxalate, of which the latter was recognized for the first time officinally in the last edition of the British Pharmacopœia, and in the U. S. Pharmacopœia of 1870.

Oxalate of cerium may be obtained from cerite, and Prof. F. F. Mayer, of New York, gives a process for the purpose, of which the following is an outline.

The mineral consists of silicates of cerium, lanthanum, and didymium, with numerous other substances in smaller proportion, the oxide of cerium constituting about 39 per cent. of the whole. The powdered mineral is made into a paste with sulphuric acid, and then heated over a lamp until the mass ceases to swell up, and no longer absorbs sulphuric acid very cautiously added. Upon the cooling of the mass, it is powdered, and exposed in a crucible to the heat of an anthracite fire until it assumes a pale brownish red color. It is now lixiviated first with hot water and then with nitric acid, and the solution treated with sulphuretted hydrogen in order to get rid of various metals by precipitation. To the clear liquid some hydrochloric acid is first added, and then a solution of oxalic acid, the former of which holds in solution the oxalate of calcium produced, the latter throws down oxalates of cerium and other metals. The precipitate, having been washed with warm water, is formed into a paste with a quantity of carbonate of magnesium equal to half that of the mineral employed; and the paste is dried on porous fire brick, finely powdered, and calcined till it becomes of a cinnamon color. It now contains all of the cerium in the form of ceroso-ceric oxide. To separate this the mass is treated with an excess of nitric acid, the solution evaporated to get rid of the excess of acid, then diluted with warm water, and lastly poured into a vessel containing boiling water acidulated with a little more than half of one per cent. of sulphuric acid. A yellow precipitate of basic sulphate of cerium is formed, while a little of the neutral sulphate, and all the lanthanum and didymium, remain dissolved. The precipitate is now dissolved in stronger sulphuric acid, the solution digested with a few crystals of hyposulphite of sodium, in order to reduce the ceroso-ceric oxide of cerium to cerous oxide, and the liquid, having been filtered, is treated with solution of oxalic acid.

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which causes a precipitate of oxalate of cerium. This is washed with warm water, and dried. (*A. J. P.*, 1860, p. 4.)

Oxalate of cerium is "a white, slightly granular powder, permanent in the air, odorless and tasteless, insoluble in water or alcohol, but soluble in hydrochloric acid. On heating the salt to a dull red heat, a yellow or yellowish-red residue of oxide of cerium is left (a brown color would indicate the presence of oxide of didymium). On boiling the salt with solution of potassa, filtering, supersaturating a portion of the cold filtrate with acetic acid, and adding test-solution of chloride of calcium, a white precipitate is obtained, soluble in hydrochloric acid. The other portion of the filtrate should not yield a precipitate on the addition of an excess of test-solution of chloride of ammonium (aluminium), or of test-solution of sulphide of ammonium (zinc). On dissolving the salt in hydrochloric acid, no effervescence should occur (abs. of carbonate), and the solution should not be precipitated or rendered turbid by hydrosulphuric acid (abs. of metallic impurities)." *U. S.* As usually seen in commerce it has a pinkish tinge, due to the presence of a trace of a compound of didymium. The British Pharmacopœia states that "if the salt be boiled with solution of potash and filtered, the filtrate is not affected by solution of chloride of ammonium, but, when supersaturated with acetic acid, it gives with chloride of calcium a white precipitate, soluble in hydrochloric acid." When heated to dull redness it yields a reddish brown powder, which is wholly soluble without effervescence in boiling hydrochloric acid, and the resulting solution gives with solution of sulphate of potassium a white crystalline precipitate. *Br.*

Medical Properties. The oxalate of cerium is supposed to act in a manner very similar to the subnitrate of bismuth. It was originally brought forward by Sir James Y. Simpson as a remedy in the vomiting of pregnancy, and has been extensively used in this affection, and also in gastric disturbances of various diseases, such as phthisis, uterine disorder, hysteria, dyspepsia, pyrosis, etc. To a less extent it has been used in intestinal inflammatory diseases. Prof. Simpson also considered it to be a good nervine tonic, and used it with great asserted advantage in chorea. The dose is a grain (0·065 Gm.), doubled if necessary, and repeated three times a day, or more frequently if a return of the vomiting should seem to require it. It may be given in pill or suspended in water.

Nitrate of cerium has also been employed, though not officinal. The late Dr. Simpson believed it to act as a nervine tonic, and has seen it useful in chronic intestinal eruption, irritable dyspepsia with gastrodynia and pyrosis, and chronic vomiting generally, as well as in that of pregnancy. The dose is the same as that of the oxalate, though it would be prudent to begin with a smaller quantity, as, being a soluble salt, it might be more disposed to irritate in overdoses.

CETACEUM. *U. S., Br.* *Spermaceti.*

(CĒ-TĀ'CĒ-ŬM.)

"A peculiar, concrete, fatty substance, obtained from Physeter macrocephalus. Linné. (*Class*, Mammalia; *Order*, Cetacea.)" *U. S.* "Nearly pure cetine, obtained, mixed with oil, from the head of the Sperm Whale, Physeter macrocephalus; separated from the oil by filtration and pressure, and afterwards purified." *Br.*

Ambre blanc, Blanc de Baleine, Spermaceti, Cétine, *Fr.;* Wallrath, Spermacetis, *G.;* Spermaceti, *It.;* Esperma de Ballena, *Sp.*

The spermaceti whale is from sixty to eighty feet long, with an enormous head, not less in its largest part than thirty feet in circumference, and constituting one-third of the whole length of the body. The upper part of the head is occupied by large cavities, separated by cartilaginous partitions, and containing an oily liquid, which, after the death of the animal, concretes into a white spongy mass consisting of spermaceti mixed with oil. This mass is removed, and the oil allowed to separate by draining. The crude spermaceti, obtained from a whale of the ordinary size, is more than sufficient to fill twelve large barrels. It still contains much oil and other impurities, from which it is freed by expression, washing with hot water, melting, straining, and repeated washing with a weak boiling lye of potash. Common whale oil

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and the oil of other cetaceous animals contain small quantities of spermaceti, which they slowly deposit on standing.*

Spermaceti is in white, pearly, semitransparent masses; of a neutral reaction; of a crystalline foliaceous texture; friable, soft, and somewhat unctuous to the touch; slightly odorous; insipid; of the sp. gr. 0·943; fusible at 44·5° C. (112° F.) (*Bostock*), not under 38° C. (100° F.) (*Br.*); volatilizable at a high temperature without change, *in vacuo*, but partially decomposed if the air is admitted; inflammable; insoluble in water; soluble in small proportion in boiling alcohol, ether, and oil of turpentine, but deposited as the liquids cool; and in the fixed oils; not affected by the mineral acids, except sulphuric, which decomposes and dissolves it; rendered yellowish and rancid by long exposure to hot air, but capable of being again purified by washing with a warm lye of potash. "Sp. gr. about 0·945. It melts near 50° C. (122° F.), and congeals near 45° C. (113° F.). It is soluble in ether, chloroform,† disulphide of carbon, and in boiling alcohol; but slightly soluble in cold benzin." *U. S.* As found in the shops it is not chemically pure, containing a fixed oil, and often a peculiar coloring principle. From these it is separated by boiling in alcohol, which on cooling deposits it in crystalline scales. Thus purified, it does not melt under 49° C. (120° F.), is soluble in 40 parts of boiling alcohol of the sp. gr. 0·821 (*Thenard*), and is harder, more shining, and less unctuous than ordinary spermaceti.

Spermaceti is a mixture of various fats. When recrystallized from alcohol as just described, the purified *cetin* is obtained, while the alcohol on evaporation deposits an oil, the *cetin-elaine* of Berzelius, which saponified yields *cetin-elaic acid*, an acid resembling but distinct from oleic acid. The cetin which crystallizes out of the alcohol is essentially *cetyl palmitate*, $C_{16}H_{31}(C_{16}H_{33}O_2)$,—that is, a compound of *cetyl alcohol* (*ethal of Chevreul*), $C_{16}H_{33}.OH$, and *palmitic acid*, $C_{16}H_{32}O_2$. According to Heintz, however, there are small amounts of other fats with the cetin; fats containing the acids, *stearic*, $C_{18}H_{36}O_2$, *myristic*, $C_{14}H_{28}O_2$, and *lauro-stearic*, $C_{12}H_{24}O_2$, and the alcohol radicles corresponding to these acids.

Medical Properties and Uses. Spermaceti has been given as a demulcent in irritations of the mucous membranes; but it possesses no peculiar virtues, and its internal use has generally been abandoned. It may be reduced to powder by the addition of a little alcohol or almond oil, or administered in emulsion, conveniently made by mixing the spermaceti, first with half its weight of olive oil, then with powdered gum arabic, and lastly with water gradually added. It is an ingredient of many ointments and cerates.

Off. Prep. Ceratum Cetacei, *U. S.;* Charta Cantharidis, *U. S.;* Charta Epispastica, *Br.;* Unguentum Aquæ Rosæ, *U. S.;* Unguentum Cetacei, *Br.*

CETRARIA. *U. S., Br.* *Cetraria.* [*Iceland Moss.*]

(CĒ-TRĀ'RĮ-Ą.)

"Cetraria Islandica. Acharius. (*Nat. Ord.* Lichenes.)" *U. S.* "The entire Lichen." *Br.*

Lichen Islandicus, *P.G.;* Mousse d'Islande, Lichen d'Islande, *Fr.;* Isländisches Moos, Isländische Flechte, Lungenmoos, *G.;* Lichene islandico, *It.;* Liquen islandico, *Sp.*

Gen. Ch. Plant cartilagino-membranous, ascending or spreading, lobed, smooth, and naked on both sides. *Apothecia* shield-like, obliquely adnate with the margin, the disk colored, plano-concave; border inflexed, derived from the frond. *Loudon's Encyc.*

Cetraria Islandica. Acharius, *Lichenog. Univ.* 512; *B. & T.* 302.—*Lichen Islandicus.* Woodv. *Med. Bot.* p. 803, t. 271. Iceland moss is foliaceous, erect, from

* According to W. Gilmour, *sperm oil* should contain not less than 4 per cent. of cetin, and if much less be obtained by the following process, adulteration has been practised. Shake one part by weight of sulphuric acid (sp. gr. 1·84) with four parts of the oil; allow to stand 20 minutes, shaking twice; add 3 ounces of distilled water; shake this thoroughly, and allow to stand 16 to 20 hours; dilute with 3 or 4 times its volume of distilled water; agitate thoroughly. On standing the cetin floats upon the top, and can readily be skimmed off, washed, dried, and weighed. (*P. J. Tr.*, vii. 328.)

† In consequence of its solubility in chloroform, stains made by dropping it on cloth may be quickly removed by that liquid.

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two to four inches high, with a dry, coriaceous, smooth, shining, laciniated frond or leaf, the lobes of which are irregularly subdivided, channelled and fringed at their edges with rigid hairs. Those divisions upon which the fruit is borne are dilated. The color is olive-brown or greenish gray above, reddish at the base, and lighter on the under than the upper surface. The fructification is in flat, shield-like, reddish brown receptacles, with elevated entire edges, placed upon the surface of the frond near its border. The plant is found in the northern latitudes of the old and new continents, and on the elevated mountains farther south. It received its name from the abundance with which it prevails in Iceland. It is also abundant on the mountains and in the sandy plains of New England. "It should be freed from pine leaves, mosses and other lichens, which are frequently found mixed with it." *U. S.*

The dried moss is of diversified color, grayish white, brown, and red, in different parts, with less of the green tint than in the recent state. It is officinally characterized as follows. "From two to four inches (5 to 10 cm.) long, foliaceous, with fringed and channelled lobes, brownish above, whitish beneath, brittle and inodorous; when softened in water, cartilaginous, and having a slight odor; its taste is mucilaginous and bitter." It is inodorous, and has a mucilaginous, bitter taste. Macerated in water, it absorbs rather more than its own weight of the fluid, and, if the water be warm, renders it bitter. Boiling water extracts all its soluble principles. The decoction thickens upon cooling, and acquires a gelatinous consistence, resembling that of starch in appearance, but without its viscidity. After some time the dissolved matter separates, and when dried forms semi-transparent masses, insoluble in cold water, alcohol, or ether, but soluble in boiling water, and in solution forming a blue compound with iodine. *Lichenin*, or *Lichen Starch*, $C_{12}H_{20}O_{10}$, resembles starch in its general characters, but differs from it in some respects. Berzelius found in 100 parts of Iceland moss 1·6 of chlorophyll, 3·0 of a peculiar bitter principle, 3·6 of uncrystallizable sugar, 3·7 of gum, 7·0 of the apotheme of extractive, 44·6 of the peculiar starch-like principle, 1·9 of the bilichenates of potassium and calcium mixed with phosphate of calcium, and 36·2 of amylaceous fibrin—the excess being 1·6 parts.

The starch-like substance named lichenin has been found to consist of two distinct proximate principles, one, for which the name of lichenin may be retained, while for the other no particular designation has been chosen, but which we may call *lichenoid*. According to Th. Berg (*Thèse de Dorpat*, 1872), cetraria yields 35·15 per cent. of the mixed principles, of which 20 per cent. is of lichenin, and 11·5 of the so-called lichenoid. To separate them, a decoction of the moss, concentrated to a small bulk, and still hot, is treated by alcohol at 85°. The lichenoid is deposited in flocculi, which gradually unite in a viscid mass. This, being washed by alcohol, until it ceases to be bitter, and then dried, yields a light friable matter partly soluble in cold water, with which it forms a yellow, limpid solution. To deprive it of mineral and coloring substances, it is dissolved in a little water, and precipitated afresh by alcohol. Lichenin is insoluble in cold water, but swells up and easily dissolves in hot water. It is insoluble in alcohol and in ether. It is only tinged by iodine. Lichenoid is, on the contrary, colored blue by that reagent. It is in part dissolved in cold water; and the undissolved part is equally colored blue by iodine. It is, like lichenin, insoluble in alcohol and ether. Both substances have strong analogies with starch, yet are distinct. For a further account of these principles, see *Journ. de Pharm.*, 1873, p. 154.

The name of *cetrarin* has been conferred on the bitter principle. The following process for obtaining it is that of Dr. Herberger. The moss, coarsely powdered, is boiled for half an hour in four times its weight of alcohol of 0·883. The liquid when cool is expressed and filtered, and treated with diluted hydrochloric acid, in the proportion of three drachms to every pound of moss employed. Water is then added in the quantity of about four times the bulk of the liquid, and the mixture left for a night in a closed matrass. The deposit which forms is collected on a filter, allowed to drain as much as possible, and submitted to the press. To purify it, the mass, while still moist, is broken into small pieces, washed with alcohol or ether, and treated with two hundred times its weight of boiling alcohol, which dissolves the cetrarin,

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leaving the other organic principles by which it has hitherto been accompanied. The greater part is deposited as the liquor cools, and the remainder may be obtained by evaporation. By this process one pound of moss yielded to Dr. Herberger 133 grains of cetrarin. This principle is white, not crystalline, light, unalterable in the air, inodorous, and exceedingly bitter, especially in alcoholic solution. Its best solvent is absolute alcohol, of which 100 parts dissolve 1·7 of cetrarin at the boiling temperature. Ether also dissolves it, and it is slightly soluble in water. Its solutions are quite neutral to test-paper. It is precipitated by the acids, and rendered much more soluble by the alkalies. Concentrated hydrochloric acid changes its color to a bright blue. It precipitates the salts of iron, copper, lead, and silver. In the dose of two grains, every two hours, it has been used successfully in intermittent fever. (*Journ. de Pharm.*, xxiii. 505.) Drs. Schnedermann and Knop have ascertained that the cetrarin above referred to consists of three distinct substances; 1, *cetraric acid*, $C_{18}H_{16}O_8$, which is the true bitter principle, crystallizable, and intensely bitter; 2, a substance resembling the fatty acids, called *lichen stearic acid*, $C_{34}H_{34}O_3$, the crystals of which melt at 120° C. (248° F.); and, 3, a green coloring substance, which they name *thallochlor*. These principles are obtained perfectly pure with great difficulty. (*Ann. der Pharm.*, lv. 144.)

The gum and starch contained in the moss render it sufficiently nutritive to serve as food for the Lapps and Icelanders, who employ it powdered and made into bread, or boiled with milk, after having partially freed it from the bitter principle by repeated maceration in water. As suggested by Berzelius, the bitterness may be entirely extracted by macerating the powdered moss, for 24 hours, in twenty-four times its weight of a solution formed with 1 part of an alkaline carbonate and 375 parts of water, then decanting the liquid, and repeating the process with an equal quantity of the solution. The powder, being now dried, is perfectly sweet.

Medical Properties and Uses. Iceland moss is demulcent, nutritious, and tonic, and well calculated for affections of the mucous membrane of the lungs and bowels, with debility of the digestive organs, or of the system generally. Hence it has been found useful in chronic catarrhs, and other chronic pulmonary affections attended with copious puruloid expectoration, in dyspepsia, in chronic dysentery and diarrhœa, and in the debility succeeding acute disease, or dependent on copious purulent discharge from external ulcers. At one time it possessed much reputation as a remedy in pulmonary consumption. It had long been employed in this disease, and in hæmoptysis, by the Danish physicians, before it became generally known. In the latter half of the last century it came into extensive use, and numerous cures supposed to have been effected by it are on record. We now know that it acts only as a mild, nutritious, demulcent tonic, and can exercise no specific influence over the tuberculous affection, though it may be of value in chronic bronchitis.

It is usually employed in the form of decoction. (See *Decoctum Cetrariæ*.) By some writers it is recommended to deprive it of the bitter principle by maceration in water or a weak alkaline solution, before preparing the decoction; but we thus reduce it to the state of a simple demulcent, or mild article of diet, in which respect it is not superior to the ordinary farinaceous or gummy substances used in medicine. The powder is sometimes given in the dose of thirty grains or a drachm (1·95–3·9 Gm.); and a preparation at one time obtained some repute, in which the ground moss was incorporated with chocolate, and used at the morning and evening meal as an ordinary beverage.

Off. Prep. Decoctum Cetrariæ.

CHARTÆ. *Papers.*

(CHÄR'TÆ.)

Papiers sparadrapiques, *Fr.*; Medicamentirte Papiere, *G.*

This class of preparations, long officinal in the French Codex, was some time since adopted into the British Pharmacopœia, but was not introduced into that of the United States until the revision of 1870.

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CHARTA CANTHARIDIS. *U. S.* *Cantharides Paper.*

(CHĂR'TĄ CĄN-THĂR'Į-DĪS.)

Charta Epispastica, *Br.;* Blistering Paper, Charta Vesicatoria; Papier épispastique, Papier à Vésicatoire aux Cantharides, *Fr.;* Spanischfliegen-Papier, *G.*

"White Wax, *eight parts* [or four ounces av.]; Spermaceti, *three parts* [or one and a half ounces av.]; Olive Oil, *four parts* [or two fluidounces]; Canada Turpentine, *one part* [or half an ounce av.]; Cantharides, in No. 40 powder, *one part* [or half an ounce av.]; Water, *ten parts* [or five fluidounces]. Mix all the substances in a tinned vessel, and boil gently for two hours, constantly stirring. Strain through a woollen strainer without expressing, and, by means of a water-bath, keep the mixture in a liquid state in a shallow, flat-bottomed vessel with an extended surface. Coat strips of sized paper with the melted plaster, on one side only, by passing them successively over the surface of the liquid; when dry, cut the strips into rectangular pieces." *U. S.*

"Take of White Wax *four ounces;* Spermaceti *one and a half ounces;* Olive Oil *two fluidounces;* Resin *three-quarters of an ounce;* Canada Balsam *one-quarter of an ounce;* Cantharides, in powder, *one ounce;* Distilled Water *six fluidounces.* Digest all the ingredients, excepting the Canada Balsam, in a water-bath for two hours, stirring them constantly; then strain, and separate the plaster from the watery liquid. Mix the Canada Balsam with the plaster melted in a shallow vessel, and pass strips of paper over the surface of the hot liquid, so that one surface of the paper shall receive a thin coating of the plaster. It may be convenient to employ paper ruled so as to indicate divisions each of which is one square inch." *Br.* The weights employed in this process are avoirdupois, and the measures Imperial.

This was intended as a convenient substitute for the common blistering plaster, and, if equally effectual, would be frequently preferred, from being already spread, as well as for its greater cleanliness and facility of application. The proportion of flies, however, is considerably less. From this cause it must be very greatly inferior in blistering power, and consequently less certain; this is a point which has been determined by experience; although it is said that, when properly applied, so as to insure close adhesion to the skin, it is not less efficient than the British plaster, or the *Cerate of Cantharides* of the U. S. Pharmacopœia. (*Med. Times and Gaz.*, 1867, p. 284.) It has been so seldom used, however, since its introduction, that it would seem hardly proper to venture an opinion upon its value.

CHARTA POTASSII NITRATIS. *U. S.* *Nitrate of Potassium Paper.*

(CHĂR'TĄ PŌ-TĂS'SĮ-Ī NĪ-TRĀ'TĪS.)

Papier nitré, *Fr.*

"Nitrate of Potassium, *twenty parts* [one ounce av.]; Distilled Water, *eighty parts* [four fluidounces]. Dissolve the Nitrate of Potassium in the Distilled Water. Immerse strips of white, unsized paper in the solution and dry them. Keep the paper in securely closed vessels." *U. S.*

This is a new officinal preparation, and is identical with the *Charta Nitrata* of the German Pharmacopœia; it is sometimes called *asthma paper.* Care should be taken to dissolve thoroughly all of the nitrate of potassium, so that it shall not be deposited upon the paper in large particles, and thus interfere with the slow and steady combustion of the paper.

Medical Properties. This paper is an excellent remedy, which in many cases of asthma affords much relief. It is used by burning in front of the patient, who inhales its fumes. Its efficacy is much increased by saturating it with fluid extract of belladonna and drying. Paper thus prepared must be used with some caution.

CHARTA SINAPIS. *U. S.* *Mustard Paper.*

(CHĂR'TĄ SĮ-NĀ'PĪS.)

Papier sinapisé, *Fr.;* Senfpapier, *G.*

"Black Mustard, in No. 60 powder; Benzin, Solution of Gutta-percha, each, *a sufficient quantity.* Pack the Mustard tightly in a conical percolator, and gradually pour Benzin upon it until the percolate ceases to produce a permanent, greasy stain

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upon blotting paper. Remove the powder from the percolator, and dry it by exposure to the air. Then mix it with so much of Solution of Gutta-percha as may be necessary to give it a semi-liquid consistence, apply the mixture, by means of a suitable brush, to one side of a piece of rather stiff, well sized paper, so as to cover it completely, and allow the surface to dry. Each square inch (or 6·5 square centimeters) of paper should contain about *six* (6) *grains* or *forty* (40) *centigrammes* of Mustard. Before being applied to the skin, the Mustard Paper should be dipped in warm water for about fifteen seconds." *U. S.*

"Take of Black Mustard Seeds, in powder, *one ounce;* Solution of Gutta-percha *two fluidounces*, or *a sufficiency*. Mix the Mustard with the Gutta-percha Solution so as to form a semi-fluid mixture, and having poured this into a shallow, flat-bottomed vessel, such as a dinner plate, pass strips of cartridge-paper over its surface, so that one side of the paper shall receive a thin coating of the mixture. Then lay the paper on a table with the coated side upwards, and let it remain exposed to the air until the coating has hardened. Before being applied to the skin, let the Mustard Paper be immersed for a few seconds in tepid water." *Br.*

The British preparation is at fault in not providing for the extraction of the fixed oil of mustard by previously percolating with benzin or carbon disulphide, otherwise the paper will be greasy, giving to the plaster an untidy appearance, and causing it to adhere to the skin. Solution of gutta-percha is unsuited for use in this preparation on account of want of adhesiveness, and tendency of the mixture, when dry, to crack and peel off. We have used instead a solution of 1 part of pure rubber in 30 of equal parts of bisulphide of carbon and benzin. On the large scale, by means of a plaster-spreading apparatus a uniform coat of this solution may be applied to paper. As the latter passes out from under the apparatus, a sieve containing the powdered mustard is shaken over it; this is fixed by the adhesive coat and firmly retained after the evaporation of the volatile liquids in a warm place. The application of the powdered mustard must be properly regulated according to the speed with which the machine delivers the coated paper. The paper is cut into pieces of convenient size, and needs only to be wetted to be ready for use.

Owing to the fact that the large manufacturers can put mustard paper upon the market at such low rates that it pays the apothecary better to buy, than to prepare it, Charta Sinapis, so far as we can learn, is rarely made in the retail stores. Experience has shown that the ready-made mustard papers err rather from too much than from too little activity. Moreover, their action cannot be regulated with the same nicety as can that of the mustard poultice. Unless in the case of travellers and of others who must wait upon themselves, the domestic application is preferable. The mustard leaves can rarely be borne for more than ten or fifteen minutes.

CHELIDONIUM. *U. S.* *Chelidonium.* [*Celandine.*]

(ȼHĒL-Ị-DŌ′NỊ-ŪM.)

"Chelidonium majus. Linné. (*Nat. Ord.* Papaveraceæ.)" *U. S.*

Herba Chelidonii, *P. G.;* Tetterwort; Chélidoine, Herbe à l'Hirondelle, *Fr.;* Schöllkraut, *G.*

"Root several-headed, branching, red-brown. Stem about twenty inches (50 cm.) long, light green, hairy; leaves about six inches (15 cm.) long, petiolate, the upper ones smaller and sessile, light green, on the lower side glaucous, lyrate-pinnatifid, the pinnæ ovate-oblong, obtuse, coarsely crenate or incised, and the terminal one often three-lobed; flowers in small, long-peduncled umbels with two sepals and four yellow petals; capsule linear, two-valved, and many-seeded. The fresh plant contains a saffron-colored milk-juice, and has an unpleasant odor and acrid taste." *U. S.*

For an account of the constituents and properties of this new officinal drug, see *Chelidonium majus* (Part II.).

CHENOPODIUM. *U. S.* *Chenopodium.* [*American Wormseed.*]

(ȼHĒ-NǪ-PŌ′DỊ-ŪM.)

"The fruit of Chenopodium ambrosioides. Linné. *Var.* anthelminticum. Gray. (*Nat. Ord.* Chenopodiaceæ.)" *U. S.*

Fructus Chenopodii Anthelmintici; Semences de Chénopode anthelmintique, *Fr.;* Amerikanischer Wurmsamen, *G.*

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Gen. Ch. Calyx five-leaved, four-cornered. *Corolla* none. *Seed* one, lenticular, superior. *Willd.*

Chenopodium anthelminticum. Willd. *Sp. Plant.* i. 1304; Barton, *Med. Bot.* ii. 183; *B. & T.* 216. This is an indigenous perennial plant, with an herbaceous, erect, branching, furrowed stem, which rises from two to five feet in height. The leaves are alternate or scattered, sessile, oblong-lanceolate, attenuated at both ends, sinuated and toothed on the margin, conspicuously veined, of a yellowish green color, and dotted on their under surface. The flowers are very numerous, small, of the same color with the leaves, and arranged in long, leafless, terminal panicles, composed of slender, dense, glomerate, alternating spikes.

This species of Chenopodium, known commonly by the names of *wormseed* and *Jerusalem oak*, grows in almost all parts of the United States, but most vigorously and abundantly in the southern section. It is usually found in the vicinity of rubbish, along fences, in the streets of villages, and in open grounds about the larger towns. It flowers from July to September, and ripens its seeds successively through the autumn. The whole herb has a strong, peculiar, offensive, yet somewhat aromatic odor, which it retains when dry. All parts of the plant are occasionally employed; but the fruit only is strictly officinal. This should be collected in October.*

Wormseed, as found in the shops, is in small grains, not larger than the head of a pin, irregularly spherical, very light, of a dull, greenish yellow, or brownish color, a bitterish, somewhat aromatic, pungent taste, and possessed in a high degree of the peculiar smell of the plant. These grains, when deprived, by rubbing them in the hand, of a capsular covering which invests the proper seed, exhibit the shining, blackish surface of the obtusely-edged seed. They abound in a volatile oil, upon which their sensible properties and medical virtues depend, and which is obtained by distillation. (See *Oleum Chenopodii.*) The same oil impregnates to a greater or less extent the whole plant.

Medical Properties and Uses. Wormseed is one of our most efficient indigenous anthelmintics, and is thought to be particularly adapted to the expulsion of the round worms in children. A dose of it is usually given before breakfast in the morning, and at bedtime in the evening, for three or four days successively, and then followed by calomel or some other brisk cathartic. If the worms are not expelled, the same plan is repeated. The medicine is most conveniently administered in powder, mixed with syrup, in the form of an electuary. The dose for a child two or three years old is from one to two scruples (1·3–2·6 Gm.). The volatile oil is more frequently given than the fruit in substance; though its offensive odor and taste sometimes render it of difficult administration. The dose for a child is from five to ten drops (0·3–0·6 C.c.) mixed with sugar, or in the form of emulsion. A tablespoonful (15 C.c.) of the expressed juice of the leaves, or a wineglassful (60 C.c.) of the decoction prepared by boiling an ounce of the fresh plant in a pint of milk, with the addition of orange-peel or other aromatic, is sometimes substituted in domestic practice for the ordinary dose of the fruit and oil.

The fruit of *Chenopodium ambrosioides*, which is very prevalent in the Middle States, is said to be used indiscriminately with that of *C. anthelminticum*, and to be employed in Brazil, under the name of *Herba Santa Maria*, as an anthelmintic and in pectoral complaints. (*P. J. Tr.*, ix. 713.) It may be distinguished by its odor, which is weaker and less offensive, and to some persons agreeable. The plant itself is often confounded with the true wormseed, from which it differs in having its flowers in leafy racemes. This Chenopodium has been employed in Europe as a remedy in nervous affections, particularly chorea. A cupful of an infusion (℥ii to 10f℥) is said to have been given with excellent results, morning and evening.

* *C. anthelminticum* is cultivated to a considerable extent in Maryland, twenty or thirty miles north of Baltimore. The seeds are sown in small beds of rich mould early in spring, and during the month of June the young plants are pulled up, and set out in ridges three feet apart, with intervals of from six to ten inches. The plants do not require to be renewed oftener than once in four or five years. The crop of the second year is more productive than that of the first. The plant is fit for distillation during the first half of September. The distillation is carried on in the same neighborhood. The whole herbaceous part of the plant is used. It is said to yield from 1·5 to 2 per cent. of the oil, and the produce of an acre will yield 20 pounds. (See *A. J. P.*, xxii. 304.)

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C. Botrys, or *Jerusalem oak*, is another indigenous species, possessing anthelmintic virtues. It is said to have been used in France with advantage in catarrh and humoral asthma.

Off. Prep. Oleum Chenopodii, *U. S.*

CHIMAPHILA. *U. S. Chimaphila.* [*Pipsissewa.*]

(CHI-MĂPH'I-LA.)

"The leaves of Chimaphila umbellata. Nuttall. (*Nat. Ord.* Ericaceæ.)" *U. S.*

Prince's Pine, Wintergreen; Herbe de Pyrole ombellée, *Fr.*; Doldenblüthiges Harnkraut, Wintergrün, *G.*

Gen. Ch. Calyx five-toothed. *Petals* five. *Style* very short, immersed in the germ. *Stigma* annular, orbicular, with a five-lobed disk. *Filaments* stipitate; stipe discoid, ciliate. *Capsules* five-celled, opening from the summits, margins unconnected. *Nuttall.*

This genus was separated from *Pyrola* by Pursh. It embraces two species, *C. umbellata* and *C. maculata*, which are both indigenous, and known by the common title of *winter-green*. The generic title is formed of two Greek words, χειμα winter, and φιλος a friend. *C. umbellata* only is officinal.

Chimaphila umbellata. Barton, *Med. Bot.* i. 17; Carson, *Illust. of Med. Bot.* i. 62, pl. 53.—*Pyrola umbellata.* Willd. *Sp. Plant.* ii. 622; Bigelow, *Am. Med. Bot.* ii. 15.—*Chimaphila corymbosa.* Pursh. *B. & T.* 165. The pipsissewa is a small evergreen plant, with a perennial, creeping, yellowish root (rhizome), which gives rise to several simple, erect or semiprocumbent stems, from four to eight inches in height, and ligneous at their base. The leaves are wedge-shaped, somewhat lanceolate, serrate, coriaceous, smooth, of a shining, sap-green color on the upper surface, paler beneath, and supported upon short footstalks, in irregular whorls, of which there are usually two on the same stem. The flowers are disposed in a small terminal corymb, and stand upon nodding peduncles. The calyx is small and divided at its border into five teeth or segments. The corolla is composed of five roundish, concave, spreading petals, which are of a white color tinged with red, and exhale an agreeable odor. The stamens are ten, with filaments shorter than the petals, and with large, nodding, bifurcated, purple anthers. The germ is globular and depressed, supporting a thick and apparently sessile stigma, the style being short and immersed in the germ. The seeds are numerous, linear, chaffy, and enclosed in a roundish, depressed, five-celled, five-valved capsule, having the persistent calyx at the base.

This humble but beautiful evergreen is a native of the northern latitudes of America, Europe, and Asia. It is found in all parts of the United States. It grows under the shade of woods, and prefers a loose sandy soil, enriched by decaying leaves. The flowers appear in June and July. All parts of the plant are endowed with active properties. The leaves and stems are kept in the shops.

C. maculata, or *spotted winter-green*, probably possesses similar virtues. The character of the leaves of the two plants will serve to distinguish them. Those of *C. maculata* are lanceolate, rounded at the base, where they are broader than near the summit, and of a deep olive green, veined with greenish white; those of the officinal species are broadest near the summit, gradually narrowing to the base, and of a uniform shining green.

Properties. Pipsissewa, when fresh and bruised, exhales a peculiar odor. The leaves have been already described. Their taste is pleasantly bitter, astringent, and sweetish; that of the stems and root unites with these qualities a considerable degree of pungency. Boiling water extracts the active properties of the plant, which are also imparted to alcohol. The leaves have been examined by Mr. Samuel Fairbank, who found in them gum, starch, sugar, extractive, pectic acid, tannic acid, resin, fatty matter, chlorophyll, yellow coloring matter, lignin, a peculiar whitish substance which he calls *chimaphilin*, and various inorganic substances, as potassa, lime, magnesia, chloride of sodium, and sulphuric, phosphoric, and silicic acids. The chimaphilin was obtained by agitating a tincture with chloroform, allowing the mixture to stand, removing the lighter liquid, and allowing the chloroformic solution to evaporate. A yellow crystalline substance was left, which, purified by solution in alcohol, filtration,

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and spontaneous evaporation, constituted the substance in question. It was also obtained by simply distilling the stems with water. It is in beautiful, golden yellow, acicular crystals, inodorous, tasteless, fusible, volatilizable unchanged, insoluble or nearly so in water, soluble in alcohol, ether, chloroform, and the fixed and volatile oils, and possessed of neither acid nor alkaline properties. (*Journ. and Trans. of the Md. Col. of Pharm.*, March, 1860.) The active principle of the leaves does not appear to have been isolated, though probably contained in the substance called bitter extractive. The so-named chimaphilin has no claims to this character, nor, we think, to the name given to it, which should be reserved for the active principle when discovered. The pungency of the stems is said by Mr. Fairbank to reside in the resin.

Medical Properties and Uses. This plant is diuretic, tonic, and astringent. It was employed by the aborigines in various complaints, especially scrofula, rheumatism, and nephritic affections. From their hands it passed into those of the European settlers, and was long a popular remedy in certain parts of the country, before it was adopted by the profession. The first regular treatise in relation to it that has come to our knowledge, was the thesis of Dr. Mitchell, published in the year 1803; but it was little thought of till the appearance of the paper of Dr. Sommerville, in *Lond. Med.-Chir. Trans.*, vol. v. It has been particularly recommended in dropsy attended with disordered digestion and general debility, and is usually very acceptable to the stomach, but it cannot be relied on, and is at present very little used in this complaint. Other disorders, in which it is said to have proved useful, are calculous and nephritic affections, and in general all those complaints of the urinary passages for which uva ursi is prescribed. It is much esteemed by some practitioners as a remedy in scrofula, both before and after the occurrence of ulceration; and it has certainly proved highly advantageous in obstinate ill-conditioned ulcers and cutaneous eruptions, supposed to be connected with the strumous diathesis. In these cases it is used both internally, and locally as a wash. It is best administered in the form of the officinal fluid extract, which may readily be made into a syrup. The dose is two fluidrachms (7·5 C.c.) three or four times a day. The decoction was formerly preferred.

Off. Prep. Decoctum Chimaphilæ, *U. S.;* Extractum Chimaphilæ Fluidum, *U. S.*

CHINOIDINUM. *U. S.* *Chinoidin.* [*Quinoidin.*]

(ĈHIN-ÖI'DI-NŬM.)

"A mixture of alkaloids, mostly amorphous, obtained as a by-product in the manufacture of the crystallizable alkaloids from Cinchona." *U. S.*

Chinoidine, Quinoidine, Precipitated Extract of Bark, Amorphous Quinine; Quinine brute ou amorphe, *Fr.*

This preparation is a *revived* officinal. It was adopted in the edition of the Pharmacopœia for 1830 under the name of impure sulphate of quinia, but was abandoned in the edition of 1840 on account of the difficulty of ascertaining its purity, and we think it unfortunate that the Committee of Revision have decided to introduce it in the present Pharmacopœia, for it is now very variable in quality and the tests introduced are not quantitative. The wisdom of deviating from the rule to adopt the *ina* termination for the Latin title of the alkaloids, and *ine* for the English name, in this case is also not apparent, for although it is a mixture, the officinal description clearly defines it as a mixture of *alkaloids*, and hence it should have the alkaloidal termination, and not that of the neutral principles. The term chinoidine was first applied to all of the amorphous alkaloids found in and existing naturally in cinchona bark, but it is now used to define a complex body consisting not only of the natural amorphous alkaloids, but those which are artificial and accidental in the derivative products resulting from the application of heat. Upon the evaporation of the mother-liquor left after the crystallization of sulphate of quinine in the preparation of that salt, a dark-colored substance is obtained, having the appearance of an extract. Sertürner supposed that he had discovered a new alkaline principle in this product; but his conclusions were invalidated by the experiments of MM. Henry and Delondre, which went to prove that the alkaline matter contained in it consisted of quinine and cinchonine, obscured by admixture with a yellowish substance that in-

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terfered with their crystallization. Nevertheless, under the name of *quinoidine* or *chinoidine*, given to the supposed new alkaloid by Sertürner, there has been long employed in Europe a substance precipitated from the mother-liquor of sulphate of quinine by means of an alkaline carbonate, having a yellowish white or brownish color, and, when moderately heated, agglutinating into a mass of resinous appearance. This substance was found by Dr. F. L. Winckler to contain an uncrystallizable alkaline principle, having the same molecular weight as quinine, and differing from that alkaloid only in the want of the property of crystallization, and in forming uncrystallizable salts with the acids. (*Pharm. Centralb.*, May, 1847, p. 310.) Liebig afterwards proved it to be identical in composition with ordinary quinine, to which he considered it as bearing the same relation that uncrystallizable sugar bears to the crystallizable. Pasteur has found that ordinary quinoidine, or amorphous quinine, consists of two alkaloids, derivatives from quinine and cinchonine, with which they are respectively isomeric, though differing in being uncrystallizable, and named, in view of their origin, *quinicine* and *cinchonicine*. The pure amorphous quinine of Liebig is the former of these alkaloids. The *amorphous quinine*, as Liebig calls it, is entirely soluble in diluted sulphuric acid and in alcohol; and, if its solution in a diluted acid yields upon the addition of ammonia exactly as much precipitate as there was of the original substance dissolved, it may be considered pure. (*A. J. P.*, xviii. 181.) We have been informed that, in an extensive chemical manufacturing establishment in Philadelphia, the loss by quinoidine in the preparation of sulphate of quinine has much diminished since the introduction of steam heat, showing the agency of heat in converting the crystallizable into the uncrystallizable salt.

Properties. The U. S. Pharmacopœia describes chinoidine as "a brownish black, or almost black solid, breaking, when cold, with a resinous, shining fracture, becoming plastic when warmed, odorless, having a bitter taste and an alkaline reaction. Almost insoluble in water, freely soluble in alcohol, chloroform, and diluted acids; partially soluble in ether and in benzol. The solutions have a very bitter taste. If Chinoidin be triturated with boiling water, the liquid, after filtration, should be clear and colorless, and should remain so on the addition of an alkali (abs. of alkaloidal salts). On ignition, Chinoidin should not leave more than 0·7 per cent. of ash." *U. S.*

A simple method of purification consists in dissolving the chinoidine in diluted hydrochloric acid, adding water and precipitating with an alkali, washing and drying.*

Tinctura Chinoidini is made, according to the German Pharmacopœia, by simply dissolving 2 parts of chinoidine in 1 of hydrochloric acid and 17 of alcohol.

Hydrochlorate of Chinoidine is made by heating 1 part of purified chinoidine with 4 parts of distilled water, adding sufficient diluted hydrochloric acid to complete the solution, filtering, evaporating, and powdering the residue.

Medical Properties. Quinoidine is undoubtedly possessed of decided antiperiodic properties, but in these it is inferior to the cinchona alkaloids. It is, moreover, very much more apt to disagree with the stomach, and is uncertain in its dose, so that, notwithstanding its great cheapness, it is but rarely used. From thirty grains to a drachm may be given in the interparoxysmal periods of an intermittent.

* As commercial chinoidine is often very impure, sometimes, according to the observations of M. de Vrij, containing as much as 35 per cent. of foreign matters, a satisfactory method of purifying it becomes important. The following has been proposed by M. de Vrij, founded on the observation of M. Pasteur, that 9 parts of chinoidine, rubbed for a long time in a mortar with a dilute solution of 2 parts of neutral oxalate of ammonium, are at length completely dissolved, with the escape of the ammonia, and entire separation of impurities. M. de Vrij boils in an iron vessel 9 parts of chinoidine with a weak solution of 2 parts of oxalate of ammonium, until ammonia ceases to escape. As the insoluble matter attaches itself in places to the surface of the vessel, he adds from time to time distilled water so as to cover this matter during the boiling. As soon as ammonia is no longer disengaged, he allows the liquor to become quite cool, and ascertains if it is made turbid by the addition of water. In this case he dilutes the solution with water, then filters, and precipitates in a capsule with an excess of solution of caustic soda. The tenacious precipitate which forms may be collected, by means of a gentle heat, in the bottom of the capsule. The clear alkaline liquid is then decanted, and the precipitated chinoidine washed repeatedly with distilled water. Thus purified, being still adhesive, it is exposed for some time to a heat of 100 C. (212° F.) to 110° C. (230° F.), at which it parts with the water it contained, and becomes, after cooling, nard and friable. The oxalate of ammonium is used in order to get rid of lime, which is a frequent impurity in chinoidine. (*Journ. de Pharm.*, 4e sér., iv. 50.)

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CHIRATA. *U. S., Br. Chirata.*

(CHI-RĀ'TA.)

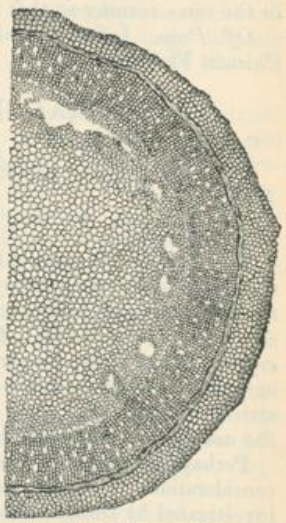
"Ophelia Chirata. Grisebach. (*Nat. Ord.* Gentianaceæ.)" "The entire plant." *Br.*

Chirette, *Fr.*; Chiretta, *G.*

Gen. Ch. Corolla withering, rotate, in æstivation twisted to the right; with glandular hollows protected by a fringed scale upon the segments. *Anthers* not changing. *Stigmas* sessile. *Capsules* conical; one-celled, with spongy placentæ upon the sutures. *Seeds* indefinite, minute. *Lindley.*

Agathotes Chirayta. Don, *Lond. Philos. Mag.* 1836, p. 76.—*Gentiana Chirayta.* Fleming, *Asiat. Research.* xi. 167.—*Ophelia Chirata.* Grisebach. *B. & T.* 183.

The *chirayta* or *chiretta* is an annual plant, about three feet high, with a branching root, and an erect, smooth, round stem, branching into an elegant leafy panicle, and furnished with opposite, embracing, lanceolate, very acute, entire, smooth, three or five-nerved leaves. The flowers are numerous, peduncled, yellow, with a four-cleft calyx having linear acute divisions, the limb of the corolla spreading and four-parted, four stamens, a single style, and a two-lobed stigma. The capsules are shorter than the permanent calyx and corolla. The plant is a native of Nepaul, and other parts of Northern India. The whole of it is gathered when the flowers begin to decay.*



Chiretta, transverse section.

The dried plant is imported into Europe in bundles, consisting mainly of the stems, with portions of the root attached. The stems contain a yellowish pith. The drug is officinally described as a "root nearly simple, about three inches (75 mm.) long; stem branched, nearly forty inches (1 m.) long, slightly quadrangular above; leaves opposite, sessile, ovate, entire, five-nerved; flowers numerous, small, with a four-lobed calyx and corolla; the whole plant smooth, pale brown, inodorous and intensely bitter." *U. S.* It imparts its virtues to water and alcohol; and they are retained in the extract. According to Lassaigne and Boissel, the stems contain resin, a yellow bitter substance, brown coloring matter, gum, and various salts. Flückiger and Höhn, who have subsequently examined the stems and roots, have extracted from them sugar, wax, chlorophyll, soft resin, tannin, an acid which they name *ophelic*, possessing the formula $C_{13}H_{20}O_{10}$, and a peculiar bitter substance, denominated *chiratin*, $C_{26}H_{48}O_{15}$. The acid is syrupy, deliquescent, yellowish brown, at first slightly sour, afterwards intensely bitter. It is soluble in water with some turbidness, probably owing to resin mixed with it, and completely soluble in alcohol, or a mixture of this with ether. It decomposes certain salts, and forms amorphous compounds with acids. Chiratin is a yellow, hygroscopic powder, but feebly crystallizable, very bitter, sparingly soluble in cold water, more so in hot water, and readily dissolved by alcohol and ether. It is neutral to test-paper, and yields a copious precipitate with tannic acid. By the action of acids, chiratin is separated into ophelic acid, and a yellowish brown, amorphous substance, bitter, scarcely soluble in water, readily soluble in spirit, and not reducing copper solutions, as the ophelic acid does. Höhn gives it the formula $C_{12}H_{24}O_3$, and names it *chiratogenin*. (*P. J. Tr.*, Aug. 1870, p. 106.)

Medical Properties and Uses. Chiretta has long been used in India. It has

* In the Indian bazaars the name chiretta is applied to various dried gentianaceous plants; the only one of them, except the officinal species, so far as we know, which has found its way into Western commerce is *Ophelia angustifolia*. This *Paharee* or *Hill chiretta* is distinguished by its inferior bitterness, and its rectangular, winged stems, whose section presents a thick woody ring and a centre nearly or entirely hollow, with only traces of pith.

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been introduced into Europe, and appears to be highly esteemed, but has not been employed to any considerable extent in this country. Its properties are those of the pure bitters, and probably do not differ from those of the other members of the family of Gentianaceæ. (See *Gentiana.*) Like these, in overdoses it nauseates and oppresses the stomach. Some have supposed that, in addition to its tonic properties, it exerts a peculiar influence over the liver, promoting the secretion of bile and correcting it when deranged, and restoring healthy evacuations in cases of habitual costiveness. It has been used in dyspepsia, and in the debility of convalescence, and generally in cases in which corroborant measures are indicated. In India it has been successfully employed in intermittents and remittents, combined with the seeds of *Guilandina Bonduc.* It may be given in powder, infusion, tincture, or extract. The dose in substance is twenty grains (1·3 Gm.). A fluid extract may be made in the same manner as that of gentian.

Off. Prep. Infusum Chiratæ, *Br.;* Tinctura Chiratæ, *U. S., Br.;* Extractum Chiratæ Fluidum, *U. S.*

CHLORAL. *U. S. Chloral.* [*Hydrate of Chloral.*]

C_2HCl_3O, H_2O; 165·2. (KLŌ'RAL.) $C_4HCl_3O_2, 2HO$; 165·2.

"Chloral should be preserved in glass-stoppered bottles, in a cool and dark place." *U. S.*

Chloral Hydras, *Br. Add.;* Chloralum Hydratum Crystallisatum, *P.G.;* Hydrate de Chloral, *Fr.;* Chloral Hydrat, *G.*

In adopting the name chloral to designate the hydrate of chloral, the U. S. Pharmacopœia has unfortunately perpetuated an inaccuracy which neither the English, the Germans, nor the French follow in their usage, the term *hydrate* being always employed as it should be. The fact that water is absolutely necessary to allow of the crystallization of the preparation, and to give it medicinal character, should be recognized in the name. As custom has sanctioned the usage here in the present article, whenever the term chloral is used, the hydrate is intended; and whenever the uncombined substance is referred to, it is designated *anhydrous chloral.*

Perhaps no medicine has come so rapidly into extensive use as that now under consideration. Though discovered by Liebig so long since as 1832, and afterwards investigated by Dumas, who determined its chemical formula, it was not until 1869 that its remedial properties were first made known by their discoverer, Dr. Otto Liebreich, of Berlin; in 1878 the consumption of chloral was estimated at one ton daily in England and America alone.

Anhydrous Chloral. In preparing anhydrous chloral, the simple method originally employed by Liebig, of acting directly on alcohol by chlorine, is generally preferred, even, we believe, by the larger manufacturers; though a more complex proceeding has been suggested by Stædeler, of distilling together proximate vegetable principles, as fecula, sugar, etc., with black oxide of manganese and hydrochloric acid, whereby the chlorine acts *in statu nascendi.* The following details of the manufacture of chloral hydrate as carried out on a commercial scale have been supplied by E. Schering, of Berlin, who has been for some years the largest manufacturer of it. Absolute alcohol in lots of 50 pounds is placed in large glass flasks and saturated with chlorine, which is passed in a continuous stream for 6 to 8 weeks. The chlorine is led into cold alcohol at first, and when no more is absorbed, the alcohol is heated at first gently and then to 60° C. (140° F.). When saturated, the mixture formed is agitated with sulphuric acid at a temperature of 60° C. (140° F.) for several hours, during which time most of the hydrochloric acid escapes. The separated chloral is then rectified over calcium carbonate. The pure chloral so obtained is then mixed in glass flasks with the necessary amount of water, and the resulting hydrate either cast into cakes or purified by crystallization. As solvents for this purpose certain of the side products of the chloral manufacture after being purified and rectified, are used, for instance, ethylen and ethyliden chlorides. Or in their absence chloroform is used; petroleum benzin, and bisulphide of carbon have also been recommended. (See also *A. J. P.*, 1873, p. 413.) According to Gerhardt, the formula of anhydrous chloral is C_2Cl_3HO; in other words aldehyd C_2H_4O, in which

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3 atoms of hydrogen have been replaced by 3 atoms of chlorine. The alcohol C_2H_6O may be supposed to give up 2 atoms of its hydrogen to form aldehyd, which exchanges 3 of its atoms of hydrogen for 3 atoms of the chlorine, the hydrogen forming hydrochloric acid with 3 other atoms of the chlorine. The name of chloral was derived from the *chlor*ine and *al*cohol from which it is formed. The anhydrous chloral thus formed is a colorless liquid, of penetrating disagreeable odor, of little taste, of the sp. gr. 1·502, and boiling at 94° C. (201·2° F.). It is soluble in ether or chloroform without change.

Meta-chloral. By continued contact of anhydrous chloral and concentrated sulphuric acid, a change is effected in the chloral, by which it becomes a solid insoluble in water, which is designated as *insoluble chloral*, or *meta-chloral*. It is tasteless, of a white color resembling porcelain, and insoluble in alcohol and ether. Its formula is $C_6H_3Cl_9O_3$, being formed by the union of three molecules of chloral. Personne has tried its effects on animals, and ascribes to it a value little differing from that of the hydrate. (*Arch. Gén.*, Sept. 1870, p. 332.) It has not hitherto been employed therapeutically.

Alcoholate of Chloral. A compound obtained by M. Roussin, which he announced as pure hydrate of chloral, was found by M. Personne to contain no water, but to be in fact a compound of alcohol and chloral, and is now known by the name of *alcoholate of chloral*, C_2HCl_3O,C_2H_6O. It results directly from the action of absolute alcohol on anhydrous chloral, and is now known to be formed as a stage in the manufacture of chloral from alcohol. As it is very likely to be confounded with chloral hydrate, the following points of difference should be noted. It forms white crystals melting at 46° C. (114·8° F.), and boils at 113·5° C. (236° F.), while chloral hydrate crystals melt at 48°–49° C. (118.4°–120·2° F.), and boil at 97·5° C. (207° F.); chloral alcoholate melts without complete solution when warmed with two volumes of water, and, on cooling, congeals below the surface of the water, while chloral hydrate is soluble in one and one-half times its weight of water; chloral alcoholate, gently heated with nitric acid of 1·2 sp. gr., is violently attacked, while chloral hydrate is scarcely acted on; chloral-alcoholate, heated on platinum foil, inflames readily, while chloral hydrate scarcely burns. (Allen, *Commerc. Org. Analysis*, p. 167.)

The three forms of chloral, the *anhydrous*, the polymeric *meta-chloral*, and the *alcoholate*, described above, have been more or less introduced into the European markets, and have required some notice to prevent them from being confounded with the hydrate, which is alone officinal. The following observations will be confined to this compound; and the reader will note that whether the simple term chloral, or the exact designation, hydrate of chloral, is used, the same substance is intended.

Properties of Hydrate of Chloral, or **Chloral,** *U. S.* This results from simply mixing anhydrous chloral with water. Acicular crystals soon form, which consist of a molecule each of the chloral and water, constituting hydrate of chloral, or officinal chloral. As employed in the United States, this comes, we believe, exclusively from Europe, and chiefly from Germany, with the exception of that produced by Dr. E. R. Squibb, of Brooklyn. It occurs in commerce mainly in two forms, in distinct crystals, which is the officinal form, or in crystalline plates, about three lines in thickness, broken into small, irregular, angular pieces, so as to be readily introduced into broad-mouthed bottles. These pieces, while retaining their tabular form, are somewhat translucent, but usually covered with a white powder, which somewhat conceals that property. This is the more common form and the cheaper; but the crystals are to be preferred, as their purity may be relied on. Chloral is white, of a peculiar pungent odor, and an acrid pungent taste, especially affecting the velum pendulum. The odor has been compared to that of an over-ripe melon. Exposed to the air it very slowly volatilizes, and, like camphor, when enclosed in a bottle, covers the interior surface with numerous minute crystallizations. The boiling point of the pure crystals, obtained from their solution in bisulphide of carbon, is 97·5° C. (207° F.). If the boiling point be under 95° C., it indicates an underhydrated preparation; if above 98° C., an over-hydrated one. (E. R. Squibb.) The pure hydrate does not take fire when heated in a spoon, but evaporates without

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residue. With the aid of heat, its solution may be effected readily in chloroform; and the solution, on cooling, deposits it in beautiful crystals, which are generally needle-shaped; but, when deposited from bisulphide of carbon, they are prisms. The watery solution is prone to decomposition, which is ultimately attended with the development of algæ. Chloral should not, therefore, be kept long in this state. (Dr. E. Labbée, *Arch. Gén.*, Sept. 1870, p. 31.) In its relation to acids and alkalies it is neutral, or, according to E. Schering, slightly acid when perfectly pure. When equal parts of chloral in crystals and of camphor in small fragments are shaken together in a bottle, and allowed to stand, they liquefy, forming a clear solution. When chloral and sulphuric acid are mixed, the temperature is greatly reduced. A solution of chloral hydrate dissolves morphine, quinine, and most of the vegetable alkaloids. (R. F. Fairthorne, *A. J. P.*, Oct. 1871, p. 447.) When ammonium sulphide is added to an aqueous solution of chloral hydrate, the mixture rapidly turns yellow, and, after passing through several shades of color, finally becomes dark brown. From this liquid diluted sulphuric acid throws down a bulky brown precipitate. This, purified from precipitated sulphur and dried, is a light brown powder of the composition $C_{18}H_{24}S_{13}N_4O_6$. Hydrogen sulphide gas forms a sulphydrate by its action on chloral. These reactions are important, as the detection of metallic poisons in toxicological cases by hydrogen sulphide has been complicated by the presence of chloral hydrate. A still more important chemical reaction of chloral is that which takes place when the hydrate, or either of its other forms, is placed under the influence of an alkali. Chloroform is developed, and along with it a formate of the alkali employed. Thus, in a strong solution of potassa, put a pinch of powdered chloral, and almost instantly the odor of chloroform becomes sensible, and some oil-like globules of chloroform are visible at the bottom of the vessel. The reaction is as follows:

$$\underset{\text{Chloral hydrate}}{C_2HCl_3O,H_2O} + \underset{\text{potassium hydrate}}{KOH} = \underset{\text{chloroform}}{CHCl_3} + \underset{\text{potassium formate}}{CHO.OK} + \underset{\text{water}}{H_2O}.$$

This relation of chloral to chloroform would serve as a ready test of the former, and may be used also to determine its quality; for pure hydrate of chloral ought by calculation to yield 76·35 per cent. of chloroform, and the best known yields, according to the table of Mason, 71·5 (72·20 Selden) per cent. If, therefore, the product of chloroform should fall much below the latter percentage, the parcel acted on is probably impure. When blood is agitated with chloral, it produces the same change, and the smell of chloroform becomes sensible after a time; and Richardson was able to collect a certain quantity by distillation. (*Labbée.*) Important pathological inferences have been drawn from this result. The following tests of purity are given in the U. S. Pharmacopœia. "Separate, rhomboidal, colorless, and transparent crystals, slowly evaporating when exposed to the air, having an aromatic, penetrating, and slightly acrid odor, a bitterish, caustic taste, and a neutral reaction. Freely soluble in water, alcohol, or ether; also soluble in four parts of chloroform, in glycerin, benzol, benzin, disulphide of carbon, fixed or volatile oils. It liquefies when mixed with carbolic acid or with camphor. Its aqueous solution soon acquires an acid reaction, but its alcoholic solution remains neutral. At about 58° C. (136° F.), it melts to a clear liquid of sp. gr. 1·575, which solidifies to a crystalline mass at a temperature between 35° and 50° C. (95° and 122° F.). At about 78° C. (172° F.) it begins to yield vapors of water and of anhydrous chloral, and it boils at 95° C. (203° F.). When dissolved in water and treated, while hot, with solution of potassa or of soda, or with water of ammonia, a vaporous, milky mixture of chloroform is obtained, with a formate in solution. If the addition of the water of ammonia be made in a test-tube, after adding a few drops of test-solution of nitrate of silver, a silver mirror will be obtained upon the glass. An aqueous solution, treated with test-solution of sulphide of ammonium, gives a reddish-brown precipitate. Chloral should be dry, and should not readily attract moisture in ordinarily dry air; when dissolved in diluted alcohol it should not redden blue litmus paper (abs. of acids), nor be precipitated upon addition of a few drops of nitric acid, and of test-solution of nitrate of silver (abs. of hydrochloric acid). Warmed in contact with an equal volume of sulphuric acid, it liquefies, but should not

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blacken; and, when vaporized by heat, no residue should remain. It should not dissolve in less than 4 times its weight of chloroform at 15° C. (59° F.), (difference from alcoholate). A portion, in a test-tube, containing a fragment of broken glass, held in water nearly boiling should boil at about 97° C. (206·6° F.) (difference from alcoholate, which boils at 115° C. (239° F.), and evidence of due hydration). If 1 Gm. be dissolved in 2 C.c. of distilled water, the solution warmed, and about 8 C.c. (or a slight excess) of solution of potassa added, the mixture filtered clear through wet filter paper, and the filtrate treated with test-solution of iodine until it is yellowish, no yellow, crystalline precipitate (iodoform) should appear, even after standing half an hour (abs. of alcoholate of chloral)." *U. S.*

Medical Properties and Uses. When chloral is ingested in full therapeutic dose (from 15 to 30 grains), it produces in from ten minutes to half an hour a quiet, placid sleep, which usually continues about three hours, when it ceases, generally without any unpleasant symptom during its progress, or after its termination. In some instances the ordinary doses fail to cause sleep, and in others the sleep is attended with dreams and hallucinations, and followed by unpleasant symptoms, like those which often succeed other hypnotics, especially opium; such as nausea, headache, unpleasant nervous disorder, etc. These diversities may be ascribed in part to peculiarity of constitution; but more frequently, in all probability, they are owing to morbid conditions existing at the time, which oppose themselves to the proper action of the choral. In an individual in health chloral will probably almost always induce a calm sleep, differing little from the natural. Moreover, these unpleasant symptoms are now much more rarely produced than formerly, and there can be but little doubt that they have often been due to impurities in the drug. The pulse is in this degree of action not affected, or is rendered a little slower; the pupil is contracted, but becomes normal so soon as the subject is awakened; the respiration is deep, full, and regular. When larger amounts are given, the sleep is much deeper, and may pass into profound coma; the respirations fall in number; the pulse is weakened and rendered slower, but may become rapid and irregular if the dose has been toxic; the temperature is reduced; the muscular system is relaxed, and both sensibility and reflex action are diminished. If a fatal dose has been given, all these symptoms are intensified: with coma, intense muscular relaxation, weak, thready pulse, and a pupil contracted at first, but afterwards dilated, the victim gradually sinks into death, paralyzed and anæsthetic. The immediate cause of death is generally a paralytic arrest of respiration; but in many cases there appears to be a simultaneous arrest of the cardiac action, and it is very possible that fatal syncope may at times occur. At post-mortem examination, congestion of the meninges and substance of the brain and cord, and of the lungs, is commonly found. The blood is thought by Richardson (*Med. Times and Gaz.*, Sept. 4, 1870) to coagulate less firmly than normal.

After the brain the motor tract of the spinal cord, including the respiratory centre, is most sensitive to the action of chloral. The loss of voluntary muscular power and the lessening of reflex activity which the drug produces, are the result of this spinal influence. Upon the sensory tract of the cord chloral acts with much less vigor, while the nerves and muscles practically escape its influence. Of course any agent which produces sleep in some measure relieves pain, but the anæsthetic influence of chloral is far from pronounced, and often patients on waking will complain bitterly of pain suffered during sleep.

The physiological action of chloral may be summed up as follows. Upon the cerebrum it acts as a most powerful and certain hypnotic; in full doses it acts as an intense depressant upon the centres at the base of the brain, and upon the spinal cord, causing slowing and weakness of the heart's action, probably vaso-motor paralysis, slowing of the respiration, and muscular weakness, lessening of reflex activity, with a certain amount of anæsthesia; in fatal doses it causes death generally by arresting respiration through paralysis of the nerve-centres, and finally stopping the heart in diastole. Its action in very small doses is uncertain, but there is considerable evidence to indicate that it irritates or stimulates the spinal and the cardiac, and even the vaso-motor, centres. On the vagi and on the motor nerve trunks it has no marked influence. Clinical experience indicates that chloral acts as a depressant to

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the heart-muscle; although some authorities believe the influence of the drug upon the heart is not direct, but exerted through the nerve-centres. Chloral has little effect on the secretions, though it is said somewhat to increase the secretion of urine. In man, it is stated by Bouchut that, in accordance with his observations, this secretion is not only increased, but has been found also augumented in density; at the same time reducing the cupro-potassic liquor, and rendered brown by potassa or subnitrate of bismuth; as if a temporary glycosuria were produced. Formic acid has never been found in the urine as a result of the taking of chloral. (*Arch. Gén.*, Sept. 1870, p. 346.)

Action as Chloral. The conversion of chloral by alkalies in solution into chloroform and formic acid first suggested its use in medicine to Liebreich (*Wiener Medizinische Wochenschrift*, August, 1869); and the theory that its action is really due to chloroform generated by the alkalinity of the blood has been received with favor by Personne and other writers, but there are very many facts which militate against the truth of this supposition. Thus chloroform cannot be detected either in the blood, breath, or excretions of chloralized animals, although chloroform at once manifests itself when it is administered, and in the so-called "salt frogs" of Cohnheim, after substitution of warm salt water for the blood of the animal, chloral acts as upon the normal batrachian.

Chloral, especially when used continuously, is said to produce in some individuals serious disturbances. Such are vaso-motor paralysis, transient skin neurosis, acute purpura, and great prostration of the heart's action, sometimes amounting to paralysis of that organ; and sometimes ending fatally, even though the doses of the chloral used were within the limits ordinarily deemed safe. For a full discussion of these phenomena, see H. C. Wood's *Therapeutics*. Dr. Hawkes, though a strong advocate for the use of chloral, has found it repeatedly prejudicial in the general paralysis of mania and in elderly persons with feeble circulation and impaired nutrition. There can be no doubt that great caution should be practised in administering the drug when the heart is very weak, or the general powers much enfeebled. Dr. Jolly relates two cases in which 5 grammes (about 76 grains), given every night, caused death, in one case after the fifth dose, and, in the second, after the thirteenth, without abnormal symptoms until after the last dose, when the action of the heart and respiration suddenly ceased, and the patient died. (*New York Med. Journ.*, Nov. 1872.) These cases would appear to justify the statement that there is a possible cumulative action of the drug. Although 480 grains have been recovered from, Dr. Fuller has recorded a case in which a single dose of thirty grains proved fatal in a young lady, and two others in which the same quantity caused alarming symptoms in similar circumstances; so that the highest dose to begin with in ordinary diseases, especially in delicate women, should not exceed twenty grains. In poisoning by chloral, if the case be seen early, the stomach should be thoroughly evacuated by an emetic or the stomach-pump, and the system afterwards supported by cardiac and respiratory stimulants, as milk punch, carbonate of ammonium, etc. Atropine, digitalis, and strychnine should be administered freely, and the same general measures taken to sustain the respiration as are usually practised in opium poisoning. Atropine is undoubtedly of value when there is failure of respiration, and care should always be taken to maintain the bodily temperature. Artificial respiration should be practised when necessary. Care also should be exercised to maintain the bodily temperature by external heat. Dr. Liebreich recommends strychnine as an antidote; having found that poisonous doses of the two substances, introduced into the same animal, neutralize each other's operation, and no serious effect ensues.

From what has been said it will be readily perceived that the two great indications for this remedy are to procure sleep and to relax spasm. In pure nervous insomnia, and in the same affection attendant on other diseases, as in acute fevers, active congestion of the brain, cerebral inflammation, mania, delirium tremens, etc., it is superior to opium; fifteen to twenty or twenty-five grains (1–1·3 or 1·565 Gm.) are generally sufficient for a commencing dose, to be repeated in half the quantity in an hour, if the first dose fail. The sleep is usually calm and undisturbed

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for three or four hours, and may be renewed, if required, by the repetition of the dose. When the sleeplessness is due to pain, opium is much more effective than chloral. The combination of chloral and morphia is often very useful in procuring sleep for the suffering. As an anæsthetic, chloral should never be employed; the intravenous use of it as practised to some extent in France is most dangerous and absolutely unjustifiable. In spasmodic affections chloral is one of the most powerful remedies known. In tetanus it is singularly useful, but must be given in very large doses. In hysteria, severe chorea, and other functional or spinal convulsions, it is no less efficient. In epilepsy and other forms of cerebral convulsions chloral is of less service, although it is frequently employed with benefit in puerperal convulsions. In local spasms it is often of service, and has been used with success in strangulated hernia, spasm of the glottis, spasmodic croup, asthma, hiccough, and even in incontinence of urine. Chloral is possessed of very decided antiseptic properties; a solution of the strength of 30 grains to the ounce will preserve animal tissues for a long time. Locally applied it is narcotic and antiseptic, and has been used in foul sores, irritable ulcers, etc.

Pharmaceutical Preparations. Chloral is best administered in solution with syrup of orange flowers, or in simple solution. The French sometimes employ *chloral cream*, made of chloral hydrate 5 parts, water 15 parts, white sugar finely powdered 100 parts, flavored with mint, orange, or vanilla. One grain of chloral is contained in 24 grains of the cream, and a teaspoonful is equivalent to about 8 grains of chloral. This preparation keeps well, and the dose may be dissolved in a little water. *Chloral liniment* may be made by dissolving 6 parts of chloral in 30 parts oil of sweet almonds. *Chloral ointment*, 6 parts chloral, 3 parts white wax, 27 parts lard; the lard and wax are melted at a gentle heat, the chloral added in powder and dissolved. *Camphorated chloral* is made by rubbing together equal parts of camphor and chloral, forming a thick liquid. *Chloral plaster*, to produce counter-irritant effects, is prepared by spreading powdered chloral on Burgundy pitch plaster.

CHLOROFORMUM PURIFICATUM. *U. S.* *Purified Chloroform.*

$CHCl_3$; 119·2. (KLŌ-RŌ-FÖR'MŬM PŪ-RĮ-FĮ-CĀ'TŬM.) C_2HCl_3: 119·2.

Chloroformum, *Br.*; Chloroformium, *P.G.*; Formylem Trichloratum; Chloroforme pur, *Fr.*; Reines Chloroform, *G.*

"Commercial Chloroform, *two hundred parts* [or seventy fluidounces]; Sulphuric Acid, *forty parts* [or eleven and a half fluidounces]; Carbonate of Sodium, *ten parts* [or five ounces av.]; Lime, in coarse powder, *one part* [or half an ounce av.]; Alcohol, *two parts* [or two and a quarter fluidounces]; Water, *twenty parts* [or ten fluidounces]. Add the Acid to the Chloroform and shake them together, occasionally, during twenty-four hours. Separate the lighter liquid and add to it the Carbonate of Sodium previously dissolved in the water. Agitate the mixture thoroughly for half an hour and set it aside; then separate the Chloroform from the supernatant layer, mix it with the Alcohol, transfer it to a dry retort, add the Lime, and, taking care that the temperature in the retort does not rise above 67·2° C. (153° F.), distil, by means of a water-bath, into a well-cooled receiver, until the residue in the retort is reduced to *two parts* [or six fluidrachms]. Keep the product in glass-stoppered bottles, in a cool and dark place." *U. S.*

"Take of Chlorinated Lime *ten pounds* [avoirdupois]; Rectified Spirit *thirty fluidounces* [Imperial measure]; Slaked Lime *a sufficiency*; Water *three gallons* [Imp. meas.]; Sulphuric Acid *a sufficiency*; Chloride of Calcium, in small fragments, *two ounces* [av.]; Distilled Water *nine fluidounces* [Imp. meas.]. Place the Water and the Spirit in a capacious still, and raise the mixture to the temperature of 100°. Add the Chlorinated Lime and five pounds [av.] of the Slaked Lime, mixing thoroughly. Connect the still with a condensing worm encompassed by cold water, and terminating in a narrow-necked receiver; and apply heat so as to cause distillation, taking care to withdraw the fire the moment the process is well established. When the distilled product measures fifty ounces, the receiver is to be withdrawn. Pour its contents into a gallon [Imp. meas.] bottle half filled with Water, mix well by shaking, and set at rest for a few minutes, when the mixture will separate into

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two strata of different densities. Let the lower stratum, which constitutes crude chloroform, be washed by agitating it in a bottle with three [fluid]ounces of the Distilled Water. Allow the Chloroform to subside, withdraw the water, and repeat the washing with the rest of the Distilled Water, in successive quantities of three [fluid]-ounces at a time. Agitate the washed Chloroform for five minutes in a bottle with an equal volume of Sulphuric Acid, allow the mixture to settle, and transfer the upper stratum of liquid to a flask containing the Chloride of Calcium mixed with half an ounce of Slaked Lime, which should be perfectly dry. Mix well by agitation. After the lapse of an hour connect the flask with a Liebig's condenser, and distil over the pure Chloroform by means of a water-bath. Preserve the product in a cool place, in a bottle furnished with an accurately ground stopper. The lighter liquid which floats on the crude Chloroform after its agitation with water, and the washings with Distilled Water, should be preserved, and employed in a subsequent operation." *Br.*

In the U. S. Pharmacopœia of 1850 a process was given for preparing chloroform; but as this is never made on a small scale by the apothecary, but purchased of the manufacturer, it was very properly transferred, at the next revision, to the Materia Medica Catalogue. But, as the chloroform of commerce is often impure, and, though fitted for external use, and for various pharmaceutical purposes, is, in this impure state, unfit for use as a respiratory anæsthetic agent, it was deemed advisable to introduce a formula by which its purification, if required, might be readily effected. This process is the first of those above given. The process of the British Pharmacopœia is for the preparation of the chloroform *ab initio*, with directions which secure its purity if complied with. In this process, the reaction by which the chloroform is produced takes place between the chlorinated lime and the alcohol; the slaked lime, which is added in accordance with the directions in the late Dublin Pharmacopœia, being intended probably to lessen the production of the chlorinated pyrogenous oil, the amount of which is greater, according to Soubeiran and Mialhe, in proportion to the relative excess of the chlorine to the lime employed. The use of this earth is stated by some chemists to give rise to Dutch liquid, or ethene chloride, $C_2H_4Cl_2$, and to increase the product at the expense of its purity.* As first distilled, the chloroform is very impure, and is directed to be washed first with ordinary water, and afterwards with distilled water, which separate alcohol, chlorine, and probably other contaminating substances. In consequence of the density of the chloroform and its insolubility in water, it readily subsides, forming a distinct layer which may be easily separated. The crude product, after having been freed from alcohol by the washing with water, is purified from the chlorinated pyrogenous oil, which comes over with the chloroform, by agitation with an equal volume of sulphuric acid, which ought to be *pure* and *colorless*, and at least of the density 1·840. The oil is charred and destroyed by the acid, which becomes yellow or reddish brown, and is partially changed into sulphurous acid. To remove the latter acid, as well as any water present, the chloroform, which floats on the surface of the acid, is removed and agitated well with chloride of calcium and slaked lime, and then again submitted to distillation. According to Gregory and Kemp, of Edinburgh, by whom the use of sulphuric acid for this purpose was proposed, chloroform is effectually purified from the pyrogenous oil by agitation with this acid if strong and pure. So long as a ring, darker than the rest of the acid, appears, after rest, at the line of contact between the acid and the chloroform, the agitation must be repeated; and the oil is known to be fully separated when the acid remains colorless. Black oxide of manganese has been employed to separate the sulphurous acid; but, in this case, the chloroform is apt to become, after the lapse of a few weeks, of a delicate pink color, which sometimes disappears and then returns. This coloration depends upon the presence of manganese, and forms an objection to the use of the black oxide as a purifier.

In the U. S. process the method of purification is somewhat different. Instead of equal measures of the impure chloroform and sulphuric acid and an agitation for only 5 minutes, the commercial chloroform is shaken occasionally for 24 hours with but

* According to Gehe & Co. (June, 1881), the yield of pure chloroform is nearly 8 per cent. of the amount of chloride of lime used; this being the average product during several months' manufacture of chloroform.

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one-fifth of its weight of the acid. To remove any water and acid that may be present, instead of chloride of calcium and lime, a little stronger alcohol is mixed with the chloroform, and then carbonate of sodium previously heated to redness, and the mixture is distilled to dryness.

It sometimes happens that the chloroform purified with sulphuric acid, though apparently pure at first, will not keep, but, after some time, becomes so loaded with chlorine and hydrochloric acid as to be altogether unfit for respiration. Dr. Christison ascertained that, if the sulphuric acid employed contain hyponitric acid, the chloroform changes in less than 24 hours. The idea has been entertained that it would be necessary to abandon sulphuric acid as a purifying agent; but experience has shown that, with certain precautions, it may be safely used; and its efficiency in getting rid of the empyreumatic impurity is so great that it is still much employed for the purpose. The British Council endeavors to escape the difficulty by using a large quantity of the acid, and allowing but very brief contact; while in the U. S. process the same end is arrived at by employing a comparatively small quantity of the acid, with a much longer period for its operation. In any case, however, the acid should be strong and pure, and especially free from any of the nitrogen acids; and care should afterwards be taken to remove every particle of the sulphuric or sulphurous acid, as is done in the officinal processes, by lime and carbonate of sodium. Dr. Squibb attributes the fact, that chloroform purified by concentrated sulphuric acid does not keep well, to the very purity attained. He believes that perfectly pure chloroform is prone to decomposition, and is rendered more stable by the addition of a small proportion of alcohol, so as to reduce its density to the officinal standard, 1·49. This he effects by adding alcohol in the proportion of ten drops to each fluidounce of good chloroform of maximum density. This recommendation is carried into effect in the U. S. process, and explains the addition of alcohol before distillation. Dr. Gregory also attributes the tendency to decomposition to its purity, and to the action of sunlight; having found that those portions which he had purified with the greatest care were soonest decomposed under the influence of light.

As chloroform of great purity is often to be purchased in the market, it is not necessary for the pharmacist to apply the officinal process of purification to every parcel that he may meet; but it is in the highest degree incumbent on him to sell none for inhalation which is not so pure as to stand the tests given in the Pharmacopœia, and if he can obtain none so pure, then to purify it himself. All pure specimens, moreover, should be kept distinct, and labelled with the officinal title of Purified Chloroform, for the sake of distinction.

The intermediate formation of chloral as a result of the reaction between alcohol and chlorinated lime suggested the preparation of chloroform from chloral, which has of late years been produced in immense quantities. The advantages which were anticipated by decomposing pure chloral hydrate with alkalies have not altogether been realized, for the product is much more expensive, and the claim of greater stability has not been sustained, as it requires just as much alcohol to preserve it as that made in the usual way.

Chloroform may be made by the action of chlorinated lime on pyroxylic spirit (wood spirit); but when thus prepared it is largely contaminated with a chlorinated pyrogenous oil, analogous to that already mentioned as being found in small proportion in chloroform prepared from alcohol. Chloroform, thus prepared, called *methylic chloroform*, is purified with much more difficulty than is that made with alcohol, called by Soubeiran *normal chloroform*. In Great Britain chloroform is now obtained by the use of methylated spirit; and the preparation, when properly purified, is stated to answer every purpose to which it is applied equally well with that obtained by the use of alcohol. Damoiseau (*Comptes-Rendus*, vol. xcii. p. 42, 1881; *N. R.*, 1881, p. 71) describes a new method of making chloroform, by passing chlorine, mixed with the proper proportion of methyl chloride, through a long tube containing animal charcoal, heated from 250° C. to 350° C. (482° F. to 662° F.). (See *Methylic Alcohol* in Part II.)

Pettenkofer inferred, from numerous experiments on the manufacture of chloroform, that very different quantities are obtained, on different occasions, from the same

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amount of materials, and the same process. The yield is less, the longer the mixture is allowed to stand before distillation, and is greater when the heat of the mixture is between 57·2° C. (135° F.) and 75° C. (167° F.) than at either a lower or higher temperature. When the latter degree is exceeded, the chloroform contains more chlorine. (*Buchner's Neues Repert.*, x. 103.)

Discovery and History. Chloroform was discovered by Mr. Samuel Guthrie, of Sackett's Harbor, N. Y., in 1831, and about the same time by Soubeiran in France, and Liebig in Germany. Guthrie obtained it by distilling a gallon from a mixture of three pounds of chlorinated lime and two gallons of alcohol of the sp. gr. 0·844, and rectifying the product by redistillation, first from a great excess of chlorinated lime, and afterwards from carbonate of potassium. (*Silliman's Journal*, vol. xxi., Jan. 1832, p. 64.) In a subsequent letter to Professor Silliman, dated Feb. 15, 1832, Mr. Guthrie states that the substance which he had obtained, "distilled off sulphuric acid, has the specific gravity of 1·486, or a little greater, and may then be regarded as free from alcohol; and if a little sulphuric acid which sometimes contaminates it be removed by washing it with a strong solution of carbonate of potassium, it may then be regarded as *absolutely pure*." (*Ibid.*, vol. xxii., July, 1832, p. 105.) It is thus evident that Mr. Guthrie obtained, in a pure state, the substance now called chloroform; but he erroneously supposed his product to be the well-known oily liquid of the Dutch chemists, which it greatly resembles, and for the preparation of which he believed he had fallen on a cheap and easy process. Under this impression, he called the substance, in his communications, *chloric ether*, one of the names by which *Dutch liquid*, or *Ethene dichloride*, is designated. He was induced to make the preparation from noticing, in Professor Silliman's Elements of Chemistry, a reference to the Dutch liquid as a grateful diffusible stimulant, when properly diluted with alcohol and water.

Properties. Chloroform is "a heavy, clear, colorless, diffusive liquid, of a characteristic, pleasant, ethereal odor, a burning, sweet taste, and a neutral reaction. Soluble in about 200 parts of water, and, in all proportions, in alcohol or ether; also in benzol, benzin, fixed or volatile oils. Sp. gr. 1·485–1·490 at 15° C. (59° F.). It boils at 60° to 61° C. (140° to 142° F.), corresponding to the presence of three-fourths (¾) to one (1) per cent. of alcohol." *U. S.* According to Remys (*Archiv der Pharm.*, 3, v. 31), pure chloroform has the sp. gravity of 1·500 at 15° C. (59° F.). Besnou gives the densities of various mixtures of alcohol and the purest commercial chloroform at 4·5° C. (40° F.) as follows:

Specific Gravity.	Chloroform, per cent.	Alcohol, per cent.	Specific Gravity.	Chloroform, per cent.	Alcohol, per cent.
1·4945	100·0	0·0	1·4772	97·5	2·5
1·4908	99·5	0·5	1·4602	95·0	5·0
1·4874	99·0	1·0	1·4262	90·0	10·0
1·4845	98·5	1·5	1·4090	87·5	12·5

When pure, it has no action on potassium, except to cover the surface of the metal with small bubbles of gas. Chloroform is a powerful antiseptic. It does not, like creasote, coagulate albumen. It is scarcely acted on by sulphuric acid in the cold, but dissolves readily in alcohol and ether. The alcoholic solution, when moderately diluted with water, forms an aromatic, saccharine liquid of a very grateful taste. A strong alcoholic solution is decomposed by abundance of water, the chloroform separating and subsiding, and the alcohol uniting with the water. It is liable to decomposition by sunlight, or even diffused daylight; and hence the propriety of keeping it in bottles, covered with dark paper, in a rather dark place. Chloroform has extensive solvent powers, being capable of dissolving caoutchouc, gutta-percha, mastic, elemi, tolu, benzoin, and copal. Amber, sandarac, lac, and wax are only partially soluble. It also dissolves iodine, bromine, the organic alkalies, the fixed and volatile oils, most resins, and fats. It dissolves sulphur and phosphorus sparingly. It possesses the power of dissolving a large quantity of camphor, and furnishes the means of admin-

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istering that medicine in an elegant form. As a general solvent, it has the advantage over ether of not being inflammable; the inflammability of the latter being the cause of frequent accidents. For an extensive list of substances, soluble, insoluble, and partly soluble in chloroform, see a paper by M. Lepage, of Gisors, France, copied into *A. J. P.*, 1852, p. 147.* It has been found by J. B. Barnes that chloroform has the power of preventing the alcoholic, lactic, and other fermentations, probably by killing the organisms that provoke these processes. Twenty minims preserved sixteen ounces of malt, to which two drachms of yeast had been added, as long as the experiment lasted. The same quantity kept fresh eight fluidounces of milk in a warm place for five days. Mucilage and infusions were preserved for weeks with one minim or even less to the ounce. Similar results were reached by Mr. F. J. Barrett and others. (*P. J. Tr.*, 1874, pp. 441, 442, 455.) The active properties of chloroform forbid its use as a preservative of medicinal infusions, but from milk it could always be removed by boiling. A. Munz (*P. J. Tr.*, 1875, p. 967) proposes the employment of chloroform as a test between chemical and living ferments, since he has found it to have no effect upon the former, though absolutely destructive to the latter.

Composition. Chloroform is composed of one atom of carbon, one of hydrogen, and three of chlorine. Its simplest derivation in theory is from marsh-gas (*methane*), CH_4, whence it is often called "*trichloro-methane.*" While it can be thus produced, by the action of chlorine upon marsh-gas, in practice, it is formed either from alcohol by the action of bleaching-powder, or from chloral by an alkaline hydrate.

The reactions are sometimes complex, but if the temperature be carefully kept at from 70° C. (158° F.) to 73° C. (163·4° F.), they are essentially as follows:

$$C_2H_6O + CaOCl_2 = CaCl_2 + C_2H_4O + H_2O;$$

that is, one molecule of bleaching-powder, reacting with one of alcohol, yields one of calcium chloride, one of aldehyd, and one of water. The aldehyd formed is then further decomposed according to the reaction:

$$2(C_2H_4O) + 6(CaOCl_2) = 3CaCl_2 + 3Ca(OH)_2 + 2(C_2HCl_3O_2);$$

that is, two molecules of aldehyd, reacting with six of bleaching-powder, yield three of calcium chloride, three of calcium hydrate, and two of chloral. The chloral is, however, decomposed by the free base calcium hydrate according to the reaction:

$$2(C_2HCl_3O_2) + Ca(OH)_2 = Ca(CHO_2)_2 + 2(CHCl_3);$$

that is, two molecules of chloral, reacting with one of calcium hydrate, yield one of calcium formate and two of chloroform.

Impurities and Tests. Chloroform is liable to contain alcohol and ether, both of which lower its specific gravity. If it have a less density than 1·38, it will float instead of sinking in a mixture of equal weights of concentrated sulphuric acid and water, after it has cooled. M. Mialhe has proposed the following test for the presence of alcohol. Drop into distilled water a small quantity of the chloroform. If pure, it will remain transparent at the bottom of the glass; but, if it contain even a small proportion of alcohol, the globules will acquire a milky appearance. Soubeiran's method was to agitate almond oil and chloroform together in a tube. If the chloroform be pure, it remains clear; if it contain as much as 5 or 6 per cent. of alcohol, it becomes milky. (*Journ. de Pharm.*, Août, 1860, p. 95.) Prof. Procter detected alcohol by adding the suspected chloroform to an oxidizing mixture of bichromate of potassium and sulphuric acid. If alcohol be present, the deep orange color of the chromic mixture will gradually become green; if absent, no change of color will take

* The following table of the solubility of the several alkaloids and their salts in chloroform, prepared with great care by A. Schlimpert, may be of some practical use. At 17·7° C. (64° F.) 100 parts of chloroform dissolve

Morphine	1·66	Sulphate of cinchonine	3·00	Caffeine	11·00
Acetate of morphine	1·66	Chinoidine	25·30	Digitaline	1·25
Quinine	15·00	Veratrine	11·60	Brucine	14·00
Sulphate of quinine	0·00	Atropine	33·00	Aconitine	22·00
Hydrochlorate of quinine	11·10	Strychnine	14·10	Santonin, pure	23·00
Cinchonine	2·50	Nitrate of strychnine	6·60	Santonin, impure	33·30

(*A. J. P.*, 1860, p. 160; from *Archiv de Pharm.*, Nov. 1859, p. 151.)

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place. (*A. J. P.*, 1856, p. 213.) Hoffmann's violet has been recently suggested as a test. If a small portion is added to chloroform containing alcohol, the solution is colored a deep purple. Boettger recommends adding to the chloroform a solution of molybdic acid in pure, strong sulphuric acid, when even a trace of alcohol will cause an intense blue color. (1879.) A. C. Oudemans, Jr, affirms that the percentage of alcohol may be correctly estimated by the power of the suspected liquid to dissolve cinchonine (*A. J. P.*, 1873, p. 223), and gives the table inserted in the note below.* The most injurious impurities are the chlorinated pyrogenous oils, already alluded to. These are different as obtained from methylic or normal chloroform. The oil, obtained by Soubeiran and Mialhe from methylic chloroform, is an oleaginous, yellow liquid, lighter than water, and of a peculiar nauseous empyreumatic odor, perceptible in the methylic chloroform itself. In commercial chloroform it is sometimes present to the amount of 6 per cent. It is easily set on fire, and burns with a smoky flame, chlorine being among the products of its combustion. The oil procured from normal chloroform, which contains it in the amount of about one-fifth of 1 per cent. only, is essentially different from the methylic chloroform oil. It is heavier than water, and has an acrid, penetrating odor, unlike that of the other oil. When the vapor of these oils is inspired or even smelt, it causes, according to Dr. Gregory, distressing sickness and headache. These pyrogenous oils are detected and removed by *pure* and *strong* sulphuric acid. Chloroform, when pure, upon being mixed with an equal volume of this acid, does not color it; but, when contaminated with these oils, gives the acid a color, varying from yellow to reddish brown, according to the amount of impurity. Alcohol also is detected and removed by sulphuric acid. In applying this test, several fluidounces of chloroform should be used; as a slight change of color cannot be easily seen in a test-tube, and care must be taken to see that mechanical impurities like cork-dust, dirt, etc., have been filtered out of the specimen, or the acid will be discolored from this cause. A still more delicate test of the oily impurities, according to Dr. Gregory, is the smell which they leave. If chloroform, thus contaminated, be poured upon the hand, it quickly evaporates, leaving the oily impurities, recognizable by their offensive odor, now no longer covered by that of the chloroform. The pure substance, rubbed on the skin, quickly evaporates, and leaves scarcely any smell. Chloroform sometimes contains Dutch liquid, which may be discovered by adding an alcoholic solution of potassa; when the mixture, if this impurity be present, will heat and give off a permanent gas, which is *chloride of acetyl*, C_2H_3OCl. (*Geuther.*)† Fuming nitric acid, heated with chloroform to 90° C. (194° F.) for 120 hours, forms a new substance, chloropicrine. (*Journ. de Pharm.*, 4e sér., xv.)

Certain conclusions of Prof. John M. Maisch upon the subject of chloroform, drawn from a series of practical and experimental observations, are worthy of notice. Chloroform may be made of the sp. gr. 1·5, or perhaps somewhat heavier, and this is its density when pure; but it will not keep so well as when of the officinal strength from 1·490 to 1·494. When pure, or even of the sp. gr. of about 1·49, it is quickly decomposed in direct sunlight, and more slowly in diffused daylight; and the presence of water, however small in quantity, favors the decomposition. The prod-

* Percentage of Alcohol.	Percentage of Cinchonine by weight, at 17° C.	Difference between it and pure Chloroform.	Percentage of Alcohol.	Percentage of Cinchonine by weight, at 17° C.	Difference between it and pure Chloroform.
0	0·28	0	6	3·39	40
1	0·90	62	7	3·79	36
2	1·46	56	8	4·15	33
3	1·99	53	9	4·48	28
4	2·49	47	10	4·76	...
5	2·96	43	11	.....	...

The cinchonine is best prepared by precipitating a weak alcoholic solution of a pure salt of the alkaloid by ammonia.

† In relation to chloroform, see the paper of Soubeiran and Mialhe, *Journ. de Pharm.*, July, 1849, copied into *A. J. P.*, xxi. 313; also the paper of Dr. Gregory, *Chem. Gaz.*, May 15, 1850.

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ucts of its decomposition are hydrochloric acid and phosgene gas. If, however, it be perfectly excluded from the light, it will keep indefinitely; Wiggers having preserved some, unaltered, for fifteen years. According to Schacht, moreover, pure chloroform will resist even sunlight, if in a perfect vacuum. To prevent the decomposition of chloroform the most effectual means is the addition of alcohol. If reduced by this to the sp. gr. 1·480 or 1·484, it will keep well in diffused daylight, and, for a time at least, even in the sun's rays, if perfectly free from moisture. At the sp. gr. 1·475 or lower, it remains unaffected whether in diffused light or in the sun, and whether the bottles be damp or dry. The measures, therefore, to secure chloroform from decomposition are two, either of which will answer; first, to keep it perfectly secluded from light, from the moment of rectification; or, secondly, to reduce the sp. gr. to 1·475 by alcohol, as suggested by Dr. Squibb. Sulphuric acid will not decompose chloroform in the dark; in the light it evolves hydrochloric acid. One of the best criteria of its purity is a constant boiling point. When of the sp. gr. 1·496, it boils at 67° C. (152·6° F.). A slight acid reaction in chloroform is not easily detected, as litmus is quite insoluble in that fluid. It is best observed by allowing a few drops of chloroform to evaporate spontaneously with one drop of an aqueous solution of litmus duly neutralized. The color will be changed to reddish. After becoming acid, chloroform may be readily regenerated, by agitating it with solution of carbonate of sodium, and distilling from a little unslaked lime. From what has been said above, chloroform to be kept for use should have the sp. gr. 1·475, and if denser than this, should be brought to it by the addition of alcohol. It is best kept in cork-stoppered bottles. As the cork is not acted on by chloroform, if it become yellow and softened, it will indicate the presence of an acid, and thus act as a test. (*A. J. P.*, 1868, p. 289.)

Boettger states that chloroform altered by the sun's rays, containing hydrochloric acid and having a chlorinous odor, may be restored and made fit for inhalation by agitation with a few fragments of caustic soda, and that the fluid may be kept exposed to light, if protected in the same way. (*Ibid.*, Sept. 1866, p. 473; from *Journ. de Pharm.*, Avril, 1864.) M. Jaillard (*Journ. de Pharm.*, 4, sér. xxii., p. 305) states that he has frequently found both hydrochloric and formic acids in chloroform exposed for sale. He employs nitrate of silver as a test, using an excess of the reagent; he filters out the precipitated chloride, and boils, when, if formic acid be present, black metallic silver is deposited.

Officinal Tests. The U. S. Pharmacopœia directs that "if 5 C.c. of Purified Chloroform be thoroughly agitated with 10 C.c. of distilled water, the latter, when separated, should not affect blue litmus paper (abs. of acids), nor test-solution of nitrate of silver (chloride), nor test-solution of iodide of potassium (free chlorine). If a portion be digested, warm, with solution of potassa, the latter should not become dark colored (abs. of aldehyde). On shaking 10 C.c. of the Chloroform with 5 C.c. of sulphuric acid, in a glass-stoppered bottle, and allowing them to remain in contact for twenty-four hours, no color should be imparted to either liquid. If a few C.c. be permitted to evaporate from blotting-paper, no foreign odor should be perceptible after the odor of Chloroform ceases to be recognized." *U. S.* These tests imply the presence of but a minute proportion of alcohol, and the total absence of chlorine and those volatile and empyreumatic substances which constitute the most injurious impurities of chloroform. A heat that would be felt through the bottle, on the admixture of sulphuric acid with chloroform, would evince the presence of too much alcohol or water. The want of discoloration from the contact of the two liquids shows the absence of empyreumatic oily matter; but a very slight discoloration might proceed from the alcohol present, and would not, therefore, be a material objection. A color bordering on that of madeira wine would imply an objectionable amount of impurities. The volatile impurities are less volatile than chloroform, and would consequently be the last to escape on the evaporation of the liquid. Impure chloroform, therefore, leaves a foreign odor behind it when allowed to evaporate from the hand, and especially when from a porcelain plate, in the amount and manner indicated; and if a specimen stand this test well, it may be considered as free from noxious volatile impurity. The slight foreign aroma without pungency,

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which is given out under these circumstances, is of no injurious significance. It is stated that chloroform made from chloral may be distinguished from other chloroform by its remaining colorless when the sulphuric acid test is employed, and by its leaving no aromatic residue when evaporated, evidences of its absolute purity. It has been claimed that this chloral chloroform does not undergo decomposition, but this has been proved not to be correct. (*A. J. P.*, xlii. 409.)

Medical Properties and Uses. Chloroform, when applied locally, is very irritant and produces decided pain, which may be followed by some numbness and local anæsthesia. If the chloroform be prevented from evaporating, its prolonged contact with the skin is apt to produce blistering. Taken internally, it is absorbed and acts upon the general system. The rapidity of its absorption, and, to some extent, its general effects, depend upon the method in which it is administered. It is commonly exhibited by the mouth or by inhalation. Taken into the stomach in doses of 15 to 25 drops (0·24–0·38 C.c.), it induces only gastric symptoms, chiefly due to its irritant properties; but when there is excessive flatulence, colic, or gastralgia, it not only causes an increased peristalsis and expulsion of any flatus present, but evinces a distinct local narcotic influence by quieting pain and spasm. Taken in doses of 1 to 2 fluidrachms (3·75–7·5 C.c.), it produces a narcotism similar to that seen when it is administered by inhalation, the narcotism, however, developing and passing off much more slowly than in the latter case. Chloroform, as prepared by Mr. Guthrie, was used internally as early as 1832 by Professor Ives and Dr. Nathan B. Ives, of New Haven, in asthma, spasmodic cough, scarlet fever, and atonic quinsy, with favorable results. (*Silliman's Journ.*, xxi. 406, 407.) It was employed by Dr. Formby, of Liverpool, in hysteria, in 1838; by Mr. Tuson, of London, in cancer and neuralgic affections, in 1843; and by M. Guillot, of Paris, in asthma, in 1844. The first case in which it was employed in inhalation is related by Professor Ives, of New Haven, under date of the 2d of Jan. 1832. The case was one of pulmonic disease, attended with general debility and difficult respiration, and was effectually relieved. (*Silliman's Journ.*, vol. xxi., Jan. 1832, p. 406.) In March, 1847, the action of the pure substance by inhalation was tried on the lower animals, by M. Flourens, and its effects on the spinal marrow described. In November of the same year, Dr. Simpson, of Edinburgh, after experimenting with a number of anæsthetic agents in order to discover a substitute for ether, tried chloroform at the suggestion of Mr. Waldie, and, having found its effects favorable, brought it forward as a new remedy for pain, by inhalation in surgery and midwifery. The advantages which he conceived it to possess over ether were the smallness of the dose, its more prompt action, more agreeable effects, less tenacious odor, greater cheapness, and greater facility of exhibition.

The usual effects produced by a full dose of chloroform, administered by inhalation, are the rapid production of coma, relaxation of the muscles, slow and often stertorous breathing, upturning of the eyes, and total insensibility to agents which ordinarily produce acute pain. The effect on the heart's action is somewhat variable, but the pulse is usually quickened, with a more or less marked loss of volume and firmness. Sometimes frothing of the mouth takes place, and, more rarely, convulsive twitches of the face and limbs. The insensibility is generally produced in one or two minutes, and usually continues for five or ten minutes; but the effect may be kept up for many hours, provided the inhalation be cautiously renewed from time to time. As a general rule, no recollection is retained of anything that occurred during the state of insensibility. In some cases sensibility is distinctly affected before consciousness, but the loss is rarely complete enough to be of any practical value; so that it is almost always necessary to produce unconsciousness before the surgeon can commence his operation.

The dose of chloroform for inhalation is a fluidrachm (3·75 C.c.), equivalent to 250 drops, or more, to be repeated in two minutes, if the desired effect should fail to be produced. The most convenient inhaler is a handkerchief, loosely twisted into the form of a bird's nest, which, after having been imbued with the chloroform, is held to the mouth and nose. The use of this simple inhaler insures a due admixture of atmospheric air with the vapor of the chloroform. The patient should

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always be in the horizontal posture. The moment insensibility is produced, which should be brought on *gradually*, the inhalation should be suspended; and, if consciousness return too soon, it should be cautiously renewed. In all cases an experienced assistant should attend to the administration of the chloroform and to nothing else, watching the state of the respiration and pulse. The moment there is the least snoring or failure of the pulse, the vapor should be withdrawn. As shown by Claude Bernard, the hypodermic use of morphine greatly prolongs the anæsthesia caused by chloroform. Chloroform should not be administered to persons subject to epilepsy, affected with organic disease of the heart, or predisposed to syncope. Even with the greatest care, there is always danger in the anæsthetic use of this agent. It is estimated (*Med. Times and Gaz.*, 1870; *Pacific Med. Journ.*, June, 1869) that death occurs once in 3000 inhalations on an average. In very many fatal cases the operation has been a very trifling one, and death has occurred in the most robust, and in those who had previously taken the anæsthetic without bad effects. The advantages which chloroform has over ether are in its greater rapidity of action, and in the fact that it is less prone to produce, as an after-effect, much nausea and vomiting. The greater safety of ether, however, more than counterbalances these advantages, so that a large proportion of surgeons believe the use of chloroform unjustifiable, except under especial circumstances. The reason that ether is so much safer than chloroform lies not chiefly in the greater power of the latter agent, but in the fact that it is directly paralyzant to the heart, whilst ether is primarily stimulant to that viscus. Experiments show that in the lower animals the arterial pressure steadily falls during the administration of the chloroform, whilst under ether it rises, and clinical experience abundantly demonstrates that the effects of these agents upon the circulation in man and in the lower animals are identical. As chloroform accidents usually occur very suddenly, the patient should always be closely watched. In most instances a peculiar pallor of the face is the first evidence of danger. The remedies for the accident are placing the patient at an angle of 45°, with the head downward, or even completely inverting the person, cold air fanned upon the face, cold water poured upon the head, sinapisms to the feet, frictions and heat to the body and extremities, and ammonia to the nostrils. If respiration ceases, the tongue should be seized with the artery-forceps, and pulled forward from off the glottis, and artificial respiration vigorously performed. When the patient can swallow, strong alcoholic drinks may be given with advantage. Dr. Halfourd has proposed the injection of liq. ammonia into the veins, and it has been successfully practised in one or two cases; and if circumstances favor it, intravenous injections of the tincture of digitalis may be employed. Faradaic irritation of the body should also be practised, and in some cases faradization of the phrenic nerve has seemed to be of service. Sometimes chloroform produces unpleasant remote effects; such as abolition of smell, perversion of taste, and loss of tonicity in the bladder and rectum.

In midwifery chloroform is believed to be safer than in surgery, and its use is very extensive. It certainly tends to increase the danger of post-partum hemorrhage, but this tendency can be overcome by the administration of ergot after the head has come well down upon the perineum. It is frequently stated that no case of death has occurred from its administration during labor; but this appears to be a mistake. On account of its power of producing muscular relaxation, chloroform is frequently employed in general and local spasms. In setting fractured bones, in reducing dislocations or strangulated hernias, etc., the surgeon frequently employs it, and it is often used by the physician in hiccough, chorea, hooping-cough, hysteria, the paroxysm of asthma, angina pectoris, biliary and nephritic colic, tetanus, poisoning from strychnine, hydrophobia, and the paroxysm of tic douloureux. In these cases it is superior to ether, when a very prompt action is desirable.

As chloroform is powerfully sedative, and ether powerfully stimulant, it was very naturally supposed that, by combining them, the depressing effects of the former might be counteracted by the latter; but experience has not confirmed the suggestion of theory in this case; as fatal effects have several times followed the joint administration of the two anæsthetics. This result may be in part explained by

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the more rapid volatilization of the chloroform, which may cause it to reach the surface of absorption with comparatively little admixture of the ethereal vapor, as suggested by Mr. Robert Ellis. (*Med. Times and Gaz.*, March 9, 1867.)

Locally, chloroform is employed as a very prompt, active counter-irritant and narcotic in neuralgia, colic, etc., and deep injections of it in the neighborhood of painful nerve trunks have been practised by Dr. Roberts Bartholow with asserted good effects.

M. Fournié has found that the vapor from a mixture of equal measures of glacial acetic acid and chloroform is even more effectual, as a local anæsthetic, than that of pure chloroform; producing complete insensibility of the skin in five minutes, if applied from a bottle heated simply by the hand. (*P. J. Tr.*, 1862, p. 385.)

Chloroform may be gelatinized by agitating it with an equal weight of white of egg in the cold. In three hours it takes the gelatinous form. A stronger preparation may be made by shaking together, in a bottle, four parts of chloroform and one of white of egg, and placing the mixture in water at 60° C. (140° F.). In four minutes the gelatinization is completed. *Gelatinized chloroform* may be applied to the skin, spread on linen, or by friction.

Chloroform, in vapor, may be used as a topical application to the rectum. M. Ehrenreich employed it with success in tenesmus. A drachm may be vaporized by the heat of warm water from a bottle, fitted with a flexible tube, inserted into the bowel. It may be applied to the skin in the form of a vapor douche, according to the method of Dr. Hardy, of Dublin. (See *Ranking's Abstract*, No. 19, p. 287.) Prof. Langenbeck, of Berlin, prefers chloroform to tincture of iodine, as an injection for the radical cure of hydrocele.

When an overdose of chloroform is taken by the mouth, it is essential to empty the stomach by the pump or siphon tube, and then treat the case much as in serious narcosis from inhalation. In a case of suicide by swallowing chloroform, in which death took place in about thirty-four hours, the lining membrane of the larynx and trachea was found inflamed, the bronchi were loaded with a dirty-gray purulent fluid, the lungs were inflamed as in the first stage of pneumonia, and the brain and its membranes congested; but these morbid appearances are not constant.

In relation to the preparations, consisting of chloroform and alcohol, which have been used under the name of "chloric ether," the reader is referred to *Spiritus Chloroformi.**

Off. Prep. Mistura Chloroformi, *U. S.;* Spiritus Chloroformi; Tinctura Chloroformi Composita, *Br.*

CHLOROFORMUM VENALE. *U. S.* *Commercial Chloroform.*

(ĈHLŌ-RO-FÔR'MŬM VĘ-NĀ'LĒ.)

"A liquid containing at least 98 per cent. of Chloroform." *U. S.*

Chloroforme vénal, *Fr.;* Käufliches Chloroform, *G.*

The employment of commercial chloroform should be restricted to preparations for external application, or as a solvent. "Commercial Chloroform has nearly the same sensible properties as Purified Chloroform (see *Chloroformum Purificatum*). Its sp. gr. should not be lower than 1·470. If 1 C.c. be agitated with 20 C.c. of distilled water, the latter, when separated, should not render test-solution of nitrate of silver more than slightly turbid (limit of foreign chlorine compounds). When shaken with an equal volume of sulphuric acid, the subsiding, acid layer should not become quite black within twenty-four hours. A portion evaporated should leave no fixed residue." *U. S.*

Off. Prep. Chloroformum Purificatum, *U. S.;* Linimentum Chloroformi, *U. S.*

* *Chlorodyne.* An empirical remedy under this name was first used in London, but is now in some of its imitations very largely employed in various parts of the world. Many formulas are extant. The following has been extensively used in Philadelphia. Hydrochlorate of morphine 8 grains, water f℥ss, hydrochloric acid f℥ss, chloroform f℥iss, tincture of cannabis Indica f℥i, hydrocyanic acid, U. S. P., ♏xii, alcohol f℥ss, oil of peppermint ♏ij, oleoresin of capsicum ♏i. The hydrochlorate of morphine and water are heated in a flask with the hydrochloric acid until a clear solution is produced, then the other ingredients are mixed together, and when the first solution is cold the mixture added to it. This is a dangerous remedy, and should be used with great care in three to ten drop doses for an adult.

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CHONDRUS. *U. S. Irish Moss.*

(KHŎN'DRUS.)

"Chondrus crispus, Lyngbye, and Chondrus mammilosus, Greville. (*Nat. Ord.* Algæ.)" *U. S.*

Carrageen, *P.G.;* Caragahen, Fucus Crispus; Carragaheen, Mousse marine pertée, *Fr.;* Irländisches Moos, Perlmoos, Knorpeltang, *G.*

Gen. Ch. Frond cartilaginous, dilating upwards into a flat, nerveless, dichotomously divided expansion, of a purplish or livid-red color. *Fructification*, subspherical capsules in the substance of the frond, rarely supported on little stalks, and containing a mass of minute free seeds. *Greville.*

Chondrus crispus. Greville, *Alg. Brit.* 129, t. 15; *B. & T.* 305.—*Sphærococcus crispus.* Agardh.—*Fucus crispus.* Linn. The *Irish moss*, or *carrageen* as it is frequently called, consists of a flat, slender, cartilaginous frond, from two to twelve inches in length, dilated as it ascends until it becomes two or three lines in width, then repeatedly and dichotomously divided, with linear, wedge-shaped segments, and more or less curled up so as to diminish the apparent length. The capsules are somewhat hemispherical, and are imbedded in the disk of the frond. The plant grows upon rocks and stones on the coast of Europe, and is especially abundant on the southern and western coasts of Ireland, where it is collected. It is also a native of the United States, and is said to be gathered largely on the southern sea-coast of Massachusetts, where it is partly torn from the rocks, and partly collected upon the beach, on which it is thrown up during storms. It is prepared for market by spreading it out high on the beach, to dry and bleach in the sun. (Aug. P. Melzar, *Proc. A. P. Ass.*, 1860.) An elaborate account of the plant, its distribution on the sea-coast of Massachusetts, and of the mode of gathering and curing it, is given by Mr. G. Hubert Bates, of Scituate, Mass. (*U. S. Agricultural Report*, 1866; also *A. J. P.*, 1868, p. 417.)

When collected, it is washed and dried. In the fresh state it is of a purplish color, but, as found in the shops, is yellowish or yellowish white, with occasionally purplish portions. It is officinally described as "yellowish or white, horny, translucent; many-forked; when softened in water, cartilaginous; segments flat, wedge-shaped, or linear; at the apex emarginate or two-lobed; it has a slight sea-weed odor, and a mucilaginous, somewhat saline taste. One part of it boiled for ten minutes with 30 parts of water, yields a solution which gelatinizes on cooling." *U. S.* It swells in cold water, but does not dissolve. Boiling water dissolves a large proportion of it, and the solution, if sufficiently concentrated, gelatinizes on cooling. According to Feuchtwanger, it contains starch and pectin, with compounds of sulphur, chlorine, and bromine, and some oxalate of calcium. Herberger found 79·1 per cent. of pectin, and 9·5 of mucus, with fatty matter, free acids, chlorides, etc., but neither iodine nor bromine. M. Dupasquier discovered in it both of these elements, which had generally escaped attention in consequence of their reaction, as soon as liberated, upon the sulphide of sodium resulting from the decomposition of the sulphate of sodium of the moss when charred. (*Journ. de Pharm.*, 3e sér., iii. 113.) The pectin Pereira thought peculiar, and proposed to call *carrageenin*. It is distinguished from gum by affording, when dissolved in water, no precipitate with alcohol; from starch, by not becoming blue with tincture of iodine; from pectin, by yielding no precipitate with acetate of lead, and no mucic acid by the action of nitric acid. M. Ch. Blondeau gives the name of *goëmine* to a substance obtained by boiling carrageen (*goémon, Fr.*) for several hours in distilled water, and precipitating the mucilaginous liquid by alcohol. The precipitate, being redissolved in water, yields on evaporation thin, transparent, elastic plates, resembling ichthyocolla, which soften and swell up on contact with cold water. This substance, which is probably complex, is without smell or taste, neutral to test-paper, and dissolves completely in alkaline liquids. Blondeau's analysis gave 21·80 per cent. of carbon, 4·87 of hydrogen, 21·36 of nitrogen, 2·51 of sulphur, and 49·46 of oxygen. Flückiger, who analyzed this mucilage with care, found in it *no* sulphur, and only 0·88 per cent. of nitrogen.

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The drug itself yielded not more than 1·012 per cent. of nitrogen. (*Pharmacographia*, 2d ed., p. 748.)*

Carrageen is nutritive and demulcent, and, being easy of digestion and not unpleasant to the taste, forms a useful article of diet in cases in which the farinaceous preparations, such as tapioca, sago, barley, etc., are usually employed. It has been particularly recommended in chronic pectoral affections, scrofulous complaints, dysentery, diarrhœa, and disorders of the kidneys and bladder. It may be used in the form of decoction, made by boiling a pint and a half of water with half an ounce of the moss down to a pint. Sugar and lemon-juice may usually be added to improve the flavor. Milk may be substituted for water, when a more nutritious preparation is required. It is recommended to macerate the moss for about ten minutes in cold water before submitting it to decoction. Any unpleasant flavor that it may have acquired from the contact of foreign substances is thus removed.

CHRYSAROBINUM. *U. S.* *Chrysarobin.*

(ĈHRĬS-Ą-RŌ-BĪ'NŬM.)

"A mixture of proximate principles, commonly misnamed Chrysophanic Acid, extracted from Goa-powder, a substance found deposited in the wood of the trunk of Andira Araroba. Aguiar. (*Nat. Ord.* Leguminosæ, Papilionaceæ.)" *U. S.*

Goa Powder, Araroba, Poh di Bahia; Poudre de Goa, *Fr.*; Goa-Pulver, *G.*

Chrysarobin, or Araroba, has long been used as a medicine in Brazil, and exported in considerable quantities to Portugal, whence it found its way through the Portuguese colonies into Eastern commerce. In the East Indies it is usually known as Goa Powder. Indeed, the identity of the two powders was first proved in 1875 by Dr. J. F. Dasilva Lima. (*P. J. Tr.*, v. 724, 801, 806.)

Chrysarobin has been supposed to be yielded by certain lichens, but was shown by Dr. R. A. Monteiro to be obtained from a leguminous tree abundant in the forests of the Brazilian province of Bahia, which was referred by Mr. E. M. Holmes to the genus Cæsalpinia, but which was determined by studies made in its native forests by Dr. J. M. de Aguiar to be an undescribed species of Andira.

Andira Araroba, Aguiar, is a large tree, attaining a height of 100 feet, with a smooth trunk, and a spheroidal, not very bushy head. The wood is yellowish, with numerous longitudinal canals, besides abundant irregular interspaces or lacunæ, in which the chrysarobin is found. (See *P. J. Tr.*, ix. 755; x. 42, 814.) The oldest trees yield the largest amount of the powder; the parts containing it are finely chipped or scraped off. The workmen who procure it often suffer severely from irritation of the eyes and face.

Properties. "A pale orange yellow, crystalline powder, permanent in the air, odorless and tasteless, almost insoluble in water, only slightly soluble in alcohol, readily soluble in ether and in boiling benzol. When heated to about 162° C. (323·6 F.), it melts, and may be partially sublimed. On ignition it is wholly dissipated. In solutions of alkalies it is soluble with a yellowish red or reddish yellow color, which is changed to red by passing air through the liquid. Sulphuric acid dissolves it with a deep blood-red color; on pouring the solution into water, the substance separates again unchanged." *U. S.* As first obtained, chrysarobin is stated to be of a pale primrose yellow, but it rapidly darkens with age, so that in commerce it varies from a dull ochre color to a dark chocolate or maroon-brown. It is sometimes a rather fine powder, but is usually more or less agglomerated, and not rarely contains fragments of woody tissue. Its taste is bitter. It is insoluble in water and most menstrua, but yields as much as 80 per cent. of its weight to solutions of caustic alkalies and to benzol. Attfield analyzed Goa powder, and found, along with 2 per cent. of resin, 5·5 per cent. of woody fibre, and 7 per cent. of bitter extractive, 80 to 84 per cent. of what he considered to be chrysophanic acid; but Liebermann and Siedler showed that this was not chrysophanic acid at all, but

* Most species of sea-weed contain a mucous substance analogous to, if not identical with, that of carrageen, but are not available for use on account of their disagreeable taste. In France the *Gigartina acicularis* is said to be extensively sold as carrageen. (Dragendorff, *Jahresb.*, 1874, p. 42.)

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a substance easily convertible into the acid, which substance they called *chrysarobin*, and gave to it the formula $C_{20}H_{26}O_7$. (*A. J. P.*, 1879, p. 80.)

Medical Uses. When taken internally in sufficient amount, chrysarobin acts as a decided gastro-intestinal irritant, producing large, very watery, brownish stools, and repeated vomiting, without much nausea. Dr. J. A. Thompson (*N. R.*, 1877, p. 167) states that it acts efficiently in doses of 20 to 25 grains (1·3–1·565 Gm.) for the adult, 10 grains (0·65 Gm.) for children 12 years of age, 6 grains (0·4 Gm.) for babies. He believes it to have practical value as affording a very prompt and efficient means of clearing out the whole primæ viæ, and of causing very large discharges of bile. It is, however, not probable that it will be used to any extent as an internal remedy.

Chrysarobin has been long used in South America and India as a remedy in skin diseases, but the attention of the general profession was first called to it in 1874 by Sir Joseph Fayrer. It is at present used largely for the preparation of chrysophanic acid, in which all of its properties appear to reside, and is itself used to some extent in diseases of the skin.

Off. Prep. Unguentum Chrysarobini.

CIMICIFUGA. *U. S.* *Cimicifuga.* [*Black Snakeroot.*]

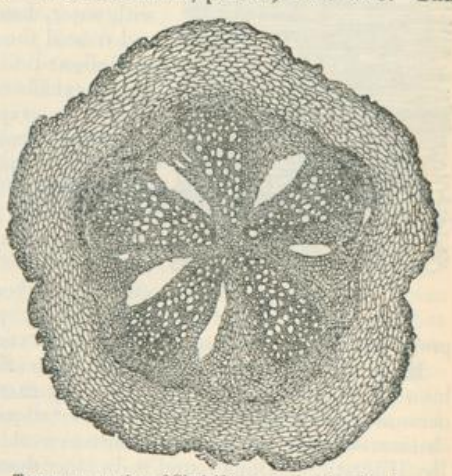
(SĬM-Ĭ-SĬF'Ū-GĂ.)

"The rhizome and rootlets of Cimicifuga racemosa. Elliott. (*Nat. Ord.* Ranunculaceæ.") *U. S.*

Black Cohosh; Racine d'Actée à Grappes, *Fr.*; Schwarze Schlangenwurzel, *G.*

Gen. Ch. Calyx four or five-leaved. *Petals* four to eight, deformed, thickish, sometimes wanting. *Capsules* one to five, oblong, many seeded. *Seeds* squamose. *Nuttall.*

Cimicifuga racemosa. Torrey, *Flor.* 219; Carson, *Illust. of Med. Bot.* i. 9, pl. 3. —*C. serpentaria.* Pursh, *Flor. Am. Sept.* p. 372.—*Actæa racemosa.* Willd. *Sp. Plant.* ii. 1139.—*Macrotys racemosa.* Eaton's *Manual*, p. 288; *B. & T.* 8. This is a tall stately plant, having a perennial root, and a simple herbaceous stem, which rises from four to eight feet in height. The leaves are large, and ternately decomposed, having oblong-ovate leaflets, incised and toothed at their edges. The flowers are small, white, and disposed in a long, terminal, wand-like raceme, with occasionally one or two shorter racemes near its base. The calyx is white, four-leaved, and deciduous; the petals are minute, and shorter than the stamens; the pistil consists of an oval germ and sessile stigma. The fruit is an ovate capsule containing numerous flat seeds.



Transverse section of Cimicifuga; rootlet showing five ligneous rays.

The *black snakeroot*, or *cohosh* as this plant is sometimes called, is a native of the United States, growing in shady or rocky woods from Canada to Florida, and flowering in June and July. The root is the part employed.

Properties. The dried root consists of a thick, irregularly bent or contorted body or caudex, from one-third of an inch to an inch in thickness, often several inches in length, furnished with many slender radicles, and rendered exceedingly rough and jagged in appearance by the remains of the stems of successive years, which to the length of an inch or more are frequently attached to the root. It is officinally described as follows. "The rhizome is horizontal, hard, two inches (5 cm.) or more long, about one inch (25 mm.) thick, with numerous stout, upright or curved

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branches, terminated by a cup-shaped scar, and with numerous, wiry, brittle, obtusely quadrangular rootlets, about one-twelfth of an inch (2 mm.) thick; the whole brownish-black, nearly inodorous, and having a bitter, acrid taste. Rhizome and branches have a smooth fracture, with a large pith, surrounded by numerous, sublinear, whitish wood-rays, and a thin, firm bark. The rootlets break with a short fracture, have a thick bark, and contain a ligneous cord branching into about four rays." *U. S.* The odor, though not strong, is peculiar and rather disagreeable, and is gradually lost by keeping. The root yields its virtues to boiling water. It was found by Mr. Tilghman, of Philadelphia, to contain gum, starch, sugar, resin, wax, fatty matter, tannic and gallic acids, a black coloring matter, a green coloring matter, lignin, and salts of potassa, lime, magnesia, and iron. (*A. J. P.*, vi. 20.) It no doubt also contains, when fresh, a volatile principle, with which its virtues may be in some degree associated; as we are confident that it is more efficacious in the recent state, than when long kept. In fact, Mr. George H. Davis, in a more recent analysis, has separated by distillation a small proportion of volatile oil, having decidedly the peculiar odor of the root. Mr. Davis also found, in addition to the principles above mentioned, albumen and extractive among the organic, and silica among the inorganic constituents. The sugar, moreover, noticed by him was of the uncrystallizable variety, and the resin of two kinds, one soluble in alcohol but not in ether, the other soluble in both these menstrua. (*A. J. P.*, xxxiii. 396.)

A crystallizable principle has been obtained from the root by Mr. T. Elwood Conard. After failing to obtain any volatile principle from the fresh root by distillation, he prepared a strong tincture of the root, treated this with the solution of subacetate of lead, which precipitated resin, tannin, and coloring matters, then filtered, and precipitated the lead by sulphuretted hydrogen in excess, and allowed the tincture to evaporate spontaneously; and, finally, having treated the residuary powder with benzin, afterwards washed it with water, dissolved it to saturation in strong alcohol, and treated the solution with alumina. The mixture was allowed to evaporate to a dry mass, which was nearly exhausted with alcohol. The solution, being allowed to evaporate, left behind a crystalline mass, somewhat resembling alum. This substance has little taste on account of its extreme insolubility in the saliva; but in alcoholic solutions has very strongly the acrid taste characteristic of the fresh root. The crystals are very soluble in cold, and more so in hot alcohol, soluble also in chloroform, and slightly in ether. They are fusible and inflammable. They are neutral, possessing neither acid nor alkaline properties. Their effects on the system were not examined. (*A. J. P.*, 1871, p. 151.)



Longitudinal section, highly magnified.

Medical Properties and Uses. The effects of cimicifuga in health have not been fully investigated. It undoubtedly exercises considerable influence over the nervous system, probably of a sedative character; but this influence, so far as our observation has gone, is shown more in morbid states of that system than in health. Dr. Hildreth, of Ohio, found it, in large doses, to produce vertigo, impaired vision, nausea, and vomiting, and a reduction of the circulation; but from very large quantities he observed no alarming narcotic effects. Dr. N. S. Davis uniformly found it to lessen the force and frequency of the pulse, to soothe pain and allay irritability. (*Trans. of Am. Med. Assoc.*, i. 352.) Large doses of it will certainly produce marked nervous depression, with severe headache and often vertigo. Its common name was probably derived from its supposed power as an antidote to the bite of the rattlesnake. It was originally employed in domestic practice in rheumatism, dropsy, hysteria, and various affections of the lungs, particularly those resembling consumption. The first published notice of its use in phthisis was by Dr. Thomas J. Garden, of Charlotte, Virginia. (*Am. Med. Recorder*, Oct. 1823.)

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In ordinary chorea, cimicifuga is an efficient remedy. At one time it was employed to a considerable extent in rheumatism, but at present is never used.

It may be given in substance, decoction, tincture, or extract. The dose of the powder is from a scruple to a drachm (1·3–3·9 Gm.). The *decoction* has been much used, but is thought by some not to contain all the virtues of the root. An ounce of the bruised root may be boiled for a short time in a pint of water, and one or two fluidounces (30–60 C.c.) given for a dose. From half a pint to a pint of the decoction may be taken without inconvenience during the day. The *tincture* is officinally made in the proportion of twenty parts in one hundred of alcohol, and given in the dose of one or two fluidrachms (3·75–7·5 C.c.). The fluid extract when properly made from good root is, however, the best preparation. The dose of it is from a half to one fluidrachm (1·9–3·75 C.c.) three or four times a day in water. The practitioners calling themselves eclectics use, under the name of *cimicifugin*, or *macrotin*, an impure resin obtained by precipitating a saturated tincture of the root with water. It is given in the dose of a grain or two (0·065–0·13 Gm.). The names, however, are inappropriate, as they should be reserved for the pure active principle or principles when discovered. (See *N. J. Med. Reporter*, viii. 247.)

Off. Prep. Extractum Cimicifugæ Fluidum, *U. S.;* Tinctura Cimicifugæ, *U. S.*

CINCHONA. *U. S. Cinchona.*

(CĬN-CHŌ'NA.)

"The bark of any species of Cinchona (*Nat. Ord.* Rubiaceæ, Cinchoneæ), containing at least 3 per cent. of its peculiar alkaloids." *U. S.*

Syn. Peruvian Bark; Cinchona Bark.

Varieties.

CINCHONA FLAVA. *Yellow Cinchona.* [*Calisaya Bark.*] *U. S.* "The bark of the trunk of Cinchona Calisaya, Weddell. (*Nat. Ord.* Rubiaceæ, Cinchoneæ), containing at least 2 per cent. of quinine." *U. S.* "The bark of Cinchona Calisaya." *Br.*

Cinchonæ Flavæ Cortex, *Br.; Yellow Cinchona Bark.*

CINCHONA RUBRA. *Red Cinchona.* [*Red Bark.*] *U. S.* "The bark of the trunk of Cinchona succirubra, Pavon (*Nat. Ord.* Rubiaceæ, Cinchoneæ), containing at least 2 per cent. of quinine." *U. S.* "The bark of Cinchona succirubra, Pavon." *Br.*

Cinchonæ Rubræ Cortex, *Br.; Red Cinchona Bark.*

CINCHONÆ PALLIDÆ CORTEX. *Br. Pale Cinchona Bark.* "The bark of the Cinchona Condaminea, *vars.* chahuarguera, Pavon, and crispa, Tafalla." *Br.*

Quinquina, *Fr.;* China, Peruvianische Rinde, *G.;* China, *It.;* Quina, *Sp.*

Botanical History.

Though the Peruvian bark was introduced into Europe so early as 1640, it was not till the year 1737 that the plant producing it was known to naturalists. In that year La Condamine, on a journey to Lima, through the province of Loxa, had an opportunity of examining the tree, of which, upon his return, he published a description in the Memoirs of the French Academy. Soon afterwards Linnæus gave it the name of *Cinchona officinalis*, in honor of the Countess of Cinchon, who is said to have first taken the bark to Europe; but, in his description of the plant, he united the species discovered by La Condamine with *C. pubescens*, a specimen of which had been sent to him from Santa Fé de Bogota. For a long time it was not known that more than one species existed; and *C. officinalis* continued, till a comparatively recent period, to be recognized by the Pharmacopœias as the only source of the Peruvian bark of commerce. But a vast number of plants belonging to the Linnæan genus Cinchona were in the course of time discovered; and the list became at length so unwieldy and heterogeneous, that botanists were compelled to distribute the species into several groups, each constituting a distinct genus, and all associated in the natural family of Cinchonaceæ. Among these genera, the *Cinchona* is that which embraces the true Peruvian bark trees, characterized by the production of the alkaloids, quinine, cinchonine, etc., as well as by certain botanical peculiarities, among which

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the most distinctive is probably the dehiscence of the capsule from the base towards the apex, or from below upward. The new genera *Exostemma* and *Buena* embrace species which have been, perhaps, most frequently referred to as Cinchonas; but they are sufficiently characterized, the former by the projection of the stamens beyond the corolla, a peculiarity which has given name to the genus, the latter by the different shape of the corolla, the separation of the calyx from the fruit at maturity, and the opening of the capsule from above downward. More recently Weddell has separated several generally admitted species from Cinchona, and instituted a new genus, which he proposes to name *Cascarilla*. This includes the former *Cinchona magnifolia* of Ruiz and Pavon (*C. oblongifolia* of Mutis), the *C. stenocarpa* of Lambert, the *C. acutifolia* of Ruiz and Pavon, the *C. oblongifolia* of Lambert, the *C. macrocarpa* of Vahl, and the *C. cava* of Pavon, which differ from the true Cinchona in having the dehiscence of the capsules from the apex towards the base, or from above downward, and the barks of which contain neither of the alkaloids above referred to. (Weddell, *Hist. Nat. des Quinquinas*, p. 77.) With this brief preliminary notice, we shall proceed to consider the true Cinchonas. It may be proper, however, first to say, that the botanists who have personally observed these plants, besides La Condamine, of whom we have before spoken, are chiefly Joseph de Jussieu, who in the year 1739 explored the country about Loxa, and gathered specimens still existing in the cabinets of Europe; Mutis, who in 1772 discovered Cinchona trees in New Granada, and afterwards, aided by his pupil, Zea, made further investigations and discoveries in the same region; Ruiz and Pavon, who in 1777 began a course of botanical inquiries in the central portions of Lower Peru, and discovered several new species; Humboldt and Bonpland, who visited several of the Peruvian bark districts, and published the results of their observations after 1792; Pöppig, who travelled in Peru so late as 1832, and published an account of his journey about the year 1835; and finally Weddell, whose researches in Bolivia are so well known, and have been so productive of valuable information in relation to the Calisaya bark.

Gen. Ch. Calyx with a turbinate tube, and a persistent five-toothed limb. *Corolla* with a round tube, a five-parted limb, and oblong lobes valvate in æstivation. *Stamens* with short filaments inserted into the middle of the tube, and linear anthers entirely closed. *Stigma* bifid, subclavate. *Capsule* ovate or oblong, somewhat furrowed on each side, bilocular, crowned with the calyx, septicidal-dehiscent, with the mericarps loosened from the base towards the apex, the introflexed part disjoined. *Placentæ* elongated. *Seeds* numerous, erect, imbricated upward, compressed, winged, with a membranous margin, and a fleshy albumen.—The plants composing this genus are trees or shrubs. The leaves are opposite, upon short petioles with flat margins, and are attended with ovate or oblong, foliaceous, free, deciduous stipules. The flowers are terminal, in corymbose panicles, and of a white or purplish rose color. *De Candolle.*

The genuine Cinchona trees are natives exclusively of South America.* In that

* *Transplanting of the Cinchona trees, and Cultivation in new Sites.* For a long time after the discovery of the virtues of Peruvian bark, no attempt appears to have been made to transplant to other countries the trees which produced it. In 1737, La Condamine collected a large number of young plants, with a view of conveying them to Europe; but, after having descended the Amazon in safety for more than a thousand leagues, they were washed overboard, near the mouth of that river, from the boat containing them, and were all lost. After this failure, though the idea of transplanting the Cinchonas was occasionally suggested, nothing was done until 1846–7, when Dr. Weddell, now celebrated for his successful exploration of the region of the Calisaya bark, sent some seeds to France, which were planted with success in the Jardin des Plantes, and thus supplied some of the conservatories of Europe with specimens of the plant. But the first successful effort, with a view to great practical results, was made in 1853, by the Dutch government, by whom Mr. Hasskarl, formerly superintendent of the Botanical Garden in Java, was sent to South America on this important mission. A number of young Cinchona plants were sent by him directly across the Pacific to Batavia, which they reached before the close of 1854. From these, and from seeds obtained from other sources, which were planted in the mountains of Java, in sites selected for their supposed conformity in climate with the native locality of the Cinchona, have sprung numerous plantations.

Stimulated by the suggestions of Dr. Royle, and by the partial success of the Dutch, the English government engaged, in 1859, the services of Mr. Clements B. Markham, who proceeded to Bolivia, in South America, and, after almost incredible hardships, arising partly from the nature of the country and partly from the jealousy of the native authorities, succeeded in collecting and transmitting to England upwards of 400 Calisaya plants. Most of these, however, were so much

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continent, however, they are widely diffused, extending from the 19th degree of south latitude, considerably south of La Paz, in Bolivia, to the mountains of Santa Marta, or, according to Weddell, to the vicinity of Caracas, on the northern coast, in about

injured, on their way from England to India, by the excessive heat of the Red Sea, that very few, on their arrival in Hindostan, had sufficient life remaining to grow when planted. Happily, the deficiency was supplied by seeds of *C. Calisaya* sent from Java, where they were produced, to Calcutta, at the request of the English Governor-General. (De Vrij, *P. J. Tr.*, 1863, p. 440.) Whilst Mr. Markham was in Bolivia, other agents were collecting other species in Peru and Ecuador, whence seeds of the pale and red bark Cinchonas reached India, and, being planted in the selected sites, proved to be very productive.

The sites selected for the Cinchona plantations were in the Neilgherry Hills, in Southern India, in the Presidency of Madras, at the junction of the East and West Ghauts, near the Sanitary Station of Ootacamund, at heights varying from 5000 to 7450 feet above the sea. These positions unite the peculiar characters of the native region of the Cinchonas in the Andes, not only as regards elevation and latitude, but also as to atmospheric moisture, an excess of which, for the greater portion of the year, seems essential to the perfection of these trees. But, though a certain excess of atmospheric moisture is necessary, yet the trees do not grow well in a wet soil, as Mr. Cross, who personally inspected the region in the Andes where the best barks are obtained, found the Cinchona plants only on the dry slopes, and never on wet ground. He remarked, moreover, that constant dampness of the atmosphere is unfavorable, as a certain amount of dry weather is necessary for the ripening of the capsules. In regard to the temperature, which is about the same throughout the year, he observed that during the hottest days the thermometer rose to 59° or 60° F., falling to 46° or 48° F. at night; but at the upper limit it ranged, during the day, from 46° to 48°, and at night fell to 35° or 36° F. (*A. J. P.*, 1867, p. 161.)

Besides the Neilgherry Hills, other sites were selected for experimental plantations; and, since the first introduction of the Cinchona trees, their culture has been extended to various points from Hakgalla, in the island of Ceylon, to the Himalaya Mountains; as in the Wynaad, the Coorg, the hills of Travancore, and especially at Peermede in the Presidency of Madras; in Sikkim and Darjeeling in the Presidency of Bengal; at Lingmulla in the Presidency of Bombay; and in the valley of Kangra in the Punjab; from the southern to the northern extremity of British India. The culture has especially flourished in Ceylon; in 1877, Mr. MacMillan estimated the number of trees at 7,000,000.

Besides the general fact of the success of the culture, other results, as unexpected as they are important, have been obtained within the last few years. It was ascertained at an early period, that the productiveness of these plants in alkaloids had not been diminished by transplanting; it is now known that this productiveness has in fact been very considerably increased. Another highly important result is the discovery by Mr. MacIvor, that the yield in alkaloids is greatly augmented by a certain treatment of the trees. It had been noticed that the cinchona alkaloids, especially in any other form than that of sulphate, were apt, on exposure to the direct light of the sun, to become reddened by the generation of coloring matter, at the expense of the alkaloid. It was a very natural inference that a similar change might take place in the living plant, as a consequence of which the proportion of alkaloids they were capable of producing, might be greatly diminished. To obviate this presumed effect, Mr. MacIvor was induced to make the experiment of covering the stems of the growing trees with a layer of moss, so as completely to protect the bark against the influence of sunlight. The result was favorable beyond all expectation; and the yield of the bark thus protected in alkaloids is said to be doubled, tripled, or increased even in larger proportion. A tree can thus be made continuously productive; for if a slip is removed longitudinally from the trunk, from top to bottom, by covering the decorticated portion with moss, the bark is renewed, at least as rich as previously in the alkaloids, while from time to time other strips may be taken, till the whole of the old bark is removed, and the new ready for removal by a repetition of the same process; and the tree is thus preserved indefinitely, probably for the whole normal length of its life. The practical difficulty with the process is that it requires skilled workmen, not always attainable, and hence the "coppicing system" still largely prevails in India. Under it the trees are cut down, not too close to the ground, when young shoots put up abundantly. It has been experimentally found best to allow only two of these shoots to remain, and that the bark contains the maximum of alkaloid in the eighth year of growth.

A very important result of the culture in India has been the appearance of hybrids. One which has received the name of *C. angustifolia* has been found to contain in its bark 11 per cent. of alkaloids, whilst a second form, believed to be a cross between *C. officinalis* and *C. Calisaya*, has been called *C. pubescens* and yielded a bark containing 12·2 per cent. of alkaloids. The culture of bark in India may be considered as fully established, although Markham affirms that the greed for immediate results has been disastrous and that the plantations are not in as good condition as formerly. The total yield of bark by Ceylon and India for the season of 1879 and 1880 was 1,172,060 pounds. The quality of the bark seems to be superior to that of South America, whilst the financial success has been such that 70 per cent. a year is said to be sometimes returned, and Mr. Markham affirms that the plantations have entirely paid for themselves, principal and interest. (For further information in regard to the culture of Cinchonas in India, see *Peruvian Bark*, by C. R. Markham. London, John Murray, 1880; also *P. J. Tr.*, xi. 244.)

Owing to the worthlessness of many of the species of Cinchona first introduced into Java, the Dutch have reaped success more slowly than the English: but by destroying the progeny of the first imports and introducing from India other more valuable species the Java plantations have at last been made to flourish, and in 1879 and 1880 yielded 70,088 pounds of good bark. Attempts have also been made to introduce the new culture into the West India island of Jamaica. Various special difficulties have environed the attempts at Cinchona culture in Jamaica; thus, in 1874, 60,000 trees were destroyed by a hurricane. Nevertheless, progress has been made, and about

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the 10th degree of north latitude. They follow, in this distance, the circuitous course of the great mountain ranges, and for the most part occupy the eastern slope of the second range of the Cordilleras. Those which yield the bark of commerce grow at various elevations upon the Andes, seldom less than 4000 feet above the sea, and require a temperature considerably lower than that which usually prevails in tropical countries.

There has been much difficulty in properly arranging the species of Cinchona. One source of the difficulty is the varying shape of the leaves of the same species, according to the degree of elevation upon the mountainous declivities, to the severity or mildness of the climate, the greater or less humidity of the soil, and to various circumstances in the growth of individual plants. Even the same tree often produces foliage of a diversified character; and a person, not aware of this fact, might be led to imagine that he had discovered different species from an examination of the leaves from one and the same branch. The fructification partakes, to a certain extent, of the same varying character. Lambert, in his "*Illustration of the genus Cinchona*," published in 1821, after admitting with Humboldt the identity of several varieties which had received specific names from other botanists, described nineteen species. De Candolle enumerated only sixteen. Lindley admits twenty-one known species, and five doubtful. Weddell describes twenty-one species, including eight new ones of his own, and two doubtful, and excluding several before admitted by other writers, which he joins to his new genus Cascarilla. (For further information, see foot-note p. 430.)

Until recently, it was impossible to decide from which species of Cinchona the several varieties of bark were respectively derived. The former references of the yellow bark to *C. cordifolia*, of the pale to *C. lancifolia*, and of the red to *C. oblongifolia*, have been very properly abandoned in all the Pharmacopœias. It is now universally admitted that the officinal barks, known in the market by these titles, are not the product of the species mentioned. It is stated by Humboldt that the property of curing agues belongs to the barks of all the Cinchonas with hairy and woolly blossoms, and to these alone. All those with smooth corollas belong to the genus Cascarilla of Weddell. Within a few years much light has been thrown upon the botanical history of the different varieties of bark, and at present most if not all of the valuable varieties can be traced to their sources. The following species are acknowledged by the Pharmacopœia of the United States.

1. *Cinchona Calisaya.* Weddell, *Hist. Nat. des Quinquinas*, p. 30, t. 3. This is a lofty tree, with a trunk often two feet or more in diameter, and a summit usually rising above the other trees of the forest. The leaves are petiolate, oblong or lanceolate-obovate, from three to six inches long and one or two in breadth, obtuse, acute or slightly attenuated at the base, softish, above smooth, of a velvety aspect, and obscurely green, beneath smooth and of a pale emerald hue, with scrobiculi at the axils of the veins, but scarcely visible on the upper surface. The stipules are about as long as the petioles, oblong, very obtuse, and very smooth. The flowers are in ovate or subcorymbose panicles. The calyx is pubescent, with a cup-shaped limb, and short triangular teeth; the corolla is rose-colored, with a cylindrical tube about four lines long, and a laciniate limb fringed at the edges; the stamina are concealed in the tube, with anthers more than twice as long as the filaments. The fruit is an ovate capsule scarcely as long as the flower, enclosing elliptical lanceolate seeds, the margin of which is irregularly toothed, with a fimbriated appearance. The tree

21,000 pounds of the bark found its way from Jamaica to the London market in the season of 1879–80.

The French have been less successful than the Dutch and English. The first plants taken by Weddell from Peru to Paris all perished. Subsequently trials have been made in the Isle of Bourbon, and at Guadeloupe, but with what final results we do not know. In Algiers, where situations believed to be suitable were selected for plantations among the mountains, no satisfactory results have yet been attained. The Brazilians have had somewhat better success near Rio Janeiro, and it is said that plants have been introduced into the Azores, which are growing well. (Soubeiran, *Journ. de Pharm.*, Feb. 1868, p. 139.)

In Bolivia the cultivation of Cinchona has also been entered upon extensively, and in 1881 cultivated South American red bark containing nearly 3 per cent. of quinine was offered in the London market, with small amounts of yellow bark of similar origin.

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grows in the forests, upon the declivities of the Andes, at the height of 6000 or 7000 feet above the ocean, in Bolivia and the southernmost part of Peru.

A variety of this species, described by Weddell under the name of *Josephiana*, is a mere shrub, not more than twelve feet high, with a slender stem, erect branches, and a strongly adherent bark. This variety is found in some places covering extensive surfaces destitute of forest trees. Weddell supposes that these tracts had once been covered with forests, which, having been destroyed by fires, have been succeeded by this stunted growth springing from the roots, and prevented from receiving its full development by the want of protection from other trees.

Mr. Markham states that the natives recognize three varieties of the Calisaya: 1. *Calisaya amarilla* or *fina* (*a. vera* of Weddell); 2. *C. morada* (*C. Boliviana*, Wedd.); and 3. *C. verde* or *alta*, a very large tree, growing lower in the valley than the other varieties, and distinguished by having the veins of the leaves never purple, but always green. (*A. J. P.*, 1866, p. 422.) By the discovery of this species, the long unsettled point of the botanical source of Calisaya bark has been determined. The immense consumption of that bark, and the wasteful methods pursued by the bark-gatherers, have caused the rapid destruction of the tree; and many years ago it had disappeared from the neighborhood of inhabited places, except in the form of a shrub. Weddell was compelled to make long journeys on foot through the forests, by paths scarcely opened, before he could get a sight of the tree in its full vigor.

2. *Cinchona Condaminea*. Humb. and Bonpl. *Plant. Equin.* i. p. 33, t. 10; Lindley, *Flor. Med.* 414; Carson, *Illust. of Med. Bot.* i. 53, pl. 45.—*Cinchona officinalis*. Linn.; Hooker, *Bot. Mag.* t. 5364. This tree, when full grown, has a stem about eighteen feet high and a foot in thickness, with opposite branches, of which the lower are horizontal, and the higher rise at their extremities. The bark of the trunk yields when wounded a bitter astringent juice. The leaves are of variable shape, but generally ovate-lanceolate, about four inches in length by less than two in breadth, smooth and scrobiculate at the axils of the veins beneath. The flowers are in axillary, downy, corymbose panicles. The tree grows on the declivities of the mountains, at an elevation of from about a mile to a mile and a half, and in a mean temperature of 67° F. It was seen by Humboldt and Bonpland in the neighborhood of Loxa, and is said also to grow near Guancabamba and Ayavaca in Peru. It is now admitted to be the source of the *crown bark of Loxa*. Weddell considers as varieties of this species, though with some hesitation, as he has never seen them alive, the following: 1, *Candolli* (*C. macrocalyx* of Pavon and De Candolle); 2, *lucumæfolia* (*C. lucumæfolia* of Pavon and Lindley); 3, *lancifolia* (*C. lancifolia* of Mutis), hereafter referred to as a distinct species; and, 4, *Pitayensis*, growing in New Granada.* The last mentioned variety has subsequently been raised by Weddell to the rank of a distinct species.

3. *C. micrantha*. Ruiz and Pavon, *Fl. Peruv.* ii. 52, t. 194; Lindley, *Flor. Med.* 412; Carson, *Illust. of Med. Bot.* i. 52, pl. 44. This is a large tree, forty feet high,

* Botanists seem disposed to return to the old Linnæan designation of this species, *Cinchona officinalis*, of which three varieties are recognized, under the names of *Bonplandiana*, *Uritusinga*, and *Crespilla*, all yielding the crown barks. Of these the *Bonplandiana* seems to have been most successfully transplanted, as upwards of 750,000 are now growing in the plantations of British India. (*Broughton.*) The varieties of this species seem to flourish best at a greater elevation than the *C. succirubra*, growing at heights from 5500 or 6000 feet even to 8350 feet above the level of the sea. The effect of the moss in increasing the productiveness of this species in alkaloids has been highly satisfactory. (*Markham.*) Instead, however, of cinchonine being the prominent alkaloid of this species, as in the pale barks of Loxa, the quinine has been found most abundant in the Indian bark, and, though the former alkaloid is generally present, yet it is usually in small proportion. Indeed, Mr. Broughton states that the trees of the variety Bonplandiana yield a bark nearly equal to the fine Calisaya bark of Bolivia, and superior in some respects for manufacturing purposes to the richer red barks, as it yields its alkaloids more readily in a free state, in consequence of the smaller amount of resin and coloring matter contained in it. The following results were obtained by Mr. Broughton in the chemical examination of the bark of this species. The dried bark of the trunk yielded altogether in alkaloids (hydrated) 3·6 per cent., of which 2·8 per cent. was quinine (or of alkaloid soluble in ether), and only 0·8 per cent. was of cinchonine and cinchonidine jointly; and 2·8 per cent. of crystallized sulphate of quinine was obtained. Another specimen was even more productive, yielding 3·0 per cent. of quinine. The bark of the same species, which had been renewed in six months under the mossing process, gave a total of alkaloids (hydrated) 6·8 per cent., of which 4·8 was of quinine, and 2·0 of cinchonine and cinchonidine jointly; and 4·1 per cent. of crystallized sulphate of quinine was obtained. (*P. J. Tr.*, 1867, p. 241.)

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with oblong leaves, from four to twelve inches in length and from two to six in breadth, scarcely acute, smooth, shining on the upper surface, and scrobiculate at the axils of the veins beneath. The flowers are in terminal, loose leafless panicles, and are smaller than those of any other species except *C. lancifolia.* (*Lindley.*) The tree grows, according to Ruiz and Pavon, in the mountains near Chicoplaya, Monzon, and Puebla de San Antonio, according to Pöppig, at Cuchero, and, according to Weddell, in the Peruvian province of Carabaya, and in Bolivia. Ruiz states that its bark is always mixed with that sent into the market from the provinces of Panatahuas, Huamilies, and Huanuco. The Edinburgh and Dublin Colleges ascribed to it the *cinchona cinerea*, the *gray* or *silver bark* of the British commerce; and the U. S. Pharmacopœia recognizes it as one of the sources of pale bark, as it undoubtedly is.

Cinchona succirubra, Pavon, which was officinally recognized in the U. S. Pharmacopœia of 1870, and, as the source of the genuine red bark, is scarcely less important than either of the preceding, has, within a few years, acquired additional value from the great success with which it has been propagated in the Highlands of Hindostan.

4. *C. succirubra.* Pavon, *MS.;* Howard, *Pharm. Journ. and Trans.*, Oct. 1856, p. 209, with a figure.—*C. ovata*, var. *erythroderma.* Weddell, *Hist. Nat. des Quinquinas*, p. 60. This species has been satisfactorily ascertained to produce the proper officinal red bark, the origin of which remained so long unknown, or at least undetermined. The name of *C. succirubra* originated with Pavon, having been applied by him, in an unpublished manuscript, to an undescribed species yielding the bark called *cinchona colorada de Huaranda*, which has been shown to be identical with officinal red bark; while a specimen of the plant itself, in the collection of Ruiz and Pavon at Kew, upon examination by Mr. J. E. Howard, of London, proved to correspond exactly with a specimen of the red bark tree which that gentleman had received from South America. The same plant was described by Weddell, in his *Natural History of the Cinchonas*, as a variety of *C. ovata*, under the designation of *Cinchona ovata*, var. *erythroderma*, and was conjectured by him to be the source of red bark, though he did not at the time feel justified in giving a decided opinion. This point, however, having been subsequently determined, and the plant elevated to the dignity of a new species, Mr. Howard proposed at first to name it *Cinchona erythroderma*, not only from courtesy to Dr. Weddell, but also from the appropriateness of the name itself, implying the redness of the bark; but Pavon's name of *succirubra* was afterwards preferred on the ground of priority, being itself also (red-juiced) expressive of a quality of the tree. This species is, when full-grown, of great magnitude; but almost all the older trees have been destroyed, and few now remain with a stem so much as a foot in diameter. The branches have a silvery epidermis, corresponding with that of the red bark in quills as often seen in the market. The leaves are ovate, varying greatly in size, often as much as nine inches by six, narrowing towards the base, somewhat membranaceous, pubescent beneath, and green on both sides. The tree inhabits a region in the present republic of Ecuador, on the western slope of Chimborazo, the seaport of which is the town of Guayaquil.*

* Botanists at present (1882) are far from being in concord in regard to the species of the genus Cinchona. As previously mentioned, the experiments made in India have shown that the trees have a remarkable tendency to hybridize, and Kuntze, as the result of studies made in the India plantations, has concluded that there are but four true species, namely, *C. Weddelliana*, Kuntze, nearly answering to *C. Calisaya*, Weddell; *C. Paviana*, Kuntze, including *C. micrantha*, Ruiz and Pavon, with various allied forms; *C. Howardiana*, Kuntze, including *C. succirubra*, Pavon, and other species of various authors; and *C. Pahudiana*, Howard. (*Cinchona, Arten, Hybriden, und Cultur der Chininbäume*, Leipzig, 1878.) The conspectus on p. 431 of the principal species of Cinchona is taken from the *Pharmacographia*. It seems to represent more nearly, as well as more concisely, the present state of our knowledge than does much of the matter in previous editions of the United States Dispensatory, and is consequently substituted for the latter.

Markham in his recent work gives the following synopsis of the valuable species.

I. C. officinalis, var. α. Condaminea, β. Bonplandia, γ. Crispa, } yielding crown bark.

II. C. succirubra, Pavon, yielding red bark.

III. C. pitayensis, C. lancifolia, C. cordifolia, } yielding colombian bark.

IV. C. nitida, C. micrantha, C. Peruviana, } yielding gray bark.

V. C. Calisaya, yielding yellow bark.

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Conspectus of the Principal Species of Cinchona.

Species (excluding sub-species and varieties) according to Weddell.	Where Figured.	Native Country.	Where Cultivated.	Product.
I. Stirps Cinchonæ officinalis.				
1. Cinchona officinalis, Hook.....	Bot. Mag. 5264.....	Ecuador (Loxa)...	India, Ceylon, Java,	Loxa or Crown Bark, Pale Bark.
2. " macrocalyx, Pav.....	Howard, N. Q.....	Peru.....	.....	{ Ashy Crown Bark. The sub-species *C. Pelton* affords an important sort called *Pelton Bark* much used in the manufacture of quinine.
3. " lucumæfolia, Pav.....	Do.	Ecuador, Peru.	.....	
4. " lancifolia, R. et P. (?)	Do.	Peru.....	.....	
5. " lancifolia, Mutis.....	Karsten tab. 11, 12.	New Granada.....	India.	Carthagena Bark, confounded with Pelton Bark, but is not so good.
6. " amygdalifolia, Weld.	Weddl. tab. 6.....	Peru, Bolivia.....	.....	{ Columbian Bark.—Imported in large quantities for manufacture of quinine. The soft Columbian Bark is produced by Howard's var. *oblonga*. A poor bark, but not now imported.
II. Stirps Cinchonæ rugosæ.				
7. Cinchona pitayensis, Weddl....	{ Karst. tab. 22. (*C.* Tyeana.) }	{ New Granada (Popayan) }	India.....	Pitayo Bark. Very valuable; used by makers of quinine; it is the chief source of quinidine.
8. " rugosa, Pav.....	Howard, N. Q.....	Peru.....	.....	Bark unknown, probably valueless.
9. " Mutisii, Lamb.....	Do.	Ecuador	.....	Bark not in commerce, contains only aricine.
10. " hirsuta, R. et P.....	Weddl. tab. 23.....	Peru.	.....	
11. " caribæensis, Weddl...	Weddl. tab. 19. ...	Peru, Bolivia.....	.....	Bark not collected.
12. " Pahudiana, How.....	Howard, N. Q.....	Peru.....	India, Java.....	A poor bark, yet of handsome appearance; propagation of tree discontinued.
13. " asperifolia, Weddl....	Weddl. tab. 20... ...	Bolivia	.....	Bark not collected.
14. " glandulifera, Pav....	Howard, N. Q.....	Peru.....	.....	Bark not known as a distinct sort.
15. " Humboldtiana, Lamb.	Do.	Peru.....	.....	Do.
16. "	Do.	Peru.....	.....	False Loxa Bark, Jaen Bark. A very bad bark.
III. Stirps Cinchonæ micranthæ.				
17. Cinchona australis, Weddl.....	Weddl. tab. 8.....	South Bolivia.....	.....	An inferior bark, mixed with Calisaya.
18. " scrobiculata, H. et B.	Do.	Peru.....	.....	Bark formerly known as *Red Cusco Bark* or *Santa Ana Bark*.
19. " peruviana, How	Howard, N. Q.....	Peru.....	India.....	
20. " nitida, R. et P.	Do.	Peru.....	India.....	Gray Bark, Huanuco or Lima Bark. Chiefly consumed on the Continent.
21. " micrantha, R. et P....	Do.	Peru.....	India.....	
IV. Stirps Cinchonæ Calisayæ.				
22. Cinchona Calisaya, Weddl.....	Weddl. tab. 9.....	Peru, Bolivia .. {	India, Ceylon, Java, Jamaica, Mexico.	{ Calisaya Bark, Bolivian Bark, Yellow Bark. The tree exists under many varieties, bark also very variable.
23. " elliptica, Weddl.....	.....	Peru (Carabaya)..	.....	{ Carabaya Bark. Bark scarcely now imported. *C. ensifera*, Miq. (flower and fruit unknown), may perhaps be this species.
V. Stirps Cinchonæ ovatæ.				
24. Cinchona purpurea, R. et P.....	Howard, N. Q.....	Peru (Huanuco)	.....	Huanuco Bark. Not now imported.
25. " rufinervis, Weddl	Do.	Peru, Bolivia.....	.....	Bark, a kind of light Calisaya.
26. " succirubra, Pav.....	Do.	Ecuador.....	India, Ceylon, Java, Jamaica.	Red Bark. Largely cultivated in British India.
27. " ovata, R. et P.	Do.	Peru, Bolivia.....	.....	Inferior Brown and Gray Barks.
28. " cordifolia, Mutis.....	Karsten tab. 8.....	{ New Granada, } Peru.	.....	{ Colombian Bark (in part). Tree exists under many varieties; bark of some used in manufacture of quinine.
29. " tucujensis, Karst	Karsten tab. 9.....	Venezuela.....	.....	Maracaibo Bark.
30. " pubescens, Vahl.....	Weddl. tab. 16.....	{ Ecuador, Peru, }	.....	{ Arica Bark (Cusco Bark from var. *Pelletieriana*). Some of the varieties contain aricine.
31. " purpurascens, Weddl.	Weddl. tab. 18.....	Bolivia.....	.....	*C. calopteræ*, Miq., is probably a var. of this species. Bark unknown in commerce.

Commercial History.

For more than a century after Peruvian bark came into use, it was procured almost exclusively from the neighborhood of Loxa. In a memoir published in 1738, La Condamine speaks of the bark of Rhiobambo, Cuença, Ayavaca, and Jaen de Bracomoros. Of these places, the first two, together with Loxa, lie within the ancient kingdom of Quito, at the southern extremity; the others are in the same vicinity, within the borders of Peru. The drug was shipped chiefly at Payta, whence it was carried to Spain, and thence spread over Europe. Beyond the limits above mentioned, the Cinchona was not supposed to exist, till, in the year 1753, a gentleman of Loxa discovered it, while on a journey to Santa Fé de Bogota, in numerous situations along his route, wherever, in fact, the elevation of the country was equal to that of Loxa, or about 6500 feet above the level of the sea. This discovery extended through Quito into New Granada, as far as two degrees and a half north of the equator. But no practical advantage was derived from it; and the information lay buried in the archives of the viceroyalty, till subsequent events brought it to light. To Mutis belongs the credit of making known the existence of the Cinchona in New Granada. He first discovered it in the neighborhood of Bogota, in 1772. A botanical expedition was afterwards organized by the Spanish government, with the view of exploring this part of their dominions, and the direction was given to Mutis. Its researches eventuated in the discovery of several species of Cinchona in New Granada; and a commerce in the bark soon commenced, which was carried on through the ports of Carthagena and Santa Martha.

To these sources another was added about the same time (1776), by the discovery of the Cinchona in the centre of Peru, in the mountainous region about the city of Huanuco, which lies on the eastern declivity of the Andes, northeast of Lima, at least six degrees south of the province of Loxa. To explore this new locality, another botanical expedition was set on foot, at the head of which were Ruiz and Pavon, the distinguished authors of the Flora Peruviana. These botanists spent several years in that region, during which time they discovered numerous species. Lima became the entrepot for the barks collected around Huanuco; and hence probably originated the name of Lima bark, so often conferred, in common language, not only upon the varieties received through that city, but also upon the medicine generally.

Soon after the last-mentioned discovery, two additional localities of the Cinchona were found; one at the northern extremity of the continent near Santa Martha,* the other very far to the south, in the provinces of La Paz and Cochabamba, then within the viceroyalty of Buenos Ayres, now in the republic of Bolivia. These latter places became the source of an abundant supply of excellent bark, which received the name of Calisaya. It was sent partly to the ports on the Pacific, partly to Buenos Ayres.

The consequence of these discoveries was a vast increase in the supply of bark, which was now shipped from the ports of Guayaquil, Payta, Lima, Arica, Buenos Ayres, Carthagena, and Santa Martha. At the same time the average quality was probably deteriorated; for, though many of the new varieties were possessed of excellent properties, yet equal care in superintending the collection and assorting of the bark could scarcely be exercised in a field so much more extended. The varieties now poured into the market soon became so numerous as to burden the memory if not to defy the discrimination of the druggist; and the best pharmacologists found themselves at a loss to discover any permanent peculiarities which might serve as the basis of a proper and useful classification. This perplexity has continued more or less to the present time; though the discovery of the alkaloidal principles has presented a ground of distinction before unknown. The restrictions upon the com-

* In relation to this locality of the Cinchonas, we are informed that Dr. Ernst, President of a Scientific Society of Caracas, in an excursion from that place, discovered on the slopes of several mountains, groups of the *Cinchona cordifolia*, var. *rotundifolia*, Weddell, *C. rotundifolia* of Pavon, at the height of 4500 feet above the sea. The bark of this tree is said to be the variety known in commerce as the *Ashy Crown bark*, one of the Loxa barks. The bark was found to contain 0·5 per cent. of quinine, and 0·67 of cinchonine. (*A. J. P.*, 1870, p. 449.)

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merce of South America, by directing the trade into irregular channels, had also a tendency to deteriorate the character of the drug. Little attention was paid to a proper assortment of the several varieties; and not only were the best barks mixed with those of inferior species and less careful preparation, but the products of other trees, bearing no resemblance to the Cinchona, were sometimes added, having been artificially prepared so as to deceive a careless observer. The markets of this country were peculiarly ill-furnished. The supplies, being derived chiefly, by means of a contraband trade, from Carthagena and other ports on the Spanish Main, or indirectly through the Havana, were necessarily of an inferior character; and most of the good bark which reached us was imported by our druggists from London, whither it was sent from Cadiz. A great change, however, in this respect, took place after the ports on the Pacific were opened to our commerce. The best kinds of bark were thus rendered directly accessible to us; and the trash which formerly glutted our markets is now in great measure excluded. Our ships trading to the Pacific run along the American coast from Valparaiso to Guayaquil, stopping at the intermediate ports of Coquimbo, Copiapo, Arica, Callao, Truxillo, etc., from all which they probably receive supplies. Much good bark has of late also been imported from Carthagena, and other ports of the Caribbean Sea, being brought down the Magdalena River from the mountainous regions of New Granada; and, since the completion of the railroad across the Isthmus, large quantities reach this country by way of Panama, to which place they are brought chiefly from the Pacific ports of Buenaventura and Guayaquil. An additional source of supply has recently been opened through the Amazon; a considerable quantity of bark having been taken to the London market from the port of Para, in Brazil, brought down that river, probably, from the Peruvian province of Huanuco. According to Mr. Howard, the bark thus obtained is of inferior quality, yielding but a small proportion of alkaloids. (*P. J. Tr.*, Dec. 1863, p. 248.)*

The persons who collect the bark are called in South America *Cascarilleros.* Considerable experience and judgment are requisite to render an individual well qualified for this business. He must not only be able to distinguish the trees which produce good bark from those less esteemed, but must also know the proper season and age at which a branch should be decorticated, and the marks by which the efficiency or inefficiency of any particular product is indicated. The bark gatherers begin their work with the setting in of the dry season in May. Sometimes they first cut down the tree, and afterwards strip off the bark from the branches; in other instances they decorticate the tree while standing. The former plan is said to be the most economical; as, when the tree is cut down, the stump pushes up shoots which in the course of time become fit for decortication, while, if deprived of its bark, the whole plant perishes. The operator separates the bark by making a longitudinal incision with a sharp knife through its whole thickness, and then forcing it off from the branch with the back of the instrument. Other means are resorted to, when the trunk or larger limbs are decorticated. According to Pöppig, the bark is not separated until three or four days after the tree is felled. It must then be speedily dried, as otherwise it becomes deteriorated. For this purpose it is taken out of the woods into some open place, where it is exposed to the sun. In drying it rolls up, or becomes quilled; and the degree to which this effect takes place is proportionate directly to the thinness of the bark, and inversely to the age of the branch from which it was derived. In packing the bark for exportation, it often happens that several different kinds are introduced in the same case. The packages are, in commercial language, called *seroons.* As found in this market they are usually covered with a case of thick and stiff ox-hide, lined within by a very coarse cloth, apparently woven out of some kind of grass.

The Cinchona forests, being in very thinly inhabited districts, do not, for the most part, belong to individuals, but are open to the enterprise of all who choose to engage in the collection of the bark. The consequence is, that the operations are

* An interesting history of the commerce in the Cinchona barks, by Dr. H. A. Weddell, will be found in the *A. J. P.* (xxvi. 539, Nov. 1854), originally from his *Voyages dans le Nord de la Bolivie*, Paris, 1853.

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carried on without reference to the future condition of this important interest; and the most wasteful modes of proceeding are often adopted.

The bitterness of the Cinchona is not confined to its bark. The leaves and flowers also have this property, which in the former is associated with acidity, in the latter with a delicious aroma, which renders the air fragrant in neighborhoods where the trees abound. The wood is nearly tasteless; but the bark of the root has the same virtues as that of the trunk.*

It was at one time supposed that the leaves might have sufficient of the active principles of the bark to justify their use in medicine; but, though they have proved useful as a tonic, experiment has not shown them to be possessed of decided antiperiodic powers, and, on chemical examination, they have yielded but a small proportion of the characteristic alkaloids.

Classification.

To form a correct and lucid system of classification is the most difficult part of the subject of bark. An arrangement founded on the botanical basis is liable to the objection, that the product of the same species may vary according to the age of the bark and the situation of the tree; and, besides, is at present scarcely practicable; as, though our knowledge of the source of the several varieties has very much extended, it is still defective on some points.

The Spanish merchants adopted a classification, dependent partly on the place of growth or shipment, and partly on the inherent properties or supposed relative value of the bark. So long as the sources of the drug were very confined, and the varieties few, this plan answered the purposes of trade; but at present it is quite inadequate; and, though some of the names originally conferred upon this principle are still retained, they are often uncertain or misapplied.

Perhaps, on the whole, the best arrangement for pharmaceutical and medicinal purposes is that founded upon difference of color. It is true that dependence cannot be placed upon this property alone; as barks of a similar color have been found to possess very different virtues; and, between the various colors considered characteristic, there is an insensible gradation, so that it is not always possible to decide where one ends and the other begins. Still, it has been found that most of the valuable barks may be arranged, according to their color, in three divisions, which, though mingling at their extremes, are very distinctly characterized, in certain specimens, by peculiarity not only in color, but also in other sensible properties, and even in chemical constitution. The three divisions alluded to are the *pale*, the *yellow*, and the *red*. This arrangement has been adopted in the Br. Pharmacopœia; and the U. S. recognizes the yellow and red, and under Cinchona any colored bark containing at least 3 per cent. of alkaloids. Until recently, as almost all the highly-esteemed barks were brought from the Pacific coast of South America, and those from the northern coast were deemed inferior, it was only the former that were recognized under the three divisions referred to. Of late, however, some of the best barks, and most productive in alkaloids, have been brought from India and Java; so that the restriction of the officinal barks to the Pacific coast was abandoned at the late revision of the U. S. Pharmacopœia; and the much better rule was adopted

* Dr. De Vrij, on examining a specimen of *C. Pahudiana*, grown in Java, obtained from the bark of the stem 1·274 per cent. of alkaloids (cinchonidine and cinchonicine, without any quinine), and afterwards from the bark of the root, 2·818 per cent. of alkaloids, of which 1·849 was quinine. Another specimen, only two years old, yielded to him from the bark of the stem 0·09 per cent. of alkaloid, without a trace of quinine; while from the root, treated so as to separate all the woody fibres, he obtained 1·941 per cent. of alkaloids, of which more than three-fourths was quinine. Four other species yielded, for the most part, analogous results. *C. Calisaya* of Java gave 3·676 per cent. of alkaloids from bark of the stem, and 4·430 from that of the root; the same species from Hindostan 1·89 to 3·10; *C. lancifolia* of Java 4·13 to 2·94; *C. succirubra*, No. 1, from Ootacamund (East India) 2·10 to 2·00; *C. succirubra* from the same place 2·65 to 7·514; and *C. micrantha* from Ootacamund 2·791 to 4·166. The result of all his experiments justified, he thought, an appeal to his government to devote a small portion of ground to the cultivation of the *C. Pahudiana*, with the view of obtaining quinine from the roots when two years old; as he believed that the alkaloids might then be profitably obtained; but his application was not favorably received; and the correctness of his inference remains still undetermined. (*Journ. de Pharm.*, Janv. 1869, pp. 17–23.)

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of recognizing all the Cinchona barks as officinal which might contain three per cent. of their proper alkaloids. Nevertheless, the former officinal varieties have been retained. In describing, therefore, the different kinds of barks, we shall treat first, under the officinal titles of *pale*, *yellow*, and *red*, of those originally brought only from the ports of the Pacific; while those coming to us from the northern ports of New Granada and Venezuela will be subsequently considered under the heading of *Carthagena barks*, by which name they have been generally known in commerce. The commercial name will be given whenever a knowledge of it can be useful. It is proper to state that the different barks are often mingled in the same package, and that, in deciding upon the character of a seroon, the druggist is guided rather by the predominance than the exclusive existence of certain distinctive properties.

1. Pale or Gray Bark.

The epithet *pale*, applied to the barks of this division, is derived from the color of the powder. The French call them *quinquinas gris*, or gray barks, from the color of the epidermis. They come into the market in cylindrical pieces, of variable length from a few inches to a foot and a half, sometimes singly, sometimes doubly quilled, from two lines to an inch in diameter, and from half a line to two or three lines in thickness. The kinds which were formerly deemed the finest are about the size of a goose-quill; but experience has shown that the young barks are not the most efficient. Their exterior surface is usually more or less rough, marked with transverse and sometimes with longitudinal fissures, and of a grayish color, owing to adhering lichens. The shade is different in different samples. Sometimes it is a light gray, approaching to white, sometimes dull and brown, sometimes a grayish fawn, and frequently diversified by the intermixture of the proper color of the epidermis with that of the patches of lichens. The interior surface, in the finer kinds, is smooth; in the coarser, occasionally rough and somewhat ligneous. Its color is a brownish orange, sometimes inclining to red, sometimes to yellow, and, in some inferior specimens, of a dusky hue. The fracture is usually smooth, with some short filaments on the internal part only. In the coarser barks it is more fibrous. The color of the powder is a pale fawn, which is of a darker hue in the inferior kinds. The taste is moderately bitter and somewhat astringent, without being disagreeable or nauseous. Authors speak also of an acidulous and aromatic flavor. The better kinds have a feeble odor, which is distinct and agreeably aromatic in powder and decoction. The pale barks are chemically characterized by containing *a much larger proportion of cinchonine and quinidine or cinchonidine than of quinine;* and their infusion does not yield a precipitate with solution of sulphate of sodium. Their appearance generally indicates that they were derived from the smaller branches. They are collected in the provinces about Loxa, or in the country which surrounds the city of Huanuco, northeast of Lima, and are probably derived chiefly from *Cinchona Condaminea*, *C. nitida*, and *C. micrantha*.

There are several commercial varieties of pale bark, obtained from different sources, and differing more or less in properties. The most highly esteemed of these is the *Loxa bark*, the finest specimens of which are sometimes called *crown bark of Loxa*, from the impression that they have the same origin and character with the bark formerly selected with great care for the use of the King of Spain and the royal family. The pale bark collected about Huanuco is named either *Lima bark*, because taken to that city for commercial distribution, or *Huanuco bark*, from its place of collection. The former name has been more common in this country, where, indeed, this commercial variety has not unfrequently been confounded with the Loxa bark. Other pale barks are the *Jaen* and *Huamilies barks*, which are scarcely known as distinct varieties in the United States.*

In this country, the pale bark has fallen into disuse. As it yields little quinine, it is not employed in the manufacture of the sulphate of that alkaloid, which has

* For an elaborate description of numerous varieties of Pale Bark, see fourteenth edition of the United States Dispensatory. This is omitted here as unnecessary, because barks are no longer purchased by their physical appearance, but by their yield of alkaloids on analysis.

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almost superseded the bark as a remedy in intermittents; and the red or yellow bark is preferred by physicians when it is necessary to resort to the medicine in substance. There is no doubt, however, that *cinchonine*, *quinidine*, and *cinchonidine* possess febrifuge properties little inferior, so that the pale bark may come into more extensive use for the preparation of the other alkaloids.

2. Yellow Bark.

The officinal term yellow bark is applicable only to the valuable variety of the drug called commercially *Calisaya*, a name which has been said, though erroneously, to be derived from a province in Bolivia, near the city of La Paz, where the bark is collected.* By the druggists *Calisaya bark* is arranged in two sub-varieties, the quilled and the flat, which sometimes come mixed together in the same seroon, sometimes separate. It is called by the French *quinquina jaune royal* (royal yellow bark), from its resemblance to a variety formerly collected for the Spanish king.

The *quilled Calisaya* (*Calisaya arrolada* of the Spanish Americans) is in pieces from three inches to two feet long, from a quarter of an inch to two or three inches in diameter, and of equally variable thickness. The epidermis is of a brownish color, diversified or concealed by silvery white, whitish, or yellowish lichens, is marked by longitudinal wrinkles and transverse fissures, and is often partially separated, and generally easily separable from the proper bark. In the larger kinds, it is thick, rough, deeply indented by the transverse fissures, which often surround the quills, and is composed of several layers, separated from each other by a reddish brown membrane. The epidermis yields a dark red powder, and is tasteless and inert. It is desirable, therefore, to get rid of it before the bark is powdered, as the medicine is thus procured of greater strength. The bark itself, without the epidermis, is from one to two lines in thickness, compact, of a short fibrous texture, and when broken presents shining points, apparently the termination of small fibres running longitudinally, which, examined by the microscope, are found, when freed from a salmon-colored powder that surrounds them, to be yellow and transparent. When the bark is powdered, they readily separate, in the form of spicula, which, like those of cowhage, insinuate themselves into the skin, and produce a disagreeable itching and irritation. The color of the bark is brownish yellow with a tinge of orange, the taste less astringent than that of the pale bark, but much more bitter; and the bitterness is somewhat peculiar. The external part of the proper bark is more bitter and astringent, and consequently stronger in medicinal power, than the internal. The odor is faint, but when the bark is boiled, resembles that of the pale varieties. The small quills closely resemble some of the pale barks, but may be distinguished by their very bitter taste. The U. S. Pharmacopœia thus describes quilled Calisaya bark. "The quills are either single or double, varying in length from one-half to two inches (1 to 5 cm.) in diameter; the bark is from one-sixteenth to one-eighth of an inch (1·5 to 3 mm.) in thickness; it is covered with a grayish cork marked by longitudinal and transverse fissures, about one inch (25 mm.) apart and forming irregular meshes with raised edges. The inner surface is cinnamon-brown and finely striate from the bast-fibres." *U. S.*

The *flat Calisaya* (*Calisaya plancha* of the Spaniards), which is derived from the large branches and trunk, is in pieces of various lengths, either quite flat, or but slightly curved, and generally destitute of the epidermis, which has been obviously removed through its own want of adhesiveness to the proper bark, and not by a knife, as is the case with some inferior barks in other respects resembling the Calisaya. "The flat pieces vary in length and width; are from one-sixth to two-fifths of an inch (4 to 10 mm.) in thickness, almost entirely deprived of the brown, corky layer, compact, of a tawny-yellow color; outer surface marked with shallow, conchoidal

* No such province exists in Bolivia. According to M. Laubert, the name is a corruption of *collisalla*, said to be derived from *colla*, a remedy, and *salla*, a rocky country. (*Journ. de Pharm.*, xxii. 614.) Weddell refers the origin of the name to the words *colli* and *saya*, which in the Quichua language signify *red* and *sort*, and have probably been applied from the redness which the outer denuded surface of the bark assumes in drying, or from the red color which the leaves sometimes exhibit.

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depressions and intervening, rather sharp ridges; inner surface closely and finely striate; the transverse fracture showing numerous, very short and rigid, glistening fibres, which are radially arranged, and rarely in small groups. The powder has a light cinnamon-brown color, and a slightly aromatic but persistently bitter taste." *U. S.* The inner surface is like that of the quilled pieces; the outer is irregular, marked with confluent longitudinal furrows and ridges, and somewhat darker colored than the inner, being of a brownish fawn, frequently diversified with darker stains. The bark is of uniform fracture throughout, generally thicker than the quilled, more fibrous in its texture, less compact, less bitter, and possessed of less medicinal power. Though weaker than the proper bark of the quills, it is usually, in equal weight, more valuable than that variety, because free from the useless epidermis. This variety of yellow bark is now (1882) practically out of the American market.

The officinal yellow bark is characterized by its strongly bitter taste, with little astringency; by its fine brownish yellow, somewhat orange color, which is still brighter in the powder; and by *containing a large proportion of quinine with very little cinchonine.* The salts of quinine and lime are so abundant, that a strong infusion of it instantly affords a precipitate when crystals of sulphate of sodium are added. (Guibourt, *Hist. des Drogues*, 4éme ed., iii. 131.)* "The true yellow Cinchona Bark should not be confounded with other Cinchona barks of a similar color, but having the bast-fibres in bundles or radial rows, and breaking with a splintery or coarsely fibrous fracture." *U. S.*

Until the recent most valuable researches of Weddell, nothing was known with certainty as to the particular species which yields Calisaya bark. At present there is no variety of which, in this respect, we have more accurate knowledge. The genuine bark is derived from the newly described species, named *C. Calisaya;* but the bark of *C. Boliviana*, another of the species discovered by Weddell, is sometimes mixed with it in the same seroons. It is produced exclusively in Bolivia, formerly upper Peru, and in the southern portion of the adjoining Peruvian province of Carabaya. Before these countries were separated from Spain, it was shipped as well from Buenos Ayres as from the ports on the Pacific; but at present it comes only from the latter. As first announced in this work, from information derived from merchants long personally engaged in commercial transactions on the Pacific coast of South America, the bark is brought from the interior to the port of Arica, whence it is sent to various other ports on the coast. The interior commerce in the drug has its centre chiefly in the town of La Paz. The trade in this bark has been much diminished, in consequence partly of its greater scarcity, partly of restrictions by the Bolivian government.

It is generally supposed to have been first introduced into commerce towards the end of the last century, and it was probably not known by its present name till that period; but La Condamine states that the Jesuits of La Paz, at a period anterior to the discovery of the febrifuge of Loxa, sent to Rome a very bitter bark by the name of *quinaquina*, which, though supposed by that traveller to have been derived from the Peruvian balsam tree, was very probably, as conjectured by Guibourt, the true cinchona. Besides, Pomet, in his *History of Drugs*, published in 1694, speaks of a bark more bitter than that of Loxa, obtained from the province of Potosi, which borders upon that of La Paz; and Chomal also states that the cinchona tree inhabited the mountains of Potosi, and produced a bark more esteemed than that which grew in the province of Quito. (Guibourt, *Journ. de Pharm.*, xvi. 235.) It is possible that, though known at this early period, it may have gone out of use; and its reintroduction into notice, towards the end of the last century, may have been mistaken for an original discovery.

* For descriptions of varieties of yellow bark, see 14th edition U. S. Dispensatory. A *false bark* has been sometimes mixed with the genuine Calisaya, which it resembles so closely as not to be easily distinguished by the eye. According to Weddell, it is the bark of *Gomphosia chlorantha*, a lofty tree, growing in the same forests where the *Calisaya* is found. It is distinguished by a peculiar odor, and by exhibiting in its transverse section, under the microscope, "a peculiar fasciculate disposition of the cortical fibres, and some vessels gorged with a ruby-colored juice." It does not contain a particle of alkaloid, but yields a volatile oil on which its odor depends. (Howard, *P. J. Tr.*, xiv. 318.)

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3. Red Bark.

The name of this variety is very appropriately applied; as the color is usually distinct both in the bark and the powder. In South America it is called *cascarilla roxa* and *colorada*. Some writers have divided it into several sub-varieties; but, in relation to the true red bark, there does not seem to be ground for such division in any essential difference of properties. Like the *Calisaya*, it comes in quills and flat pieces, which are probably derived from different parts of the same tree. It is imported in chests.

Some of the pieces are entirely rolled, some partially so, as if they had been taken from half the circumference of the branch; others are nearly or quite flat. They vary greatly in size, the quill being sometimes less than half an inch in diameter, sometimes as much as two inches; while the flat pieces are occasionally very large and thick, as if derived from the trunk of a tree. They are covered with a reddish brown or gray, sometimes whitish epidermis, which is rugged, wrinkled longitudinally, and in the thicker pieces marked with furrows, which in some places penetrate to the surface of the proper bark. In many specimens, numerous small roundish or oblong eminences, called warts, may be observed upon the outer surface. Beneath the epidermis is a layer, dark red, brittle and compact, which possesses some bitterness and astringency, but much less than the interior parts. These are woody and fibrous, of a more or less lively brownish red color, which is usually very distinct, but in some specimens passes into orange and even yellowish brown; so that it is not always possible to distinguish the variety by this property alone. The taste is bitter and astringent, and the odor similar to that of other good barks. Red bark is chemically distinguished by *containing considerable quantities of both quinine and cinchonine*. It yields a turbid salmon-colored decoction with water. Mr. Howard, in examining slender sections of a fine specimen of red bark under the microscope, noticed numerous stellate groups of crystals diffused irregularly throughout its substance, which he believed to consist of quinovate of quinine, formed during the drying of the bark. He also noticed other crystalline forms which he ascribed to the quinovates severally of cinchonine, quinidine, and cinchonidine. (*P. J. Tr.*, May, 1865, p. 584.)* The U. S. Pharmacopœia thus describes red bark. "In quills and in flat or inflexed pieces, varying in length and width, and from one-eighth to one-half of an inch (3 to 12 mm.) in thickness; compact; of a deep brown-red color; outer surface covered with numerous, suberous warts and ridges, or longitudinally and somewhat transversely fissured; inner surface rather coarsely striate; transverse fracture short-fibrous; the bast-fibres in interrupted, radial lines; the powder deep brown-red, slightly odorous, astringent and bitter. Red Cinchona should not be confounded with other Cinchona barks, having an orange-red color, and breaking with a coarse, splintery fracture. Thin, quilled Red Cinchona of a light red-brown color should be rejected." *U. S.*

Non-officinal or Carthagena Barks.

Under this head may be classed all the Cinchona barks brought from the northern Atlantic ports of South America. In commerce, they are variously called *Pitayà*, *Bogota*, *Carthagena*, *Maracaybo*, and *Santa Martha barks*, according to the place in the vicinity of which they are collected, or the particular port at which they may be shipped. Formerly these barks were for the most part of inferior quality, and were therefore not recognized in the Pharmacopœias; but the deficient supply and consequent high price of Calisaya have directed enterprise into other quarters; and large quantities of very good bark were thrown into commerce from New Granada, derived chiefly from the neighborhood of Bogota and Popayan, and brought down the river Magdalena. Since the completion of the railroad across the Isthmus of Panama, considerable quantities have been brought to us by that route, being shipped from the port of Buenaventura, on the Pacific coast. There can be little doubt that the commerce in these barks will continue and increase; as some of them are inferior in their yield of alkaloids only to the Calisaya, if even to that variety, and the region from which they are procured is almost virgin soil. It has appeared

* For description of varieties of Red Bark, see fourteenth edition of U. S. Dispensatory.

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to us, from an examination of such of them as have come under our notice, that they may all, at least with one exception, be referred without violence to some one or another of the varieties of Carthagena bark already recognized; but these better kinds formerly seldom reached the market; because, partaking of the general reputation of the inferior barks from the same region, it was feared that they might not pay the cost of importation. Most of the Carthagena barks are characterized by a soft, whitish or yellowish white epidermis, which may be easily scraped by the nail, and which, though often more or less completely removed, almost always leaves behind traces sufficient to indicate its character. Those of them which may, in other respects, bear some resemblance to Calisaya, are in general readily distinguishable by this character of the epidermis when it remains, and, when it is wanting, by the peculiar appearance of the outer surface, showing that the exterior coating has been scraped off, or shaved off with a knife. They all contain the alkaloids in greater or less proportion, though they differ much in this respect. In reference to the relative proportion of the different alkaloids, they have nothing in common, except perhaps that they yield proportionately more cinchonine, cinchonidine, and quinidine than the Calisaya, resembling, in this respect, the pale and red barks. Inferior barks, with the soft, white epidermis, are found on the western coast of South America, where they are known as *white barks;** but they seldom reach us. In the state of powder, the inferior Carthagena barks were formerly, and are still, to a certain extent, kept in the shops, and sold for tooth-powder, etc., under the name of *common bark*. They have not unfrequently been substituted, either fraudulently or by mistake, for the better kinds.

The Carthagena barks were formerly classified, according to their color, into the *yellow*, *orange*, *red*, and *brown*; but this mode of distinction must now be abandoned; for these varieties of color may be found in the barks identical in other respects, and derived from the same species of Cinchona. The well characterized Carthagena barks may all be referred to one of the three following varieties.

1. *Hard Carthagena Bark. Hard Yellow Carthagena Bark. Yellow Bark of Santa Fé. Common Yellow Carthagena Bark.—China flava dura.* Von Bergen. *Quinquina de Carthagène jaune pâle.* Guibourt. This is in pieces of various size and form, sometimes wholly or partially quilled, and sometimes flat; and the flat pieces present the appearance of having been warped in drying, being frequently curved longitudinally backward, and sometimes also in the transverse direction or spirally. The quills are from three to eight lines in diameter, from half a line to a line and a half thick, and from five to nine and rarely fifteen inches long. The flat pieces are thicker, from half an inch to two inches broad, and from four to eight and sometimes twelve inches in length. As found in this market, the bark is some-

* *Paytine* or *Paytina*. Having been requested by a merchant to examine for quinine a *white bark* from the Pacific port of *Payta*, Dr. O. Hesse, in the year 1870, discovered that the bark contained alkaloids, but not one of those proved to exist in the proper Cinchona barks. The alkaloid specially noticed by him, may be prepared from the alcoholic extract, by treating this with soda, and agitating with ether, which dissolves the alkaloid with some coloring matter. The ethereal liquid, agitated with dilute sulphuric acid, furnishes a solution of the sulphate. This is decolorized by a little animal charcoal, almost neutralized with heat by ammonia, then, after cooling, is treated with iodide of potassium, until this ceases to produce a precipitate. The salt thus formed is entirely deposited in 24 hours. Separated from the mother-water, it is treated with dilute solution of soda, and shaken with ether. This, holding the alkaloid in solution, is separated from the heavier liquid; and, having been washed with water, yields, on spontaneous evaporation, the alkaloid in fine colorless crystals. Dr. Hesse gives the new alkaloid the name of *paytine*, after the port whence the bark was obtained. Paytine is in well-defined prismatic crystals. It has a bitter taste. It melts at 156° C., and distils partially at a higher temperature, leaving a carbonaceous residue. It is very soluble in alcohol, ether, benzin, and chloroform, but little soluble in water and alkaline solution. According to the analysis of Hesse it is represented by the formula $C_{21}H_{24}N_2O$ for the pure anhydrous alkaloid, with the addition of one mol. of water in the crystals. It seems to be without poisonous properties, as dogs have taken it freely without evil results. It has not been tried on man; but is a good subject for therapeutical experiment, especially in miasmatic fevers. According to Dr. Hesse, the bark which yields it, though bearing a superficial resemblance to the Calisaya, cannot, from its interior structure, have been the product of a Cinchona. The bark is in pieces about one foot long, two inches broad, and two or three lines thick; and consists mainly of greenish yellow cells, between which is lodged, in large quantities, a white pulverulent matter. It has so little firmness that its fibres are crushed under the pressure of the finger-nail. It has been found to contain another alkaloid besides paytine; but this has not been examined. For further particulars about the alkaloid see the *Journ. de Pharm.*, Nov.-Dec. 1870, p. 389.

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times in small, irregularly square or oblong, flattish, and variously warped pieces, from one to four inches long, and from one to three lines in thickness, mixed with small quills or fragments of quills; the former appearing as if chipped from the trunk or larger branches, the latter evidently derived from the small branches. In this shape it was treated of in some former editions of this work, as a distinct variety, under the name of *Santa Martha Bark*, which it at one time held in the market; but a closer examination has convinced us that it is the same bark as the one above described, though collected in a different manner. The quills are generally more covered with the whitish epidermis than the flat pieces, in which it is often nearly or quite removed. The inner surface of the latter, though sometimes smooth, is often rough and splintery, as if forcibly separated from the wood. The color of the proper bark is a pale, dull, brownish yellow, darker in parcels which have been long kept; and the surface often appears as if rubbed over with powdered bark. The texture is rather firm and compact, and the fracture abrupt, without being smooth or presenting long splinters. The taste is bitter and nauseous. This variety of bark is now universally ascribed to *C. cordifolia*.

2. *Fibrous Carthagena Bark. Fibrous Yellow Carthagena Bark. Spongy Carthagena Bark. Bogota Bark. Coquetta Bark.*—*Quinia naranjanda.* Mutis.—*Quinquina orangé.* Humboldt.—*China flava fibrosa.* Von Bergen.—*Quinquina. Carthegène spongieux.* Guibourt. This is in quills or half-quills, or is slightly rolled; and there are comparatively few pieces which are quite flat, even among the largest barks. The quills are from half an inch to an inch and a half in diameter, and of extremely variable length, with a yellowish brown epidermis, often covered with crustaceous lichens so as to render the surface of the bark whitish and smooth, and exhibiting not unfrequently longitudinal and transverse fissures. The larger barks, which are much the most frequent in commerce, are usually from six to twelve inches long, from one to two inches broad, and from two to five lines in thickness; but they often vary much from these dimensions, being sometimes in the smallest fragments, and sometimes forming semi-cylinders four or five inches in diameter, a foot and a half long, and nine lines thick. They are usually without epidermis, which has been scraped off, or pared off with a knife, leaving the surface smooth and uniform in the former case, and somewhat angular in the latter. Sometimes, however, the epidermis either partially or wholly remains, when it generally exhibits the soft whitish surface characteristic of most of the Carthagena barks. The bark is very fibrous, presenting generally, when broken, long, sometimes stringy splinters, though the outer edge of the fracture is occasionally short from the cellular, or remains of the suberous coat. Its texture is loose, soft, and spongy under the teeth, and the bark itself is usually light. The color both of the trimmed outer surface, and the inner, and of the bark itself, varies from an ochreous or light brownish yellow, to orange, and red; but, for the most part, it presents more or less of the orange tint, which induced Mutis to give it the title of *orange bark*. The red color is found especially in the largest barks. The larger pieces are sometimes marked on the outside with a deep spiral impression, produced probably by a climbing plant winding around the stem of the tree. The color of the powder is yellowish, with not unfrequently an orange tint. The taste is more or less bitter, but varies in this respect extremely; some barks being almost insipid, while others have a very decided taste. There can be little doubt that these barks are all derived from the *Cinchona lancifolia* of Mutis. It is asserted that the red variety of the bark is obtained from trees which grow side by side with those which yield the yellow or orange.

The productiveness of the fibrous bark in alkaloids varies greatly in the different specimens. Thus, while some have yielded scarcely any product, others have been found to afford more than three per cent. They probably contain all the cinchona alkaloids; but some have been found more abundant in one, and others in another. Thus, the red is said to be especially rich in quinidine (cinchonidine); a Pitaya bark, which we believe to belong to the fibrous Carthagena, has yielded a very large product of quinine; while, in not a few specimens which have been examined, the cinchonine predominates. (*A. J. P.*, xxv. 308.) It is probable that the richness in these principles depends in some degree on the natural position of the plants;

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those growing in low situations being less productive than those higher on the mountains.*

A specimen labelled *yellow bark of Loxa*, brought from South America several years since by Dr. Dillard, of the U. S. Navy, and said to be used in Loxa for making extract of bark, presents characteristics closely analogous to those of fibrous Carthagena bark, sufficiently so to justify the supposition that it was derived from the same species of Cinchona; and we have seen a specimen sent hither from Guayaquil, which has the same character, and is so rich in alkaloids as to be worked with advantage.†

3. *Hard Pitaya Bark.—Pitaya Condaminea Bark.* Pereira.—*Quinquina brun de Carthagène. Quinquina Pitaya, ou de la Colombia, ou d'Antioquia.* Guibourt. This bark, though seen by Guibourt so long since as 1830, did not come into general notice until some years afterwards. Much of it has been imported into Philadelphia, coming sometimes through Carthagena, and sometimes over the Isthmus of Panama, whither it is brought from Buenaventura. The following description is drawn from an examination of the bark contained in several seroons that have come under our notice. It is in small irregular pieces, from less than an inch to about four inches long, which are obviously the fragments of larger pieces both quilled and flat. Dr. Pereira states that he had pieces more than a foot in length. In thickness it varies from less than a line to four or five lines. Most of the fragments are covered with the whitish, soft epidermis, characteristic of the Carthagena barks; but some of them have a dark brown epidermis, rugose with innumerable cracks in all directions; and others are partially or wholly destitute of the outer covering, presenting generally, in the denuded part, a dark uniform or somewhat wrinkled surface. The inner surface is finely and compactly fibrous, and of a dull yellowish brown color with a reddish tinge; and the whole of the liber or true bark has the same color and texture. But outside of the liber there is in many pieces a very distinct resinous layer, which is sometimes of considerable thickness, and, when cut across by a knife, exhibits a dark reddish brown, shining surface. The resinous layer is the most striking peculiarity of the bark, though not present in all of the pieces, which sometimes consist of the liber alone. The fracture is towards the interior shortly fibrous, towards the exterior often smooth, in consequence of the layer just referred to. The whole bark is rather hard, compact, and heavy; differing in this respect very decidedly from the last mentioned variety. It has more resemblance to the hard Carthagena, from which, however, it differs by its deeper and redder color, its much more developed resinous coat, and its occasional grater-like epidermis. The taste is very bitter, and the yield in alkaloids considerable. Mr. Weightman informed us that he had obtained from it an average product of 1·6 per cent. of sulphate of quinine, and 0·34 of sulphate of cinchonine, independently of the amorphous or uncrystallizable alkaloidal matter. It must, therefore, be ranked among the efficient barks, though not so productive as the fine variety of fibrous bark denominated soft Pitaya. It contains also a large proportion of resin.

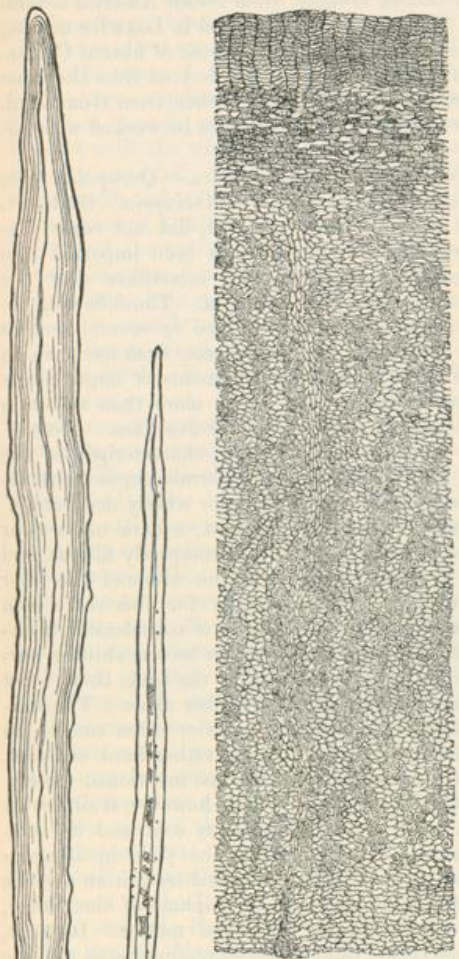
This bark comes from the mountain of Pitaya near Popayan, and the particular

* Karsten states that the bark of *C. lancifolia*, which on the average yields 2·5 per cent. of sulphate of quinine and from 1·0 to 1·5 per cent. of sulphate of cinchonine, often yields neither, and sometimes 4·5 per cent. of the two. The bark of the young branches yields much less than that of the trunk. (*A. J. P.*, xxx. 534.)

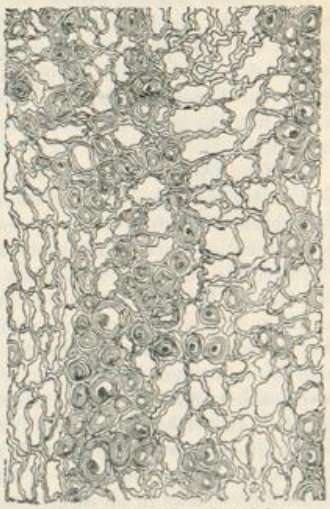
† *Fibrous Carthagena Bark.* The following is an abbreviation of Von Bergen's description of this variety. In shape and dimensions it does not materially differ from the preceding; but the flatter pieces are almost always a little rolled, or curved laterally. The epidermis is in general either in part or wholly rubbed off. When it is present, the outer surface is nearly smooth, only marked here and there with faint irregular transverse fissures and longitudinal furrows. Its color varies from a dirty whitish gray to yellowish, but is sometimes more or less dark. When the outer surface is rubbed off, as is almost always the case in the flat pieces, the color is nearly pure ochre yellow. Where the whole thickness of the outer coat is wanting, as happens here and there in spots, the surface is dark cinnamon, or dark ochre yellow, and commonly dull or powdery. The inner surface is usually even, but sometimes irregular and splintery, and always harsh to the fingers, leaving small splinters sticking in the skin when drawn over it. It is of a nearly pure ochre yellow color, and is very powdery. The fracture distinguishes this variety from the preceding, and from all others. The longitudinal fracture is strikingly fibrous, and in the flat pieces the fragments still hang together by connecting fibres.

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seroons examined by ourselves were said to have been brought down the Magdalena river from the town of Honda. It is referred by Dr. Pereira and Mr. Howard to



Transverse section of Cuprea bark.



Highly magnified section of Cuprea bark, showing bast-cells.

Bast-cells from Carthagena and Cuprea barks.

the *Cinchona Condaminea*, var. *Pitayensis* of Weddell, of which that author has made a distinct species, under the name of *Cinchona Pitayensis*. (*Ann. des Sci. Nat.*, May, 1849.)*

Cuprea Bark.—As early as 1820, a Brazilian surgeon, by the name of Remijio, pointed out to his countrymen that the bark of certain small trees or shrubs growing in Brazil were as effective as the Peruvian bark in malarial fevers, and ever since in Brazil these plants have been known by the names of *Quinia de Sera*, or *Quinia de Remijio*. St. Hilaire (*Plantes Us. Bras.*) placed these shrubs in the genus Cinchona, as *C. Remijiana*, *ferruginea*, and *Vellozii*; but De Candolle (*Prodromus*, iv. 357) erected for them a new genus, Remijia, which has since been universally recognized by botanists. It is distinguished from Cinchona by the fruit capsules opening semi-loculicidally, by its peltate seeds, and by its inflorescence in elongated axillary racemes with opposite fascicles of flowers. In 1857 a new bark appeared in the London market, but only within the last few years has this so-called *Cuprea bark* appeared in large quantities. After its value became known the search for it in South America became very active; indeed, in Colombia a "fever" is said to have broken out, which has caused agriculture to be neglected and deranged the business of the country, whilst in London the supply has been so great as to break the whole cinchona market. Mr. S. G. Rosengarten informs us that the bark reaches this country from London, and also directly from

* More minute descriptions of the Carthagena barks may be found in the foot-notes to the fourteenth edition of the U. S. Dispensatory.

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Colombia. There are two distinct regions which yield it: one is the lower part of the basin of the Magdalena River, in the province of Santander, the trees growing in the mountain chain of La Paz, and the port of export being Bucaramanga; the other the basin of the Orinoco, among the mountains which constitute the eastern branch of the Cordillera of the Andes.

Bentham states that the genus Remijia comprises 13 species; according to the researches of José Triana, but two of these, *R. Purdieana*, Wedd. (*Ann. Sci. Nat.*, 3e sér., xi. p. 272), and *R. pedunculata*, Triana (*Cinchona pedunculata*, Karsten), yield the Cuprea bark of commerce. (*P. J. Tr.*, April, 1882.) An exceedingly important fact connected with these trees is that they grow in a dry climate, and in position a little above the level of the sea, and hence without doubt could be cultivated in many intertropical countries where the Cinchonas will not grow. They would in all probability flourish within the limits of the United States.

The specimens of Cuprea bark which have been furnished us as typical by the Messrs. Rosengarten are composed of pieces varying from half an inch to 3 or 4 inches in length, from a quarter to a twelfth of an inch in thickness, strong and hard, varying from a yellowish to a red cinnamon color, and having a somewhat cupreous tint, distinctly curled, *very smooth* upon their inner surface, on their outer surface smoothish, or in the larger specimens rough, with the epidermis usually adherent; marked, except in the very large pieces, with fine wrinkles, and sometimes with transverse or spiral grooves, which are sometimes quite shallow, but often are deeply and sharply cut. The texture is dense and hard, the fracture is short, not fibrous, and free from spicules. The microscopic characters differ from that of the true Cinchonas in the bast-cells being small and with their cavity widely open, not obliterated by secondary layers. The figure represents a bast-cell obtained from a Carthagena bark, and one from Cuprea bark equally magnified.

Cuprea bark varies in the percentage of quinine it contains. The Messrs. Rosengarten state that the yield in their laboratories has been from 1 to 2 per cent., and that usually the bark is remarkably free from inferior alkaloids. The complete absence of cinchonidine is said to be characteristic of them. Messrs. D. Howard and I. Hodgkin, Dr. B. H. Paul, and Mr. Cownley and Mr. T. G. Whiffen almost simultaneously announced the discovery of a new alkaloid, *homoquinine* or *ultraquinine*, which there is some reason for believing is a double salt of quinine and quinidine. (*Chem. News*, xlv. 6.) The characteristic chemical product is the alkaloid *cinchonamine*, whose right to a separate existence seems to be well established. (See page 448.)

False Barks.

Before dismissing the subject of the varieties of Cinchona, it is proper to observe that numerous barks have at various times been introduced into the market, and sold as closely resembling or identical with the febrifuge of Peru, which experience has proved to differ from it materially, both in chemical composition and in medical virtues. These barks are generally procured from trees formerly ranked among the Cinchonas, but now arranged in other genera. They are distinguished from the true Peruvian bark by the absence of its peculiar alkaloids. Hence they are readily distinguished by means of *Grahe's test*. This depends upon the fact that the cinchona alkaloids and barks containing them yield, when heated, beautiful purplish vapors, condensing into a similarly colored tar. (See p. 451, note.) Hesse's method of testing is probably the best: it consists in extracting the bark by slightly acidulated water, solidifying the liquid with the powdered bark, and heating in a large test-tube. If the bark be a true Cinchona, the vapors will be unmistakable. The microscopic character of the false barks also distinguish them from the genuine. Among them are—1, a bark known to the French pharmaceutists by the name of *quinquina nova*, or *new bark*, the product of *Cascarilla oblongifolia*,* which, though at one time thought to be possessed of some virtues, has been proved to be worthless; 2, the *Caribæan bark*, from *Exostemma Caribæa;* 3, the *St. Lucia bark*, or *quinquina piton* of the French, derived from *Exostemma floribunda;* and, 4, a bark of uncertain botanical origin, called in France

* For minute description of this bark, see fourteenth edition U. S. Dispensatory.

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quinquina bicolore, and in Italy *china bicolorata*, and sometimes erroneously named *Pitaya bark*. Of these the last only is known in this country. A considerable quantity of it was some time since imported into New Orleans, whence a portion reached this city. The specimen in our possession is in quills, for the most part singly, but in some instances doubly rolled, from eight or ten inches to more than two feet in length, and from a quarter of an inch to an inch or more in diameter. The outer surface is of a dull grayish olive color, with numerous large oval or irregular spots, much lighter colored, sometimes even whitish and slightly depressed beneath the general surface, as if a layer of the epidermis had fallen off within their limits. It is to this appearance that the bark owes the name of *bicolorata*. The color of the internal surface is deep brown or almost blackish; that of the fresh fracture, brownish red. The bark is hard, compact, and thin, seldom as much as a line thick, and breaks with a short rough fracture. It is inodorous, and has a very bitter taste, not unlike that of some of the inferior kinds of Cinchona.*

The inner bark of an Indian species of *Hymenodictyon*, formerly considered as a Cinchona, and named *C. excelsa*, has been supposed to possess properties analogous to those of genuine cinchona. It has been chemically examined by Mr. Broughton, who succeeded in obtaining from it a pure crystalline principle, ascertained to be identical with *æsculin*, the characteristic principle of *Æsculus Hippocastanum*, or common horse chestnut. He could find no trace of any of the cinchona alkaloids. (*P. J. Tr.*, March, 1868, p. 418.)

Bark Structure. The general structure of Cinchona barks does not differ from that of other barks, though in some of their microscopical details they are peculiar. The true epidermis is found only upon the growing twigs, and is never present in the commercial cinchona; the so-called epidermis of the various Cinchona barks of commerce being really the outer corky layer, the *exophlæum*, or *outer bark* of botanists. Within it is the *mesophlæum*, or *middle bark;* and innermost of all, the *endophlæum*, *inner bark*, or *liber*. The tuberous outer bark is composed of flat, thick-walled cells, and in some Cinchonas, instead of forming a distinct outer coating, sends processes into the mesophlæum, or it may occur in scattered islets through the middle bark. Under these circumstances, the middle bark may finally altogether be supplanted; if now the exophlæum be shed or rubbed off, a bark is finally left composed entirely of liber, as is the case, for example, with the large, flat pieces of true Calisaya. The middle bark, when present, is formed out of irregular parenchymatous cells, among which may, in some species, be seen the so-called latex vessels, composed of soft, elongated, unbranched cells, more or less completely fused together into channels. In old bark these latex vessels are often entirely obliterated. The parenchymatous cells sometimes contain minute starch granules, and occasionally single cells may be found, having crystals of oxalate of lime, or a softish, reddish, resinoid mass, in their interiors. These constitute the so-called *crystal* and *resin cells* of authors.

The endophlæum is divided by distinct medullary rays into wedge-like masses of parenchymatous tissue, containing the liber, or bast-cells, which, on section, are seen to be thick-walled, with a faint yellowish tint. The liber-cells are the most distinctive feature of Cinchona barks. (See Fig.) "They are elongated and bluntly pointed at their ends, but never branched, mostly spindle-shaped, straight, or slightly curved, and not exceeding in length 3 mm. They are consequently of a simpler structure than the analogous cells of most other officinal barks. They are about $\frac{1}{4}$ to $\frac{1}{3}$ mm. thick, their transverse section exhibiting a quadrangular rather than a circular outline. Their walls are strongly thickened by numerous secondary deposits, the cavity being reduced to a narrow cleft, a structure which explains the brittleness of the fibres. The liber fibres are either irregularly scattered in the liber rays, or they form radial lines transversely intersected by narrow strips of parenchyma, or they are

* In previous editions of this work, it was stated that this bark had been employed in Italy successfully in intermittents, and that Folchi and Peretti had discovered in it a new alkaloid, which they named *pitayaine*. But there is reason to believe that this was a mistake, caused by the confused use of the name Pitaya bark; and that the bark employed in Italy, and analyzed by the chemists mentioned, was that described as *hard pitaya* in a preceding page. It is conjectured that the alkaloid *pitayaine* may have been either quinidine or cinchonidine, or a mixture of the two.

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densely packed in short bundles. It is a peculiarity of Cinchona barks that these bundles consist always of a few fibres (3 to 5 or 7), whereas in many other barks (as cinnamon) analogous bundles are made up of a large number of fibres."* (*Pharmacographia*, p. 356.)

It has been asserted that crystals of salts of the alkaloids can be seen with the microscope in Cinchona bark, but this is an error. These crystals are only to be found in sections which have been boiled in a dilute solution of caustic alkali, and then washed with water, and are probably alkaloids that have been set free by the decomposition of the quinovates by the potash or soda.

Various attempts have been made to identify the different species of Cinchona by the structure of their barks, and we append in a foot-note† the analyses of Prof.

* Any one desirous of studying these bast-cells can easily separate them by boiling fragments of the bark in dilute nitric acid until thoroughly pulpified and then teasing out with needles.

† Prof. Maisch's Analysis.

1.—*Bast fibres single, sometimes in groups of 2, or rarely more; medium-sized.*

C. Calisaya. Laticiferous ducts in young bark; no resin-cells; old bark with prominent secondary cork; medullary rays narrow.

C. glandulifera. Laticiferous ducts in 1 or 2 rows; resin-cells few; bast rays narrow; medullary rays large-celled.

2. *Bast fibres single, or oftener in groups; not in distinct radial lines.*

C. micrantha. No laticiferous ducts; resin-cells few or none; bast fibres medium; medullary rays narrow.

C. purpurea. Laticiferous ducts in 1 or 2 rows; resin-cells numerous; bast fibres thin, with some incomplete fibres; medullary rays broadly wedge-shaped at end.

C. pubescens. Laticiferous ducts in 1 row; resin-cells numerous; bast fibres large, variable, with incomplete fibres; medullary rays broad.

3. *Bast fibres in interrupted single or double radial lines.*

C. succirubra. Laticiferous ducts in 1 row, in old bark often filled with cells; bast and medullary rays narrow; bast fibres medium.

C. officinalis. Laticiferous ducts thin, soon obliterated; resin-cells none; bast fibres medium; medullary rays narrow.

C. Pitayensis. Laticiferous ducts none; resin-cells few or none; bast fibres thin; medullary rays mostly narrow, wedge-shaped at end.

C. cordifolia. Laticiferous ducts none; resin-cells few; bast fibres small, with some incomplete fibres; medullary rays large-celled.

C. lancifolia. Laticiferous ducts none; resin-cells many; bast fibres medium, with some incomplete fibres; medullary rays large-celled.

C. nitida. Laticiferous ducts none; resin-cells few or none; bast fibres mostly thin, but many thick or medium; medullary rays narrow.

C. Peruviana. Laticiferous ducts (in 1 row) and resin-cells small; bast fibres small, many incompletely filled.

4. *Bast fibres in nearly uninterrupted radial lines.*

C. scrobiculata. Laticiferous ducts in 1 or 2 rows; resin-cells and bast fibres numerous; medullary rays large-celled.

Mr. Reeve's Analysis.

1. *Resin-cells absent.*

Laticiferous ducts present (in young bark); thickest fibres observed average ·095 mm. in diameter; fibres mostly separate. *C. Calisaya.*

Laticiferous ducts present (sometimes obscured in old bark); thickest fibres average ·085 mm. in diameter; fibres in lines, and occasionally groups of 2 to 8. *C. succiruba.*

Laticiferous ducts present (soon obliterated). *C. officinalis.*

2. *Resin-cells few or none* (i.e., *they vary*).

Laticiferous ducts absent; thickest fibres ·10 mm. in diameter; fibres in groups of 2 or 3, in older barks of more; medullary rays thin and indistinct. *C. micrantha.*

Laticiferous ducts absent; thickest observed fibres average ·075 mm.; thin fibres, mostly in single lines; section in places or sometimes entirely light gray. *C. Pitayensis.*

3. *Resin-cells present.*

Laticiferous ducts absent; thickest fibres average ·084 mm.; numerous resin-cells; fibres in line or groups of 2 to 4, with some staff-cells; medullary rays large-celled. *C. lancifolia.*

Laticiferous ducts absent; thickest fibres average ·078 mm.; resin-cells few; medullary rays large-celled; fibres small (sometimes few), in mostly single lines of 2 to 4, with some staff-cells; in some regions the fibres are dark red-brown, becoming bright rose-red with KOH. *C. cordifolia.*

Laticiferous ducts present; thickest observed fibres average ·106 mm.; numerous resin-cells; medullary rays broadly wedge-shaped; fibres in groups of 3 to 5, with some staff-cells. *C. purpurea.*

Laticiferous ducts present: numerous resin-cells; medullary rays broad; fibres large, in groups of 2 to 3, with staff-cells. *C. pubescens.*

Laticiferous ducts present; numerous resin-cells; fibres very numerous, in uninterrupted, usually single lines. *C. scrobiculata.*

Same as last, but few resin-cells. *C. glandulifera.*

Resin-cells, laticiferous ducts, and fibres small, many fibres incompletely filled in lines of 2 to 6. *C. Peruviana.*

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Maisch and Mr. J. C. Reeve. The constancy of the characters is, however, very doubtful, and in some studies of commercial barks, owing to the contradictory characters presented, we have found it impossible to apply the asserted facts, so as to determine by the microscope from what species the bark had been procured.

Chemical History.

In the analysis of Peruvian bark, the attention of chemists was at first directed exclusively to the action of water and alcohol upon it, and to the determination of the relative proportions of its gummy or extractive and resinous matter. The presence of tannin and of various alkaline or earthy salts in minute quantities was afterwards demonstrated. Fourcroy made an elaborate analysis, which proved the existence of other principles in the bark besides those previously ascertained. Dr. Westring was the first who attempted the discovery of an active principle in the bark, on which its febrifuge virtues might depend; but he was not successful. Seguin afterwards pursued the same track, and endeavored, by observing the effects of various reagents, to discover the relative value of different varieties of the drug; but his conclusions have not been supported by subsequent experiment. M. Deschamps, an apothecary of Lyons, obtained from bark a crystallizable salt of lime, the acid of which Vauquelin afterwards separated, and called *kinic acid*. The latter chemist also pushed to a much further extent the researches of Seguin as to the influence of reagents, and arrived at the conclusion that those barks were most efficient which gave precipitates with tannin or the infusion of galls. Reuss, of Moscow, succeeded in isolating a peculiar coloring matter from red bark, which he designated by the name of *cinchonic red*, and obtained a bitter substance which probably consisted in part of the peculiar alkaline principles subsequently discovered. The first step, however, towards the discovery of cinchonine and quinine appears to have been taken by the late Dr. Duncan, of Edinburgh, so early as 1803. He believed the precipitate, afforded by the infusion of cinchona with that of galls, to be a peculiar vegetable principle, and accordingly denominated it *cinchonine*. Dr. Gomez, a Portuguese physician, convinced that the active principle of bark resided in this cinchonine, but mixed with impurities, instituted experiments upon some pale bark, which resulted in the separation of a white crystalline substance, considered by him to be the pure *cinchonine* of Dr. Duncan. It was obtained by the action of potassa upon an aqueous infusion of the alcoholic extract of the bark, and was undoubtedly the principle now universally known by the name of *cinchonine* or *cinchonia*. But Dr. Gomez was ignorant of its precise nature, considering it to be analogous to resin. M. Laubert afterwards obtained the same principle by a different process, and described it under the name of *white matter*, or *pure white resin*. To Pelletier and Caventou was reserved the honor of crowning all these experiments, and applying the results which they obtained to important practical purposes. In 1820, they demonstrated the alkaline character of the principle discovered by Gomez and Laubert, and gave it definitively the name of *cinchonine*. They discovered in the yellow or Calisaya bark another alkaline principle, which they denominated *quinine*. Both these bases they proved to exist in the barks, combined with *kinic* or *quinic acid*, in the state of *kinate of cinchonine and of quinine*. It was, moreover, established by their labors that the febrifuge property of bark depends upon the presence of these two principles. In 1833, MM. O. Henry and Delondre discovered a new alkaloid, but afterwards, finding its composition in its anhydrous state the same as that of quinine, concluded that it was a hydrate of that base. About 1844, Winckler announced anew the existence of the same principle which he considered distinct, and named *chinidine;* and, under the similar title of *quinidine*, it has now taken its place among the cinchona alkaloids. In 1853, M. Pasteur found that what had been considered as quinidine consisted in fact of two alkaloids, for one of which he retained the name of quinidine, and called the other *cinchonidine;* and, on pushing his investigations further, he ascertained that no less than six alkaloids may be obtained from different varieties of Peruvian bark; namely, *quinine* and *quinidine* isomeric with each other, *cinchonine* and *cinchonidine* also isomeric, and two others, derivatives from the preceding through the agency of heat, viz., *quinicine* from quinine, and *cinchonicine* from cinchonine, each

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being isomeric with the alkaloid from which it is derived.* The termination *a* or *ia* has heretofore been adopted by American and English chemists to distinguish the organic alkaloids from other organic proximate principles, the names of which terminate in *in* or *ine*, the terms quinine and cinchonine becoming *quinia* and *cinchonia*. On the same principle, *quinidine*, *quinicine*, *cinchonidine*, and *cinchonicine* were called respectively *quinidia*, *quinicia*, *cinchonidia*, and *cinchonicia*. The Committee of Revision of the Pharmacopœia, 1880, have, however, accepted the custom of continental writers, and the *a* and *ia* termination has been dropped and *ine* substituted.

At the present time, 1882, the following alkaloids are recognized, as either existing naturally, or produced artificially, from the Cinchona barks.

Natural Alkaloids. 1. QUININE, $C_{20}H_{24}N_2O_2$. 2. QUINIDINE (*Conchinine of Hesse*), $C_{20}H_{24}N_2O_2$. 3. CINCHONINE, $C_{20}H_{24}N_2O$. 4. CINCHONIDINE, $C_{20}H_{24}N_2O$. (These four alkaloids are the most important, and the only ones used medicinally, or to be found in the market.) 5. *Quinamine*, $C_{19}H_{24}N_2O_2$. 6. *Quinidamine* (*Conchinamine of Hesse*), $C_{19}H_{24}N_2O_2$. 7. *Homoquinine* or *Ultra-quinine*. 8. *Cinchonamine*. 9. *Paytine*, $C_{21}H_{24}N_2OH_2O$. 10. *Homocinchonine*, $C_{19}H_{22}N_2O$. 11. *Homocinchonidine*, $C_{19}H_{22}N_2O$. 12. *Cusconine*, $C_{23}H_{26}N_2O_4 2H_2O$. 13. *Cusconidine*. 14. *Aricine* (*Cinchovatine of Manzini*), $C_{23}H_{26}N_2O_4$. 15. *Paricine*, $C_{16}H_{18}N_2O$. 16. *Paytamine*. 17. *Dihomocinchonine*. 18. *Dicinchonine*, $C_{40}H_{48}N_4O_2$? 19. *Diquinidine* (*Diconchinine of Hesse*), $C_{40}H_{46}N_4O_3$. 20. *Javanine*. 21. *Cincholine*.

The Artificial Alkaloids at present known are: 1. *Quinicine*, $C_{20}H_{24}N_2O_2$. 2. *Cinchonicine*, $C_{20}H_{24}N_2O$. 3. *Quinamicine*, $C_{19}H_{24}N_2O_2$. 4. *Quinamidine*, $C_{19}H_{24}N_2O_2$. 5. *Protoquinamicine*, $C_{17}H_{20}N_2O_2$. 6. *Apoquinamine*, $C_{19}H_{22}N_2O$. 7. *Homocinchonicine*, $C_{19}H_{22}N_2O$. 8. *Hydrocinchonine*, $C_{20}H_{26}N_2O$.

Chinoidine or *Quinoidine* is a term now applied to the resinous substance, consisting not only of the *amorphous* natural alkaloids, but to those which are produced artificially, through the action of heat and acids upon the crystalline alkaloids. It is now officinal. The other constituents of Cinchona bark are *Kinic* or *Quinic*, *Kinovic* or *Quinovic*, *Cinchotannic* or *Quinotannic* acids, *Kinovin* or *Quinovin*, *Cinchonic red*, volatile butyraceous oil in small quantity, red and yellow coloring matter. These constituents will now be considered in detail.

Quinine, *Quinidine*, *Cinchonine*, *Cinchonidine*, or their sulphates, having been made officinal, will be treated of under separate heads (see Index). *Quinicine* and *Cinchonicine*, being derivatives of quinine and cinchonine, will be considered under their respective sources.

QUINAMINE, *Quinamia*, $C_{19}H_{24}N_2O_2$. Dr. O. Hesse discovered this cinchona alkaloid in the bark of *C. succirubra* from Darjeeling in 1872. He has since found it in all of the East Indian succirubra barks, as well as in the barks of *C. nitida*, *C. Calisaya*, var. *Schuhkrafft*, *C. erythrantha*, *C. erythroderma*, *C rosulenta*, and *C. Calisaya* (Para bark). De Vrij (*L'Union Pharm.*, 1877, p. 204; *N. R.*, 1877, p. 300) has published a process for its preparation. It crystallizes in very long, asbestos-like, white prisms, without water of crystallization. It is insoluble in water, and solution of potassa or ammonia; is readily dissolved by hot alcohol, which deposits it in crystals, and less readily by diluted alcohol. Ether dissolves it rather easily at ordinary temperature, more readily when boiling hot, and gives it up crystallized on cooling and evaporation. In alcoholic solution it has an alkaline reaction. It neutralizes sulphuric and hydrochloric acids, forming with the latter an amorphous salt, but with the former one that crystallizes with difficulty in hexagonal scales and short prisms. Its solution is dextrogyrate. Its reaction with chloride of gold is very characteristic; the solution of the chloride producing with it a yellowish white precipitate, which soon becomes purple, and separates gold; the supernatant liquid assuming a purplish red, and afterwards a brown color. (For other characters, see *A. J. P.*, 1872, p. 302.)

QUINIDAMINE, *Quinidamia* (*Conchinamine of Hesse*), $C_{19}H_{24}N_2O_2$, is found in *C. rosulenta* and *C. succirubra*, and probably exists in other species of red bark.

* It is unfortunate that in Germany some confusion yet exists in the names adopted for the cinchona alkaloids. Cinchonidine is frequently called *chinidine*, and Hesse insists on calling quinidine *conchinine*.

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It crystallizes in long, brilliant prisms, which melt at 123° C. (253·4° F.). A crystalline hydriodide has been produced. Like quinamine, its gold salt soon decomposes.

HOMOQUININE, $C_{19}H_{22}N_2O_2$, was discovered in 1881 simultaneously, by D. Howard and J. Hodgkin, B. H. Paul, A. J. Cownley and T. G. Whiffen (*P. J. Tr.*, 1881, p. 497; 1882, p. 905). It was named by Howard, and Hesse states that J. A. Tod observed the alkaloid in 1880. It is obtained from the Cuprea bark, and was first noticed by Paul and Cownley on account of the readiness with which it crystallized from its ethereal solution. It exists in the bark sometimes to the extent of 0·3 per cent. *Ultraquinine* is the name suggested for *Homoquinine* by Whiffen, on account of its extreme lævogyrate properties. It is freely soluble in alcohol and chloroform, sparingly in ether, from which it crystallizes in proportion as it can take up water. (*Hesse.*) It is also soluble in diluted sulphuric acid, producing fluorescence, and gives, with chlorine water and ammonia, a green coloration (thalleioquin). The sulphate coincides exactly in properties with sulphate of quinine except in its behavior with ether. Its tartrate closely resembles tartrate of cinchonidine. Homoquinine and its salts behave towards polarized light like quinine.

CINCHONAMINE, $C_{19}H_{24}N_2O$. This alkaloid was discovered in 1881 by M. Arnaud in Cuprea bark. It exists in the proportion of 0·2 per cent., and is usually associated with cinchonine. His process is to treat the bark with milk of lime, dry the mixture, exhaust with boiling alcohol, distil off the alcohol, and take up the residue with diluted hydrochloric acid; hydrochlorate of cinchonamine crystallizes out, hydrochlorate of cinchonine remaining in solution. Cinchonamine is insoluble in cold water, soluble in 30 parts of alcohol, more soluble in hot alcohol, in 100 parts of ether. It is dextrogyrate.

PAYTINE, $C_{21}H_{24}N_2O,H_2O$, was discovered by Hesse in the white Payta bark. PAYTAMINE is an amorphous alkaloid accompanying *Paytine*.

HOMOCINCHONINE, $C_{19}H_{22}N_2O$, *the Cinchonodine of Koch*, is obtained from the bark of *C. rosulenta*; it is lævogyrate, and crystallizes from its alcoholic solution in large prisms. It has been mistaken for *aricine*.

DIHOMOCINCHONINE, $C_{38}H_{44}N_4O_2$, is an amorphous alkaloid obtained from *C. rosulenta*. It is dextrogyrate.

HOMOCINCHONIDINE, $C_{19}H_{22}N_2O$, is also obtained from *C. rosulenta*. It crystallizes in large prisms, and forms a neutral sulphate containing six molecules of water, which may be had in commerce.

CUSCONINE, $C_{23}H_{26}N_2O_4.2H_2O$, was discovered by Leverköhn. It is a constituent of the cusco bark, *C. pubescens* var. *Pelletieriana*, and Hesse has recently found it in Cuprea bark. It is nearly insoluble in water, soluble in 35 parts of ether, more easily in alcohol, very soluble in chloroform. It may be distinguished from other cinchona alkaloids by forming with sulphuric acid a neutral sulphate, which is amorphous, gelatinous, and yellow, and insoluble in an excess of the acid.

CUSCONIDINE is an amorphous alkaloid found in cusco bark, accompanying cusconine.

ARICINE, $C_{23}H_{26}N_2O_4$. *Cinchovatine.* This alkaloid, found in cusco bark, and quite recently in Cuprea bark, was formerly believed by Hesse to be identical with cinchonidine. Pelletier and Cariol obtained *aricine* as far back as 1829 (see note, p. 308, 14th ed. U. S. D.). Its separate existence is now (1882) not doubted. It crystallizes in prisms, and its salts are of sparing solubility.

PARICINE, $C_{16}H_{18}N_2O$, is found with quinamine in the bark of *C. succirubra* of Darjeeling, and, according to Hesse, it may be separated from all the cinchona alkaloids with which it may be associated in solution by treating with carbonate of sodium, which precipitates paricine first.

DICINCHONINE is found in chinoidine. It is amorphous.

DIQUINIDINE, *Diconchinine of Hesse*, $C_{40}H_{46}N_4O_2$, is found principally in chinoidine which has been obtained from barks containing quinine and quinidine. It is dextrogyrate, produces a fluorescent solution with diluted sulphuric acid, and gives the thalleioquin reaction.

JAVANINE, obtained by Hesse from *C. Calisaya* var. *Javanica*.

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CINCHOLINE, a pale yellow, liquid alkaloid, having an odor recalling that of chinoline, discovered by Hesse in 1882. (See *P. J. Tr.*, May 6, 1882.)

Of the artificial bases, QUINAMICINE and QUINAMIDINE are isomeric; they are both amorphous, and are produced by heating quinamine in contact with diluted sulphuric acid. If the action of sulphuric acid be continued at 120° C. (248° F.) to 130° C. (266° F.), an amorphous brownish substance is formed which may be precipitated by carbonate of sodium, and is insoluble in ether. Hesse has named this PROTO-QUINAMICINE.

APOQUINAMINE is isomeric with homocinchonine, and is prepared by boiling quinamine or quinamidine with hydrochloric acid for a short time. It is white, amorphous, soluble in ether, alcohol, and diluted hydrochloric acid. HOMOCINCHONICINE is prepared from homocinchonidine just as cinchonicine and quinicine are from cinchonine and quinine,—*i.e.*, by heating their sulphates.

HYDROCINCHONINE, $C_{20}H_{26}N_2O$, discovered by Caventou, is obtained by treating cinchonine with potassium permanganate. It is soluble in 1300 parts of water, more soluble in alcohol and ether. The statement that it may be found in commercial cinchonine has not been confirmed.

The other constituents of Cinchona bark are of less importance.

Kinic Acid (*Cinchonic* or *Quinic Acid*), $C_7H_{12}O_6$. This acid was isolated as early as 1785 by Hofmann, an apothecary of Leer, who obtained it from the calcium salt from cinchona. It exists in a number of important plants,—ivy, oak, elm, ash, coffee, etc. It may be desirable to procure the alkaloids in the state of saline combination in which they exist in the bark; since it is possible that they may exert an influence over the system in this state, somewhat different from that produced by their combinations with the sulphuric or other mineral acid. As it is impossible to procure the kinates immediately from the bark in a pure state, it becomes necessary first to obtain the kinic acid separately, which may thus become of some practical importance. We shall, therefore, briefly describe the mode of procuring it, and its characteristic properties. It is most usually prepared from the kinate of calcium, the residue obtained in the manufacture of sulphate of quinine (see *Quininæ Sulphas*) by decomposing an aqueous solution of kinate of calcium with oxalic acid, filtering out the precipitated oxalate of calcium, and evaporating the filtrate to the crystallizing point; or by evaporating the infusion of bark to a solid consistence, and treating the extract with alcohol, we have in the residue a viscid matter consisting chiefly of mucilage with kinate of calcium, which is insoluble in alcohol. If an aqueous solution of this substance be formed, and allowed to evaporate at a gentle heat, crystals of the kinate will be deposited, which may be purified by a second crystallization. The salt thus obtained, being dissolved in water, is decomposed by means of oxalic acid, which precipitates the lime, and leaves the *kinic acid* in solution. This may be procured in the crystalline state by spontaneous evaporation, though as usually prepared it is in the form of a thick syrupy liquid. The crystals are transparent and colorless, sour to the taste, and readily soluble in alcohol and in water. By heating kinic acid or a kinate with manganese dioxide and sulphuric acid, we get yellow crystals of *kinone*, better known as *quinone*, $C_6H_4O_2$; a reaction which may be used for ascertaining the presence of kinic acid. The kinates of cinchonine and quinine may be obtained either by the direct combination of their constituents, or by the mutual decomposition of the sulphates of those alkaloids and kinate of calcium. *Kinate of cinchonine* has a bitter and astringent taste, is very soluble in water, is soluble also in alcohol, and is crystallized with difficulty. *Kinate of quinine* is also very soluble in water, but less so in rectified alcohol. Its taste is very bitter, resembling that of yellow bark. It crystallizes in beautiful stellate groups, which are opaque or semi-transparent. The salt is with difficulty obtained free from color, and only by employing the ingredients in a state of extreme purity. (*Ann. de Chim. et de Phys.*, Juillet, 1829.) Lautemann found, in experiments upon himself, that kinic acid, when taken into the system, undergoes a conversion into hippuric acid, and in this state escapes with the urine. (*Ann. der Chem. und Pharm.*, cxxv. 9.) M. Rabuteau has investigated the physiological properties of kinic acid, and has found it closely to resemble the ordinary vegetable acids, being harmless in its effects on the system, and forming with water

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a refreshing drink like lemonade. Like other vegetable acids, also, it is decomposed in the system, forming, when taken in the state of an alkaline salt, a carbonate of the alkali in the blood, and rendering that fluid alkaline. (*Am. Journ. of Med. Sci.*, Oct. 1872, p. 524.) Kinic acid is said by Zwenger to have been found in the leaves of *Vaccinium Myrtillus*. (*A. J. P.*, March, 1861, p. 128.)

Quinovin or *Kinovin*. *Kinovic Bitter*, $C_{30}H_{48}O_5$. Originally discovered in the false bark called quinquina nova or new bark, this substance has since been found in the Calisaya bark, and probably exists, in greater or less proportion, in all the Cinchona barks. It was detected by De Vrij not only in the bark, but also in the wood and leaves of *C. Calisaya* and *C. lucumæfolia*. (*Journ. de Pharm.*, Avril, 1860, pp. 225 and 258.) It is white, uncrystallizable, almost insoluble in water, but readily dissolved by alcohol and ether. It is very bitter, and, as it is asserted to have no febrifuge virtues, may on this account mislead the judgment in relation to the activity of the bark in which it may be found. Some barks are said to owe their bitterness mainly to this ingredient. Winckler gives, as a certain test of its presence in any bark, the sulphate of copper, which is indifferent to infusion of bark containing none of this principle, but detects the smallest proportion of it by producing a dirty green color, soon followed by the deposition of a fine similarly colored powder. This is a salt of copper, and has a very bitter and metallic taste. (See *A. J. P.*, xxv. 343.)

Kinovin in alcoholic solution was shown in 1859 by Hlasiwetz to be resolved by means of hydrochloric acid gas into kinovic acid, $C_{24}H_{38}O_4$, and an uncrystallizable sugar *mannitan*, $C_6H_{12}O_5$, by assimilation of H_2O. The formation of kinovic acid takes place more easily if kinovin is placed in contact with sodium amalgam and spirit of wine, when after 12 hours mannitan and kinovate of sodium are formed. (*Pharmacographia*, 2d ed., p. 364.)

Kinovic or *Quinovic Acid*, resulting as before stated from the decomposition of kinovin, and possessing the formula $C_{24}H_{38}O_4$, is white, in rhomboidal crystals, insoluble in water, but slightly soluble in ether, somewhat more so in boiling alcohol, but very soluble in ammonia and the fixed alkalies. All its solutions are decidedly bitter. Its acid properties are feeble, yet it is capable of decomposing the alkaline carbonates. (*Journ. de Pharm.*, Nov. 1859, p. 386.) De Vrij proposes the following method of isolating kinovin. Macerate powdered cinchona with a very weak solution of caustic potassa or soda, precipitate the filtered liquid with an acid, redissolve the precipitate in milk of lime to separate the cinchonic red, filter and precipitate the solution boiling hot with hydrochloric acid, separate the precipitate, wash it, express as much as possible, and lastly dry it on porous stones, and powder it. Thus prepared, the kinovic bitter forms soluble compounds with magnesia and lime, and has been employed, in this mode of combination, as a tonic in the hospital of Batavia, with encouraging success. (*Ibid.*, Avril, 1860, p. 258.) Dr. Kerner (*Deutsche Klin.*, xx. p. 81) speaks very favorably of kinovic acid, as an excellent and at the same time perfectly safe tonic, which produces no narcotic symptoms, and given to adults, in the quantity of half or three-quarters of an ounce, causes not the slightest ill effect. He prefers it in the form of kinovate of calcium, of which 40 grains (2·6 Gm.) is the average dose. (*Am. Journ. of Med. Sci.*, Oct. 1869, p. 543.)

A bitter principle was extracted from Calisaya bark by Winckler. He named it *kinovic bitter;* but, having been supposed to possess acid properties, it was afterwards denominated *quinovic* or *kinovic acid*. The compounds are, however, distinct, although associated.

By the experiments of Henry, Jr., and Plisson, it may be considered as established that the alkaloids of the different varieties of bark are combined at the same time with kinic acid, and with one or more of the coloring matters, which, in relation to these substances, appear to act the part of acids. This idea was originally suggested by Robiquet. (*Journ. de Pharm.*, xii. 282, 369.) The compounds of quinine, cinchonine, etc., with the coloring matter, are scarcely soluble in water, while their kinates are very soluble.

The odor of bark appears to depend on a *volatile oil*, which Fabroni and Trommsdorff obtained by distillation with water. The oil floated on the surface of the water, was of a thick consistence, and had a bitterish, acrid taste, with the odor of bark.

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The *fatty matter*, which was first obtained pure by M. Laubert, is of a greenish color as obtained from the pale bark, orange yellow from the yellow. It is insoluble in water, soluble in boiling alcohol, which deposits a part of it on cooling, very soluble in ether even cold, and saponifiable with the alkalies.

The *cinchonic red* of Reuss, the *insoluble red coloring matter* of Pelletier and Caventou, is reddish brown, insipid, inodorous, largely soluble in alcohol especially when hot, and almost insoluble in ether or water, though the latter dissolves a little at the boiling temperature. The acids promote its solubility in water. It precipitates tartar emetic, but not gelatin; but if treated with a cold solution of potassa or soda, or by ammonia, lime, or baryta, with heat, and then precipitated by an acid, it acquires the property of forming an insoluble compound with gelatin. It is most abundant in the red bark (over 10 per cent.), and least so in the pale.

The *yellow coloring matter* has little taste, is soluble in water, alcohol, and ether, precipitates neither gelatin nor tartar emetic, and is itself precipitated by subacetate of lead.

Cinchotannic Acid. *Tannic acid, tannin*, or *soluble red coloring matter* of Pelletier and Caventou, has been considered as possessing all the properties which characterize the proximate vegetable principles associated together under the name cinchotannic acid. It has a brownish red color and an austere taste, is soluble in water and alcohol, combines with metallic oxides, and produces precipitates with the salts of iron, which vary in color according to the variety of bark, being deep green with the pale bark, blackish brown with the yellow, and reddish brown with the red. It also forms white precipitates with tartar emetic and gelatin, and readily combines with atmospheric oxygen, becoming insoluble. It must, however, differ materially from the tannic acid of galls, which could not exist in aqueous solutions containing cinchonine and quinine without forming insoluble compounds with them. Rembold has shown that when cinchotannic acid is boiled with diluted sulphuric acid cinchonic red is produced, sugar being formed at the same time by fusing cinchona red with caustic potash, protocatechuic acid, $C_7H_6O_4$, is formed.

Incompatibles. Of the relations of bark to the several solvents employed in pharmacy we shall speak hereafter, under the heads of its infusion, decoction, and tincture; where we shall also have an opportunity of mentioning some of the more prominent substances which afford precipitates with its liquid preparations. It is sufficient at present to state that all the substances which precipitate the infusion of bark do not by any means necessarily affect its virtues; as it contains several inert ingredients which form insoluble compounds with bodies that do not disturb its active principles. As *tannic acid* forms with the alkaloids compounds insoluble in water, it is desirable that substances containing this acid in a free state should not be prescribed in connection with the infusion or decoction of bark; for, though these insoluble tannates might be found efficacious if administered, yet, being precipitated from the liquid, they would be apt to be thrown away as dregs, or at any rate would communicate, if agitated, an unpleasant turbidness. The same may be said of the *tincture* and *compound solution of iodine*, which form insoluble compounds with all the cinchona alkaloids, and of the *alkalies, alkaline carbonates*, and *alkaline earths*, which precipitate these alkaloids from their aqueous solution.

Estimation of Value. It is evident, from what has been said, that an infusion of bark, on account of the tannin-like principle which it contains, may precipitate gelatin, tartar emetic, and the salts of iron, without having a particle of cinchonine, quinine, or other alkaloid in its composition; and that consequently any inference as to its value, drawn from these chemical properties, would be fallacious; but, as the active principles are thrown down by the tannic acid of galls, no bark can be considered good which does not afford a precipitate with the infusion of this substance.*

* *Grahe's test.* A test of the Cinchona barks, containing one or more of their characteristic alkaloids, has been proposed by Grahe. It is founded on the fact, that, when these barks are exposed to destructive distillation, a product is obtained of a bright carmine color, which is yielded by no other bark under the same circumstances, and not by cinchona unless it contain one or more of its peculiar alkaloids. Nor do the pure alkaloids afford it; but, if mixed with a little acetic, kinic, tannic, citric, or tartaric acid, they exhibit the reaction, showing that in the bark it takes place between the alkaloids and organic acids contained in it. Grahe applies the test by heating a piece

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It is impossible to determine, with accuracy, the relative proportion of the active ingredients in the different varieties of cinchona; as the quantity is by no means uniform in different specimens of the same variety. The results of the most recent experiments have been already stated under the head of the several varieties of bark described. But it is highly important, in relation to any particular sample of bark, to be able to ascertain its medicinal efficiency, which is measured by the quantity of the peculiar cinchona alkaloids it may contain. The U. S. Pharmacopœia for the first time in its history gives a process for assaying Cinchona bark; this is deemed necessary because of the impossibility of judging of the quality of the bark by its physical appearances. The manufacturing chemist never trusts to anything short of a careful chemical assay, and Cinchona bark should never be dispensed or used without having its quality tested or certified to by a competent authority. The following process of assay was contributed to the Committee of Revision by Prof. A. B. Prescott, of Ann Arbor, Mich., who acknowledges valuable assistance from Dr. W. M. Mew, Chemical Service U.S.A., Medical Museum, Washington, D. C. It is based upon De Vrij's method, and will give sufficiently accurate results for the uses of the pharmacist. Each manufacturer and quinologist usually has a process of his own, which he carefully keeps secret, and a method which will accurately differentiate the quantities of the alkaloids is usually difficult and unreliable in the hands of the inexperienced.

"Assay of Cinchona Bark. I. *For Total Alkaloids.* Cinchona, in No. 80 powder, and fully dried at 100° C. (212° F.), *twenty grammes;* Lime, *five grammes;* Diluted Sulphuric Acid, Solution of Soda, Alcohol, Distilled Water, each, *a sufficient quantity.* Make the Lime into a milk with 50 C.c. of Distilled Water, thoroughly mix therewith the Cinchona, and dry the mixture completely at a temperature not above 80° C. (176° F.). Digest the dried mixture with 200 C.c. of Alcohol, in a flask, near the temperature of boiling, for an hour. When cool, pour the mixture upon a filter of about six inches (15 cm.) diameter. Rinse the flask and wash the filter with 200 C.c. of Alcohol, used in several portions, letting the filter drain after use of each portion. To the filtered liquid add enough Diluted Sulphuric Acid to render the liquid acid to test-paper. Let any resulting precipitate (sulphate of calcium) subside; then decant the liquid, in portions, upon a very small filter, and wash the residue and filter with small portions of Alcohol. Distil or evaporate the filtrate to expel all the Alcohol, cool, pass through a small filter, and wash the latter with Distilled Water slightly acidulated with Diluted Sulphuric Acid, until the washings are no longer made turbid by Solution of Soda. To the filtered liquid, concentrated to the volume of about 50 C.c., when nearly cool, add enough Solution of Soda to render it strongly alkaline. Collect the precipitate on a wetted filter, let it drain, and wash it with small portions of Distilled Water (using as little as possible), until the washings give but a slight turbidity with test-solution of chloride of barium. Drain the filter by laying it upon blotting or filter papers until it is nearly dry. Detach the precipitate carefully from the filter and transfer it to a weighed capsule, wash the filter with Distilled Water acidulated with Diluted Sulphuric Acid, make the filtrate alkaline by Solution of Soda, and, if a precipitate result, wash it on a very small filter, let it drain well and transfer it to the capsule. Dry the contents of the latter at 100° C. (212° F.) to a constant weight, cool it in a desiccator and weigh. The number of grammes multiplied by *five* (5), equals the percentage of total alkaloids in the Cinchona.

"II. *For Quinine.* To the total alkaloids from 20 grammes of Cinchona, previously weighed, add Distilled Water acidulated with Diluted Sulphuric Acid, until the mixture remains for ten or fifteen minutes after digestion, just distinctly acid to test-paper. Transfer to a weighed beaker, rinsing with Distilled Water, and adding of this enough to make the whole weigh *seventy* (70) *times* the weight of the alka-

of the bark weighing from five to ten grains in an ordinary test-tube, and gradually increasing the heat to redness. Whitish smoke, and watery vapor condensing on the surface of the tube, are first given off, which are soon followed by the appearance of redness in the fumes, and by the deposition, an inch above the heated part, of a red pulverulent film, which is gradually changed into a thick, oily liquid, running down the glass in drops or streaks of a fine carmine color. (*Chemisches Centralblatt*, Feb. 17, 1858, p. 97.) For further information see p. 443.

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loids. Add now, in drops, Solution of Soda previously well diluted with Distilled Water, until the mixture is exactly neutral to test-paper. Digest at 60° C. (140° F.) for five minutes, then cool to 15° C. (59° F.) and maintain at this temperature for half an hour. If crystals do not appear in the glass vessel, the total alkaloids do not contain quinine in quantity over *eight* (8) *per cent.* of their weight (corresponding *to nine* (9) *per cent.* of sulphate of quinine crystallized). If crystals appear in the mixture, pass the latter through a filter not larger than necessary, prepared by drying two filter papers of two to three and a half inches (5 to 9 cm.) diameter, trimming them to an equal weight, folding them separately, and placing one within the other so as to make a plain filter four-fold on each side. When the liquid has drained away, wash the filter and contents with Distilled Water of a temperature of 15° C. (59° F.), added in small portions, until the entire filtered liquid weighs *ninety* (90) *times* the weight of the alkaloids taken. Dry the filter, without separating its folds, at 60° C. (140 F.), to a constant weight, cool, and weigh the inner filter and contents, taking the outer filter for a counter-weight. To the weight of effloresced sulphate of quinine so obtained, add 11·5 per cent. of its amount (for water of crystallization), and add 0·12 per cent. of the weight of the entire filtered liquid (for solubility of the crystals at 15° C.) 59° F. The sum in grammes, multiplied by *five* (5), equals the percentage of crystallized sulphate of quinine equivalent to the quinine in the Cinchona." *U. S.*

The British Pharmacopœia gives the following methods of testing Cinchona barks.

1. "*Test for Yellow Cinchona.* Boil 100 grains of the bark, reduced to very fine powder, for a quarter of an hour, in a fluidounce of distilled water acidulated with ten minims of hydrochloric acid; and allow it to macerate for twenty-four hours. Transfer the whole to a small percolator, and, after the fluid has ceased to drop, add at intervals about an ounce and a half of similarly acidulated water, or until the fluid which passes through is free from color. Add to the percolated fluid solution of subacetate of lead until the whole of the coloring matter has been removed, taking care that the fluid remains acid in reaction. Filter, and wash with a little distilled water. To the filtrate add about thirty-five grains of caustic potash, or as much as will cause the precipitate which is at first formed to be nearly redissolved, and afterwards six fluidrachms of pure ether. Then shake briskly, and, having removed the ether, repeat the process twice with three fluidrachms of ether, or until a drop of the ether employed leaves on evaporation scarcely any perceptible residue. Lastly, evaporate the mixed ethereal solutions in a capsule. The residue, which consists of nearly pure Quinia, when dry, should weigh not less than two grains, and should be readily soluble in diluted sulphuric acid.

2. "*Test for Pale Cinchona.* Two hundred grains of the bark, treated in the manner directed in the test for yellow cinchona bark, with the substitution of chloroform for ether, should yield not less than one grain of alkaloids.

3. "*Test for Red Cinchona.* One hundred grains of the bark, treated in the manner directed in the test for yellow cinchona, with the substitution of chloroform for ether, should yield not less than 1·5 grain of alkaloids." *Br.*

It is usually sufficient to ascertain the quantity of total alkaloids in bark, for this is really a test of the efficacy of the bark for pharmaceutical purposes; for all the organic alkaline principles contained in it are efficient as medicines, and in all probability in a nearly equal degree. But, for manufacturing purposes, it is necessary to push the investigation further, and ascertain the proportion of the several alkaloids in the mixture. This is most conveniently done by means of ether. Cinchonine is scarcely soluble in ether, quinidine is soluble in small proportion, quinine is freely soluble. When, therefore, a mixture of these alkaloids is treated with that menstruum, quinine and quinidine are dissolved, and cinchonine left. The two former may be separated by allowing the ethereal solution to evaporate. Quinidine crystallizes from the solution, and quinine is obtained uncrystallized, as the last product of the evaporation of the ether. These remarks apply to quinidine, as it was understood before the investigations of Pasteur.*

* Mr. Robert Howard employs the following method of ascertaining the presence or absence of these alkaloids, severally, in any mixture of their sulphates, founded on the fact that ten grains

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From the most recent and carefully conducted assays, it appears that the best officinal yellow Calisaya bark, the finest red bark, and the finest fibrous Carthagena bark (*soft Pitaya*) are about equal in their amount of alkaloids, each containing from 3 to 4 per cent., and the Indian and Java barks frequently exceed these yields; De Vrij obtained from bark of *C. officinalis* grown at Ootacamund total alkaloids as high as 11·96 per cent. (9·1 per cent. of which was quinine). The highest yield yet recorded was obtained by De Vrij from Ootacamund bark, 13·5 per cent., the greater part of which was quinine. Between these and the barks of lowest

of sulphate of quinine dissolve in sixty drops of ether, but only one grain of sulphate of quinidine. Ten grains of the salt are put into a strong test-tube, ten drops of dilute sulphuric acid (one of acid and five of water) with fifteen drops of water are added, and a moderate heat applied till the salt is dissolved. When the solution has quite cooled, sixty drops of officinal ether with twenty of spirit of ammonia are added, and the mixture is well shaken, the tube being closed by the thumb. After this the tube is closely stopped with a well-fitting cork, and gently shaken from time to time. If the salt contain only quinine, or not more than 10 per cent. of quinidine, it will be completely dissolved, while, at the surface of contact of the two clear liquids, only mechanical impurities will be seen. After some time the layer of ether becomes gelatinous, and then no further observation can be made. Ten grains of the salt examined may contain one grain of quinidine, and yet be completely dissolved by the ether and ammonia; but in this case the quinidine will soon begin to crystallize in the layer of ether. The least trace of quinidine may be detected by employing, instead of ordinary ether, the same fluid previously saturated with quinidine, in which case all the quinidine must remain undissolved. It is necessary, in the last experiment, to observe, after the shaking, whether or not all has dissolved; for, owing to the great tendency of quinidine to crystallize, it may again separate, and thus become a source of error. If more than a tenth of quinidine, or if cinchonine be present in the salt, an insoluble precipitate will be seen between the layers of the two fluids. If it be quinidine, it will be dissolved on the addition of proportionately more ether; while, if it be cinchonine, it will remain unaffected. (*P. J. Tr.*, xi. 394.)

De Vrij uses the following method of ascertaining the alkaloid strength of cinchona, and of obtaining the several alkaloids separate. Having dried a portion of powdered bark at 100° C., and weighed it, mix with it one-fourth of slaked lime, and boil for five minutes with ten times its weight of alcohol of sp. gr. 0·85. Put the whole on a filter, and exhaust by adding successively portions of boiling alcohol, until the whole weight of the spirit used equals twenty times that of the bark. Acidulate the tincture with diluted acetic acid so that it shall redden litmus, and then evaporate on a water-bath till all the alcohol is expelled. Treat the residue separately with water till the filtered liquid is no longer made turbid by an alkali. The solution thus obtained contains all the alkaloids; the kinovic acid, resin, fat, and other impurities remaining on the filter. If the filter and its contents be treated with milk of lime, the quantity of kinovic acid can be determined. The watery solution is now to be reduced by evaporation on a water-bath to a small bulk, and then mixed with an excess of slaked lime, by which the alkaloids are precipitated. Now throw the whole on the smallest possible filter, and wash with the minimum of cold water. If proper care be taken, the amount of water necessary to remove the coloring matter is so small, that the loss of alkaloids through their slight solubility in lime-water may be disregarded. After the filter has been duly washed, and dried, boil it repeatedly with alcohol of 0·82, till this will dissolve nothing more; then filter, evaporate the slightly colored alcoholic solution in a weighed platinum vessel, and heat the residue on a water-bath till it ceases to lose weight. The amount of alkaloids is now known. Sometimes a trace of coloring matter is left undissolved. If this is sufficient to be weighed, it must be deducted from the amount of the alkaloids; but generally the quantity is insufficient to merit notice.

To ascertain their character, dissolve in the smallest quantity of very dilute acetic acid. Put the solution in a closed funnel, provided with a cork, agitate with a slight excess of caustic soda, and a quantity of ether equal to fifteen times the weight of the alkaloids, and let the mixture stand for six hours; for, though cinchonidine and quinidine are sparingly soluble in ether, a considerable amount is dissolved on the first agitation, which separates in crystals in a few hours. Now evaporate the ethereal solution, and dry the residue on a water-bath till the weight remains constant. The residue is quinine, with traces of cinchonidine, quinidine, and cinchonine; and in many cases a large amount of a still unknown fusible alkaloid. By the known reactions of chlorine and ammonia, and by the preparation of Herapathite, the nature of this residue can be ascertained.

The alkaloids which have not been dissolved by the ether are now again to be dissolved in the smallest quantity of diluted acetic acid, and the solution mixed with a few drops of a concentrated solution of iodide of potassium. After stirring with a glass rod, a sandy crystalline precipitate will occur if quinidine be present. In such a case, the hydriodate of quinidine is collected on a filter, dried at 100° C. (212° F.), and weighed, and the quantity of quinidine ascertained by calculation; 100 grains of the hydriodate being equivalent to 71·68 of quinidine, according to the formula $C_{20}H_{24}N_2O_2,HI$.

The liquid separated by filtration from the hydriodate is precipitated by caustic soda, and the precipitate will be either cinchonine, or a mixture of this with cinchonidine.

The presence of cinchonine or quinidine among the alkaloids may be conjectured at the time of the treatment with ether; for, if one of these is present, it is partially deposited in a crystalline state after some time.

While the presence of quinidine can easily be ascertained by iodide of potassium even in small quantities, that of cinchonidine can be determined with certainty only by the polarizing apparatus, by which De Vrij has detected the cinchonidine of Pasteur even in the bark of the *C. Pahudiana* of Java. (*P. J. Tr.*, vi. 51.)

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value there is every grade of productiveness, down to a mere trace of alkaloidal matter.*

Medical Properties and Uses. This valuable remedy was unknown to the civilized world till about the middle of the seventeenth century, though the natives of Peru are generally supposed to have been long previously acquainted with its febrifuge powers. Humboldt, however, is of a different opinion. In his Memoir on the Cinchona forests, he states that it is unknown as a remedy to the Indians inhabiting the country where it grows; and, as these people adhere pertinaciously to the habits of their ancestors, he concludes that it never was employed by them. They have generally the most violent prejudices against it, considering it poisonous, and in the treatment of fever prefer the milder indigenous remedies. Ruiz and Pavon, however, ascribe the discovery to the Indians; and Tschudi states, in his Travels in Peru (*Am. ed.*, ii. 280), that the inhabitants of the Peruvian forests drink an infusion of the green bark as a remedy in intermittent fever.† On the other hand, the statements of Humboldt have recently been confirmed by the travellers Markham and Spence, the former remarking that the native Indian doctors do not use the bark, and the latter that the Cascarilleros of Ecuador believe that their red bark is used solely for dyeing. It is uncertain whether, as Jussieu stated in 1739, the Jesuit fathers received their knowledge from the Indians, or, as Humboldt believes, discovered the virtues of the drug for themselves, having been led to make trial of it by its extreme bitterness. The Countess of Cinchon, wife of the Viceroy of Peru, having in her own person experienced the beneficial effects of the bark, is said, on her return to Spain in the year 1640, to have first introduced the remedy into Europe. Hence the name of *pulvis Comitissæ*, by which it was first known. After its introduction, it was distributed and sold by the Jesuits, who are said to have obtained for it the price of its weight in silver. From this circumstance it was called *Jesuit's powder*, a title which it long retained. In 1653, Dr. Chifflet, physician to the Archduke Leopold, directed the attention of all Europe to the bark by his work entitled *Pulvis Febrifugus Orbis Americani*. This gave rise to a very active controversy; the high price of the drug aiding very greatly those who opposed its introduction. According to Sturm, twenty doses in 1658 cost sixty florins. It seems first to have been advertised in England for sale in 1658 by a James Thomson, and by 1660 it was much employed. It still, however, encountered much prejudice and ignorance, and was not made officinal in the London Pharmacopœia until 1677. Sir Robert Talbot (or Talbor) used it as a secret remedy with so much address and success that in 1679 he cured Charles II. of a tertian, and subsequently sold his secret to Louis XIV. of France, who published it in 1681.

When taken into the stomach, bark usually excites in a short time a sense of warmth in the epigastrium, which often diffuses itself over the abdomen and even the breast, and is sometimes attended with considerable gastric and intestinal irritation. Nausea and vomiting are sometimes produced, especially if the stomach was previously in an inflamed or irritated state. Purging, moreover, is not an unfrequent attendant upon its action. After some time has elapsed, the circulation often experiences its influence, as exhibited in the somewhat increased frequency of pulse; and, if the dose be repeated, the whole system becomes more or less affected, and all the functions undergo a moderate degree of excitement. Its action upon the nervous system is often evinced by a sense of tension, or fulness, or slight pain in the head, singing in the ears, and partial deafness, which are always experienced by many

* To obviate the disadvantages arising from the variable strength of bark, M. Guillermond recommends to fix on an appropriate strength, as indicated by the percentage of quinine, below the highest yet much above the lowest, and either to select bark of this strength, or to bring that employed to the medium strength, by adding a stronger or weaker bark, as the case may require, in due proportion. He recommends as this standard the yield of 3·2 per cent. of sulphate of quinine. This is to be treated by alcohol till entirely exhausted, and the tincture evaporated so as to yield an extract which shall exactly represent the virtues of the bark, and shall always have the same strength. From this extract all the preparations of bark are to be made, which will thus always be uniform in strength. (*Journ. de Pharm.*, Août, 1863, p. 124.)

† Tschudi also observes that he has found the fresh bark more efficacious than the dried; as, in less than half the usual dose, it not only effects cures in a short time, but insures the patient against the return of the disease.

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individuals when brought completely under its influence. The effects above mentioned entitle bark to a place among the tonics, and it is usually ranked at the very head of this class of medicines. It has, however, certain, at present inscrutable, powers, which enable it to combat the action of malaria. It is, therefore, *antiperiodic*, but why it is so is at present entirely unknown. At present it is never itself employed in intermittents, and for the details of its action upon the system the reader is referred to the article upon the sulphate of quinine. As a tonic, bark is advantageously employed in chronic diseases connected with debility; as, for example, in scrofula, dropsy, passive hemorrhages, certain forms of dyspepsia, obstinate cutaneous affections, amenorrhœa, chorea, hysteria; in fact, whenever a corroborant influence is desired, and no contraindicating symptoms exist. But in all these cases it greatly behooves the physician to examine well the condition of the system, and, before resorting to the tonic, to ascertain the real existence of an enfeebled condition of the functions, and the absence of such local irritations or inflammations, especially of the stomach or bowels, as might be aggravated by its use. In doubtful cases, we have been in the habit of considering the occurrence of profuse sweating during sleep as an indication for its use, and, under these circumstances, have prescribed it very advantageously, in the form of sulphate of quinine, in acute rheumatism, and in the advanced stages of protracted fevers. Cinchona bark was formerly used in doses of 10 grains to a drachm (0·65 Gm. to 3·9 Gm.), but at present is never exhibited in its crude state.

Off. Prep. of Yellow Bark. Extractum Cinchonæ, *U. S.;* Extractum Cinchonæ Fluidum, *U. S.;* Extractum Cinchonæ Flavæ Liquidum, *Br.;* Infusum Cinchonæ; Tinctura Cinchonæ, *U. S.;* Tinctura Cinchonæ Flavæ, *Br.*

Off. Prep. of Pale Bark. Mistura Ferri Aromatica, *Br.;* Tinctura Cinchonæ Composita, *Br.*

Off. Prep. of Red Bark. Tinctura Cinchonæ Composita, *U. S.*

CINCHONIDINÆ SULPHAS. *U. S.* *Sulphate of Cinchonidine.*

(CĪN-ĊHŌ-NĪ-DĪ'NÆ SŪL'PHĀS.)

$(C_{20}H_{24}N_2O)_2H_2SO_4.3H_2O$; 768. $(C_{20}H_{12}NO)_2.HO,SO_3.3HO$; 384.

"The neutral sulphate of an alkaloid prepared from certain species of Cinchona, chiefly Red Cinchona." *U. S.*

Sulphate of Cinchonidia; Schwefelsaures Cinchonidin, *G.;* Sulfate de Cinchonidine, *Fr.*

This is a new officinal, which has largely come into use lately. It is prepared from the mother-liquors obtained in the manufacture of sulphate of quinine, and is separated from the sulphates of the other alkaloids by fractional crystallization. The British-India and Javanese cultivated red barks usually contain large quantities of cinchonidine. Of the South American barks, probably the Colombian varieties yield the largest proportion of cinchonidine. Owing to some confusion in naming cinchonidine and quinidine, this alkaloid is sometimes incorrectly called in Germany *chinidine*. Skraup's researches on the composition of cinchonine and cinchonidine have not been endorsed by the Committee of Revision, and his partially accepted formula $C_{19}H_{22}N_2O$ is therefore not adopted.

Properties. Sulphate of cinchonidine occurs in "white, silky, lustrous needles, or thin quadratic prisms, odorless, having a very bitter taste, and a neutral or faintly alkaline reaction. Soluble in 100 parts of water and in 71 parts of alcohol at 15° C. (59° F.), in 4 parts of boiling water, in 12 parts of boiling alcohol, freely in acidulated water and in 1000 parts of chloroform (the undissolved portions becoming gelatinous); very sparingly soluble in ether or benzol. At 100° C. (212° F.) the salt loses its water of crystallization. From a dilute aqueous solution the salt crystallizes with 13·13 per cent. (6 to 7 mol.) of water of crystallization; from a concentrated aqueous solution with 7·03 per cent. (3 to 4 mol.). On ignition, the salt is dissipated without leaving a residue. The aqueous solution of the salt yields, on addition of water of ammonia, a white precipitate (Cinchonidine) which requires a large excess of ammonia to dissolve it, and which is soluble in about 75 times its weight of ether. With test-solution of iodide of mercury and potassium, the aque-

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ous solution yields a curdy precipitate, and with test-solution of chloride of barium a white precipitate insoluble in hydrochloric acid. The moderately dilute aqueous solution of the salt, acidulated with sulphuric acid, should not show more than a slight blue fluorescence (abs. of more than traces of sulphate of quinine or of quinidine). The salt should not be colored by the addition of sulphuric acid (abs. of foreign organic matters). If 1 Gm. be dried at 100° C. (212° F.) until it ceases to lose weight, the residue, cooled in a desiccator, should weigh not less than 0·92 Gm. If 0·5 Gm. of the salt be digested with 20 C.c. of cold distilled water, 0·5 Gm. of tartrate of potassium and sodium added, the mixture macerated, with frequent agitation, for one hour at 15° C. (59° F.), then filtered, and a drop of water of ammonia added to the filtrate, not more than a slight turbidity should appear (abs. of more than 0 5 per cent. of sulphate of cinchonine, or of more than 1·5 per cent. of sulphate of quinidine)." *U. S.*

Cinchonidine. The alkaloid itself is not officinal; as usually seen it is in white, light, pulverulent masses. It is crystallizable, soluble in 1680 parts of cold and in a somewhat smaller quantity of hot water, in about 20 parts of alcohol and 70 parts of ether. It melts at 206·5° C. (404° F.), and becomes a solid mass of crystals at 190° C. (374° F.). The *acid sulphate* (sometimes called *bisulphate*) is much more soluble in water than the officinal sulphate. The *salicylate of cinchonidine* is neutral and crystalline, insoluble in cold water, sparingly in hot water, easily soluble in alcohol and diluted alcohol. It may be prepared by the direct combination of salicylic acid with the alkaloid. (Rosengarten, *A. J. P.*, 1879, p. 616.) The *hydrobromate* has been employed by Prof. Gubler hypodermically. (*N. R.*, 1879, p. 366.)

Medical Properties. So far as our knowledge goes, this alkaloid influences the system similarly to quinine; the only difference being seemingly that it is less powerful. It may be given in a dose one-third greater than those of quinine, but should not be relied on in very severe cases.

CINCHONINA. *U. S.* *Cinchonine.* [*Cinchonia.*]

$C_{20}H_{24}N_2O$; 308. (CĪN-ĊHQ-NĪ'NA.) $C_{20}H_{12}NO$; 154.

"An alkaloid prepared from different species of Cinchona." *U. S.*

This alkaloid is introduced for the first time into the U. S. Pharmacopœia. The sulphate has had an extensive use, is again officinal, and is the source from whence this alkaloid is usually prepared. Cinchonine is most conveniently precipitated from an aqueous solution of sulphate of cinchonine by water of ammonia. Several processes have been employed for the preparation of cinchonine. One of the simplest is the following. Powdered pale bark is submitted to the action of sulphuric or hydrochloric acid very much diluted, and the solution obtained is precipitated by an excess of lime. The precipitate is collected on a filter, washed with water, and treated with boiling alcohol. The alcoholic solution is filtered while hot, and deposits the cinchonine when it cools. A further quantity is obtained by evaporation. If not perfectly white, it may be made so, by converting it into a sulphate with dilute sulphuric acid, then treating the solution with animal charcoal, filtering, precipitating by an alkali, and redissolving by alcohol in the manner already mentioned. It may also be obtained from the mother-waters of sulphate of quinine by diluting them with water, precipitating with ammonia, collecting the precipitate on a filter, washing and drying it, and then dissolving it in boiling alcohol, which deposits the cinchonine in a crystalline form upon cooling. It may be still further purified by a second solution and crystallization. Its formula is generally accepted as $C_{20}H_{24}N_2O$, the molecular weight of which is 308. Skraup (1878) proposes, instead of this, the formula $C_{19}H_{22}N_2O$.

Properties. This alkaloid occurs in "white, somewhat lustrous prisms or needles, permanent in the air, odorless, at first nearly tasteless, but developing a bitter aftertaste, and having an alkaline reaction. Almost insoluble in cold or hot water, soluble in 110 parts of alcohol at 15° C. (59° F.), in 28 parts of boiling alcohol, 371 parts of ether, 350 parts of chloroform, and readily soluble in diluted acids, forming salts of a very bitter taste. At about 250° C. (482° F.) it melts and turns

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brown with partial sublimation. On ignition, the alkaloid is dissipated without leaving a residue. A solution of the alkaloid in diluted sulphuric acid, should not exhibit more than a faint blue fluorescence (abs. of more than traces of quinine or quinidine). On precipitating the alkaloid from this solution by water of ammonia, it is very sparingly dissolved by the latter (difference from and abs. of quinine), and requires at least 300 parts of ether for solution (difference from quinine, quinidine, and cinchonidine). The salt should not be colored, or but very slightly colored, by the addition of sulphuric acid (abs. of foreign organic matter)." *U. S.* Waddington found it to sublime readily, without change, in perfectly characteristic crystals. (*P. J. Tr.*, March, 1868, p. 414.)* Its alkaline character is very decided, as it neutralizes the strongest acids. Of the salts of cinchonine, the sulphate, nitrate, hydrochlorate, phosphate, and acetate are soluble in water. The neutral tartrate, oxalate, and gallate are insoluble in cold water, but soluble in hot water, alcohol, or an excess of acid. Winkler has shown that cinchonine is rendered uncrystallizable or amorphous by sulphuric acid in excess, aided by heat; a fact of importance in the preparation of the sulphate of this alkaloid. (*Chem. Gaz.*, March 15, 1848.) Cinchonine is but little more soluble in carbonic acid water than in pure water, and does not, like quinine, yield crystals of the carbonate on exposure of its carbonic acid solution. (*Comptes-Rendus*, Nov. 7, 1853, p. 727.) It differs from quinine by its rotating the plane of polarization to the right, by the want of fluorescence in its solutions, and by its failing to give the *thalleioquin* test.

Exposed to the air, cinchonine does not suffer decomposition, but very slowly absorbs carbonic acid gas, and acquires the property of effervescing slightly with acids. It is precipitated sulphur yellow by the terchloride of gold. Chlorine water dissolves it or any of its salts without change; but if ammonia be now added, a white precipitate is produced. It is thus distinguishable from quinine. (See *Quinine.*) Dr. J. W. Bill, U.S.A., proposes ferrocyanide of potassium as a very delicate test of cinchonine. If added to the solution of a salt of this alkaloid, it produces a yellowish white curdy precipitate, which is dissolved upon the application of a gentle heat, but is again deposited, when the liquid cools, as an abundant crop of golden yellow crystals. No other alkaloid exhibits the same reaction. A cloudy precipitate is produced by the same reagent with a salt of quinine; but this does not happen when the ferrocyanide is in excess; and, if the precipitate be dissolved by heat, no subsidence takes place on cooling. Hence, in the application of this test to cinchonine, a slight excess of the ferrocyanide should be added. (*Am. Journ. of Science and Arts*, July, 1858, p. 108.)

By the action of permanganate of potassium cinchonine is decomposed, with the effect of producing, besides other products, a distinct neutral principle, named *cinchotenine*, $C_{18}H_{20}N_2O_2 + 3H_2O$, a crystallizable acid, the *carbocinchonic*, $C_{20}H_{14}N_2O_4$, and an alkaloid, which the authors name *hydrocinchonine*, $C_{20}H_{26}N_2O$, as it differs from cinchonine (cinchonia) only in having two additional atoms of hydrogen. For a special account of these principles the reader can consult *P. J. Tr.*, 1869, p. 291; from a paper by Messrs. Caventou and Willm, presented to the Chemical Society of Paris.

Medical Properties. The physiological action of cinchonine is similar to but less powerful than that of quinine. Thus, Conzen (quoted by Husemann) has found that its action on infusoria and on fermentation is similar to but weaker than that of its sister alkaloid, and that on the movements of the white blood-corpuscles its influence seems transient. Upon dogs, according to Bernatzik's experiments, the lethal dose of cinchonine is to that of quinine as 5 is to 4. As an antiperiodic or tonic, cinchonine exerts an influence similar to that of quinine, but is probably about one-third weaker than that alkaloid, and must be used in correspondingly larger dose.

* It is asserted that the hydrochlorates of quinine, cinchonine, and quinidine, heated on a slip of platinum, short of combustion, emit a purple vapor like iodine. Neither the alkaloids nor their sulphates have this property; but the addition of one-tenth of hydrochlorate will cause the evolution of the colored vapor. (*Journ. de Pharm. et de Chim.*, 4e sér., iii. 397.)

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CINCHONINÆ SULPHAS. *U.S.* *Sulphate of Cinchonine.*

(CĬN-ĊHŌ-NĪ'NÆ SŬL'PHĂS.)

$(C_{20}H_{24}N_2O)_2H_2SO_4.2H_2O$; 750. $(C_{20}H_{12}NO)_2.HO,SO_3.2HO$; 375.

Cinchoniæ Sulphas, *Pharm.* 1870; Cinchoninum Sulfuricum, *P.G.;* Sulfate de Cinchonine, *Fr.;* Schwefelsaures Cinchonin, *G.*

The process officinal in U. S. P. 1870 is as follows. "Take of the mother-water, remaining after the crystallization of Sulphate of Quinine, in the process for preparing that salt, *a convenient quantity;* Solution of Soda, Alcohol, Diluted Sulphuric Acid, Animal Charcoal, in fine powder, each, *a sufficient quantity.* To the mother-water add gradually, with constant stirring, Solution of Soda, until the liquid becomes alkaline. Collect on a filter the precipitate formed, wash it with water, and dry it. Then wash it with successive small portions of alcohol, to remove other alkaloids which may be present. Mix the residue with eight times its weight of water, and, having heated the mixture, add gradually Diluted Sulphuric Acid until it is saturated and becomes clear. Then boil the liquid with Animal Charcoal, filter it while hot, and set it aside to crystallize. Lastly, drain the crystals, and dry them on bibulous paper. By evaporating the mother-liquid, more crystals may be obtained." *U. S.*

In consequence of its greater solubility, Sulphate of Cinchonine remains behind in the mother-waters, when sulphate of quinine crystallizes, in the process for preparing the latter salt. To separate it from other substances contained in the mother-waters, it is decomposed by solution of soda, which is preferable to potassa, as it forms a very soluble salt, with sulphuric acid, whereas the sulphate of potassium, being of difficult solubility, might fall with the precipitated cinchonine. The precipitate may be safely washed with small portions of alcohol, as the alkaloid is almost insoluble in that liquid when cold. It is next reconverted into the sulphate; and the solution, having been boiled with *unpurified* animal charcoal to decolorize it, and at the same time neutralize any possible excess of sulphuric acid which might interfere with the crystallization of the salt, is filtered while hot, and then allowed to stand. It is peculiarly important that there should be no excess of sulphuric acid while the solution is exposed to heat, as, under this influence, the alkaloid is much disposed to become uncrystallizable. Hence the advantage of using unpurified animal charcoal or bone-black, as the carbonate of calcium contained in it neutralizes any excess of the acid. The sulphate of cinchonine, held in solution by the liquid while hot, is deposited by it upon cooling in crystals.

It may be prepared also by first obtaining cinchonine from one of the pale barks; treating this with water acidulated with sulphuric acid, added gradually till the alkaloid is dissolved; then boiling with purified animal charcoal, filtering the solution while hot, and setting it aside to crystallize.

There are two sulphates of cinchonine, the neutral and the acid-sulphate. The officinal salt is the neutral sulphate. It is in "hard, white, shining prisms of the clino-rhombic system, permanent in the air, odorless, having a very bitter taste and a neutral or faintly alkaline reaction. Soluble in about 70 parts of water and in 6 parts of alcohol at 15° C. (59° F.), in 14 parts of boiling water, 1·5 parts of boiling alcohol, 60 parts of chloroform, and easily so in diluted acids; insoluble in ether or benzol. At 100° C. (212° F.) the salt loses its water of crystallization, and at about 240° C. (464° F.) it melts with partial sublimation. On ignition, the salt is dissipated without leaving a residue. The aqueous solution of the salt yields a curdy precipitate with test-solution of iodide of mercury and potassium. With water of ammonia it yields a white precipitate (Cinchonine) which is very sparingly soluble in an excess of ammonia (difference from quinine), and not soluble in less than 300 parts of ether (difference from quinine, quinidine, and cinchonidine).*

* A test, distinguishing between the sulphates of quinine and of cinchonine, has been announced by M. Palm, of Russia, in the polysulphide of potassium prepared by boiling solution of potassa with an excess of sulphur. When a solution of this sulphide is added to a boiling solution of sulphate of quinine, the latter, however small the quantity present, is thrown down as a red terebinthinate mass, which hardens on cooling, and then assumes the appearance of a resin; while with sulphate of cinchonine a white powder is precipitated containing sulphur. (*Journ. de Pharm.*, Mai, 1864.)

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With test-solution of chloride of barium it yields a white precipitate insoluble in hydrochloric acid. A moderately dilute solution of the salt, acidulated with sulphuric acid, should not show more than a faint blue fluorescence (abs. of more than traces of sulphate of quinine or of quinidine). If 1 Gm. be dried at 100° C. (212° F.), until it ceases to lose weight, the residue, cooled in a desiccator, should weigh not less than 0·952 Gm. If the salt, dried at a gentle heat, be macerated, for half an hour, with frequent agitation, with 70 times its weight of chloroform at 15° C. (59° F.), it should wholly, or almost wholly, dissolve (any more than traces of sulphate of quinine or sulphate of cinchonidine remaining undissolved). It should not be colored by contact with sulphuric acid (abs. of foreign organic matters)." *U. S.* The *acid sulphate*, or *bisulphate*, $C_{20}H_{24}N_2OH_2SO_4,3H_2O$, is prepared by adding sulphuric acid to the neutral sulphate. According to Baup, 100 parts are soluble in 45 parts of water and in 100 parts of absolute alcohol; it is insoluble in ether. It crystallizes in rhombic octahedrons.

Medical Properties and Uses. It is now determined that sulphate of cinchonine has the same remedial properties as sulphate of quinine, but must be given in somewhat larger dose. As a tonic it may be given in the dose of a grain or two (0·065–0·13 Gm.) three or four times a day; as an antiperiodic, 15 grains to 40 grains (1·0–2·6 Gm.) may be given between the paroxysms. It may be taken in pill or solution made by the addition of dilute sulphuric acid, in the proportion of a minim or two drops for each grain of the salt.

CINNAMOMUM. *U. S.* *Cinnamon.*

(CĬN-NĂ-MŌ'MŬM.)

"The inner bark of the shoots of Cinnamomum Zeylanicum, Breyne (Ceylon Cinnamon); or the bark of the shoots of one or more undetermined species of Cinnamomum grown in China (Chinese Cinnamon). (*Nat. Ord.* Lauraceæ.)" *U. S.* "The inner bark of shoots from the truncated stocks of Cinnamomum Zeylanicum." *Br.*

Cinnamomi Cortex, *Br.;* Cinnamon Bark; Cortex Cinnamonii Zeylonici, *P.G.;* Cinnamomum Acutum, *s.* Verum; Cannelle de Ceylon, Cannelle, *Fr.;* Brauner Canel, Zeylonzimmt, Zimmt, *G.;* Canella, *It.;* Canela, *Sp.;* Kurundu, *Cingalese;* Karua puttay, *Tamil.*

CASSIA.—Cortex Cinnamomi Cassiæ, *P.G.;* Cinnamomum Chinense, Cassia Cinnamomea; Cassia Lignea; Cassia Bark; Casse, Cannelle de Chine, *Fr.;* Cassienzimmt, Zimmtkassie, Chinesischer (Gemeiner) Zimmt, *G.;* Canellina, *It.;* Casia, *Sp.*

The U. S. Pharmacopœia embraces, under the title of Cinnamon, not only the bark of that name obtained from the island of Ceylon, which is the only variety recog-

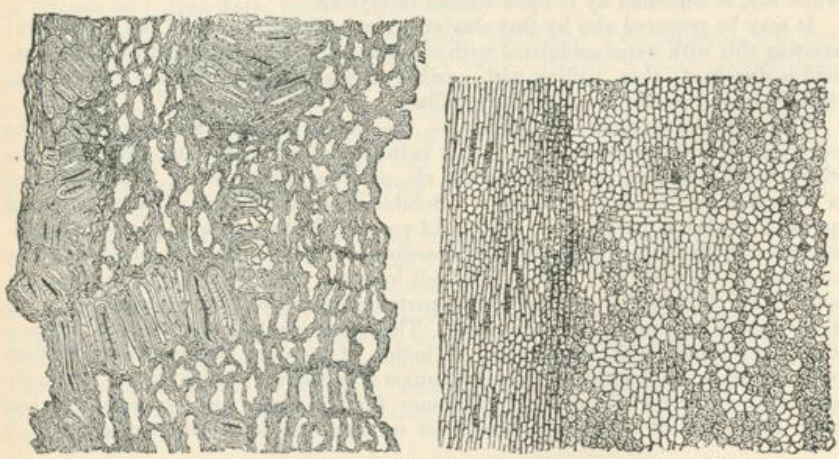
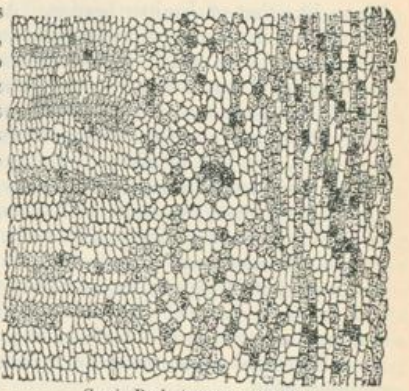


FIG. 1.—True Cinnamon, transverse section (very highly magnified). Cassia Bark, longitudinal section.

nized in the British Pharmacopœia, but also the commercial cassia, which is imported from China; and, as the two products, though very different in price, and somewhat in flavor, possess identical medical properties and are used for the same

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purposes, there seems to be no necessity for giving them distinct officinal designations. Indeed, the barks of all the species of the genus Cinnamomum, possessing analogous properties, are as much entitled to the common name of cinnamon, as the barks of the Cinchonas are to the name of cinchona, and the juice of different species of Aloe to that of aloes. Both *cinnamomum* and *cassia* were terms employed by the ancients, but whether exactly as now understood it is impossible to determine. The term *cassia*, or *cassia lignea*, has been generally used in modern times to designate the coarser barks analogous to cinnamon. It was probably first applied to the barks from Malabar, and afterwards extended to those of China and other parts of Eastern Asia. It has been customary to ascribe *cassia lignea* to the *Laurus Cassia* of Linnæus; but the specific character given by that botanist was so indefinite, and based on such imperfect information, that the species has been almost unanimously abandoned by botanists. The barks sold as cinnamon and cassia in different parts of the world are derived from various species of Cinnamomum. We shall describe only the two species recognized in the U. S. Pharmacopœia.



Cassia Bark, transverse section.

Gen. Ch. Flowers hermaphrodite or polygamous. *Perianth* six-cleft, the upper half of each segment deciduous. *Stamens* nine, with four-celled anthers, six (opposite the perianth-segments) opening inwards without glands, three (opposite three of the above) opening outwards and bearing a gland on each side at the base. *Staminodia* three (opposite the three other outer stamens), with capitate or cordate abortive anthers. *Berry* resting on the enlarged six-lobed base of the perianth." (Bentham, *Flora Hongkongensis.*) As thus defined, the genus Cinnamomum does not include the genus Camphora; for the modification of character necessary to do this, see *Camphora.*

1. *Cinnamomum Zeylanicum.* Nees, *Laurineæ*, 52; Lindley, *Flor. Med.* 329; Hayne, *Darstel. und Beschreib., etc.* xii. 263.—*Laurus Cinnamomum.* Linn. This is a tree about 20 or 30 feet high, with a trunk from 12 to 18 inches in diameter, and covered with a thick, scabrous bark. The branches are numerous, strong, horizontal, and declining; and the young shoots are beautifully speckled with dark green and light orange colors. The leaves are opposite for the most part, coriaceous, entire, ovate, or ovate-oblong, obtusely pointed, and three-nerved, with the lateral nerves vanishing as they approach the point. There are also two less obvious nerves, one on each side arising from the base, proceeding towards the border of the leaf, and then quickly vanishing. The footstalks are short and slightly channelled, and, together with the extreme twigs, are smooth and without the least appearance of down. In one variety, the leaves are very broad and somewhat cordate. When mature, they are of a shining green upon their upper surface, and lighter colored beneath. The flowers are small, white, and arranged in axillary and terminal panicles. The fruit is an oval berry, which adheres like the acorn to the receptacle, is larger than the black currant, and when ripe has a bluish brown surface, diversified with numerous white spots.

The tree emits no smell perceptible at any distance. The bark of the root has the odor of cinnamon with the pungency of camphor, and yields this principle upon distillation. The leaves have a spicy odor when rubbed, and a hot taste. A volatile oil distilled from them has been introduced into commerce.* The petiole has

* The *cinnamon leaf oil*, as imported into Great Britain, is of two kinds, one containing a considerable quantity of a fatty fixed oil, perhaps cinnamon-suet from the fruit, the other a pure volatile oil. The oil is said to be obtained by distilling the leaves after maceration in sea-water. It resembles the oil of cloves and pimento in sensible properties, having a brownish color, a penetrating, fragrant odor, and a very pungent taste. According to Stenhouse, it is of the sp. gr. 1·053, has an acid reaction, and consists of eugenic acid, a neutral substance with the formula $C_{10}H_{16}$, and a minute proportion of benzoic acid. (*P. J. Tr.*, xiv. 319.)

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the flavor of cinnamon. It is a singular fact that the odor of the flowers is to people in general disagreeable, being compared by some to the scent exhaled from newly-sawn bones. The fruit has a terebinthinate odor when opened, and a taste in some degree like that of Juniper berries. A fatty substance, called *cinnamon-suet*, is obtained from it when ripe, by bruising and then boiling it in water, and removing the oleaginous matter which rises to the surface, and concretes upon cooling. It is the prepared bark that constitutes the genuine cinnamon.

This species is a native of Ceylon, where it has long been cultivated. It is said also to be a native of the Malabar Coast, and has at various periods been introduced into Java, the Isle of France, Bourbon, the Cape Verds, Brazil, Cayenne, several of the West India islands, and Egypt, and in some of these places is at this time highly productive, especially in Cayenne, where the plant was flourishing so early as 1755. It is exceedingly influenced, as regards the aromatic character of its bark, by the circumstances of soil, climate, and mode of culture. Thus, we are told by Marshall that in Ceylon, beyond the limits of Negombo and Matura, in the western and southern parts of the island, the bark is never of good quality, being greatly deficient in the aromatic flavor of the cinnamon; and that even within these limits it is of unequal value, from the various influence of exposure, soil, shade, and other circumstances.

2. *C. aromaticum.* Nees, *Laurineæ*, 52; Lindley, *Flor. Med.* 330.—*C. Cassia.* Blume, Ed. Ph.; Hayne, *Darstel. und Beschreib., etc.* xii. 23.—*Laurus Cassia.* Aiton, *Hort. Kew.* ii. 427.—Not *Laurus Cassia* of Linn. This is of about the same magnitude as the former species, and, like it, has nearly opposite, shortly petiolate, coriaceous, entire leaves, of a shining green upon the upper surface, lighter colored beneath, and furnished with three nerves, of which the two latter vanish towards the point. The leaves, however, differ in being oblong-lanceolate and pointed, and in exhibiting, under the microscope, a very fine down upon the under surface. The footstalks and extreme twigs are also downy. The flowers are in narrow, silky panicles. The plant grows in China, Sumatra, and other parts of Eastern Asia, and is said to be cultivated in Java. It is believed to be the species which furnishes, wholly or in part, the Chinese cinnamon or cassia brought from Canton, and is supposed to be the source of the *cassia buds.*

Besides the two species above described, others have been thought to contribute to the cinnamon and cassia of commerce. In 1839 (*Madras Journ. Lit. & Sci.*, No. 22), Dr. Wight stated that in his belief cinnamon was derived from 12 to 18 specially distinct trees. *C. inners*, Reinw., is distinguished from *C. Zeylanicum* by the nervation of its leaves, which are also paler and thinner than those of the officinal plant, of which, however, it is probably only a variety. It yields the so-called *wild cinnamon* of Japan. *C. Loureirii* of Nees, growing in the mountains of Cochin-China, near Laos, and in Japan, affords, according to Loureiro, a cinnamon of which the finest kind is superior to that of Ceylon. *C. nitidum*, growing in Ceylon, Java, and on the continent of India, is said to have been the chief source of the drug known formerly by the name of *Folia Malabathri*, and consisting of the leaves of different species of Cinnamomum mixed together. *C. Culilawan* of the Moluccas yields the aromatic bark called culilawan, noticed in Part II. of this work; and similar barks are obtained from another species of the same region, named *C. rubrum*, and from *C. Sintoc* of Java. *Massoy-bark*, from which an aromatic volatile oil is obtained called *oil of massoy*, is the product of *C. Kiamis.* (Gmelin, *Handbook*, xiv. 380.) In the mountains of Eastern Bengal, at a height of 1000 to 4000 feet, flourish *C. obtusifolium*, Nees, *C. pauciflorum*, Nees, and *C. Tamala*, W., and these afford quantities of a bark which is brought to Calcutta for shipment under the name of *cassia lignea*, or *cassia.*

Culture, Collection, Commerce, etc. Our remarks under this head will first be directed to the cinnamon of Ceylon, in relation to which we have more precise information than concerning that obtained from other sources. The bark was originally collected exclusively from the tree in a wild state; but the Dutch introduced the practice of cultivating it, which has been continued since the British came into possession of the island. The principal cinnamon gardens are in the vicinity

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of Columbo. The seeds are planted in a prepared soil at certain distances; and, as four or five are placed in a spot, the plants usually grow in clusters like the hazel-bush. In favorable situations they attain the height of five or six feet in six or seven years; and a healthy bush will then afford two or three shoots fit for peeling, and every second year afterwards from four to seven shoots in a good soil. The cinnamon harvest commences in May, and continues till late in October. The first object is to select shoots proper for decortication, and those are seldom cut which are less than half an inch or more than two or three inches in diameter. The bark is divided by longitudinal incisions, of which two are made in the smaller shoots, several in the larger, and is then removed in strips by means of a suitable instrument. The pieces are next collected in bundles, and allowed to remain in this state for a short time, so as to undergo a degree of fermentation, which facilitates the separation of the epidermis. This, with the green matter beneath it, is removed by placing the strip of bark upon a convex piece of wood, and scraping its external surface with a curved knife. The bark now dries and contracts, assuming the appearance of a quill. The peeler introduces the smaller tubes into the larger, and connects them also endwise, thus forming a congeries of quills which is about forty inches long. When sufficiently dry, these cylinders are collected into bundles weighing about thirty pounds, and bound together by pieces of split bamboo. The commerce in Ceylon cinnamon was formerly monopolized by the East India Company; but the cultivation is now unrestricted, and the bark may be freely exported upon the payment of a fixed duty. It is assorted in the island into three qualities, distinguished by the designations of *first*, *second*, and *third*. The inferior kinds, which are of insufficient value to pay the duty, are used for the preparation of oil of cinnamon.

Immense quantities of cinnamon are exported from China, the finest of which is little inferior to that of Ceylon, though the mass of it is much coarser. It passes in commerce under the name of *cassia*, and is said by Mr. Reeves to be brought to Canton from the province of Kwangse, where the tree producing it grows very abundantly. (*Trans. Medico-Bot. Soc.*, 1828, p. 26.) It has already been stated that this tree is supposed to be the *Cinnamomum aromaticum;* but we have no positive proof of the fact. Travellers inform us that cinnamon is also collected in Cochin-China; but that the best of it is monopolized by the sovereign of the country. It is supposed to be obtained from the *Cinnamomum Loureirii* of Nees, the *Laurus Cinnamomum* of Loureiro. According to Siebold, the bark of the large branches is of inferior quality and is rejected; that from the smallest branches resembles the Ceylon cinnamon in thickness, but has a very pungent taste and smell, and is little esteemed; while the intermediate branches yield an excellent bark, about a line in thickness, which is even more highly valued than the cinnamon of Ceylon, and yields a sweeter and less pungent oil. (*Annal. der Pharm.*, xx. 280.) Cinnamon of good quality is said to be collected in Java; and considerable quantities of inferior quality have been thrown into commerce, as *cassia lignea*, from the Malabar Coast. Manilla and the Isle of France are also mentioned as sources whence this drug is supplied. Little, however reaches the United States from these places. The island of Martinique, Cayenne, and several of the West India islands, yield to commerce considerable quantities of cinnamon of various qualities. That of Cayenne is of two kinds, one of which closely resembles, though it does not quite equal, the aromatic of Ceylon, the other resembles the Chinese. The former is supposed to be derived from plants propagated from a Ceylonese stock, the latter from those which have sprung from a tree introduced from Sumatra.

By far the greater proportion of cinnamon brought to this country is imported from China. It is entered as *cassia* at the custom-house, while the same article brought from other sources is almost uniformly entered as cinnamon. Much of it is afterwards exported.

From what source the ancients derived their cinnamon and cassia is not certainly known. Neither the plants nor their localities, as described by Dioscorides, Pliny, and Theophrastus, correspond precisely with our present knowledge; but in this respect much allowance must be made for the inaccurate geography of the ancients. It is not improbable that the Arabian navigators, at a very early period, conveyed

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this spice within the limits of Phœnician and Grecian, and subsequently of Roman commerce.

Properties. *Ceylon cinnamon* is in long cylindrical fasciculi, composed of numerous quills, the larger enclosing the smaller. In the original sticks, which are somewhat more than three feet in length, two or three fasciculi are neatly joined at the end, so as to appear as if the whole were one continuous piece. The finest is of a light brownish yellow color, almost as thin as paper, smooth, often somewhat shining, pliable to a considerable extent, with a splintery fracture when broken. It has a pleasant fragrant odor, and a warm, aromatic, pungent, sweetish, slightly astringent, and highly agreeable taste. When distilled it affords but a small quantity of essential oil, which, however, has an exceedingly grateful flavor. It is brought to this country from England; but it is costly. The inferior sorts are browner, thicker, less splintery, and of a less agreeable flavor, and are little if at all superior to the best Chinese. The finer variety of *Cayenne cinnamon* approaches in character that above described, but is paler and in thicker pieces, being usually collected from older branches. That which is gathered very young is scarcely distinguishable from the cinnamon of Ceylon. "*Ceylon Cinnamon* is in long, closely-rolled quills, composed of eight or more layers of bark of the thickness of paper; pale yellowish-brown; outer surface smooth, marked with wavy lines; inner surface scarcely striate; fracture splintery; odor fragrant; taste sweet and warmly aromatic." *U. S.**

Chinese cinnamon, or *Cassia*, is in tubes from one-eighth of an inch to an inch in diameter, usually single, sometimes double, but very rarely more than double. In some instances the bark is rolled very much upon itself, in others is not even completely quilled, forming segments more or less extensive of a hollow cylinder. It is of a redder or darker color than the finest Ceylon cinnamon, thicker, rougher, denser, and breaks with a shorter fracture. It has a stronger, more pungent and astringent, but less sweet and grateful taste, and, though of a similar odor, is less agreeably fragrant. It is the kind almost universally kept in our shops. Of a similar character is the cinnamon imported directly from various parts of the East Indies. But under the name of cassia have also been brought to us very inferior kinds of cinnamon, collected from the trunks or large branches of the trees, or injured by want of care in keeping, or perhaps derived from inferior species. It is said that cinnamon from which the oil has been distilled is sometimes fraudulently mixed with the genuine. These inferior kinds are detected, independently of their greater thickness and coarseness of fracture, by their deficiency in the peculiar sensible properties of the spice. "*Chinese Cinnamon* (Cassia Bark) is in quills about one twenty-fifth of an inch (1 mm.) or more in thickness; nearly deprived of the corky layer; brown, outer surface somewhat rough; fracture nearly smooth; odor and taste analogous to that [*sic*] of Ceylon Cinnamon, but less delicate." *U. S.*

The *Pharmacographia* gives the following tests for distinguishing powdered cassia from powdered cinnamon, and for recognizing the inferior varieties of cassia. Make a decoction of powdered cinnamon of known genuineness, and one of similar strength of the suspected powder; when cool and strained, test a fluidounce of each with one or two drops of tincture of iodine. A decoction of cinnamon is but little affected, but in that of cassia a deep blue-black tint is immediately produced. The cheap kinds of cassia known as *cassia vera* may be distinguished from the more valuable Chinese cassia as well as from cinnamon by their richness in mucilage; this can be extracted by cold water as a thick glairy liquid, giving dense ropy precipitates with corrosive sublimate or neutral acetate of lead, but not with alcohol.

Microscopic Structure. Ceylon cinnamon usually consists simply of liber, the outer coatings having been stripped off during its preparation for market. Three layers are distinguishable in the liber. "1. The external surface, which is composed of one to three rows of large thick-walled cells (Fig. 1), forming a coherent ring; it is only interrupted by bundles of liber fibres, which are obvious even to the unaided eye. 2. The middle layer is built up of about 10 rows of parenchymatous thin-walled cells, interrupted by much larger cells containing deposits of mucilage, while other cells not larger than those of the parenchyme itself are loaded with essential oil.

* For an account of the cultivation of *C. Zeylanicum*, see *P. J. Tr.*, xi. 261.

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3. The innermost layer exhibits the same thin-walled but smaller cells, yet intersected by narrow somewhat darker medullary rays, and likewise interrupted by cells containing either mucilage or essential oil, instead of bundles of liber fibres. Fibres mostly isolated are scattered through the two inner layers, the parenchyme of which abounds in small starch granules accompanied by tannic matter. On a longitudinal section the length of the liber fibres becomes more evident, as well as oil-ducts and gum-ducts." (*Pharmacographia.*)

The coarser cassia bark, or cassia lignea, usually has some of the external or corky layer adherent to it, and always the parenchymatous mesophlæum or middle bark, but the liber constitutes the chief mass. Isolated liber fibres and thick-walled cells (stone-cells) are scattered even through the outer layers of a transverse section. In the middle zone they are numerous, but do not form a coherent sclerenchymatous ring as in Ceylon cinnamon. The innermost part of the liber shares the structural character of cinnamon, with difference due to age, as, for instance, the greater development of the medullary rays. Oil-cells and gum-ducts are likewise distributed in the parenchyme of the former. The finest cassia or Chinese cinnamon has the three layers described in Ceylon cinnamon, but is readily distinguished by the adherent outer parenchymatous and suberous layer.

Chemical Composition. According to the analysis of Vauquelin, cinnamon contains a peculiar volatile oil, tannin, mucilage, a coloring matter, an acid, and lignin. The tannin is of the variety which yields a greenish black precipitate with the salts of iron. The oil obtained from the Cayenne cinnamon he found to be more biting than that from the Ceylonese, and at the same time to be somewhat peppery. Bucholz found in 100 parts of *cassia lignea*, 0·8 of volatile oil, 4·0 of resin, 14·6 of gummy extractive (probably including tannin), 64·3 of lignin and bassorin, and 16·3 of water including loss. This aromatic yields its virtues wholly to alcohol, and less readily to water. At the temperature of boiling alcohol very little of the oil rises, and an extract prepared from the tincture retains, therefore, the aromatic properties. For an account of the volatile oil, see *Oleum Cinnamomi.*

Medical Properties and Uses. Cinnamon is among the most grateful and efficient of the aromatics. It is warm and cordial to the stomach, carminative, astringent, and, like most other substances of this class, more powerful as a local than as a general stimulant. It is seldom prescribed alone, though, when given in powder or infusion, it will sometimes allay nausea, check vomiting, and relieve flatulence. It is chiefly used as an adjuvant to other less pleasant medicines, and enters into a great number of officinal preparations. It is often employed in diarrhœa, in connection with chalk and astringents, and has recently been recommended as peculiarly efficacious in uterine hemorrhage. The dose of the powder is from ten grains to a scruple (0·65–1·3 Gm.).

Cassia Buds. This spice consists of the calyx of one or more species of Cinnamomum, surrounding the young germ, and, as stated by Dr. Martius, on the authority of the elder Nees, about one-quarter of the normal size. It is produced in China; and Mr. Reeves states that great quantities of it are brought to Canton from the province which affords cassia. The species which yields it is in all probability the same with that which yields the bark, though it has been ascribed by Nees to *Cinnamomum Loureirii.* In favor of the former opinion is the statement of Dr. Christison, that *C. aromaticum*, cultivated in the hot-houses of Europe, bears a flower-bud which closely resembles the cassia bud when at the same period of advancement. Cassia buds have some resemblance to cloves, and are compared to small nails with round heads. The enclosed germen is sometimes removed, and they are then cup-shaped at top. They have a brown color, with the flavor of cinnamon, and yield an essential oil upon distillation. They may be used for the same purposes as the bark.

Off. Prep. Aqua Cinnamomi, *Br.;* Decoctum Hæmatoxyli, *Br.;* Infusum Catechu, *Br.;* Pulvis Aromaticus, *U. S.;* Pulvis Catechu Compositus, *Br.;* Pulvis Cinnamomi Comp., *Br.;* Pulvis Cretæ Aromaticus, *Br.;* Pulvis Kino Comp., *Br.;* Syrupus Rhei Aromaticus, *U. S.;* Tinctura Cardamomi Comp.; Tinct. Catechu; Tinct. Cinnamomi; Tinct. Lavandulæ Comp., *U. S., Br.;* Vinum Opii, *U. S.*

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COCCUS. *U. S., Br. Cochineal.*

(CŎC'CŲS.)

"The dried female of Coccus cacti. Linné. (*Class* Insecta; *Order* Hemiptera.)" *U.S.* "The dried female insect, Coccus Cacti." *Br.*

Coccionella, *P. G.;* Cochenille, *Fr., G.;* Scharlachwurm, *G.;* Coceiniglia, *It.;* Cochinilla, *Sp.*

The coccus is a genus of hemipterous insects, having the snout or rostrum in the breast, the antennæ filiform, and the posterior part of the abdomen furnished with bristles. The male has two erect wings, the female is wingless. The *C. Cacti* is characterized by its depressed, downy, transversely wrinkled body, its purplish abdomen, its short and black legs, and its subulate antennæ, which are about one-third of the length of the body. (*Rees's Cyclopædia.*) Another species, *C. Ilicis*, which inhabits a species of oak, is collected in the mountainous parts of the Morea, in Greece, and used as a dye-stuff in the East, under the name of *kermes*, *chermes*, or *alkermes*. The dried insects are nearly globular, smooth, about the size of a pea, and of a reddish brown color. They yield a carmine-colored powder, and with a salt of tin, a fine scarlet-red dye. They probably contain carminic acid, though we have met with no analysis of them. The Coccus Cacti is found wild in Mexico and Central America, inhabiting different species of Cactus and allied genera of plants, and is said to have been discovered also in some of the West India islands, and the southern parts of the United States. In Mexico, particularly in the provinces of Oaxaca and Guerrero, it is an important object of culture. The Indians form plantations of the *nopal* (*Opuntia cochinillifera*), upon which the insect feeds and propagates. During the rainy season, a number of the females are preserved under cover, upon the branches of the plant, and, after the cessation of the rains, are distributed upon the plants without. They perish quickly, after having deposited their eggs. These, hatched by the heat of the sun, give origin to innumerable minute insects, which spread themselves over the plant. The males, of which, according to Mr. Ellis, the proportion is not greater than one to one hundred or two hundred females, being provided with wings and very active, approach and fecundate the latter. After this period, the females, which before moved about, attach themselves to the leaves, and increase rapidly in size; so that, in the end, their legs, antennæ, and probosces are scarcely discoverable; and they appear more like excrescences on the plant than distinct animated beings. They are now gathered for use, by detaching them by means of a blunt knife, a quill, or a feather; a few being left to continue the race. They are destroyed either by dipping them enclosed in a bag into boiling water, or by the heat of a stove. In the former case they are subsequently dried in the sun. The males, which are much smaller than the full-grown females, are not collected. It is said that of the wild insect there are six generations every year, furnishing an equal number of crops; but the domestic is collected only three times annually, the propagation being suspended during the rainy season, in consequence of the inability of the insect to support the inclemency of the weather. The insect has been taken from Mexico to the Canary Islands; and very large quantities of cochineal have been delivered to commerce from the island of Teneriffe.* Its culture is said to have proved successful in Java and Algeria, but unprofitable in Spain.†

Cochineal is defined in the U. S. Pharmacopœia as follows: "About one-fifth of an inch (5 mm.) long; of a purplish-gray or purplish-black color; nearly hemispherical; somewhat oblong and angular in outline; flat or concave beneath; convex above; transversely wrinkled; easily pulverizable, yielding a dark-red powder. Odor faint; taste slightly bitterish. It contains a red coloring matter soluble in water, alcohol, or water of ammonia, slightly soluble in ether, insoluble in fixed and

* Various species of Opuntia are adapted to the support of the cochineal insect, especially those which are very juicy, with few thorns and a thick skin. It is the *O. Ficus Indica* which is chiefly cultivated in Teneriffe, the dry but hot climate of which is peculiarly adapted to the growth both of the plant and the insect. For an account of the mode of rearing the cochineal insect in the Canary Islands, see *P. J. Tr.*, Sept. 1871; in Central America, see *A. J. P.*, 1873, p. 30; *N. R.*, 1880, p. 175.

† In Asia Minor, in the vicinity of Oushak, are great quantities of an insect, closely resembling the Coccus Cacti, which feed on a species of Cistus; but it is unknown whether any portion has been introduced into general commerce. (*A. J. P.*, xxxv. 455.)

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volatile oils. On macerating Cochineal in water, the insect swells up, but no insoluble powder should be separated." *U. S.*

As kept in the shops, the finer cochineal, *grana fina* of Spanish commerce, is in irregularly circular or oval, somewhat angular grains, about one-eighth of an inch in diameter, convex on one side, concave or flat on the other, and marked with several transverse wrinkles. Two varieties of this kind of cochineal are known to the druggist, distinguished by their external appearance. One is of a reddish gray color, formed by an intermixture of the dark color of the insect with the whiteness of a powder by which it is almost covered, and with patches of a rosy tinge irregularly interspersed. From its diversified appearance, it is called by the Spaniards *cochinilla jaspeada*. It is the variety commonly kept in our shops. The other, *cochinilla renegrida*, or *grana nigra*, is dark-colored, almost black, with only a minute quantity of the whitish powder between the wrinkles. The two are distinguished in our markets by the names of *silver grains* and *black grains*. Some suppose the difference to arise from the mode of preparation; the gray cochineal consisting of the insects destroyed by a dry heat; the black, of those destroyed by hot water, which removes the external whitish powder. According to Mr. Faber, who derived his information from a merchant residing in the neighborhood where the cochineal is collected, the silver grains consist of the impregnated female just before she has laid her eggs; the black, of the female after the eggs have been laid and hatched. (*A. J. P.*, xviii. 47.) There is little or no difference in their quality.* Another and much inferior variety is the *grana sylvestra*, or wild cochineal, consisting partly of very small separate insects, partly of roundish or oval masses, which exhibit, under the microscope, minute and apparently new-born insects, enclosed in a white or reddish cotton-like substance. It is scarcely known in our drug market.

Cochineal has a faint heavy odor, and a bitter slightly acidulous taste. Its powder is of a purplish carmine color, tinging the saliva intensely red. According to Pelletier and Caventou, it consists of a peculiar coloring principle, a peculiar animal matter constituting the skeleton of the insect, stearin, olein, an odorous fatty acid, and various salts. Tyrosin, a crystallizable animal principle, has been found by De la Rue. (*Gmelin*, xiii. 358.) It was also analyzed by John, who called the coloring principle *cochinilin*. It is, however, universally known now as *carminic acid*, and has the composition $C_{17}H_{18}O_{10}$. Hlasiwetz and Grabowski (*Ann. Chem. und. Ph.*, 141, p. 329) have shown that it is a glucoside, and is decomposed by boiling with diluted sulphuric acid into a non-fermentable sugar and *carmine red*, $C_{11}H_{12}O_7$. Carminic acid is of a brilliant purple-red color, unalterable in dry air, is decomposed at temperatures over 136° C. (276·8° F.), is very soluble in water, soluble in cold, and more so in boiling alcohol, insoluble in ether, and without nitrogen. It is obtained by macerating cochineal in ether, and treating the residue with successive portions of boiling alcohol, which on cooling deposits a part of the carminic acid, and yields the remainder by spontaneous evaporation. It may be freed from a small proportion of adhering fatty matter by dissolving it in alcohol of 40° Baumé, and then adding an equal quantity of ether. The pure carminic acid is deposited in the course of a few days. The watery infusion of cochineal is of a violet-crimson color, which is brightened by the acids and deepened by the alkalies. The coloring matter is readily precipitated. The salts of zinc, bismuth, and nickel produce a lilac precipitate, and those of iron a dark purple approaching to black. The salts of tin, especially the nitrate and chloride, precipitate the coloring matter of a brilliant scarlet, and form the basis of those splendid scarlet and crimson dyes, which have rendered cochineal so valuable in the arts. With alumina the coloring matter forms the pigment called *lake*. The finest *lakes* are obtained by mixing the decoction of cochineal with freshly prepared gelatinous alumina. The pigment called *carmine* is the coloring matter of cochineal precipitated from the decoction by acids, the salts of tin, etc., or

* *Cake cochineal* is the name given to a variety of the drug, produced in the Argentine Republic. A specimen, examined by Dr. Stark, was in flat cakes about a quarter of an inch thick, and, under the microscope, was seen to consist chiefly of the cochineal insect, mixed with small portions of the thorns and epidermis of the cactus, in consequence of careless gathering. It is inferior for dyeing purposes to the ordinary variety. (*P. J. Tr.*, xiv. 346.)

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by animal gelatin, and when properly made is of the most intense and brilliant scarlet. J. J. Hess proved that if fatty matters found in cochineal were removed by treatment with alcohol, a much more brilliant carmine could be produced. He found in Guatemala cochineal 17 per cent. of a crystalline stearopten, in Java cochineal 7 per cent., and in Canary cochineal 18 per cent. (Dingler, *P. J. Tr.*, 235, 88; *N. R.*, 1880, p. 338.) The degree of coloring power in cochineal may be approximately measured by the decolorizing effect produced by solution of permanganate of potassium. For a method of applying this process, the reader is referred to a paper by J. M. Merrick, of Boston, in *A. J. P.*, 1871, p. 263; from *Amer. Chem.* (April, 1871).

Cochineal has been adulterated by causing certain heavy substances, such as powdered talc, carbonate of lead, and sulphate of barium, by shaking in a bag or otherwise, to adhere, by means of some glutinous material, to the surface of the insects, and thus increase their weight. Cochineal yields 1·5 per cent. of ashes. Five specimens of the drug have been examined, which left in their ashes respectively 8, 12, 16, 18, and 25 per cent. of the salt of baryta. (*A. J. P.*, 1870, p. 220.) The fraud may be detected by the absence, under the microscope, of a woolly appearance, which characterizes the white powder upon the surface of the unadulterated insect. Metallic lead, which is said frequently to exist in fine particles in the artificial coating, may be discovered by powdering the cochineal, and suspending it in water, when the metal will remain behind. Grains of a substance artificially prepared to imitate the dried insect have been mixed with the genuine in France. A close inspection will serve to detect the difference. (*Journ. de Pharm.*, 3e sér., ix. 110.) Vermilion and chromered (dichromate of lead) are said also to have been largely used in the adulteration of carmine, to the extent sometimes of 60 or even 70 per cent. (*P. J. Tr.*, 1860, p. 547.) There can be no difficulty in detecting them by the appropriate tests. Starch has been used, according to Prof. Maisch, for the same purpose in the United States, and in one specimen he found 57·14 per cent. (*A. J. P.*, xxxiii. 18.)

Medical Properties, etc. Cochineal is supposed by some to possess anodyne properties, and has been highly recommended in hooping-cough and neuralgic affections, but is probably useless. In pharmacy it is employed to color tinctures and ointments. To infants with hooping-cough, cochineal in substance is given in the dose of about one-third of a grain (0·02 Gm.) three times a day. The dose of a tincture, prepared by macerating one part of the medicine in eight parts of diluted alcohol, is for an adult from twenty to thirty drops (1·25–1·9 C.c.), twice a day. In neuralgic paroxysms, Sauter gave half a tablespoonful (7·5 C.c.), with the asserted effect of curing the disease.

Off. Prep. Tinctura Cardamomi Composita; Tinct. Cinchonæ Comp., *Br.;* Tinct. Cocci, *Br.*

CODEINA. *U. S.* *Codeine.* [*Codeia.*]

$C_{18}H_{21}NO_3.H_2O$; 317. (CŌ-DĒ-Ī'NĂ.) $C_{36}H_{21}NO_6.2HO$; 317.

"An alkaloid prepared from Opium." *U. S.*

Codeinum, *P.G.;* Codeine, *Fr.;* Codein, *G.*

Codeine was discovered in 1832 by Robiquet in the hydrochlorate of morphine prepared according to the process of Gregory. It exists in opium combined like morphine with meconic acid, and is extracted along with that alkaloid in the preparation of the hydrochlorate. (See *Morphina.*) When the solution of the mixed hydrochlorates of morphine and codeine is treated with ammonia, the former alkaloid is precipitated, and the codeine, remaining in solution, may be obtained by evaporation and crystallization. It may be purified by treating the crystals with hot ether, which dissolves them, and yields the codeine in colorless crystals on spontaneous evaporation. Codeine occurs in "white, or yellowish-white, more or less translucent, rhombic prisms, somewhat efflorescent in warm air, odorless, having a slightly bitter taste and an alkaline reaction. Soluble in 80 parts of water at 15° C. (59° F.) and in 17 parts of boiling water; very soluble in alcohol and in chloroform; also soluble in 6 parts of ether and in 10 parts of benzol, but almost insoluble in benzin. When heated to 120° C. (248° F.), Codeine loses its water of crystallization. At about 150° C. (302° F.) it melts, and, on ignition, it is completely dissipated. Codeine is dissolved by sulphuric acid containing 1 per cent. of molyb-

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date of sodium, to a liquid having, at first, a dirty green color, which, after a while, becomes pure blue and gradually fades, within a few hours, to pale yellow. On dissolving Codeine in sulphuric acid, a colorless liquid results, which, on the addition of a trace of ferric chloride, and gentle warming, becomes deep blue. An aqueous solution of Codeine, added to test-solution of mercuric chloride, should produce no precipitate; and if Codeine be added to nitric acid of sp. gr. 1·200, it will dissolve to a yellow liquid which should not become red (difference from and abs. of morphine)." *U. S.* When added in excess to boiling water, the undissolved portion melts and sinks to the bottom, having the appearance of an oil. It may be separated from morphine by a solution of potassa or soda, which dissolves the morphine, and leaves the codeine. It has an alkaline reaction on test-paper, and combines with acids to form salts, some of which are crystallizable, particularly the nitrate. Its capacity of saturation is almost identical with that of morphine. According to Robiquet, 1 part of hydrochloric acid is saturated by 7·837 of codeine, and by 7·88 of morphine. It is distinguishable, however from the latter principle by the different form of its crystals, which are octohedral, by its solubility in boiling ether, greater solubility in water, and insolubility in alkaline solutions, and by not assuming a red color with nitric acid, or a blue one with ferric salts. Tincture of galls precipitates from its solutions a tannate of codeine. Crystallized from a watery solution, it contains about 6 per cent. of water, which is driven off at 100° C. (212° F.). The crystals obtained from a solution in ether contain no water.

Medical Properties. It is probable that pure codeine is a very feeble alkaloid, tolerated by the human system in very large doses. On the other hand, cases of severe poisoning have been published, and experimenters have claimed for it a very powerful influence upon the lower animals. As late as 1874, Dr. Myrtle reported the instance of a man who was almost killed by four grains of codeine, prepared by Messrs. Smith, of Edinburgh. (*Br. Med. Journ.*, 1874, i. 478.) The symptoms were first vascular excitement and exhilaration, then depression, with great anxiety, nausea and vomiting, cold pale, moist skin, slight contraction of the pupil, and delirious sleeplessness. On the other hand, Dr. S. Weir Mitchell took five grains of codeine without effect, save some nausea, slight giddiness, and cerebral heaviness, and a trifling acceleration of the pulse; whilst we have given codeine prepared by Powers & Weightman, of Philadelphia, in doses of eight grains a day without distinct effect. It is very evident that commercial codeine has been and probably still is of varying composition, and the results frequently obtained have been produced by coherent alkaloids. Mr. Wm. Weightman informs us that nearly the whole product of their laboratory goes to France, where it appears to be largely used as a calmative drug, free from many of the objections to opium, but in no way comparing with it in power. Within the last year or two it has been highly lauded in the treatment of diabetes mellitus, and cases of recovery under its use reported. In the grave form of this disorder we have seen it fail to exert any perceptible influence, but the evidence is sufficient to demand a fair trial of the remedy in any individual case. On account of its frequent contamination, care should be exercised as to the commencing dose, but no effect at all is to be expected from less than one grain (0·06 Gm.), and this dose may be rapidly increased until some symptoms are produced. It may be given in pill or in syrupy solution.

COLCHICI RADIX. *U. S.* *Colchicum Root.*

(CŌL'ĊHĮ-CĪ RĀ'DĬX—kŏl'kĭ-sī.)

"The Corm of Colchicum autumnale. Linné. (*Nat. Ord.* Melanthaceæ.)" *U. S.*
"The fresh corm of Colchicum autumnale, collected about the end of June; and the same stripped of its coats, sliced transversely, and dried at a temperature not exceeding 150°." *Br.*

Colchici Cormus, *Br.:* Colchicum Corm; Bulbus s. Tuber Colchici; Meadow-Saffron Root, Bulbe de Colchique, de Safran bâtard, *Fr.:* Zeitlosenknollen, *G.*

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COLCHICI SEMEN. *U.S.* *Colchicum Seed.*

(CŎL'ÇHĮ-CĪ SĒ'MĔN—kŏl'kį-sĭ.)

"The seed of Colchicum autumnale. Linné. (*Nat. Ord.* Melanthaceæ.)" *U. S.*
"The fully ripe seeds of Colchicum autumnale." *Br.*

Colchici Semina, *Br.;* Colchicum Seeds; Semen Colchici, *P.G.;* Semences de Colchique, Colchique, *Fr.;* Zeitlose, Herbst-Zeitlose, Zeitlosensamen, *G.;* Colchico, *It., Sp.*

Gen. Ch. A *spathe.* *Corolla* six-parted, with a tube proceeding directly from the root. *Capsules* three, connected, inflated. *Willd.*

Colchicum autumnale. Willd. *Sp. Plant.* ii. 272; Woodv. *Med. Bot.* p. 759, t. 258. This species of Colchicum, often called *meadow-saffron,* is a perennial bulbous plant, the leaves of which appear in spring, and the flowers in autumn. Its manner of growth is peculiar, and deserves notice as connected in some measure with its medicinal efficacy. In the latter part of summer, a new bulb, or *cormus* as the part is now called, begins to form at the lateral inferior portion of the old one, which receives the young offshoot in its bosom, and embraces it half round. The new plant sends out fibres from its base, and is furnished with a radical spathe, which is cylindrical, tubular, cloven at top on one side, and half under ground. In September, from two to six flowers, of a lilac or pale-purple color, emerge from the spathe, unaccompanied with leaves. The corolla consists of a tube five inches long, concealed for two-thirds of its length in the ground, and of a limb divided into six segments. The flowers perish by the end of October, and the rudiments of the fruit remain under ground till the following spring, when they rise upon a stem above the surface, in the form of a three-lobed, three-celled capsule. The leaves of the new plant appear at the same time; so that in fact they follow the flower instead of preceding it, as might be inferred from the order of the seasons in which they respectively show themselves. The leaves are radical, spear-shaped, erect, numerous, about five inches long, and one inch broad at the base. In the mean time, the new bulb has been increasing at the expense of the old one, which, having performed its appointed office, perishes; while the former, after attaining its full growth, sends forth shoots, and in its turn decays. The old bulb, in its second spring, and a little before it perishes, sometimes puts forth one or more small bulbs, which are the sources of new plants.

C. autumnale is a native of the temperate parts of Europe and of Northern Africa, growing in moist pastures and meadows. Attempts have been made to introduce its culture into this country, but with no great success; though small quantities of the bulb, of apparently good quality, have been brought into the market. The flowers possess virtues similar to the bulb and seeds.

COLCHICI RADIX. The medicinal virtue of the bulb depends much upon the season at which it is collected. Early in the spring, it is too young to have fully developed its peculiar properties; and, late in the fall, it has become exhausted by the nourishment afforded to the new plant. The proper period for its collection is from the early part of June, when it has usually attained perfection, to the middle of August, when the offset appears.* It may be owing, in part, to this inequality at different seasons, that entirely opposite reports have been given of its powers. Krapf ate whole bulbs without inconvenience; Haller found the bulbs entirely void of taste and acrimony; and we are told that in Carniola the peasants use it as food with impunity in the autumn. On the other hand, there can be no doubt of its highly irritating and poisonous nature, when fully developed, under ordinary circumstances. Perhaps soil and climate may have some influence in modifying its character.

The bulb is often used in the fresh state in the countries where it grows; as it is apt to be injured in drying, unless the process is carefully conducted. The usual plan is to cut the bulb, as soon after it has been dug up as possible, into thin transverse slices, which are spread out separately upon paper or perforated trays, and dried with a moderate heat. The reason for drying it quickly, after removal from the ground, is that it otherwise begins to vegetate, and a change in its chemical nature takes place; and such is its retentiveness of life, that, if not cut in slices, it is liable to

* Dr. Christison, however, has found the roots collected in April to be more bitter than those gathered in July, and conjectures that the common opinion of their superior efficacy at the latter season may not be well founded. Prof. Schroff states, as the result of his observation, that the autumn root is much stronger than that dug in summer. (See *A. J. P.,* xxix. 324.)

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undergo a partial vegetation even during the drying process. Dr. Houlton recommends that the bulb be stripped of its dry coating, carefully deprived of the bud or young bulb, and then dried whole. It is owing to the high vitality of the bud that the bulb is so apt to vegetate. During desiccation there is great loss of weight, 70 per cent. being the average for a number of years in the laboratory of Messrs. Allen & Hanburys, in London.

Properties. The recent bulb or cormus of *C. autumnale* resembles that of the tulip in shape and size, and is covered with a brown membranous coat. Internally it is solid, white and fleshy, and, when cut transversely, yields, if mature, an acrid milky juice. There is often a small lateral projection from its base, which is the bud for the development of a new plant: this bud is frequently broken off in drying. When dried, and deprived of its external membranous covering, the corm is of an ash-brown color, convex on one side, and somewhat flattened on the other, where it is marked by a deep groove, extending from the base to the summit. As found in our shops it is always in the dried state, sometimes in segments made by vertical sections of the bulb, but generally in transverse circular slices, about the eighth or tenth of an inch in thickness, with a notch at one part of their circumference. "About one inch (25 mm.) long, ovoid, flattish and with a groove on one side; externally brownish and wrinkled; internally white and solid; often in transverse slices, reniform in shape, and breaking with a short, mealy fracture; inodorous; taste sweetish, bitter and acrid. Colchicum root which is very dark colored internally, or breaks with a horny fracture, should be rejected." *U. S.* The cut surface is white, and of an amylaceous aspect. Examined with the microscope, the corm is seen to be composed of large irregular cells, full of ovoid, angular, sometimes compound, starch grains, and interspersed with spiral vessels in vascular bundles. The odor of the recent bulb is said to be hircine. It is diminished but not lost by drying. The taste is bitter, hot, and acrid. Its constituents, according to Pelletier and Caventou, are a vegetable alkali combined with an excess of gallic acid; a fatty matter composed of olein, stearin, and a peculiar volatile acid analogous to cevadic acid; a yellow coloring matter; gum; starch; inulin in large quantity; and lignin. The active properties are ascribed to the alkaline principle, which was believed by its discoverers to be identical with *veratrine*, but has been subsequently found to be peculiar, and has received the appropriate name of *colchicine*, or *colchicia*.* Wine and vinegar extract

* *Colchicia* or *Colchicine*, and *Colchiceine*. The alkaloid of colchicum has been a subject of some controversy. According to Geiger and Hesse, to whom has been ascribed the credit of determining its precise nature, *colchicine* (*colchicia*) is crystallizable, and has a very bitter and sharp taste, but is destitute of the extreme acrimony of veratrine, and does not, like that principle, excite violent sneezing when applied to the nostrils. It differs also in being more soluble in water, and less poisonous. To a kitten eight weeks old, one-tenth of a grain was given dissolved in dilute alcohol. Violent purging and vomiting were produced, with apparently severe pain and convulsions, and the animal died at the end of twelve hours. The stomach and bowels were found violently inflamed, with effusion of blood through their whole extent. A kitten somewhat younger was destroyed in ten minutes by only the twentieth of a grain of veratrine; and, on examination after death, marks of inflammation were found only in the upper part of the œsophagus. The alkaloid was obtained from the seeds by a process similar to that employed in the preparation of hyoscyamine from hyoscyamus. (See *Hyoscyamus.*) A simpler process is to digest the seeds of meadow-saffron in boiling alcohol, precipitate with magnesia, treat the precipitated matter with boiling alcohol, and finally filter and evaporate.

The nature of the active principle of colchicum subsequently engaged the attention of L. Oberlin. Upon repeating the process of Geiger and Hesse, he was unable to obtain a crystallizable product, and came to the conclusion that the substance obtained by them was complex. By acidifying its watery solution by sulphuric or hydrochloric acid, and concentrating until the liquid became intensely yellow, he obtained, upon the addition of water, a yellowish white precipitate, which, when well washed and freed from coloring matter, dissolved readily in alcohol or ether, and crystallized with facility. The crystalline product thus obtained he proposed to call *colchiceine*. It is a neutral substance, contains no acid, crystallizes in pearly lamellæ, is almost insoluble in cold water, to which, however, it imparts a slight bitterness, is more soluble in boiling water, and readily dissolves in alcohol, ether, methylic alcohol, and chloroform. It is dissolved by concentrated sulphuric, hydrochloric, and nitric acids, becoming yellow, by acetic acid without change of color, and by ammonia and potassa. It is not altered or precipitated by acetate or subacetate of lead, nitrate of silver, mercuric chloride, or infusion of galls, but is rendered green by sesquichloride of iron. It consists of carbon, hydrogen, nitrogen, and oxygen. It was found to be very poisonous to rabbits, killing an animal in 12 hours in the dose of about one-seventh of a grain, and in a few minutes in five times that quantity. (*Comptes-Rendus*, Dec. 1856, p. 1199. See also *A. J. P.*, xxxi. 235.)

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all the virtues of the bulb. Dr. A. T. Thomson states that the milky juice of fresh colchicum produces a fine blue color, if rubbed with the tincture of guaiac, and that the same effect is obtained from an acetic solution of the dried bulb. He considers

Subsequently Mr. J. E. Carter, of Philadelphia, has made some experiments which appear to invalidate the conclusions of Oberlin as to the nature of colchicine, and to confirm the previous opinion of its alkaloid character. Mr. Carter used the bulb, instead of the seeds, which had previously in general been made the subject of experiment. He employed two processes for the extraction of the alkaloid, but found the following most productive. The dried and powdered bulb was exhausted by alcohol of 0·835 by means of percolation; the tincture thus obtained was evaporated to the consistence of syrup; water acidulated with acetic acid was added, and the liquor, after filtration, was nearly neutralized with ammonia, and then precipitated by solution of tannic acid; the precipitated tannate, after being well washed, was rubbed with five times its weight of freshly prepared hydrated oxide of lead, small quantities of alcohol being added from time to time during the trituration; the whole was then filtered, and the filtered liquid evaporated at a gentle heat. Twenty grains were thus obtained from three pounds of the dried root. Thus obtained, *colchicine* was yellowish in mass, nearly white in powder, inodorous, bitter without being acrid, not sternutatory, soluble in water hot or cold, still more so in dilute acids and alkaline solutions, very soluble in alcohol and chloroform, sparingly so in pure ether, and insoluble in benzol. Mr. Carter did not succeed in crystallizing it. It was alkaline to test-paper, neutralized the acids, and with sulphuric acid formed a crystallizable salt. The most delicate test appeared to be that of sulphuric acid and nitre. A piece of nitre, added to its solution in sulphuric acid, produced a beautiful blue color, changing to green, dark brown or purple, and finally reddish yellow. (For a further account of Mr. Carter's experiments, see *A. J. P.*, 1858, p. 209.)

Since Mr. Carter's experiments, others have engaged in the same inquiry. Ludwig confirms the statements of Oberlin. Hubler, operating on the unbruised seeds by a process similar to that of Mr. Carter with the cormus, for the details of which we refer to *A. J. P.* (1866, p. 105), obtained an amorphous substance, soluble without residue in water and in alcohol, of an odor like that of hay, and very bitter. It had no effect on test-paper; its solution was precipitated yellow by chloride of gold, and white by corrosive sublimate; mineral acids and alkalies turned it yellow; at 140° C. (284° F.) it melted, with no other observable change except in color, which became brown; and its composition was represented by the formula $C_{17}H_{19}NO_5$. When treated with acids it yielded crystallizable bodies, but these, instead of salts, were a new product, isomeric with colchicine, but in character resembling if not identical with the colchiceine of Oberlin, which is therefore a result of change in the colchicine. Both these substances are poisonous. Between the substance obtained by Hubler and the one by Carter, there is this apparently irreconcilable difference, that the latter is decidedly though feebly alkaline, while the former is entirely neutral. Either there is some error on the part of one of these experimenters, or the alkaloid obtained from the cormus is different from the active principle of the seeds.

That Mr. Carter's statement was correct has been fully confirmed by Prof. J. M. Maisch, who made a very careful examination of a portion of the colchicine obtained by Mr. Carter, and kept as a specimen, with the following results. It was an amorphous powder; of a light yellow color, a faint odor, and intense bitterness; sparingly soluble in ether, and readily in water and alcohol. The aqueous solution was slightly turbid, probably from the decomposition by time and exposure of a portion of the colchicine into resin and colchiceine. Heated on platinum foil, it melted, and at a higher temperature took fire, and burned without residue. It restored the blue color of reddened litmus, and even neutralized sulphuric acid in very minute proportion. It answered to the best tests of colchicine, namely, 1, the effect on its solution of both acids and alkalies, which cause it to assume a yellow color, and, 2, the violet and blue color produced by oxidizing agents on the dry colchicine. When treated first with concentrated sulphuric acid, and then with nitric acid or a fragment of a nitrate, it went through a series of changes of color, ending in yellow. The same effect resulted from sulphuric acid with a trace of chromate or bichromate of potassium, sesquichloride of iron, or binoxide of lead; the first two causing a green color with the solution, through the intermixture of their yellowishness with the blue developed. The colchicine also answered to the following tests of the alkaloids, giving precipitates with iodohydrargyrate of potassium, phosphomolybdic acid, and tannic acid.

Colchiceine was produced by treating colchicine with diluted sulphuric and hydrochloric acids, evaporating the solution to dryness, repeating this operation once and again, then dissolving the residue in water, filtering the solution to separate the resin formed, evaporating with an excess of carbonate of lead to remove acid, treating with strong alcohol, and slowly evaporating. Colchiceine was deposited in yellow crystals, the solution of which precipitated, like colchicine, tannic and phosphomolybdic acids, and iodohydrargyrate of mercury, but exercised no reaction on litmus paper whether red or blue.

The inference from these experiments is that the active principle of colchicum, known by the name of colchicine, is an alkaloid, but that its salts in solution, on being kept, or evaporated, especially if heat is used, are decomposed, and converted into resin and colchiceine, the latter of which crystallizes; and, as this is isomeric with colchicine, the probability is that the resin has the same composition. In preparing colchicum pharmaceutically, if it be desired to retain the colchicine unchanged, both acids and alkalies should be avoided, especially when heat is employed. Of the officinal preparations, the two fluid extracts contain the colchicine as in nature; the acetic extract has a portion at least of colchiceine in its composition. In the wines, when kept, the colchicine probably passes gradually into colchiceine. (*A. J. P.*, 1867, p. 97.) But it has not been proved that these latter preparations are in any degree less efficacious remedially; and in the absence of all experience to the contrary, the inference is that colchiceine may have all the powers of colchicine; for the acetic extract, and the wines after being long kept, have often been used in practice, without having been found less effectual than other preparations of colchicum.

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the appearance of this color, when the slices are rubbed with a little distilled vinegar and tincture of guaiac, as a proof that the drug is good and has been well dried. Dr. J. M. Maclagan has shown that this change of color is produced with the albumen, which is not affected if previously coagulated; so that the value of the test consists simply in proving that the drying has not been effected at a heat above 180°, or the temperature at which albumen coagulates. A very deep or large notch in the circumference of the slices is considered an unfavorable sign; as it indicates that the bulb has been somewhat exhausted in the nourishment of the offset. The decoction yields a deep blue precipitate with solution of iodine, white precipitates with acetate and subacetate of lead, mercurous nitrate, and nitrate of silver, and a slight precipitate with tincture of galls. The value of colchicum is best tested by its bitterness.

Medical Properties and Uses. When taken internally in therapeutic dose, colchicum usually produces no other symptoms than intestinal pains and looseness of the bowels. In some rare cases it is said to give rise to copious diuresis or diaphoresis instead of purging. When larger amounts are exhibited, the purging is more pronounced, and there may be also vomiting. With these symptoms there may be some depression, which seems to be due to the gastro-intestinal irritation rather than to the direct action of the poison. In an overdose, it may produce dangerous and even fatal effects. Excessive nausea and vomiting, abdominal pains, purging and tenesmus, great thirst, sinking of the pulse, coldness of the extremities, and general prostration, with occasional symptoms of nervous derangement, such as headache, delirium, and stupor, are among the results of its poisonous action. A peculiarity of its influence is that when its dose is increased beyond a certain point there is not a corresponding increase in the rapidity of the fatal issue. This is probably because it kills not by a direct influence upon the heart or nervous system, but by causing gastro-enteritis. On post-mortem examination the alimentary mucous membrane is found much inflamed.

Colchicum was well known to the ancients as a poison, and is said to have been employed by them as a remedy in gout and other diseases. Störck revived its use among the moderns. He gave it as a diuretic and expectorant in dropsy and humoral asthma; and on the continent of Europe it acquired considerable reputation in these complaints; but the uncertainty of its operation led to its general abandonment, and it had fallen into almost entire neglect, when Dr. Want, of London, again brought it into notice by attempting to prove its identity with the active ingredient of the *eau médicinale d'Husson*, so highly celebrated as a cure for gout. In James's Dispensatory, printed in 1747, it is said to be used in gout as an external application. The chief employment of the meadow-saffron is at present in the treatment of gout and rheumatism, in which experience has abundantly proved it to be a highly valuable remedy. We have, within our own observation, found it especially useful in these affections, when of a shifting or neuralgic character. It sometimes produces relief without obviously affecting the system; but it is more efficient when it evinces its influence upon the skin or alimentary canal. Professor Chelius states that it changes the chemical constitution of the urine in arthritic patients, producing an evident increase of the uric acid. Dr. Maclagan has found it greatly to increase the proportion both of urea and uric acid in the urine, and, where these previously existed in the blood, to separate them from it. (*Ed. Monthly Journ. of Med. Sci.*, N. S., v. 23.) But Graves and Gardner affirm that the urates diminish under its influence, and in a very careful and extended research Dr. A. B. Garrod found that its action upon the uric acid elimination is very irregular and uncertain. Dr. Elliotson successfully treated a case of prurigo with the wine of colchicum, given in the dose of half a drachm (1·9 C.c.) three times a day, and continued for three weeks; and it has been found useful in urticaria and other cutaneous affections, probably of a gouty nature. At various times colchicum has been used in various diseases, but in modern practice is employed almost solely in gout. Even in rheumatism it is at present rarely administered. It is generally given in the state of vinous tincture (see *Vinum Colchici Radicis*); but there are various other officinal preparations, any one of which may be used efficiently. The dose of the dried bulb is

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from two to eight grains (0·13–0·52 Gm.), which may be repeated every four or six hours till its effects are obtained.

COLCHICI SEMEN.—The seeds of the meadow-saffron ripen in summer, and should be collected about the end of July or beginning of August. They never arrive at maturity in plants cultivated in a dry soil, or in confined gardens. (*Williams.*) They are nearly spherical, about the eighth of an inch in diameter, of a reddish brown color externally, white within, and of a bitter acrid taste. "Sub-globular, about one-twelfth of an inch (2 mm.) thick, very slightly pointed at the hilum; reddish-brown, pitted, internally whitish; very hard and tough; inodorous; bitter and somewhat acrid." *U. S.* They are chiefly composed of a gray horny albumen, constituted of very thick-walled cells, and surrounded by a closely adherent testa. The leafless embryo is very small, and is situated close to the surface opposite the strophiole. Dr. Williams, of Ipswich, England, first brought them into notice in 1820 as superior to the bulb. Prof. Schroff, however, has found that their activity is inferior to that of the dried bulb, dug in autumn (*A. J. P.*, xxix. 324); and recent studies indicate that they contain only a very small percentage of alkaloid. A wine, fluid extract, and tincture of the seeds are directed in the U. S. Pharmacopœia. Their dose is about the same as that of the bulb.

Off. Prep. of the Root. Extractum Colchici, *Br.;* Extractum Colchici Aceticum; Extractum Colchici Radicis Fluidum, *U. S.;* Vinum Colchici, *Br.;* Vinum Colchici Radicis, *U. S.*

Off. Prep. of the Seed. Extractum Colchici Seminis Fluidum, *U. S.;* Tinctura Colchici Seminis, *U. S.;* Tinct. Colchici Seminum, *Br.;* Vinum Colchici Seminis, *U. S.*

COLLODIUM. *U. S., Br.* *Collodion.*

(CŌL-LŌ'DI-ŪM.)

Collodion, *Fr.;* Collodium, *G.*

"Pyroxylin, *four parts* [or half an ounce av.]; Stronger Ether, *seventy parts* [or 11 fluidounces 5 fluidrachms]; Alcohol, *twenty-six parts* [or 3 fluidounces 7 fluidrachms], To make *one hundred parts* [or about one pint]. To the Pyroxylin, contained in a tared bottle, add the Alcohol and let it stand for fifteen minutes; then add the Ether, and shake the mixture until the Pyroxylin is dissolved. Cork the bottle well, and set it aside until the liquid has become clear. Then decant it from any sediment which may have formed, and transfer it to bottles, which should be securely corked. Keep the Collodion in a cool place, remote from lights or fire." *U. S.*

"Take of Pyroxylin *one ounce* [avoirdupois]; Ether *thirty-six fluidounces* [Imperial measure]; Rectified Spirit *twelve fluidounces* [Imp. meas.]. Mix the Ether and the Spirit, and add the Pyroxylin. Set aside for a few days, and, should there be any sediment, decant the clear solution. Keep it in a well-corked bottle." *Br.*

Collodion is a solution of gun cotton. On account of the facility with which ether evaporates, it is the better menstruum for remedial purposes; but gun cotton will not dissolve in that liquid when quite pure, and the addition of a little alcohol is necessary. Formerly the U. S. Pharmacopœia directed that the gun cotton be prepared at the time of making the collodion, giving directions for the purpose, but at the revision of 1870 the process of the British Pharmacopœia was substantially adopted, a formula for the preparation of pyroxylin being given separately in the Pharmacopœia. The present formula differs very slightly from that of 1870, containing a little more pyroxylin and alcohol. (See *Pyroxylin.*) A change has been made, however, in directing the collodion to be decanted from the sediment. In the Pharm. 1870 the sediment was directed to be re-incorporated with the clear collodion, and the result was the making of a tougher film. This sediment consists of undecomposed filaments of cotton, and these become partially felted, as the ethereal liquid evaporates, and the film is forming; this direction of the former Pharmacopœia was usually disregarded.

Collodion is a transparent, colorless liquid, of a syrupy consistence, and ethereal smell. When applied to a dry surface, the ether quickly evaporates, and a transparent film is left, having remarkable adhesiveness and contractility. On account of the great volatility of ether, collodion must be kept in bottles well stopped. When

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insecurely kept, the liquid thickens and becomes less fit for the use of the surgeon. The thickened liquid sometimes contains acicular crystals, as was first observed by Mr. Higginson of London, and afterwards by Prof. Leidy, of this city.

Collodion was first applied to the purposes of surgery by Dr. J. Parker Maynard,* of Boston, when a student of medicine, in January, 1847. It is employed for holding together the edges of incised wounds, for covering ulcers or abraded or diseased surfaces, chilblains, chapped nipples, etc., with an impervious film not acted upon by water, and for encasing parts which require to be kept without relative motion. It is applied, brushed over the part, or by means of strips of muslin. In whatever way applied, the solvent quickly evaporates, and leaves the solid adhesive material. The rigid film thus formed contracts with a good deal of force. This property adapts collodion for certain purposes, such as drawing together the edges of wounds, exciting pressure on buboes, etc. When, however, the surgeon desires simply to protect a surface, a flexible, non-contracting film is preferable, and the officinal *Collodion flexile* should be used.

Collodion has been variously medicated, and thus made the vehicle of several important medicines for external application. *Iodized collodion* has been proposed by Dr. C. Fleming, for the purpose of obtaining the specific effects of iodine in a rapid manner, especially on tumors. It is made by dissolving from ten to twenty grains of iodine in a fluidounce of collodion. M. Aran has proposed a *ferruginous collodion*, made of equal parts of collodion and tincture of chloride of iron, as a remedy in erysipelas.† A *caustic collodion* may be prepared by dissolving 4 parts of corrosive sublimate in 30 of collodion. Dr. Macke, of Sorau, has used this preparation for destroying nævi materni. The eschar formed is one or two lines in thickness, and separates in from three to six days, leaving but a trifling cicatrix. (See *A. J. P.*, May, 1858, for formulas in which collodion is made the vehicle of iodine, belladonna, sulphur, etc.) All these medicated collodions are most conveniently applied by means of a camel's-hair brush. Collodion is also much used in photography.‡

Off. Prep. Collodium Flexile, *U. S.*; Collodium Stypticum, *U. S.*

COLLODIUM CUM CANTHARIDE. *U. S.* *Collodion with Cantharides.* [*Cantharidal Collodion.*]

(COL-LŌ'DI-ŪM CŪM CAN-THĂR'I-DĒ.)

Collodium Cantharidatum, *P. G.*; Collodium Cantharidale, s. Vesicans; Collodion vésicant (cantharidé), *Fr.*; Blasenziehendes Collodium, *G.*

"Cantharides, in No. 60 powder, *sixty parts*;§ Flexible Collodion, *eighty-five parts*; Commercial Chloroform, *a sufficient quantity*. Pack the powder firmly in a cylindrical percolator, and gradually pour Commercial Chloroform upon it, until *two hundred and fifty* (250) *parts* of tincture are obtained, or until the Cantharides are exhausted. Recover, by distillation on a water-bath, about *two hundred* (200) *parts* of the Chloroform, and evaporate the residue in a capsule, by means of a

* Dr. Maynard recommended the following formula. Take of sulphuric acid of sp. gr. 1·850 *two parts*, and of nitric acid of sp. gr. 1·450 *one part*. Mix them, and, having permitted the heat to fall to about 100° F., add raw cotton to saturation. Let it macerate for one or two hours; then pour off the acids, wash the cotton till the washings cease to affect litmus paper, and dry thoroughly. The gummy matter thus formed is now to be dissolved in ether of the sp. gr. about ·750, or in a mixture of three parts of pure ether and one part of alcohol of 95 per cent. Two ounces of cotton will make about a pint of collodion. (*Bost. Med. and Surg. Journ.*, 1866, p. 39.)

† *Paresi's Styptic Collodion.* Collodion, 100 parts; Carbolic acid, 10 parts; Pure tannin, 5 parts; Benzoic acid, 3 parts. Agitate till thoroughly mixed. On evaporation it leaves a brown pellicle, adhering strongly to tissues, and effecting instant coagulation of the blood and albumen.

Iodoform Collodion is made, according to Moleschott, by dissolving 1 part of iodoform, in fine powder, in 15 parts of flexible collodion. It is recommended for relieving pain caused by gout, and for orchitis, pericarditis, etc.

‡ *Silk Collodion.* M. Persoz, the younger, prepares a collodion by bringing silk to the condition of the material from which the worm spins its thread. This he does by dissolving it in a solution of chloride of zinc, and then separating the solvent by means of dialysis. The chloride passes through the parchment of a dialyzer, leaving the silk substance in a soft fibreless state. The material thus obtained is said to be applicable to photographic purposes. Before it could be used as collodion, it would be necessary to dissolve it in a volatile liquid, which would evaporate spontaneously on application to the surface. (See *A. J. P.*, 1867, p. 182.)

§ As the liquid ingredients in this preparation are more conveniently weighed than measured, the equivalent measures have been omitted.

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water-bath, until it weighs *fifteen* (15) *parts*. Dissolve this in the Flexible Collodion, and let it stand at rest for forty-eight hours. Finally, pour off the clear portion from any sediment which may have been deposited, and transfer it to bottles, which should be securely corked. Keep the Cantharidal Collodion in a cool place, remote from lights or fire." *U. S.*

The officinal process differs considerably in the manipulation from that of the U. S. P. 1870, although the finished preparation is not essentially different. Chloroform is used to extract the cantharidin from the powdered cantharides, by percolation; the chloroform is afterwards recovered by distillation, and the oily residue containing the vesicant is dissolved in the flexible collodion. The practical objection to the process is its costliness, for, notwithstanding the greatest care, considerable chloroform would be wasted through volatilization in the process of percolation and distillation in the hands of the pharmacist. The efficiency of chloroform as a solvent of cantharidin has been shown by Professor Procter. The original process of M. Ilisch was to exhaust, by percolation, a pound of cantharides, with a mixture consisting of a pound of ether and three ounces of acetic ether; and in two ounces of this liquid to dissolve 25 grains of gun cotton. Professor Procter states that it has been found more advantageous to exhaust the flies with ether, distil off the ether, and mix the oily residue with collodion already prepared of the proper consistence (*A. J. P.*, xxiv. 303); and this is probably a better formula than the officinal, if care is used in recovering the ether to avoid contact with flame. Mr. Charles S. Rand (*A. J. P.*, xxii. 18) states that Ilisch's preparation, made with double the proportion of ether, vesicates equally well, and proposes the addition of about 1 per cent. of Venice turpentine, which he has found to prevent the disagreeable and sometimes painful contraction of the collodion upon drying. The preparation may be kept indefinitely, in an opaque glass-stoppered bottle, without change; but, on exposure to the light, the greenish coloring matter of the flies bleaches, and the liquid becomes yellowish.*

Cantharidal collodion is a very convenient epispastic remedy. It may be applied to the surface by means of a camel's-hair brush, and, after the evaporation of the ether, which takes place in less than a minute, may be reapplied if the surface should not be well covered. It produces a blister in about the same time as the ordinary cerate, and has the advantages that it is applied with greater facility, is better adapted to cover uneven surfaces, and retains its place more certainly. According to Mr. Rand, if the evaporation of the ether be restrained by a piece of oiled silk immediately after its application, it will act much more speedily.

COLLODIUM FLEXILE. *U. S., Br.* *Flexible Collodion.*

(CŌL-LŌ'DI-ŬM FLĔX'I-LĒ.)

Collodium Elasticum, *P.G.;* Collodion élastique, *Fr.;* Elastisches Collodium, *G.*

"Collodion, *ninety-two parts*;† Canada Turpentine, *five parts;* Castor Oil, *three parts*, To make *one hundred parts*. Mix them, and keep the mixture in a well-corked bottle, in a cool place, remote from lights or fire." *U. S.*

"Take of Collodion *six fluidounces* [Imperial measure]; Canada Balsam *one hundred and twenty grains;* Castor Oil *one fluidrachm* [Imp. meas.]. Mix, and keep in a well-corked bottle." *Br.*

The contractility of the collodion film has long been felt as a drawback to its use simply for the purposes of protection. Mr. C. S. Rand, of Philadelphia, proposed to obviate this by dissolving one part of gun cotton and three of Venice turpentine in twenty parts of ether. To give more flexibility to the film, M. Sourisseau, of Kaiserberg, suggested the addition of one part of elemi to twelve of collodion. According to Mr. Startin, of London, opacity and elasticity may be imparted at the same time, by adding from half a drachm to a drachm of lard, or some similar fatty matter, previously dissolved in ether, to an ounce of collodion. The qualities of softness and

* *Croton Oil Collodion* is made by mixing equal weights of croton oil and flexible collodion. (*Report on Revision of U. S. Pharm., A. P. A.*, 1880.)

† As the liquid ingredients in this preparation are more conveniently weighed than measured, the equivalent measures have been omitted.

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elasticity may also be given by combining collodion with castor oil, in the proportion of thirty parts to two, agreeably to the plan of M. Guersant, who found it useful, thus modified, in erysipelas; and the proportion of castor oil may be increased if thought desirable. This is the method preferred by the French Codex. An elastic collodion, somewhat similar, in which, besides castor oil, Venice turpentine and white wax are ingredients, has been proposed by E. Lauras. (*P. J. Tr.*, xii. 303.) According to MM. Cap and Garot, the most successful way for obtaining an elastic collodion is to mix two parts of glycerin with one hundred of collodion. *Glycerized collodion* is exceedingly supple, does not crack and scale off from the skin, and accommodates itself to the motions of the part. In order to imitate the color of the skin, an ethereal tincture of turmeric or saffron may be added, so as to produce the desired tint. Dr. Meller has proposed a solution of shellac in highly rectified alcohol, so as to have a gelatinous consistence, as a substitute for collodion. Of all these plans, probably that followed in the officinal directions is the best. Dr. Tournie recommends, in superficial cervical adenitis with redness, painting the part with several layers of flexible collodion every two days. (*Med. Times and Gaz.*, 1874, p. 540.)

COLLODIUM STYPTICUM. *U. S.* *Styptic Collodion.*

(CŌL-LŌ'DI-ŬM STĬP'TI-CŬM.)

Styptic Colloid, Xylostyptic Ether; Collodion styptique, *Fr.*

"Tannic Acid, *twenty parts* [or eighty grains av.]; Alcohol, *five parts* [or twenty-six minims]; Stronger Ether, *twenty parts* [or one hundred and ten minims]; Collodion, *fifty-five parts* [or four and a half fluidrachms], To make *one hundred parts* [or about one fluidounce]. Place the Tannic Acid in a tared bottle, add the Alcohol, Ether, and Collodion, and agitate until the Tannic Acid is dissolved. Keep the product in well corked bottles, in a cool place, remote from lights or fire." *U. S.*

This new officinal is a modification of the *styptic colloid* of Dr. B. W. Richardson, of London (*P. J. Tr.*, 1867, p. 29), a preparation which has had considerable use, particularly in hospitals. Experience has shown, however, that Dr. Richardson's formula contained too little tannin; and the original quantity has been increased in the U. S. process from a little over four to twenty per cent. The manipulation in the officinal formula might be improved by directing the tannic acid to be rubbed into a smooth paste in a mortar with sufficient alcohol, before introducing into the bottle. This would enable the pharmacist to prepare it extemporaneously. When applied on wounded or abraded surfaces, it soon loses the ether and alcohol, and a firm coating is left, in which, besides the tannin and colloidal substance, are the coagulated blood and secretions from the surface, forming a covering for the part by which the air is excluded. The liquid is applied with a camel's-hair brush, or by means of cotton saturated with it, to the edges of wounds closed by stitches, to ulcerated surfaces and bleeding parts. If it be desired to make a special impression on the diseased surface, carbolic acid, creasote, iodine, morphine, etc., may be incorporated with the styptic fluid.

COLOCYNTHIS. *U. S.* *Colocynth.*

(CŌL-Ọ-CĬN'THĮS.)

"The fruit of Citrullus Colocynthis, Schrader (*Nat. Ord.* Cucurbitaceæ), deprived of its rind." *U. S.* "The dried decorticated fruit, freed from seeds, of Citrullus Colocynthis." *Br.*

Colocynthidis Pulpa, *Br.;* Colocynth Pulp; Fructus Colocynthidis, *P.G.;* Poma Colocynthidis; Pulpe de Coloquinte; Coloquinte, *Fr.;* Coloquintenapfel, Koloquintenmark, Koloquinten, *G.;* Coloquintida, *It., Sp.*

Gen. Ch. MALE. *Calyx* five-toothed. *Corolla* five-parted. *Filaments* three. FEMALE. *Calyx* five-toothed. *Corolla* five-parted. *Pistil* three-cleft. *Seeds* of the *gourd* with a sharp edge. *Willd.*

Cucumis Colocynthis. Willd. *Sp. Plant.* iv. 611; Woodv. *Med. Bot.* p. 189, t. 71.—*Citrullus Colocynthis*, Royle's Mat. Med. The *bitter cucumber* is an annual plant, bearing considerable resemblance to the common watermelon. The stems, which are herbaceous and beset with rough hairs, trail upon the ground, or rise upon neigh-

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boring bodies, to which they attach themselves by their numerous tendrils. The leaves, which stand alternately on long petioles, are triangular, many-cleft, variously sinuated, obtuse, hairy, of a fine green color on the upper surface, rough and pale on the under. The flowers are yellow, and appear singly at the axils of the leaves. The fruit is a globular pepo, of the size of a small orange, yellow and smooth when ripe; and contains, within a hard, coriaceous rind, a white, spongy, medullary matter, enclosing numerous ovate, compressed, white or brownish seeds.

The plant is a native of Turkey, and abounds in the islands of the Archipelago. It grows also in various parts of Africa and Asia. Burckhardt, in his travels across Nubia, found the country covered with it; Thunberg met with it at the Cape of Good Hope; and Ainslie says that it grows in many parts of Lower India, particularly in sandy places near the sea. It is said to be cultivated in Spain, to abound in Morocco and in the neighboring countries, and even to have been collected in Japan. The fruit is gathered in autumn, when it begins to become yellow, and, having been peeled, is dried quickly in a stove or by the sun. Thus prepared, it is imported from the Levant. Small quantities are said to be imported into England from Mogador in the form of brown, unpeeled globular gourds.*

Properties. As kept in the shops, colocynth is in the shape of whitish balls about the size of an orange, very light and spongy, and abounding in seeds which constitute three-fourths of their weight. The seeds are somewhat bitter, but possess little activity, and, according to Captain Lyon, are even used as food in the north of Africa.† When the medicine is prepared for use, they are separated and rejected, the pulpy or medullary matter only being employed. This has a very feeble odor, but a nauseous and intensely bitter taste. The U. S. Pharm. thus describes colocynth. "From two to four inches (5 to 10 cm.) in diameter; globular; white or yellowish-white; light; spongy; readily breaking into three wedge-shaped pieces, each containing, near the rounded surface, many flat, ovate, brown seeds; inodorous; taste intensely bitter. Hard and dark colored Colocynth should be rejected. The pulp, when used, should be deprived of the seeds." *U. S.* Water and alcohol extract the virtues of colocynth. It is a matter of importance to be able to determine whether the drug miller who usually powders colocynth is careful to reject the seeds. If the seeds have been ground with the mass, the microscope will show the presence of numerous albuminous granules derived from the cotyledons. (W. T. Clark, *P. J. Tr.*, vii. 509.) These are best found by putting a small amount of the powder on the glass slide, adding a drop of water, and gently rubbing the cover glass over it: fragments of the double-walled embryo sac showing on the outer side, elongated, more or less hexagonal, thin-walled cells, and on the inner side irregular, tabular, thick-walled cells. Powdered colocynth containing a large number of starch granules has suffered adulteration. Vauquelin obtained the bitter principle of colocynth in a separate state, and called it *colocynthin*. According to Meissner, 100 parts of the dry pulp of colocynth contain 14·4 parts of colocynthin, 10·0 of extractive, 4·2 of fixed oil, 13·2 of a resinous substance insoluble in ether, 9·5 of gum, 3·0 of pectic acid (pectin), 17·6 of gummy extract derived from the lignin by means of potassa, 2·7 of phosphate of calcium, 3·0 of phosphate of magnesium, and 19·0 of lignin, besides water.‡ Colocynthin is obtained by boiling the pulp in water, evaporating the decoction,

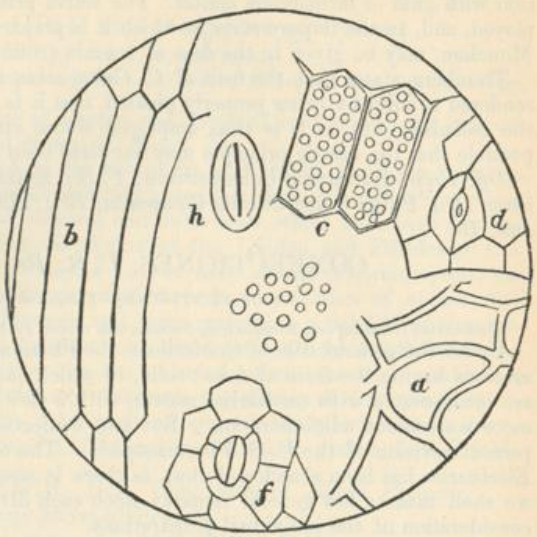
* In Union Village, Lebanon, Ohio, the Shakers formerly prepared an extract from a hybrid between the colocynth and the watermelon. The two plants were placed close to each other, and the hybrid resulting yielded the second year a gourd resembling a watermelon, but very bitter, and affording an abundant extract. This is stated to be equal in purgative properties to that of colocynth, but at present it is not manufactured.

† Dr. Nachtigal confirms this statement of Captain Lyon; but with the qualification, that, before being eaten, the seeds are deprived of their coating by some mechanical means, and the kernels are heated to the boiling point, then washed with cold water, dried, and powdered. Professor Flückiger found a bitter principle in the testa, which accounts for its rejection as food, though rendering improper the rejection of the seed in preparing the extract. He found in the kernels about 45 per cent. of fixed oil and 18 per cent. of albumen. (*A. J. P.*, 1872, p. 538.)

‡ Dr. Waltz supposes that he has found another peculiar principle, *colocynthitin*. It was obtained by treating with ether the alcoholic extract previously exhausted by water, decolorizing the ethereal solution with animal charcoal, evaporating to dryness, and dissolving the residue in anhydrous alcohol, which deposited it in crystals on spontaneous evaporation. It is white and tasteless, and is probably a resin. (*N. Jahrbuch der Pharm.*, xvi. 10.)

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treating the extract thus procured with alcohol, evaporating the alcoholic solution, and submitting the residue, which consists of the bitter principle and acetate of potassium, to the action of a little cold water, which dissolves the latter, and leaves the greater part of the former untouched. Mr. Bastick obtained it by exhausting the pulp with cold water, heating the solution to ebullition, adding subacetate of lead so long as a precipitate was produced, filtering the liquor when cold, adding dilute sulphuric acid gradually until it no longer occasioned a precipitate, boiling to expel free acetic acid, filtering to separate sulphate of lead, evaporating cautiously nearly to dryness, extracting the colocynthin from the residuum by strong alcohol, which left the salts, and finally evaporating the alcoholic solution. The following process, employed by Dr. Waltz, probably yields it in a purer state. Colocynth is exhausted by alcohol of 0·84, the tincture evaporated to dryness, the residue treated with water, and the solution precipitated first with acetate and afterwards with subacetate of lead. The yellow filtered liquor is then treated with sulphuretted hydrogen to separate the lead, and, after filtration, with solution of tannic acid, which throws down a compound of tannic acid and colocynthin. This is dissolved in alcohol, the tannin thrown down by subacetate of lead, the excess of lead separated, and the liquid digested with animal charcoal, filtered, and evaporated. The residue, washed with anhydrous ether, is pure colocynthin. This is yellowish, somewhat translucent, brittle and friable, fusible by a heat below 100° C. (212° F.), inflammable, more soluble in alcohol than in water, but capable of rendering the latter intensely bitter. M. Mouchon states that it is insoluble in ether. It is neither acid nor alkaline; but its aqueous solution gives with infusion of galls a copious white precipitate. Its formula, according to Dr. Waltz, is $C_{56}H_{84}O_{23}$. Upon the same authority it is a glucoside, being resolved, by the action of sulphuric acid, into sugar and a peculiar resinous substance termed *colocyntheïn*. An infusion of colocynth, made with boiling water, gelatinizes upon cooling. Neumann obtained from 768 parts of the pulp, treated first with alcohol and then with water, 168 parts of alcoholic and 216 of aqueous extract.



470 Diameters.

a, inner layer of embryo sac; *b*, outer layer of ditto; *c*, cells of palisaded layer with granules; *d*, stomata from cotyledon; *e*, granules from cotyledons; *f*, epidermis of rind; *h*, starch granule (side view).

Medical Properties and Uses. The pulp of colocynth is a powerful drastic, hydragogue cathartic, producing, when given in large doses, violent griping, and sometimes bloody discharges, with dangerous inflammation of the bowels. Death has resulted from a teaspoonful and a half of the powder. (*Christison.*) Even in moderate doses it sometimes acts with much harshness, and is, therefore, seldom prescribed alone. By some writers it is said to be diuretic. It was frequently employed by the ancient Greeks and the Arabians, though its drastic nature was not unknown to them. Among the moderns it is occasionally used in obstinate dropsy, and in various affections depending on disordered action of the brain. In combination with other cathartics it loses much of its violence, but retains its purgative energy, and in this state is extensively employed. The compound extract of colocynth is a favorite preparation with many practitioners; and, combined with calomel, extract of jalap, and gamboge, it forms a highly efficient and safe cathartic, especially useful in congestion of the portal circle and torpidity of the liver. (See

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Pilulæ Catharticæ Compositæ.) The dose of colocynth is from five to ten grains (0·33–0·65 Gm.). It is best administered in minute division, effected by trituration with gum or farinaceous matter. The active principle has sometimes been employed, and, in the impure state in which it is prepared by the process of M. Emile Mouchon, may be given in the dose of a grain (·065 Gm.).*

Thunberg states that the fruit of *C. Colocynthis*, at the Cape of Good Hope, is rendered so mild by being properly pickled, that it is eaten both by the natives and the colonists; but, as it is thus employed before attaining perfect maturity, it is possible that the drastic principle may not have been developed.

Off. Prep. Extractum Colocynthidis, *U. S.;* Extractum Colocynthidis Compositum, *Br.;* Pilula Colocynthidis Composita, *Br.;* Pilula Colocynthidis et Hyoscyami, *Br.*

CONFECTIONES. *U. S., Br.* *Confections.*

(CON-FĔC-TĮ-Ō'NĒS—kŏn-fĕk-shę-ō'nēz.)

Electuaries; Conserves, Electuaires, Saccharolés mous, *Fr.;* Conserven, Latwergen, *G.*

Under the general title of Confections, the Pharmacopœias include all those preparations having the form of a soft solid, in which one or more medicinal substances are incorporated with saccharine matter, with a view either to their preservation or more convenient administration. But two confections have been retained in the present revision of the U. S. Pharmacopœia. The old division into Conserves and Electuaries has been abandoned; but, as there is some ground for the distinction, we shall make a few general remarks upon each division, before proceeding to the consideration of the individual preparations.

Conserves consist of recent vegetable substances and refined sugar beaten into a uniform mass. By means of the sugar, the vegetable matter is enabled to resist for some time the decomposition to which it would otherwise be exposed in the undried state, and the properties of the recent plant are thus retained to a certain extent unaltered. But, as active medicines even thus treated undergo some change, and those which lose their virtues by desiccation cannot be long preserved, the few conserves now retained are intended rather as convenient vehicles of other substances than for separate exhibition. The sugar used in their preparation should be reduced to a fine powder by pounding and sifting, as otherwise it will not mix uniformly with the other ingredients.

Electuaries are mixtures consisting of medicinal substances, especially dry powders, combined with syrup or honey, in order to render them less unpleasant to the taste, and more convenient for internal use. They are usually prepared extemporaneously; and it is only when their complex nature renders it convenient to keep them ready made in the shops, or some peculiarity in the mode of mixing the ingredients requires attention, that they become proper objects for officinal direction. Their consistence should not be so soft, on the one hand, as to allow the ingredients to separate, nor so firm, on the other, as to prevent them from being swallowed without mastication. Different substances require different proportions of syrup. Light vegetable powders usually require twice their weight, gum-resins two-thirds of their weight, resins somewhat less, mineral substances about half their weight, and deliquescent salts not more than one-tenth. Should the electuary be found, after having been kept for a short time, to swell up and emit gas, it should be beaten over again in a mortar, so that any portion of the sugar which may have crystallized may be again accurately incorporated with the other ingredients. Should it, on the contrary, become dry and hard from the mutual reaction of its constituents, more syrup should be added, so as to give it the requisite consistence. If the dryness result from the mere evaporation of the aqueous part, water should be added instead of syrup, and the same remark is applicable to the conserves. To prevent the hardening of electuaries, the French writers recommend the use of syrup prepared from brown sugar, which is less apt to crystallize than that made from the refined. Molasses would answer the same purpose; but its taste might be objectionable. Some

* For further processes for preparing colocynthin, see U. S. D., fourteenth edition, or *A. J. P.*, xxviii. 166; 1863, 116.

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employ honey, but this is not always acceptable to the stomach. Glycerin might sometimes be used with advantage.*

CONFECTIO OPII. *Br. Confection of Opium.*

(CQN-FĔC'TI-Ō Ō'PI-Ī—kǫn-fĕk'shę-ō.)

Electuarium Theriaca, *P. G.;* Confection (Electuaire) opiacé, Thériaque, *Fr.;* Opiumlatwerge, Theriak, *G.*

"Take of Compound Powder of Opium *one hundred and ninety-two grains;* Syrup *one fluidounce* [Imperial measure]. Mix." *Br.*

This preparation was dropped in the last revision of the U. S. Pharm. It was intended as a substitute for those exceedingly complex and unscientific preparations, formerly known by the names of *theriaca* and *mithridate*, which have been expelled from modern pharmacy. It was an officinal of the London and Edinburgh Colleges, and, after having been discarded in the first British Pharmacopœia, was adopted in the last edition. The preparation is a combination of opium with spices, which render it more stimulant, and more grateful to a debilitated stomach. It may be given in atonic gout, flatulent colic, diarrhœa unattended with inflammation, and other diseases requiring the use of a stimulant narcotic. Added to Peruvian bark or sulphate of quinine, it increases the efficacy of this remedy in obstinate cases of intermittent fever. One grain of opium is contained in about thirty-six grains of the U. S. confection of 1870,† and in about forty grains of the British.

CONFECTIO PIPERIS. *Br. Confection of Black Pepper.*

(CQN-FĔC'TI-Ō PĪ'PĘR-ĪS.)

Electuarium Piperis; Electuaire de Poivre, *Fr.;* Pfefferlatwerge, *G.*

"Take of Black Pepper, in fine powder, *two ounces;* Caraway Fruit, in fine powder, *three ounces;* Clarified Honey *fifteen ounces.* Rub them well together in a mortar." *Br.* This preparation was intended as a substitute for *Ward's paste*, which acquired some reputation in Great Britain as a remedy in piles and ulcers of the rectum. To do good, it must be continued, according to Mr. Brodie, for two, three, or four months. The dose is from one to two drachms repeated two or three times a day. Its stimulating properties render it inapplicable to cases attended with much inflammation.

CONFECTIO ROSÆ. *U. S. Confection of Rose.*

(CQN-FĔC'TI-Ō RŌ'ŞÆ.)

Confectio Rosæ Gallicæ, *Br.;* Confection of Roses; Conserva Rosarum; Conserve de Rose rouge, *Fr.;* Rosen-Conserve, *G.*

"Red Rose, in No. 60 powder, *eight parts* [or one ounce av.]; Sugar, in fine powder, *sixty-four parts* [or eight ounces av.]; Clarified Honey, *twelve parts* [or one and a half ounces av.]; Rose Water, *sixteen parts* [or two fluidounces], To make *one hundred parts* [or twelve and a half ounces]. Rub the Red Rose with the Rose Water heated to 65° C. (149° F.), then gradually add the Sugar and Honey, and beat the whole together until thoroughly mixed." *U. S.*

* *Confectio Aromatica. Aromatic Confection.* (Electuarium Aromaticum; Électuaire, Confection aromatique, *Fr.;* Aromatische Latwerge, Gewürzlatwerge, *G.*) "Take of Aromatic Powder *four troyounces;* Clarified Honey *four troyounces*, or *a sufficient quantity.* Rub the Aromatic Powder with Clarified Honey until a uniform mass of the proper consistence is obtained." *U. S.* 1870. The aromatic confection has been abandoned in the U. S. and Br. Pharmacopœias, probably because readily prepared extemporaneously. It affords, nevertheless, a convenient means of administering the spices contained in it, and an agreeable vehicle for other medicines. The 1870 U. S. formula differed favorably from that of 1850 in the omission of the saffron; and the place of the syrup of orange peel has been economically supplied by using a larger proportion of honey. The confection is given in debilitated states of the stomach. The dose is from ten to sixty grains (0·65–3·9 Gm.)."

Confectio Aurantii Corticis. Confection of Orange Peel. (Conserva Aurantii; Conserve d'Ecorce d'Orange, *Fr.;* Apfelsinenschalen-Conserve, *G.*) "Take of Sweet Orange Peel, recently separated from the fruit by grating, *twelve troyounces;* Sugar [refined] *thirty-six troyounces.* Beat the Orange Peel with the Sugar, gradually added, until they are thoroughly mixed." *U. S.* 1870. This confection, like the preceding, has been dropped in the U. S. and Br. Pharmacopœias. It is not used as frequently as it deserves to be. It is, when well made, a grateful aromatic vehicle or adjunct for tonic and purgative powders.

† "Take of Opium, in fine powder, *two hundred and seventy grains;* Aromatic Powder *six troyounces;* Clarified Honey *fourteen troyounces.* Rub the Opium with the Aromatic Powder, then add the Honey, and beat the whole together until thoroughly mixed." *U. S.* 1870.

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"Take of Fresh Red-Rose Petals *one pound;* Refined Sugar *three pounds.* Beat the Petals to a pulp in a stone mortar; add the Sugar, and rub them well together." *Br.*

This preparation differs from that formerly officinal only in a slight increase, 4 per cent., in the quantity of sugar; this is rather an improvement.

In the British process the unblown petals only are used, and these should be deprived of their claws; in other words, the rose-buds should be cut off a short distance above their base, and the lower portion rejected. In the last three editions of the U. S. Pharmacopœia, dried roses have been substituted for the fresh, as the latter are not brought to our market. The process is very similar to that of the French Codex. We have been informed, however, that much of the confection of roses made in Philadelphia on the large scale is prepared from the fresh petals of the hundred-leaved rose and others, by beating them into a pulp with sugar, as in the British process. An excuse for this deviation from the officinal formula is, that the confection thus made has greater adhesiveness than the officinal, and is therefore better fitted for the formation of pills.

This confection is slightly astringent, but is almost exclusively used as a vehicle of other medicines, or to impart consistence to the pilular mass.

Off. Prep. Pilula Aloes Barbadensis, *Br.;* Pil. Aloes et Assafœtidæ, *Br.;* Pil. Aloes et Ferri, *Br.;* Pil. Aloes et Myrrhæ, *Br.;* Pil. Aloes Socotrinæ, *Br.;* Pil. Ferri Carbonatis, *Br.;* Pilulæ Hydrargyri; Pil. Plumbi cum Opio, *Br.*

CONFECTIO ROSÆ CANINÆ. *Br.* *Confection of Hips.*

(CŌN-FĔC'TĬ-Ō CĀ-NĪ'NÆ.)

Confectio Cynosbati, Conserva Cynorrhodi; Conserve de Cynorrhodon, *Fr.;* Hainbutten-Conserve, *G.*

"Take of Hips deprived of their seeds *one pound;* Refined Sugar *two pounds.* Beat the Hips to a pulp in a stone mortar, and rub the pulp through a sieve, then add the Sugar, and rub them well together." *Br.*

This preparation is acidulous and refrigerant, and is used in Europe for forming more active medicines into pills and electuaries. On standing it is apt to develop saccharine crystals, and is therefore not so eligible as confection of rose.

Off. Prep. Pilula Quiniæ, *Br.*

CONFECTIO SCAMMONII. *Br.* *Confection of Scammony.*

(CŌN-FĔC'TĬ-Ō SCĂM-MŌ'NĬ-Ī.)

Électuaire ou Confection de Scammonée, *Fr.;* Scammonium-Latwerge, *G.*

"Take of Scammony, in fine powder, *three ounces;* Ginger, in fine powder, *one ounce and a half;* Oil of Caraway *one fluidrachm;* Oil of Cloves *half a fluidrachm;* Syrup *three fluidounces;* Clarified Honey *one ounce and a half.* Rub the powders with the Syrup and the Honey into a uniform mass, then add the Oils and mix." *Br.* The ounce used in this process is the avoirdupois ounce.

The confection is actively cathartic in the dose of half a drachm or a drachm, but is very little used. The British Pharmacopœia now directs scammony alone in its formula without the alternative of the resin given in the first edition. This is a decided improvement. As this drug is generally found in the market, it has but little more than half the strength of the resin. It is true that the purest and best scammony is much stronger than this, yet it is decidedly weaker than its resin, and the Pharmacopœia itself describes it as containing only from 80 to 90 per cent. of this ingredient. It appears to have been a strange want of precision thus to confound the two, as if they were to be given in the same dose.

CONFECTIO SENNÆ. *U. S.* *Confection of Senna.*

(CŌN-FĔC'TĬ-Ō SĔN'NÆ.)

Electuarium e Senna, *P. G.;* Electuarium de Senna Compositum, Electuarium Lenitivum; Électuaire de Séné composé, Électuaire lénitif, *Fr.;* Sennalatwerge, *G.*

"Senna, in No. 60 powder, *ten parts;* Coriander, in No. 40 powder, *six parts;*

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Cassia Fistula, bruised, *sixteen parts;* Tamarind, *ten parts;* Prune, sliced, *seven parts;* Fig, bruised, *twelve parts;* Sugar, in fine powder, *fifty parts;* Water, *sixty parts,* To make *one hundred parts.* Place the Cassia Fistula, Tamarind, Prune, and Fig in a close vessel with *forty-five* (45) *parts* of the Water, and digest for three hours, by means of a water-bath. Separate the coarser portions with the hand, and rub the pulpy mass, first through a coarse hair sieve, and then through a fine one, or through a muslin cloth. Mix the residue with the remainder of the Water, and, having digested the mixture for a short time, treat it as before, and add the product to the pulpy liquid first obtained. Then, by means of a water-bath, dissolve the Sugar in the pulpy liquid, and evaporate the whole until it weighs *eighty-four* (84) *parts.* Lastly, add the Senna and Coriander, and incorporate them thoroughly with the other ingredients while yet warm." *U. S.*

"Take of Senna, in fine powder, *seven ounces;* Coriander Fruit, in fine powder, *three ounces;* Figs *twelve ounces;* Tamarind *nine ounces;* Cassia Pulp *nine ounces;* Prunes *six ounces;* Extract of Liquorice *three-quarters of an ounce;* Refined Sugar *thirty ounces;* Distilled Water *a sufficiency.* Boil the Figs and Prunes gently with twenty-four [fluid]ounces of Distilled Water in a covered vessel for four hours; then, having added more Distilled Water to make up the quantity to its original volume, mix the Tamarind and Cassia Pulp, digest for two hours, and rub the softened pulp of the fruits through a hair sieve, rejecting the seeds and other hard parts. To the pulped product add the Sugar and Extract of Liquorice and dissolve them with a gentle heat; while the mixture is still warm, add to it gradually the mixed Senna and Coriander powders, and mix the whole thoroughly, making the weight of the resulting Confection seventy-five ounces either by evaporation or by the addition of more Distilled Water." *Br.* The ounce employed in the British process is the avoirdupois ounce.

The Confection of Senna, when correctly made, is an elegant preparation, and keeps well if properly secured. The present U. S. process differs from that of 1860 in preparing the pulps, as suggested in former editions of this Dispensatory, instead of taking them already prepared. There may be difficulty, however, in the evaporation to 84 parts, particularly if the pulpy drugs are of good quality. The present preparation contains nearly 20 per cent. more sugar than that officinal in 1870, and nearly 2 per cent. more senna. It is not uncommon to omit the cassia pulp in the preparation of the confection, as the pods are not always to be found in the market. But, as this is next to senna the most active ingredient, the omission is to be regretted. Cassia fistula is now readily procured in commerce, and there can be no excuse for its omission. It has also been proposed to substitute the fluid extract of senna for the crude drug (*A. J. P.*, xliii. 123); but, as the fluid extract is of such uncertain quality, the leaves themselves are certainly preferable.

This is one of our best and most pleasant laxatives, being admirably adapted to cases of habitual costiveness, especially in pregnant women and persons affected with piles. It is also very useful in constipation during convalescence from acute disease. The dose is two drachms (7·8 Gm.), to be taken at bedtime.

CONFECTIO SULPHURIS. *Br.* *Confection of Sulphur.*

(CQN-FĔC'TI-Ō SŬL'FHŪ-RĪS.)

Electuarium Sulphuris; Électuaire de Soufre, *Fr.;* Schwefel-Latwerge, *G.*

"Take of Sublimed Sulphur *four ounces* [avoirdupois]; Acid Tartrate of Potash *one ounce* [av.]; Syrup of Orange Peel *four fluidounces.* Rub them well together." *Br.*

This is merely a mode of administering the two laxatives, sulphur and bitartrate of potassium; and the relative proportion of the latter is so small that it can have little effect. The dose is from one to two drachms or more.

CONFECTIO TEREBINTHINÆ. *Br.* *Confection of Turpentine.*

(CQN-FĔC'TI-Ō TĔR-Ē-BĬN'THI-NÆ.)

Electuarium Terebinthinatum; Électuaire térébinthiné, *Fr.;* Terpentinol-Latwerge, *G.*

"Take of Oil of Turpentine *one fluidounce;* Liquorice Root, in powder, *one*

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ounce [avoirdupois]; Clarified Honey *two ounces* [av.]. Rub the Oil of Turpentine with the Liquorice, add the Honey, and mix to a uniform consistence." *Br.*

Confections might be multiplied indefinitely upon the principle which appears to have been adopted here, that, namely, of giving a convenient formula for the administration of medicines. The effects of this confection are those only of the oil of turpentine. The dose may be from a scruple to a drachm.

CONII FOLIA. *Br. Conium Leaves.*

(CŌ-NĪ'Ī FŌ'LI-Ą.)

Hemlock Leaves; Herba Conii, *P.G.;* Herba Cicutæ Majoris; Feuilles de grande Ciguë (de Ciguë officinale), *Fr.;* Schierlingskraut, Schierlings-Blätter, *G.*

"The fresh leaves and young branches of Spotted Hemlock, Conium maculatum; also the leaves separated from the branches and carefully dried; gathered from wild British plants when the fruit begins to form." *Br.*

CONIUM. *U.S., Br. Conium.* [*Hemlock.*]

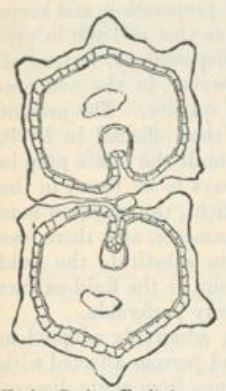
(CŌ-NĪ'ŬM.)

"The full-grown fruit of Conium maculatum. Linné. (*Nat. Ord.* Umbelliferæ, Campylospermæ), gathered while yet green." *U. S.* "The dried ripe fruit of Conium maculatum, Spotted Hemlock." *Br.*

Conii Fructus, *Br.;* Hemlock Fruit; Fruits de grande Ciguë, Ciguë ordinaire, Grand Ciguë, *Fr.;* Gefleckter Schierling, Schierlingsfrüchte, *G.;* Cicuta, *It., Sp.*

Gen. Ch. Partial involucre halved, usually three-leaved. *Fruit* nearly globular, five-streaked, notched on both sides. *Willd.*

Conium maculatum. Willd. *Sp. Plant.* i. 1395; Bigelow, *Am. Med. Bot.* i. 113; Woodv. *Med. Bot.* p. 104, t. 42. This is an umbelliferous plant, having a biennial spindle-shaped whitish root, and an herbaceous branching stem, from three to six feet high, round, hollow, smooth, shining, slightly striated, and marked with brownish purple spots. The lower leaves are tripinnate, more than a foot in length, shining, and attached to the joints of the stem by sheathing petioles; the upper are smaller, bipinnate, and inserted at the division of the branches; both have channelled footstalks, and incised leaflets, which are deep green on their upper surface and paler beneath. The flowers are very small, white, and disposed in compound terminal umbels. The general involucre consists of from three to seven lanceolate, reflected leaflets, whitish at their edges; the partial involucre, of three or four, oval, pointed, spreading, and on one side only. There are five petals, cordate, with their points inflected, and nearly equal. The stamens are spreading, and about as long as the corolla; the styles diverging. The fruit, commonly called seeds, is roundish-ovate, a line and a half or rather less in length by a line in breadth, striated, and composed of two plano-convex, easily separable parts, which have on their outer surface five crenated ribs separated by slightly wrinkled furrows. On cross-section the absence of oil-ducts becomes apparent, and a deep furrow upon the commissural face of the albumen gives a reniform appearance. As kept in the shops, the mericarps are usually separated. They are thus described in the U. S. Pharmacopœia. "About one-eighth of an inch (3 mm.) long; broadly ovate; laterally compressed; gray-green; often divided into the two mericarps, each with five crenate ribs, without oil-tubes, and containing a seed which is grooved on the face; odor and taste slight. When triturated with solution of potassa, Conium gives off a strong, disagreeable odor." *U. S.*



Unripe Conium Fruit, transverse section.

Conium is a native of Europe, and has become naturalized in the United States, where it is also cultivated for medicinal purposes. It grows usually in clusters along the roadsides, or in waste grounds, and is found most abundantly near old settlements. It flowers in June and July. The whole plant, especially at this period, exhales a

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fetid odor, compared by some to that of mice, by others to that of the urine of cats; and narcotic effects result from breathing for a long time air loaded with the effluvia. The plant varies in narcotic power according to the weather and climate, being most active in hot and dry seasons and in warm countries. The hemlock of Greece, Italy, and Spain is said to be much more energetic than that of the north of Europe. As a general rule, those plants are most active which grow in a sunny exposure. The term *cicuta*, which has often been applied to this plant, belongs to a different genus. The leaves and fruit are officinal.

The proper season for gathering the leaves is when the plant is in flower; and Dr. Fothergill asserts, from experiment, that they are most active about the time when the flowers begin to fade. The footstalks* should be rejected, and the leaflets quickly dried, either in the hot sun, on tin plates before a fire, or by a stove-heat not exceeding 120° F. They should be kept in boxes or tin cases, excluded from the air and light, by exposure to which they lose their fine green color, and become deteriorated. The same end is answered by pulverizing them, and preserving the powder in opaque and well-stopped bottles. But little reliance can be placed on the dried leaves; as, even when possessed of a strong odor and a fine green color, they may be destitute of the narcotic principle. When rubbed with caustic potassa they should exhale the odor of conine. The fruit retains its activity much longer than the leaves. Dr. Christison found them to have sustained no diminution of power after having been kept eight years. Hirtz inferred from experiment that extract of the seeds was ten times stronger than that of the leaves.

Properties. The dried leaves of the hemlock have a strong, heavy, narcotic odor, less disagreeable than that of the recent plant. Their taste is bitterish and nauseous; their color a dark green, which is retained in the powder. A slight degree of acrimony possessed by the fresh leaves is said to be dissipated by drying. The seeds have a yellowish gray color, a feeble odor, and a bitterish taste. Their form has already been described. Water distilled from the fresh leaves has the odor of hemlock, and a nauseous taste, but does not produce narcotic effects. The decoction has little taste, and the extract resulting from its evaporation is nearly inert. From these facts it is inferable that the active principle, as it exists in the plant, is not volatile at 100° C. (212° F.), and, if soluble in water, is injured by a boiling heat. Alcohol and ether take up the narcotic properties of the leaves; and the ethereal extract, which is of a rich dark green color, is stated by Dr. A. T. Thomson to have the smell and taste of the plant in perfection, and in the dose of half a grain to produce headache and vertigo. Upon destructive distillation, the leaves yield a very poisonous empyreumatic oil. Schrader found in the juice of the leaves, resin, extractive, gum, albumen, a green fecula, and various saline substances. Brandes obtained from the plant a very odorous oil, albumen, resin, coloring matter, and salts.

So long ago as 1827, Giseke obtained an alkaline liquid by distilling hemlock leaves with water and caustic lime; but he did not succeed in isolating the substance in which the alkalinity resided. Geiger was the first who obtained the active principle in a separate state, and proved it to be alkaline. It appears that there are two volatile substances in hemlock; one of them an *oil*, which is in very small quantity, and has never been chemically studied; it is obtained by simple distillation. The volatile alkaloid, *conine*, is the active principle. As it exists in the plant in combination with an acid, it is not readily volatilized; but when alkali is previously added, it freely comes over with the distillate. The acid of conium Peschier believed to be peculiar, and named *coniic acid*. Other observers claim that it is *malic acid*. Geiger obtained conine by the following process. He distilled fresh hemlock with caustic potassa and water, neutralized with sulphuric acid the alkaline liquid which came over, evaporated this liquid to the consistence of syrup, added anhydrous alcohol so long as a precipitate of sulphate of ammonium was afforded, separated this salt by filtration, distilled off the alcohol, mixed the residue with a strong solution of caustic potassa, and distilled anew. The conine passed over with the water, from which it separated, floating on the surface in the form of a yellowish oil. Accord-

* Dr. Manlius Smith, of Manlius, N. Y., has demonstrated that the footstalks are almost destitute of the active alkaline principle. (*Ann. de Thérap.*, 1873, p. 39.)

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ing to Dr. Christison, an easier process is to distil cautiously a mixture of a strong solution of potassa and the alcoholic extract of the unripe fruit. As obtained by the above process, conine is in the state of a hydrate, containing one-fourth of its weight of water and a little ammonia. From the former, it may be freed by chloride of calcium; from the latter, by exposing it under an exhausted receiver, till it ceases to emit bubbles of gas.

The fresh leaves or seeds should be employed in the preparation of conine; as the alkaloid undergoes decomposition by time and exposure. The seeds contain most of this principle; but even in these it exists in very small proportion. From 6 pounds of the fresh and 9 of the dried seeds, Geiger obtained about an ounce of conine; while from 100 pounds of the fresh herb he got only a drachm, and from the dried leaves none. Christison recommends the full-grown fruit while yet green, and states that 8 pounds will yield half an ounce of hydrate of conine, and contains much more. In relation to the relative strength of different parts of the plant, Dr. Manlius Smith, of New York, gives, as the result of a series of carefully conducted experiments, that the unripe fruit of the conium is far preferable to the dried leaves, and is even stronger than the full-grown fruit, that it may be dried without serious injury, and that a very active preparation may be made from it. He also found that full-grown fruit, collected in August, and dried in the dark, retained its activity unimpaired for several years. This would appear to contradict in some measure previous opinions of the injurious effects of time. (*P. J. Tr.*, Feb. 1869, pp. 491–2.)

CONINE is in the form of a yellowish oily liquid, of sp. gr. 0·87 to 0·89, of a very acrid taste, and a strong penetrating odor, compared to that of the urine of mice, and recalling the smell of fresh hemlock, though not identical with it. In volatility it resembles the essential oils, readily rising with the vapor of boiling water, but when unmixed, requiring for ebullition a temperature of 170° C. (338° F.). It is freely soluble in alcohol, ether, the fixed and volatile oils, and slightly so in water. It unites with about one-fourth of its weight of water to form a hydrate. It reddens turmeric, and neutralizes the acids, forming with them soluble salts, some of which are crystallizable. With tannic acid it forms an insoluble compound. Like ammonia, it occasions a white cloud when approached by a rod moistened with hydrochloric acid; and the resulting hydrochlorate, contrary to previous statements, is asserted by Prof. Wertheim to be crystallizable, and not in the least deliquescent. The statement of Wertheim as to the crystallization of the hydrochlorate has been confirmed by Geo. C. Close, who prepared it by directly uniting its constituents and evaporating its solution by means of a water-bath. The salt crystallized from the solution. He did not succeed in obtaining crystallizable salts with sulphuric, citric, or oxalic acids. (*A. J. P.*, 1869, p. 62.) It coagulates albumen, and precipitates the salts of aluminium, copper, zinc, manganese, and iron. It also precipitates nitrate of silver, but in excess redissolves the precipitate. Most of its salts are decomposed by evaporation. When exposed to the air, it speedily assumes a deep brown color, and is ultimately converted into a resinous matter, and into ammonia which escapes. Under the influence of heat this change takes place with much greater rapidity. The presence of conine may be detected in an extract, or other preparation of hemlock, by rubbing it with potassa, which instantly develops its peculiar odor. Its formula is $C_8H_{15}N$.* In its effects on the system it closely resembles hemlock itself. Dr. Christison found it, contrary to the experience of Geiger, more active in the saline state than when uncombined. It is a most energetic poison; one drop of it injected into the eye of a rabbit killing the animal in nine minutes, and three drops killing a stout cat in a minute and a half when similarly applied. A recently prepared extract of hemlock acted precisely as conine. Locally the alkaloid appears to act as an irritant.

* Orfila gives the following additional chemical characters of conine. Heated in a capsule, it forms white vapors, *having a strong smell of celery and of the urine of mice.* Weak tincture of iodine gives a white precipitate, becoming olive with excess of the tincture. *Pure concentrated sulphuric acid does not alter it;* but when the mixture is heated, it becomes first brown, then blood-red, and finally black. *Nitric acid imparts a topaz color,* not changed by heat. The chlorides of platinum and of gold give yellow precipitates, and corrosive sublimate a white one. Permanganate of potassium is immediately decolorized. *Neutral acetate of lead gives no precipitate,* nor does the subacetate. The parts of this note in italics indicate the means of distinguishing this alkaloid from nicotine. (See *P. J. Tr.*, xi. 89.)

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Methylconine. From a communication by Drs. A. von Planta and Aug. Kekulé to the *Annal. der Chem. und Pharm.* (lxxxix., s. 129–156), it would appear that commercial conine consists most commonly of at least two homologous bases; one being the proper *conine* ($C_8H_{15}N$), which contains one atom of hydrogen capable of being replaced by radicals, and the other, named *methylconine*, $C_8H_{14}NCH_3$, in which the methyl group CH_3 has been substituted for the replaceable H atom of conine. In relation to the modes of separating these alkaloids and their distinctive properties, we must content ourselves with referring to the original paper.

Conhydrine. Prof. T. Wertheim has also found a new alkaloid mixed with the conine obtained by distillation from fresh hemlock flowers. It is crystallizable, fusible below 100° C. (212° F.), and volatilizable at a higher temperature, diffusing the peculiar odor of conine, or one very much like it. Water dissolves it considerably, ether and alcohol freely; and the solution has a strong alkaline reaction. Its formula is given as $C_8H_{17}NO$. When distilled with anhydrous phosphoric oxide it splits into conine and one molecule of water. (*A. J. P.*, xxix. 321.) It may be separated from conine by exposing the mixed alkaloids to a freezing mixture, expressing, and then repeatedly crystallizing from ether. (*Gmelin*, xiii. 169.)

Artificial Conine, Paraconine. Conine is said to have been artificially produced by Hugo Schiff. From the reaction of *butyric aldehyd* with an alcoholic solution of ammonia, he obtained two bases, one of which, *dibutyraldine*, yielded on distillation, first a neutral oily substance, and afterwards a strong alkaline base, which proved to be conine, having all the physiological properties of natural conine. The amount, however, hitherto produced is small and costly. (*A. J. P.*, April, 1871, p. 161.) Subsequently, however, the same chemist found the artificial product to be not chemically identical with the native alkaloid, though isomeric with it, and he proposes to name it *paraconine*. (*Ibid.*, Dec. 1872, p. 539.)

Medical Properties and Uses. Hemlock is supposed to be the narcotic used by the Athenians to destroy the life of condemned individuals, and by which Socrates and Phocion died. It was also used by the ancients as a medicine, but fell into entire neglect, and did not again come into notice till the time of Störck, by whom it was much employed and extravagantly praised. Anodyne, soporific, antispasmodic, antaphrodisiac, deobstruent, and diuretic properties have been ascribed to it. It was highly recommended by Störck as a remedy in schirrus and cancerous ulcers, and has since been employed in all kinds of chronic enlargements, and in diseases most numerous and most diverse.

Modern research has, however, greatly limited the use of the medicine, rendering its possession of alterative properties more than doubtful. When taken internally in sufficient dose it produces very profound muscular weakness, associated it may be with vertigo and disordered vision. After toxic doses the muscular prostration is extreme, the eyelids droop from weakness, the voice is suppressed, the pupils dilated, the light almost lost, consciousness is usually preserved to the last; and life finally is extinguished without struggle. In some cases there have been convulsive movements, and violent cardiac palpitation has been noted. The chief action of the poison is upon the motor nerves, which it paralyzes; the efferent or sensitive nerves are also affected, but to a much less extent. Conium probably exerts no direct influence upon the cerebral centres, but there is some reason for believing that it is a spinal depressant. At present conium is rarely employed by the general practitioner, except in spasmodic affections, such as chorea and hooping-cough. Probably the most frequent use of it is by alienists for the production of calm in maniacal excitement.

The powdered leaves, and the inspissated juice (the extract of the Pharmacopœias), are the forms in which conium has been usually administered; but the juice of the fresh leaves, prepared with the addition of a small proportion of alcohol, has been adopted in the Br. Pharmacopœia. Either the leaves or the extract may be given in the dose of three or four grains (0·20–0·26 Gm.) twice a day, gradually increased till the occurrence of slight vertigo or nausea indicates that it has taken effect. To maintain a given impression, it is necessary to increase the dose even more rapidly than is customary with most other narcotics; as the system becomes very speedily habituated to its influence. In some instances, the quantity administered in one day has

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been augmented to more than two ounces. The strength of the preparations of hemlock is exceedingly unequal; and caution is therefore necessary, when the medicine is given in very large quantities, to employ the same parcel, or, if a change be made, to commence with the new parcel in small doses, so as to obviate any danger which might result from its greater power. Unpleasant consequences have followed a neglect of this precaution. There are also an officinal tincture, a fluid extract, an abstract, and an alcoholic extract, all of which, when properly made, are considered efficient preparations. The fresh juice of the plant has been recommended by Hufeland in the dose of from twelve to forty drops (0·72–2·5 C.c.). The expressed juice of the fresh plant, with a little alcohol for its preservation, recently introduced into the Pharmacopœias, is one of the most reliable forms in which the leaves can be used. The powdered seeds should be given in a dose considerably smaller than that of the leaves.* The fresh leaves are sometimes used externally as an anodyne cataplasm; and the extract, and an ointment prepared from the leaves, are applied to the same purpose. A plaster made from the extract has also been employed.†

Conine has been occasionally employed, both internally and externally, with asserted advantage, for the same purposes as hemlock itself, or the extract. It has been particularly recommended in hooping-cough. Dr. Spengler, of Herborn, gave it to an infant a year old in the dose of one-sixteenth of a grain every six hours, with the effect of curing the disease in ten days. (*Ann. de Thérap.*, 1853, p. 73.) According to the formula of Fronmüller, two drops are dissolved in twenty-four drops of alcohol, and three drops of the solution are given each on a piece of sugar. (*Arch. Gén.*, 4e sér., xxiii. 226.) From one-quarter to three-quarters of a drop (0·15–0·45 C.c.) may be given to an adult, and one drop (0·06 C.c.) by enema in emulsion of starch. Dr. Harley has prepared an acid benzoate of conine by adding two mols. of the acid to one of the base, and found the resulting salt effectual in the dose of half a grain. (*P. J. Tr.*, Jan. 1871, p. 585.) A solution of one part in one hundred of very dilute alcohol has been used with advantage in certain cases of scrofulous ophthalmia with photophobia, applied several times daily by friction about the eyelids. (*Journ. de Pharm.*, 3e sér., xix. 219.) Prof. Mauthner, of Vienna, recommends it especially in the spasmodic contraction of the orbicularis in scrofulous children, using a solution containing half a grain of conine in a drachm of almond oil, which he applies by a pencil to the eyelids twice or thrice daily. As a collyrium, from one to three drops may be added to six drachms of pure water, and two drachms of mucilage of quince seeds. Introduced into the cavity of a carious tooth, it is said to be very effectual in toothache. For this purpose it should be diluted with ten parts of tincture of cinnamon, and applied by means of a camel's-hair pencil. In diseases of the skin it may be used as an ointment, made with three drops to a drachm of simple ointment. In neuralgia, three or four drops (0·18–0·24 C.c.) may be applied on linen to the skin, and confined by oiled silk.

The hydrochlorate of conine has been recommended for exhibition by Mr. G. C. Close, as preferable to the uncombined alkaloid. From half a grain he experienced no sensible effects; but a grain produced the characteristic symptoms of conine in an even unpleasant degree. These doses are probably dangerous, and not more than a fourth of a grain (0·015 Gm.) should be given as a commencing dose. (*A. J. P.*, 1869, p. 62.) According to Mourrut, one of the best crystallizable salts of conine is the *bromhydrate*. Most of the conine of the market, however, is somewhat impure; it is accompanied by a brown oily body, which adheres to the crystals with great persistence. A variety of conine prepared in Germany, however, is almost colorless, and gives much better

* The root, while containing a small proportion of conine, is too feeble, according to the experiments of Dr. John Harley, of London, to be used practically with advantage. Dr. Harley has found in the root three new proximate principles, one a very bitter resin which he names *conamarine*, and the two others, crystallizable bodies, named, respectively, *rhizoconin* and *rhizoconolein*. They are all neutral, and so far as known medicinally inert. (See *P. J. Tr.*, Aug. 1867.)

† The following formula of Planche has been approved by the Society of Pharmacy, of Paris. Take of extract of hemlock 90 parts, of purified elemi 20 parts, of white wax 10 parts. Melt the resin and wax with a gentle heat, and incorporate the extract with the mixture. (*Journ. de Pharm.*, Juillet, 1862, p. 46.)

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results. The alkaloid is treated with aqueous bromhydric acid, which causes, especially with the brown variety of conine, an elevation of temperature, and a disengagement of white fumes of the odor of conine; the mixture then turns green, and finally blackish red. The crystals, which form after some time, may be obtained quite colorless by repeated crystallizations. They are colorless prismatic needles, soluble in water and alcohol, less so in ether and chloroform, inodorous and almost tasteless, and are not deliquescent. They should be kept in the dark, otherwise they assume a red tint. The salt has been used by various practitioners with great success, in the treatment of hooping-cough, in doses of about one-twelfth of a grain (·005 Gm.), if necessary, every hour, for a child three years of age; or one-thirtieth of a grain (·002 Gm.) for a child of one year; or one-sixth of a grain (·01 Gm.) for adults. In sciatica it has been employed hypodermically in quantities of one-twelfth of a grain (·005 Gm.) with good results. (*Répert. de Pharm.*, 1876, p. 369; *N. R.*, 1876, 1879, pp. 18, 178.)

Though fatal to some animals, hemlock is eaten with impunity by others, as horses, goats, and sheep. The best method of relieving its poisonous effects is the speedy evacuation of the stomach.*

Off. Prep. Abstractum Conii, Extractum Conii Alcoholicum, Extractum Conii Fluidum, *U. S.*; Tinctura Conii, *U. S.*, *Br.*

Off. Prep. of the Leaves. Cataplasma Conii, *Br.*; Extractum Conii, *Br.*

COPAIBA. *U. S., Br.* *Copaiba.* [*Balsam of Copaiba.*]

(CŌ-PĀ'I-BĄ.)

"The oleoresin of Copaifera Langsdorffii, Desfontaines, and of other species of *Copaifera*. (*Nat. Ord.* Leguminosæ, Papilionaceæ.)" *U. S.* "The oleo-resin obtained from incisions made in the trunk of Copaifera multijuga and other species of Copaifera." *Br.*

Balsamum Copaiva, *P.G.;* Balsam Copaiba, Balsam Capivi; Copahu, Oleo-résine (Baume) de Copahu, *Fr.;* Copaiva; Copaiva-Balsam, *G.;* Balsamo di Copaiba, *It.;* Balsamo de Copayva, *Sp.*

Gen. Ch. Calyx none. *Petals* four. *Legume* ovate. *Seed* one, with an ovate arillus. *Willd.*

Copaiba was first noticed in a work published by Purchas, in England, in 1625. The next reference to it was by Cristoval d'Acuña, in 1638. In 1648, Marcgrav and Piso gave a detailed account of the tree which produces it, and the methods of gathering it. Jacquin in 1763 described a species of Copaifera, growing in Martinique, which he named *C. officinalis*. As this was believed to be the same plant with the one observed by Marcgrav in Brazil, it was adopted in the Pharmacopœias; but their identity was denied; and Desfontaines proposed for Jacquin's species the title of *C. Jacquini*, in honor of that botanist. It is now known that many species of Copaifera exist in Brazil and other parts of South America; and all of them, according to Martius, yield copaiba. Besides *C. officinalis* or *C. Jacquini*, the following are described by Hayne:—*C. Guianensis*, *C. Langsdorffii*, *C. coriacea*, *C. Beyrichii*, *C.*

* Dr. Harley's experiments on the relative value of the different preparations of conium are based upon their physiological effects. The results obtained were as follows. 1. The Extractum Conii, *B. P.*, and Succus Conii, *B. P.*—20 grains of the extract equalled 2 fluidrachms of the juice (10 gr. to f℥j). 4. Succus Conii, *B. P.;* Tincture of the green fruit (London ℥v in ℥xx);—four drachms of the juice equalled fifty minims of the tincture (℥iv to ♏50). 11. Different preparations of Succus, *B. P.*, prepared by different persons,—Buckle's (the plant yielding 75 per cent. of juice) and Hanbury's (the plant yielding 35 per cent. of juice);—nine drachms of Buckle's equalled three drachms of Hanbury's—(℥ix to ℥iij). 12. Extract of green fruit, Tincture of green fruit, and Succus, *B. P.*—Three grains of the extract equalled four fluidrachms of the Tincture, and four drachms of Succus (gr. iij of extract=f℥iv of Tincture, and ℥iv of Succus). 14. Of *Squibb's fluid extract* 50 minims equal of the *Tinct.* of the *green fruit*, London, ℥iss; of the Succus Conii, *B. P.*, ℥v: of the Tincture of the fresh plant, ℥iiiss to ℥iv; and of the Tincture of the dry plant, f℥j. 15. Of Squibb's fluid extract ℥j equals of pale Succus ℥vi, of dark Succus ℥ij; of Tincture of the green fruit ℥iss; of Tincture of the fresh plant ℥iv; Neutral Benzoate of Conine, gr. ¾. 18. Of Succus Conii, *B. P.* (Buckle's), ℥vj=Benzoate of Conine, gr. ½. The author draws the following conclusions from his experiments. The green fruit, as the basis of Tinctures and Extracts, is decidedly superior to any other part of the plant; and the spirituous extract of the green fruit should be substituted for the almost worthless Extract of the Br. Pharm. The variable strength of the Succus is an objection. (*P. J. Tr.*, Jan. 1871, p. 585.)

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Martii, *C. bijuga*, *C. nitida*, *C. laxa*, *C. cordifolia*, *C. Jussieui*, *C. Sellowii*, *C. oblongifolia*, and *C. multijuga*. Hayne believed that *C. bijuga* was the plant seen by Marcgrav and Piso. The four species to which in the Pharmacographia the production of copaiba is especially attributed are *C. officinalis*, L., *C. Guianensis*, Desf., *C. coriacea*, Mart., and the *C. Langsdorffii*.

C. officinalis is a native of Venezuela, and grows in the province of Carthagena, mingled with the trees which afford the balsam of Tolu. It grows also in some of the West India islands, particularly Trinidad and Martinique. Though recognized in former editions of the U. S. Pharmacopœia as a source of copaiba, it probably yields little of that now in use. According to Hayne (x. t. 17 f. c.), the species from which most of the copaiba of commerce is derived is *C. multijuga*, growing in the province of Para. It was recognized by the U. S. P. 1870; but Bentham, after examining the only specimens extant, asserts it not to be a Copaifera at all. It is probable that *C. Guianensis*, which inhabits the neighboring territory of Guiana, especially in the vicinity of the Rio Negro, affords also considerable quantities; and *C. Langsdorffii* and *C. coriacea*, which are natives of São Paulo, are thought to yield most of the juice collected in the latter province. *C. nitida*, inhabiting the province of Minas-Geraes, probably also contributes to the commercial supplies, through Rio Janeiro.

The juice is obtained by making a square chamber in the stems of the trees reaching to the very centre; and the operation is said to be repeated several times in the same season. A single tree is said to yield about eighty-four English Imperial pints. As it flows from the wound, it is clear, colorless, and very thin, but soon acquires a thicker consistence, and a yellowish tinge. It is most largely collected in the provinces of Para and Maranham, in Brazil, and is brought to this country from the port of Para, in small casks or barrels. Large quantities of it come from Maracaybo, in Venezuela, and from other ports on the Caribbean Sea, whence it is brought in casks, demijohns, cans, jugs, etc. The drug is also exported from Angostura, Cayenne, Rio Janeiro, and some of the West India islands.

Properties. Copaiba is a clear, transparent liquid, usually of the consistence of olive oil, of a pale yellow color, a peculiar not unpleasant odor, and a bitterish, hot, nauseous taste. Its sp. gr. varies ordinarily from 0·950 to 1·000, but has been known to be as low as 0·916. (Procter, *A. J. P.*, xxii. 292.)* It is insoluble in water, but entirely soluble in absolute alcohol, ether, and the fixed and volatile oils. Strong alkaline solutions dissolve it perfectly; but the resulting solution becomes turbid when largely diluted with water. With the alkalies and alkaline earths it forms saponaceous compounds, in which the resin of the copaiba acts the part of an acid. It dissolves magnesia, especially with the aid of heat, and even disengages carbonic acid from the carbonate of that earth. If triturated with a sixteenth of its weight of magnesia and set aside, it gradually assumes a solid consistence; and a similar change is produced with hydrate of lime. (See *Pilulæ Copaibæ*.) Its essential constituents are volatile oil and resin, with a minute proportion of an acid which appears to be acetic. (*Durand.*) As it contains no benzoic acid, it cannot with propriety retain its old title of *balsam of copaiva*. The substances which it most closely resembles, both in composition and properties, are the turpentines. (See *Oleum Copaibæ*.)

"A transparent or translucent, more or less viscid liquid, of a color varying from pale yellow to brownish-yellow; having a peculiar, aromatic odor and a persistently bitter and acrid taste. Sp. gr. 0·940–0·993. It is readily soluble in absolute alcohol. It is not fluorescent, and when heated to 130° C. (266° F.), does not become gelatinous. When subjected to heat, it does not evolve the odor of turpentine, and after distilling off the volatile oil the residue, when cool, should be hard and friable (abs. of fixed oils). The essential oil distilled off from the oleoresin, when recti-

* The variety of copaiba found by Prof. Procter to have this low sp. gr. was supposed to be from Para. It was of a light straw color, very fluid, and possessed of the pure copaiba odor. It contained 80 per cent. of volatile oil and 20 of resin, and was not affected by recently calcined magnesia. It appears to be the same with a variety described by Dr. L. Posselt in the *Chemical Gazette* for May 1, 1849. The view of Prof. Procter that it is the product of young trees, in which the juice has not become fully elaborated, is highly probable. As the virtues of copaiba depend mainly on the oil, this variety should be more efficacious than the copaiba in common use.

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fied, should not begin to boil below 200° C. (392° F.). On adding 1 drop of Copaiba to 19 drops of disulphide of carbon and shaking the mixture with 1 drop of a cold mixture of equal parts of sulphuric and nitric acids, it should not acquire a purplish-red or violet color (abs. of gurjun balsam)." *U. S.*

The *resinous* mass which remains after the distillation of the oil is hard, brittle, translucent, greenish brown, and nearly destitute of smell and taste. By mixing it with the oil in proper proportion, we may obtain a liquid identical or nearly so with the original juice. This resinous mass is of an acid character, and yields a series of amorphous salts. It may be obtained pure by exposing a mixture of 9 parts of copaiba and 2 parts of aqueous ammonia (sp. gr. 0·95) to a temperature of 10° C. In this way crystals of *copaivic acid*, $C_{20}H_{30}O_2$, are obtained. This acid agrees with the *abietic acid* of colophony in composition, but not in properties.

Copaivic acid is readily soluble in alcohol, and especially in warmed copaiba itself; much less in ether. When recrystallized from alcohol, copaivic acid fuses at 116°–117° C. (241°–242·6° F.). (*A. J. P.*, 1879, p. 305.) An analogous substance, *oxycopaivic acid*, $C_{20}H_{28}O_3$, was found in 1841 by H. von Fehling in Para copaiba; and Strauss in 1865 extracted *metacopaivic acid*, $C_{22}H_{34}O_4$, from Maracaybo copaiba.

Copaivic acid forms crystallizable salt with alkalies, and the *copaiviate of sodium*, $NaC_{20}H_{29}O_2$, made by combining equivalent quantities of the acid and soda, is claimed by Zlamál and Roquette to be more efficient than any other preparation of copaiba. A *miscible copaiba* proposed by Groves was made by treating copaiba with a saturated solution of carbonate of potassium. It resembled ordinary copaiba in appearance and consistence, but was alkaline, and when shaken with water, instead of floating on the surface readily formed a white emulsion, more or less stable according to the degree of dilution. (*P. J. Tr.*, ix. 195.)

Copaiba, upon exposure to the air, acquires a deeper color, a thicker consistence, and greater density, and, if spread out upon an extended surface, ultimately becomes dry and brittle. This change is owing partly to the volatilization, partly to the oxidation of the essential oil. As it is the soft resin that results from the oxidation of the oil, it follows that the proportion of this resin increases with age. Considerable diversity must, therefore, exist in the drug, both in physical properties and the properties of its ingredients, according to its age and degree of exposure. Similar differences also exist in the copaiba procured from different sources. Thus, that of the *West Indies*, when compared with the *Brazilian*, which is the variety above described, and in common use, is of a thicker consistence, of a deeper or darker yellow color, less transparent, and of a less agreeable, more terebinthinate odor; and specimens obtained from the ports of Venezuela or Colombia were found, upon examination by M. Vigne, to differ from each other not only in physical properties, but also in their chemical relations. (*Journ. de Pharm.*, N. S., i. 52.) The same is true, as observed by M. Buignet, in their action on polarized light, in which they differ not only in degree, but sometimes also even in direction. (*Journ. de Pharm.*, Oct. 1861, pp. 266–7.) It is not impossible that differences may exist in the juice according to the circumstances of its collection. The species of Copaifera from which the juice is collected, as well as the age of the tree, its position, and the season of collection, must also have influence over the product. It is highly probable that the resinous matter results from oxidation of the oil in the cells of the plant, and that the less elaborated the juice may be, the larger proportion it will contain of the oil. It is said that a volatile oil flows abundantly from a tree near Bogota, which is employed to adulterate the copaiba collected in that vicinity and shipped from Maracaybo and other neighboring ports.

Adulterations. Copaiba is said to be frequently adulterated.* The fixed oils are the most frequent addition, especially castor oil, which, in consequence of its solubility in alcohol, cannot, like the others, be detected by the agency of that fluid.

* Some years since a substance was imported into New York, under the name of *red copaiba*, which had not a single character of the genuine drug. It was of a thick, semifluid consistence, not unlike that of balsam of Tolu, as it often reaches us, a brown color similar to that of the same balsam, though darker, and an unpleasant yet somewhat aromatic odor, recalling that of liquid-ambar, but less agreeable. Its origin is unknown.

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Various plans have been proposed for detecting the presence of castor oil. The simplest is to boil a drachm of the copaiba in a pint of water, till the liquid is wholly evaporated. If the copaiba contain a fixed oil, the residue will be more or less soft, according to the quantity present; otherwise it will be hard. Another mode, proposed by M. Planche, consists in shaking together in a bottle one part of solution of ammonia of the sp. gr. 0·9212 (22° Baumé) with two and a half parts of copaiba, at a temperature of from 50° to 60° F. The mixture, at first cloudy, quickly becomes transparent if the copaiba is pure, but remains more or less opaque if it is adulterated with castor oil. According to J. E. Simon, however, a variety of genuine copaiba occurs in commerce in which this test fails (*A. J. P.*, xvi. 236); and it does not apply to the variety containing 80 per cent. of volatile oil, described by Prof. Procter. (See note, p. 490.) Carbonate of magnesium, caustic potassa, and sulphuric acid have also been proposed as tests. In the late Edinburgh Pharmacopœia, it was stated that copaiba "dissolves a fourth part of its weight of carbonate of magnesium, with the aid of a gentle heat, and continues translucent." The presence of a small proportion of any fixed oil renders the mixture opaque. One part of potassa dissolved in two of water forms a clear solution with nine parts of pure copaiba, and the liquid continues clear when moderately diluted with water or alcohol; but the presence of one-sixth of fixed oil in the copaiba occasions more or less opacity in the liquid, and half the quantity causes the precipitation of white flakes in a few hours. (*Stolze.*) Turpentine, which is said to be sometimes added to copaiba, may be detected by its smell, especially if the copaiba be heated. According to Mr. Redwood, most of the proposed tests of the purity of copaiba are liable to fallacy; and the best measure of its activity is the quantity of volatile oil it affords by distillation. Castor oil, Venice turpentine, linseed oil, or Gurjun Balsam may be detected by means of petroleum benzin, which makes a clear solution with pure copaiba, but if either of the substances mentioned be present a milky mixture, which soon settles into two layers, is formed, the copaiba solution being on top (*A. J. P.*, July, 1873; *Proc. A. P. A.*, xxiv. 191; xxvi. 286). Prof. Maisch has found that *ten* volumes of benzin, instead of *three* as proposed by Prof. Wayne, must be added to one of copaiba to get the best results from this test. Indeed, it has been shown that pure copaiba will sometimes show turbidity when mixed with benzin. (*A. J. P.*, 1877, p. 131.) Hager recommends the use of absolute alcohol, which he says completely dissolves, without turbidity, all the varieties of copaiba except the Para, whose solution on standing clears itself by the deposition of a few white flakes. J. M. Fulton asserts that some pure copaibas are not entirely dissolved by absolute alcohol. (*A. J. P.*, 1877.)

Medical Properties and Uses. Copaiba is gently stimulant, diuretic, laxative, and in very large doses often actively purgative. It produces, when swallowed, a sense of heat in the throat and stomach, and extends an irritant action, not only throughout the alimentary canal, but also to the urinary passages, and in fact, in a greater or less degree, to all the mucous membranes, for which it appears to have a strong affinity. The urine acquires a peculiar odor during its use, and its smell may be detected in the breath. It sometimes occasions an eruption upon the skin, resembling that of measles, and attended with disagreeable itching and tingling. A case has been recently recorded, in which an acute attack of pemphigus over the whole body attended its use. (*N. Y. Med. Journ.*, Jan. 1873, p. 416.) Nausea and vomiting, painful purgation, strangury, and bloody urine, and a general state of fever are caused by excessive doses. As a remedy it has been found most efficient in diseases of the mucous membranes, particularly those of a chronic character. Thus, it is given with occasional advantage in leucorrhœa, gleet, chronic dysentery, and diarrhœa, painful hemorrhoidal affections, and chronic bronchitis, and has even been used in diphtheria and pseudo-membranous croup. By the late Dr. La Roche, of Philadelphia, it was highly recommended in catarrh and chronic irritation of the bladder. (*Am. Journ. of Med. Sci.*, xiv. 13.) It has been given in psoriasis and dropsy, and is said to be used as a vermifuge in Brazil. The complaint, however, in which it is most employed is gonorrhœa. It should not be administered in the first stages, when the inflammation is severe and acute, nor is it applicable to very

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chronic, indolent forms of the disorder, such as gleet. It was formerly much esteemed as a vulnerary, and as an application to ulcers; but it is now seldom used externally. Dr. Ruschenberger recommends it locally in chilblains. (*Med. Examiner*, i. 77.) Prof. Marchal, of Strasburg, has employed it with great success in gonorrhœa and leucorrhœa, injecting an emulsion made with 5 parts of copaiba, 8 of gum arabic, and 100 of water, or applying it smeared on catheters or tampons.

The dose of copaiba is from twenty drops to a fluidrachm (1·25–3·75 C.c.) three times a day, or a smaller quantity repeated more frequently. It may be given dropped on sugar, but in this form is often so exceedingly offensive as to render some concealment of its nauseous qualities necessary. A less disagreeable form is that of emulsion, prepared by rubbing the copaiba first with mucilage or the yolk of an egg, and sugar, and afterwards with some aromatic water, as that of mint or cinnamon. The *volatile oil*, which is officinal, may be given in the dose of ten or fifteen drops, in emulsion, or, as is almost universally preferred, in capsules.

Both the volatile oil and resin are eliminated by the kidneys in an altered condition: if to the urine of a person taking the drug nitric acid be added, a precipitate is thrown down, which may be mistaken for albumen. The volatile oil is more active than is the resin, which is not, however, inert. Dr. Wilks, of Guy's Hospital, London, speaks of the resin with great confidence as a hydragogue diuretic in obstinate dropsy, given in the dose of fifteen or twenty grains three or four times a day. (*Lancet*, March 22, 1873.)

Velpeau has found the best effects from copaiba in the form of enema. He gives two drachms made into an emulsion with the yolk of an egg, twenty or thirty drops of laudanum, and eight fluidounces of water. Dr. E. Langlebert recommends a distilled water of copaiba internally, in the dose of one or two fluidounces (30–60 C.c.) three or four times a day, and as a vehicle in urethral injections.

Off. Prep. Massa Copaiba, *U. S.*

CORIANDRUM. *U. S. Coriander.*

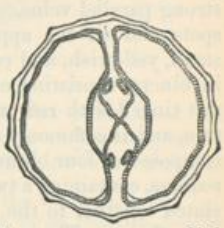
(CŌ-RĮ-ĂN'DRŲM.)

"The fruit of Coriandrum sativum. Linné. (*Nat. Ord.* Umbelliferæ, Cœlospermæ.)" *U. S.* "The dried ripe fruit of Coriandrum sativum, cultivated in Britain." *Br.*

Coriandri Fructus, *Br.*; Coriander Fruit; Fructus Coriandri, *P.G.*; Coriandre, *Fr.*; Koriander, *G.*; Coriandro, *It.*; Cilantro, *Sp.*

Gen. Ch. Corolla radiate. *Petals* inflex-emarginate. *Universal involucre* one-leafed. *Partial involucres* halved. *Fruit* spherical. *Willd.*

Coriandrum sativum. Willd. *Sp. Plant.* i. 1448; Woodv. *Med. Bot.* p. 137, t. 53. This is an annual plant, with an erect, round, smooth, branching stem, rising about two feet, and furnished with compound leaves, of which the upper are thrice ternate, with linear pointed leaflets, the lower pinnate, with the pinnæ cut into irregular serrated lobes like those of parsley. The flowers are white or rose-colored, and in compound terminal umbels; the fruit globular, and composed of two concave hemispherical portions.



Transverse section, magnified.

C. sativum is a native of Italy, but at present grows wild in most parts of Europe, having become naturalized in consequence of its extended cultivation. The flowers appear in June, and the fruit ripens in August. It is a singular fact, that all parts of the fresh plant are extremely fetid when bruised, while the fruit becomes fragrant by drying. This is the officinal portion. It is brought to us from Europe.

The fruit of the coriander is globular, about an eighth of an inch in diameter, obscurely ten-ribbed, with minute indications of secondary ribs in the furrows, of a grayish or brownish yellow color, and separable into the two mericarps (half-fruits), which are only bound together by the membranous pericarp. Each half-fruit is provided with two oil-tubes on the conjoining face. The whole fruit has the persistent

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calyx at its base, and is sometimes surmounted by the adhering conical style. Coriander is thus described by the U. S. Pharm. "Globular; about one-sixth of an inch (4 mm.) in diameter; crowned with the calyx-teeth; brownish-yellow, with slight, longitudinal ridges; the two mericarps cohering, enclosing a lenticular cavity, and each furnished on the face with two oil-tubes; odor and taste agreeably aromatic." *U. S.* The aromatic smell and taste depend on a *volatile oil*, which may be obtained separate by distillation, and is said to belong to the camphene family. One pound of the seeds yields forty-two grains of the oil. (*Zeller.*) It is colorless or pale yellow, with an agreeable odor of coriander, a mild aromatic taste, and a sp. gr. varying from 0·859 to 0·871. It has the composition $C_{10}H_{18}O$, and is therefore isomeric with borneol. It is one of the most permanent of the volatile oils, resisting oxidation for a long time. The virtues of the fruit are imparted to alcohol by maceration, and less readily to water.

Medical Properties and Uses. Coriander has, in a moderate degree, the ordinary medicinal virtues of the aromatics. It is almost exclusively employed in combination with other medicines, either to cover their taste, to render them acceptable to the stomach, or to correct their griping qualities. It was well known to the ancients. The dose is from a scruple to a drachm (1·3–3·9 Gm.).

Off. Prep. Confectio Sennæ, *U. S.;* Oleum Coriandri, *Br.;* Syrupus Rhei, *Br.,* Syrupus Sennæ, *Br.;* Tinctura Rhei, *Br.;* Tinctura Sennæ, *Br.*

CORNUS. *U. S.* *Cornus.* [*Dogwood.*]

(CÔR'NŬS.)

"The bark of the root of Cornus Florida. Linné. (*Nat. Ord.* Cornaceæ.)" *U. S.*

Écorce de Cornouiller à grandes Fleurs, *Fr.;* Grossblüthige Cornelrinde, *G.*

Gen. Ch. Flowers perfect or dicœcious. *Calyx* minutely four-toothed. *Petals* four, oblong, spreading. *Stamens* four. *Filaments* slender. *Style* slender. *Stigma* terminal, flat, or capitate. *Drupe* small, with a two-celled and two-seeded stone. *Gray's Manual.*

Cornus Florida. Willd. *Sp. Plant.* i. 661; Bigelow, *Am. Med. Bot.* ii. 73; Barton, *Med. Bot.* i. 44. This is a small indigenous tree, usually about fifteen or twenty feet in height, though sometimes not less than thirty or thirty-five feet. It is of slow growth; and the stem, which generally attains a diameter of four or five inches, is compact, and covered with a brownish bark, the epidermis of which is minutely divided by numerous superficial cracks or fissures. The branches are spreading, and regularly disposed, sometimes opposite, sometimes in fours nearly in the form of crosses. The leaves are opposite, oval, about three inches long, pointed, dark green and sulcated on the upper surface, glaucous or whitish beneath, and marked with strong parallel veins. Towards the close of summer they are speckled with black spots, and on the approach of cold weather become red. The proper flowers are small, yellowish, and collected in heads, which are surrounded by a large conspicuous involucre, consisting of four white obcordate leaves, having the notch at their summit tinged with red or purple. This involucre constitutes the chief beauty of the tree, and is commonly called the flower. The calyx is four-toothed, and the corolla composed of four obtuse reflexed petals. The fruit is an oval drupe, of a vivid glossy redness, containing a two-celled and two-seeded nucleus. The drupes are usually associated together to the number of three or four, and remain on the tree till after the early frosts. They ripen in September. The dogwood is found in all parts of the United States, from Massachusetts to the Mississippi and the Gulf of Mexico, but is most abundant in the Middle States. In the month of May it is clothed with a profusion of large white blossom-clusters, which render it one of the most conspicuous ornaments of the American forests. The bark is the officinal portion, and is derived for use both from the stem and the branches, and from the root. That from the root is preferred.

As brought into market, the bark is in pieces of various size, usually more or less rolled, sometimes invested with a fawn-colored epidermis, sometimes partially or wholly deprived of it, of a reddish gray color, very brittle, and affording, when pul-

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verized, a grayish powder tinged with red. "In curved pieces of various sizes, about one-eighth of an inch (3 mm.) thick; deprived of the furrowed, brown-gray, corky layer; outer and inner surface pale-reddish, or light reddish-brown, striate; transverse and longitudinal fracture short, whitish, with brown, yellow striæ; inodorous; astringent and bitter." *U. S.* The odor of dogwood is feeble, its taste bitter, astringent, and slightly aromatic. Water and alcohol extract its virtues. From the experiments of Dr. Walker and Mr. James Cockburn (*A. J. P.*, vii. 109), it appears to contain bitter extractive, gum, resin, tannin, gallic acid, fixed oil, wax, red coloring matter, lignin, and salts of potassa and iron. Mr. Cockburn also obtained a crystallized substance, without taste, the characters of which, however, were not sufficiently investigated to authorize an opinion as to its nature. A peculiar bitter principle, for which the name of *cornine* was proposed, was announced as an ingredient by Mr. Carpenter; but his results have not been confirmed. Prof. John M. Maisch appears subsequently to have obtained the bitter principle pure in solution, but, in consequence of its extreme facility of decomposition, did not succeed in isolating it. Geiger (*Ann. Ch. und Pharm.*, xiv. 206) first obtained the bitter principle *cornin*, or *cornic acid*, in white, silky, bitter needles, readily soluble in water and alcohol, little in ether, colored dark by alkalies. It is neutral and is not precipitated by infusion of nutgalls, but is precipitated by acetate of lead and by silver solutions. A. G. Frey (*A. J. P.*, 1879, p. 390) also obtained *cornin* in pure white crystals out of alcohol. The flowers of *C. Florida* have the same bitter taste as the bark, and, though not officinal, are sometimes employed for the same purposes.*

Medical Properties and Uses. *Cornus Florida* is tonic and astringent. By Dr. Walker it was found, when taken internally, to increase the force and frequency of the pulse, and the heat of the body. It is thought to possess remedial properties analogous to those of Peruvian bark, for which it has occasionally been successfully substituted in the treatment of intermittent fevers; but the introduction of sulphate of quinine into use has nearly banished this, as well as many other substitutes for cinchona, from regular practice. The dogwood has also been employed in low fevers, and other complaints for which Peruvian bark is usually prescribed.

It may be given in powder, decoction, or extract. The dose of the powder is from a scruple to a drachm (1·3–3·9 Gm.), repeated, in cases of intermittent fever, so that from one to two ounces may be taken in the interval between the paroxysms. The decoction was officinal in 1870. The dried bark is said to be preferable to the fresh; as it possesses all the activity of the latter, without being so liable to offend the stomach and bowels. An extract might probably be used with advantage in intermittents in large doses.

Off. Prep. Extractum Cornûs Fluidum, *U. S.*

CREASOTUM. *U. S., Br.* *Creasote.*

(CRĒ-Ą-SŌ'TŪM.)

"A product of the distillation of wood-tar." *U. S., Br.*

Kreosotum, *P.G.;* Créosote, *Fr.;* Kreosot, *G.*

This is a substance discovered in 1830 by Reichenbach in the products of the distillation of wood. This distillation of wood yields products very analogous to one fraction of the coal-tar obtained by the destructive distillation of bituminous

* Two other indigenous dogwoods were formerly recognized in the U. S. secondary list. *C. circinata* is a shrub from six to ten feet high, with warty branches, large, roundish, pointed leaves, waved on their edges and downy beneath, and white flowers disposed in depressed cymes. The fruit is blue. The plant is a native of the United States, extending from Canada to Virginia, and growing on hill-sides and the banks of rivers. It flowers in June and July. The bark, when dried, is in quills of a whitish or ash color, and affords a powder resembling that of ipecacuanha. Its taste is bitter, astringent, and aromatic. In chemical composition, so far as this has been ascertained, it is analogous to *Cornus Florida*.

C. sericea is usually six or eight feet in height, with numerous erect stems, which are covered with a shining reddish bark, and send out opposite spreading branches. The young shoots are more or less pubescent. The leaves are opposite, petiolate, ovate, pointed, entire, and on the under surface covered with soft brownish hairs. The flowers are small, white, and disposed in terminal cymes, which are depressed and woolly. The fruit consists of globular, berry-formed drupes, of a cerulean blue color, and collected in bunches. The bark of both of these species is said to be of equal medical value with that of *C. Florida*.

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coal. This fraction is the heavy oil of coal-tar, which comes over between 165° C. (329° F.) and 200° C. (392° F.): it is often called "*coal-tar creasote*," and contains a group of phenols, including carbolic acid, or common *phenol*, C_6H_6O, boiling at 182° C. (359·6 F.), *cresylic acid*, or *cresol*, C_7H_8O, boiling at 198° C. (388·4 F.), and *xylenol*, or *dimethyl phenol*, $C_8H_{10}O$, boiling at 211° C. (411·8° F.).

"Wood-tar creasote," on the other hand, is chiefly composed of the following phenols. *Guiacol*, or *oxycresol*, $C_7H_8O_2$, boiling at 200° C. (392 F.), *creasol*, $C_8H_{10}O_2$, boiling at 217° C. (422·6° F.), *methyl-creasol*, $C_9H_{12}O_2$, boiling at 214° C. (417° F.) to 218° C. (424·4° F.), and *phlorol*, $C_8H_{10}O_1$, boiling at 219° C. (426·2 F.). (See also *Allen's Commerc. Org. Analysis*, p. 306.)

Preparation. Creasote is obtained either from wood-tar or from crude pyroligneous acid. When wood-tar is used, it is distilled until it has attained the consistence of pitch. The distilled liquid divides itself into three layers, an aqueous between two oily layers. The inferior oily layer, which alone contains the creasote, is separated, and saturated with carbonate of potassium to remove acetic acid. The liquid is allowed to rest, and the new oil which separates is decanted from it. This oil is distilled, and yields products lighter than water, and a liquid heavier. The latter alone is preserved, and, after having been agitated repeatedly with weak phosphoric acid to neutralize ammonia, is allowed to remain at rest for some time. It is next washed as long as acidity is removed, and then distilled with a fresh portion of weak phosphoric acid; care being taken to cohobate from time to time. The oily liquid thus rectified is colorless, and contains much creasote, but also a portion of *eupion*, or light oil distillate. To separate the latter, the liquid is mixed with a solution of caustic potassa of the density 1·12, which dissolves the creasote, but not the eupion. The eupion, which floats above from its levity, is then separated; and the alkaline solution of the creasote is exposed to the air, until it becomes brown in consequence of the decomposition of a foreign matter, and is then saturated with sulphuric acid. This sets free the creasote, which is decanted, and again distilled. The treatment by solution of potassa, sulphuric acid, etc., is to be repeated until the creasote no longer becomes brown by exposure to the air, but only slightly reddish. It is then dissolved in a stronger solution of potassa and distilled again, and finally redistilled for the last time, rejecting the first portion which comes over on account of its containing much water, collecting the next portion, and avoiding to push the distillation too far. The product collected in this distillation is creasote.

When creasote is extracted from pyroligneous acid, the first step is to dissolve sulphate of sodium in it to saturation. The oil which separates and floats above is decanted, and, having been allowed to remain at rest for a few days, is saturated by carbonate of potassium with the assistance of heat, and distilled with water. The oleaginous liquid obtained is of a pale yellow color, and is to be treated with phosphoric acid, etc., as above detailed, in relation to the treatment of the corresponding oil obtained from wood-tar.

Properties. Creasote, when pure, is a colorless oleaginous liquid, of the consistence of oil of almonds, slightly greasy to the touch, volatilizable by heat, and having a caustic, burning taste, and a penetrating, disagreeable odor, like that of smoked meat, and analogous to, yet different from, that of phenol. As met with in the shops, it has frequently a brownish tinge. It burns with a sooty flame. Applied in a concentrated state to the skin, it corrugates and then destroys the cuticle, causing a white spot. On paper it leaves a greasy stain, which disappears in a few hours, or in ten minutes if heated to 100° C. (212° F.). Its sp. gr. is 1·057 at 55° (*Gorup-Besanez*), 1·035–1·085 (*U. S.*), 1·071 (*Br.*). It boils at about 203° C. (397° F.), and remains fluid at —27° C. (—17°F.). It is a non-conductor of electricity, and refracts light strongly. It is devoid of acid or alkaline reaction. Mixed with water, it forms two solutions; one consisting of one part of creasote and about eighty of water, the other, of one part of water and ten of creasote (*Berzelius.*) It dissolves a large proportion of iodine and phosphorus, and a considerable amount of sulphur, especially when assisted by heat.

The Pharmacopœia describes creasote as "an almost colorless or yellowish,

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strongly refractive, oily liquid, turning to reddish-yellow or brown by exposure to light, having a penetrating, smoky odor, a burning, caustic taste and a neutral reaction. Sp. gr. 1·035–1·085. It begins to boil near 200° C. (392° F.), and most of it distils over between 205° and 220° C. (401°–428° F.). When cooled to —20° C. (—4°F.) it becomes thick, but does not solidify. It is inflammable, burning with a luminous, smoky flame. Creasote is soluble in about 80 parts of water at 15° C. (59° F.) to a somewhat turbid liquid, and in 12 parts of boiling water; it dissolves, in all proportions, in absolute alcohol, ether, chloroform, benzin, disulphide of carbon, or acetic acid. When applied to the skin, it produces a white stain. Creasote does not coagulate albumen or collodion (difference from carbolic acid). If 1 volume of Creasote be mixed with 1 volume of glycerin, a nearly clear mixture will result, from which the Creasote will be separated by the addition of 1 or more volumes of water. On adding to 10 C.c. of a 1 per cent. aqueous solution of Creasote, 1 drop of test-solution of ferric chloride, the liquid acquires a violet-blue tint, which rapidly changes to greenish and brown, with formation, usually, of a brown precipitate (diff. from carbolic acid)." *U. S.*

Creasote instantly dissolves ammonia, and retains it with great force. Strong nitric and sulphuric acids decompose it; the former giving rise to reddish vapors, the latter to a red color, which becomes black on the addition of more of the acid. Dilute nitric acid converts it into a brown resin, which, treated with ammonia, and then dissolved in boiling alcohol, gives, by evaporation, certain salts of ammonia, two of which contain new acids, discovered by Laurent. Hydrochloric acid produces no change in it. The British Pharmacopœia gives, as one of the characters of its creasote, that a "slip of deal dipped into it, and afterwards into hydrochloric acid, and then allowed to dry in the air, acquires a greenish blue color;" and consequently does not consider the presence of carbolic acid as a contamination. The probability is that the creasote upon which the description in the British Pharmacopœia was prepared was not really derived from wood, but from coal-tar. The true creasote differs from carbolic acid in not coagulating collodion. M. Gorup-Besanez states that with a neutral solution of perchloride of iron, beech-wood creasote, dissolved in alcohol, gives a green color, whilst a similar solution of the product of coal-tar causes a brown color; but, dissolved in water, the true creasote produces no change, while coal-tar creasote produces a blue. (*A. J. P.*, 1868, p. 257.) Mr. T. N. R. Morson, of London, who has long been a manufacturer of creasote, complains of the discredit into which it has fallen in consequence of the substitution for it in commerce, of carbolic acid; while he says that the directions of the Pharmacopœia for the distinction of the two are insufficient, and gives a test, discovered by his son Mr. Thos. Morson, which is at once simple and satisfactory. It consists in the solvent power of glycerin over carbolic acid, which is dissolved by it in all proportions, while pure creasote is insoluble or nearly so; and, consequently, if any liquid, assumed to be creasote, dissolves largely in glycerin, it probably consists in the whole, or in large part, of carbolic acid. (*P. J. Tr.*, May, 1872, p. 921.) Subsequent experiments appear to show that this test succeeds best with Morson's creasote; and beech-wood creasote, although pure, sometimes mixes with glycerin without turbidity. A still better test, according to Mr. John A. Clark, is an alcoholic solution of perchloride of iron (*Tr. Ferri Perchlor.* B. Ph.), which with an alcoholic solution of creasote produces a deep greenish blue color, but with carbolic acid a light brown. (*A. J. P.*, June, 1873, p. 269.) Creasote dissolves a large number of metallic salts, and reduces a few to the metallic state; as, for example, nitrate and acetate of silver. It powerfully coagulates albumen, and in this way is supposed to act as a hæmostatic. Froehde's reagent (a solution of 1 part of molybdic acid in 100 parts of sulphuric acid) is recommended by E. W. Davy as a distinguishing test for carbolic acid. (*P. J. Tr.*, 1878, p. 1022.) A drop or two of the doubtful liquid is to be agitated with two fluidrachms of distilled water, the whole filtered, and a drop or two of the test-solution added. Pure creasote gives a brown or reddish brown reaction on standing or slight warming, passing to a light yellowish brown; with carbolic acid, the brown passing to a maroon soon develops a more or less intense purple.

Of all the properties of creasote, the most remarkable is its power of preserving

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meat. It is this property which has suggested its name, derived from *κρεάς, flesh*, and *σώζω, I preserve.*

Impurities and Adulterations. Creasote is apt to contain eupion, and is sometimes adulterated with rectified oil of tar, and the fixed and volatile oils. All these substances are detected by strong acetic acid, which dissolves the creasote, and leaves them behind, floating above the creasote solution. Creasote, however, from beechwood tar, is only partially dissolved by hot acetic acid of ordinary strength. Fixed oils are also discovered by a stain on paper not discharged by heat. Any trace of the matter which produces the brownish tinge is detected by the liquid becoming discolored by exposure to sunshine.

Commercial creasote almost always contains carbolic and cresylic acids, from coal-tar; and indeed, much of what is sold for creasote is nothing more than impure carbolic acid. (See *Acidum Carbolicum.*) It has been already stated that this acid strongly resembles creasote; and this resemblance probably extends also to their therapeutical effects; so that the substitution is less to be regretted than might otherwise be the case. But, as the effects of the two on the system may not be identical, it is highly desirable to be able to distinguish between them. Tests for this purpose have been given above, and, with those quoted from the Pharmacopœia, are sufficient for the purpose.

Medical Properties, etc. The influence of creasote upon the animal economy has never been carefully studied, but is probably identical with that of carbolic acid. It is never used in medicine except for its local action. Applied in this way it is a powerful paralyzant of nerve-tissue, and hence is frequently employed with great advantage in cases of nausea, vomiting, or diarrhœa dependent upon excessive irritability, without acute inflammation, of the gastric or intestinal mucous membrane; it has also been successfully used in nausea and vomiting of pregnancy or hysteria, in cholera morbus, cholera infantum, lienteric diarrhœa, typhoid fever, and even in dysentery. When in these cases there is a tendency to fermentation of the contents of the stomach or bowels, creasote is especially valuable, and may often be combined advantageously with an alkali or chalk. Externally creasote has been employed for exactly the same diseases as has carbolic acid. Indeed, the latter remedy, on account of its superior cheapness, has almost entirely supplanted it.

The skin diseases to the treatment of which creasote has been supposed to be best suited are those of a scaly character. In burns its efficacy has been insisted on, especially in those attended with excessive suppuration and fungous granulations. In chilblains also it is stated to be a useful application. Mixed with four parts of lard, it is said to have proved very serviceable in erysipelas. When applied to wounds it acts as a hæmostatic, stopping the capillary hemorrhage, but possessing no power to arrest the bleeding from large vessels. Accordingly, creasote water has been applied locally in menorrhagia, and to arrest uterine hemorrhage and the bleeding from leech-bites. The ulcers, in the treatment of which it has been found most useful, are those of an indolent and gangrenous character, in which its several properties of escharotic, stimulant, and antiseptic are usefully brought into play. In all these cases, should the remedy cause irritation, it must be suspended, or alternated with emollient and soothing applications. Injected into fistulous ulcers, it proves a useful resource, by exciting the callous surfaces and disposing them to unite.

Wherever there are foul ulcers, gangrenous surfaces, or inflamed serous, mucous, or glandular tissues giving rise to fetid discharges, creasote may be substituted for carbolic acid; as examples, may be mentioned fetid leucorrhœa, puerperal metritis, fetid otorrhœa, putrid or diphtheritic sore throat, chronic empyema. The strength of the application may vary from that of pure creasote to a single drop to the fluidounce of water, according to the delicacy of the part and the severity of the disease. On account of its local anæsthetic and antiseptic influence, it is much employed by dentists for the obtunding of sensitive dentine and as an ingredient of pastes for the destruction of nerves. One or two drops of the pure substance must be carefully introduced into the hollow of the tooth, on a little cotton, avoiding contact with the tongue or cheek. To render it effectual, the hollow of the tooth must be well cleansed before it is applied. A mixture of 15 parts of creasote and 10 of collo-

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dion is said to have a jelly-like consistence, and to be usefully applied to carious teeth, which it protects from the air; but, as pure creasote does not coagulate collodion, this remark applies properly to the impure carbolic acid, before stated to be commonly sold under the same name.

Under the name of VAPOR CREASOTI (*Inhalation of Creasote*), the British Pharmacopœia directs a preparation consisting of 12 minims of creasote and 8 fluid-ounces of boiling water, which are to be mixed in an inhaling apparatus, so arranged that the air shall be made to pass through the solution and then inhaled. It may be used in chronic inflammation of the air-passages.

The internal dose of creasote is one to three minims (0·6–0·18 C.c.), administered in pill, mixture, or solution. In an overdose, it acts as a poison, producing giddiness, obscurity of vision, depressed action of the heart, convulsions, and coma. Whether the soluble sulphates would be antidotal to it, as to carbolic acid, is uncertain, but there is no other available antidote. The medical treatment consists in the evacuation of the poison, and the administration of ammonia and other stimulants.

The addition of three or four drops of creasote to a pint of ink effectually prevents it from becoming mouldy. Dr. Christison finds that creasote water is as good a preservative of some anatomical preparations as spirit, with the advantage of not hardening the parts. It is probably to creasote that the antiseptic properties of wood-smoke and of pyroligneous acid are owing.

Off. Prep. Aqua Creasoti, *U. S.;* Mistura Creasoti, *Br.;* Unguentum Creasoti; Vapor Creasoti, *Br.*

CRETA. *Br. Chalk.*

$CaCO_3$; 100. (CRĒ'TĄ.) CaO, CO_2; 50.

"Native friable carbonate of lime." *Br.*

Craie, *Fr.;* Kreide, *G.;* Creta, *It.;* Greda, *Sp., Port.*

Carbonate of calcium, in the extended meaning of the term, is the most abundant of simple minerals, constituting, according to its state of aggregation and other peculiarities, the different varieties of calcareous spar, common and shell limestone, marble, marl, and chalk. It occurs also in the animal kingdom, forming the principal part of shells, and a small proportion of the bones of the higher orders of animals. It is present in small quantity in most natural waters, being held in solution by the carbonic acid which they contain. In the waters of limestone districts it is a very common impregnation, and causes purging in those not accustomed to their use. In all such cases, boiling the water, by expelling the carbonic acid, causes the carbonate to be deposited. It has been shown, however, that carbonate of calcium is itself in a slight degree soluble in water; so that a small proportion remains in limestone water which has been long exposed to boiling. Hofmann estimated the quantity remaining in solution at thirty-four milligrammes in a litre. That the carbonate is not held in solution by free carbonic acid is shown by the fact that lime-water causes no precipitation. (*Journ. de Pharm. et de Chim.*, 4e sér., iii. 147.) Besides being officinal in the state of chalk, carbonate of calcium is also ordered as it exists in marble and oyster-shell, and as obtained by precipitation. (See *Marmor*, *Testa*, and *Calcii Carbonas Præcipitata.*) In the present article we shall confine our observations to chalk. This occurs abundantly in the south of England and the north of France. It exists massive in beds, and very frequently contains nodules of flint, and fossil remains of land and marine animals. Until recently it was not known to exist in the United States; but Prof. F. V. Hayden states that chalk-beds identical with those of Europe extend for 400 miles along the Missouri River in Dakota.

Properties. Chalk is an insipid, inodorous, insoluble, opaque, soft solid, generally white, but grayish white when impure. It is rough to the touch, easily pulverized, and breaks with an earthy fracture. It soils the fingers, yields a white trace when drawn across an unyielding surface, and when applied to the tongue adheres slightly. Its sp. gr. varies from 2·3 to 2·6. It is never a perfectly pure carbonate of calcium, but contains, besides gritty silicious particles, small portions of alumina and ferric oxide. If pure, it is entirely soluble in hydrochloric acid; but usually a little silica is left. If this solution is not precipitated by ammonia, it is free from

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alumina and iron. Like all carbonates, it effervesces with acids. Though insoluble in water, it dissolves in an excess of carbonic acid.

Chalk, on account of the gritty particles which it contains, is unfit for medicinal use until it has undergone levigation, when it is called *prepared chalk*. (See *Creta Præparata*.)

Pharm. Use. In preparing carbonic acid gas, *Br.*

Off. Prep. Creta Præparata, *U. S.*, *Br.*

CRETA PRÆPARATA. *U. S.*, *Br.* *Prepared Chalk.*

(CRĒ'TĄ PRÆ-PĄ-RĀ'TĄ.—prē-pą-rā'tą.)

"Native, friable Carbonate of Calcium [$CaCO_3$; 100.—CaO,CO_2; 50], freed from most of its impurities by elutriation." *U. S.*

Craie préparée, *Fr.*; Präparirte Kreide, *G.*

Below will be found the process officinal in the Pharmacopœia of 1870.*

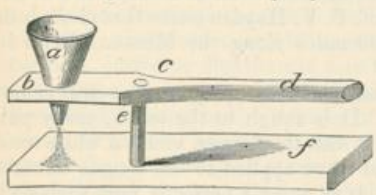
The Br. Pharmacopœia has abandoned its former process, and is now content with defining the medicine to be "chalk freed from most of its impurities by elutriation, and afterwards dried in small masses, which are usually of a conical form."

The object of the above process is to reduce chalk to a very fine powder. The mineral, previously pulverized, should be rubbed with a little water upon a porphyry slab, by means of a muller of the same material. Having been thus very minutely divided, it is agitated with water, which upon standing a short time deposits the coarser particles, and, being then poured off, slowly lets fall the remainder in an impalpable state. The former part of the process is called *levigation*, the latter *elutriation*. The soft mass which remains after the decanting of the clear liquor is made to fall upon an absorbent surface in small portions, which when dried have a conical shape.† Practically, prepared chalk is generally made on the large scale from *whiting* by the manufacturer. (See *P. J. Tr.*, vii. 146.)

No directions are given now in the Pharmacopœia for its preparation; it is thus described. "A white, amorphous powder, generally agglutinated in form of small cones, permanent in the air, odorless and tasteless, and insoluble in water or alcohol. It is soluble in hydrochloric, nitric or acetic acid with copious effervescence, and without leaving more than a trifling residue. By exposure to a red heat, the salt loses carbonic acid gas, and the residue has an alkaline reaction. A neutral solution of the salt in acetic acid yields, with test-solution of oxalate of ammonium, a white precipitate soluble in hydrochloric, but insoluble in acetic acid. Another portion of the same solution should yield no precipitate with test-solution of sulphate of calcium (abs. of barium, strontium). On adding to another portion of the solution, first, chloride of ammonium, then carbonate of ammonium and water of ammonia in slight excess, and gently warming, the filtrate separated from the resulting precipitate should not be rendered more than faintly turbid by test-solution of phosphate

* "Take of Chalk *a convenient quantity*. Add a little water to the chalk, and rub it into fine powder. Throw this into a large vessel nearly full of water, stir briskly, and, after a short interval, decant the supernatant liquor, while yet turbid, into another vessel. Treat the coarser particles of the Chalk, remaining in the first vessel, in a similar manner, and add the turbid liquid to that previously decanted. Lastly, set the liquor by that the powder may subside, and, having poured off the water, dry the powder." *U. S.* 1870.

† Several insoluble substances, besides chalk, are brought habitually into the form of small cones, such as prepared oyster-shell, phosphate of calcium, rust of iron, subnitrate of bismuth, oxide of zinc, etc. This is usually effected by the use of a simple implement, consisting of a funnel of tinned iron, with the neck removed (*a*), fixed at the expanded extremity (*b*) of a piece of wood about a foot long (*c*), having its other end in the form of a handle (*d*), with a stout piece of wood about 4 inches long (*e*) attached perpendicularly to the lower side of it, so as to serve as a support when fixed in a socket. The material to be shaped is introduced in a very soft, almost diffluent state into the funnel, and the instrument, then raised in the hand by the handle, is brought down so that its



support shall strike with a gentle shock against a flat surface of chalk stone (*f*), and these little shocks are rapidly repeated. At each one of them a small portion of the soft mass escapes from the mouth of the funnel, and falls on the stone, where it hardens into the shape of a cone; the chalk serving to absorb the moisture rapidly, and thus enabling it quickly to solidify.

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of sodium (limit of magnesium). Another portion of the solution should not assume more than a slightly bluish tint with a few drops of test-solution of ferrocyanide of potassium (limit of iron)." *U. S.*

Medical Properties and Uses. This is the only form in which chalk is used in medicine. It is an excellent antacid; and, as the salts which it forms in the stomach and bowels, if not astringent, are at least not purgative, it is admirably adapted to diarrhœa accompanied with acidity. It is also sometimes used in acidity of stomach attending dyspepsia and gout, when a laxative effect is to be avoided; is one of the best antidotes for oxalic acid; and has been recommended in rachitis. In scrofulous affections it may sometimes do good by forming soluble salts with acid in the primæ viæ, and thus finding an entrance into the blood-vessels. It is frequently employed as an application to burns and ulcers, which it moderately stimulates, while it absorbs the ichorous discharge, and thus prevents it from irritating the diseased surface, or the sound skin. It is given internally in the form of powder, or suspended in water by the intervention of gum arabic and sugar. (See *Mistura Cretæ.*) It is better fitted for the chalk mixture than the precipitated carbonate of calcium, in consequence of its more impalpable character and greater powers of adhesion. The dose is from ten to forty grains (0·65–2·6 Gm.) or more.

Pharm. Uses. In preparing Acidum Citricum, *Br.;* Acidum Tartaricum, *Br.*

Off. Prep. Hydrargyrum cum Cretâ; Mistura Cretæ; Pulvis Cretæ Compositus, *U. S.;* Pulvis Cretæ Aromaticus, *Br.;* Pulvis Cretæ Aromaticus cum Opio, *Br.;* Trochisci Cretæ, *U. S.*

CROCUS. *U. S., Br. Saffron.*

(CRŌ'CŬS.)

"The stigmas of Crocus sativus. Linné. (*Nat. Ord.* Iridaceæ.)" *U. S.* "The dried stigma, and part of the style, of Crocus sativus." *Br.*

Safran, *Fr., G.;* Zafferano, *It.;* Azafran, *Sp.*

Gen. Ch. Corolla six-parted, equal. *Stigmas* convoluted. *Willd.*

Crocus sativus. Willd. *Sp. Plant.* i. 194; Woodv. *Med. Bot.* p. 763, t. 259. The common cultivated saffron is a perennial plant, with a rounded and depressed bulb or cormus, from which the flower rises a little above the ground, upon a long, slender, white, and succulent tube. The flower is large, of a beautiful lilac or bluish purple color, and appears in September or October. The leaves are radical, linear, slightly revolute, dark green upon their upper surface with a white longitudinal furrow in the centre, paler underneath with a prominent flattened midrib, and enclosed at their base, together with the tube of the corolla, in a membranous sheath, from which they emerge soon after the appearance of the flower. The style hangs out on one side between the two segments of the corolla, and terminates in three long convoluted stigmas, which are of a rich orange color, highly odorous, rolled in at the edges, and notched at the summit. These stigmas are the officinal part of the plant. The stigmas of the *Crocus orientalis* are used in the East.

C. sativus, or *autumnal crocus*, is believed to be a native of Greece and Asia Minor, where it has been cultivated from the earliest ages. It is, however, unknown in a wild state, and, as the French plant does not produce seed, Chappellier claims that it is a hybrid. (*Bull. Soc. Bot. de France*, xx.) More recently, however, Chappellier has found that the ordinary crocus, as grown in France, is readily fertilized by the Grecian variety, and it is most probable that the species is a distinct one. There are three main varieties of it, the French, the Grecian, and the Chinese. The first of these is superior in color and flavor, the second in the amount of yield, whilst the third is said to unite these qualities. Saffron is also cultivated for medicinal use in Sicily, Spain, France, England, and other temperate countries of Europe. Large quantities of saffron are raised in Egypt, Persia, and Cashmere, whence it is sent to India. Much of the drug reaches the market of Constantinople from the neighborhood of Tiflis and the Caucasus. We cultivate the plant in this country chiefly, if not solely, as a garden flower. It is liable to two diseases, which interfere with its culture; one dependent on a parasitic fungus which attaches itself to the bulb, the other called by the cultivators in France *tacon*, by which the bulb is converted into a blackish powder. (*Journ. de Pharm.*, xviii. 41.)

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In England the flowers appear in October, and the leaves continue green through the winter; but the plant does not ripen its seed, and is propagated by offsets from the bulb. These are planted in grounds prepared for the purpose, and are arranged either in rows or in small patches at certain distances. The flowers are gathered soon after they show themselves, as the period of flowering is very short. The stigmas, or summits of the pistils, together with a portion of the style, are separated from the remainder of the flower, and carefully dried by artificial heat, or in the sun. During this process, they are sometimes made to assume the form of a cake by pressure; but the finest saffron is that which has been dried loosely. The two forms are distinguished by the names of *cake-saffron* and *hay-saffron*. Five pounds of the fresh stigmas are said to yield one pound of the dried.

The English saffron, formerly most highly esteemed in this country, has disappeared from our market. What may be sold under the name is probably derived from other sources. Much of the drug is imported from Gibraltar, packed in canisters. Parcels of it are also brought from Trieste and other ports of the Mediterranean. The Spanish saffron is generally considered the best. Genuine *cake-saffron* is at present seldom found in commerce. According to Landerer, the stigmas of several other species besides those of *C. sativus* are gathered and sold as saffron in Greece and Turkey.*

Properties. Saffron has a peculiar, sweetish, aromatic odor, a warm, pungent, bitter taste, and a rich deep orange color, which it imparts to the saliva when chewed. The stigmas of which it consists are an inch or more in length, expanded and notched at the upper extremity, and narrowing towards the lower, where they terminate in a slender, capillary, yellowish portion, forming a part of the style. They are thus described by the U. S. Pharmacopœia. "Separate, or three, attached to the top of the style, about an inch and a quarter (3 cm.) long, flattish-tubular, almost thread-like, broader and notched above; orange-brown; odor strong, peculiar, aromatic; taste bitterish and aromatic. When chewed it tinges the saliva deep orange-yellow. Saffron should not be mixed with the yellow styles. When pressed between filtering-paper it should not leave an oily stain. When soaked in water it colors the liquid orange-yellow, and should not deposit any pulverulent mineral matter, nor show the presence of organic substances differing in shape from that described." *U. S.* Analyzed by Vogel and Bouillon-Lagrange, it afforded 65 per cent. of a peculiar extractive matter, and 7·5 of an odorous volatile oil, together with wax, gum, albumen, saline matter, water, and lignin. The extractive was named *polychroïte*, from the changes of color which it undergoes by the action of reagents. Weiss (Wiggers and Husemann, *Jahresbericht*, 1868, p. 35) has shown that *polychroïte* is a glucoside, from the decomposition of which results the coloring matter proper of the saffron, to which he applies the name *crocin*. For the preparation of polychroïte according to Weiss, saffron is extracted with ether, by which fat, wax, and essential oil were removed; and it was then exhausted with water. From the aqueous solution, gummy

* At the International Exhibition, in London, in the year 1862, Dr. Geo. B. Wood noticed a specimen of saffron from the island of Ceylon, closely resembling that of the *Crocus sativus*. It consisted of the stigmas of the *Crocus orientalis*.

According to Mr. Charles A. Heinitsh, until within a few years, saffron was cultivated to a considerable extent in Lancaster County, Pa. The plant requires a rich soil, which should be deeply dug and heavily manured. The bulbs are planted in August, eight inches apart, and the growing plant should be kept free from weeds. The flowering period begins about the middle of September, and continues till the beginning of October. The flowers are picked early in the morning, and the stigmas separated and dried in the shade. This is done every day during the period of flowering. He thinks the cultivation can be profitably conducted. A plot of 72 square feet will produce 9000 stigmas, weighing 420 grains, or from 33 to 36 lbs. to the acre. (*A. J. P.*, 1867, p. 38.)

M. Monthus, an experienced cultivator in France, prefers a dry calcareous soil; plants the bulbs 3 or 4 inches deep; after the harvest in October manures the ground; and renews the planting every three years. He thus prevents the diseases peculiar to the plant.

M. Monthus recommends the *petals* of the flower as applicable to the same purposes as the stigmas, having found them to be possessed of aromatic properties. They demand no peculiar caution in drying; but to preserve them it is necessary to exclude light and moisture. Acids redden them with extreme facility, and alkalies turn them green. He therefore recommends a tincture to be made from them, as a substitute for syrup of violets. He prepares the tincture by macerating 10 parts of the dried flowers in 100 parts of alcohol of 40°, for 48 hours. A longer maceration would destroy the color. Paper may be stained with the tincture, and kept green or red, the former for acids, the latter for alkalies. (*Journ. de Pharm.*, Juillet, 1867, p. 54.)

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matters and some inorganic salts were precipitated by strong alcohol. After the separation of these substances polychroïte was precipitated by addition of ether. Thus obtained, it is an orange-red, viscid, deliquescent substance, which dried over sulphuric acid becomes brittle and of a fine ruby-red color. It has a sweetish taste, but is devoid of odor, readily soluble in spirit of wine or water, and sparingly in absolute alcohol. By dilute acids it is decomposed into *crocin*, sugar, and an aromatic volatile oil having the smell of saffron. Weiss gives the following formula for this decomposition.

$$\underset{\text{Polychroïte.}}{C_{48}H_{60}O_{18}} + H_2O = 2\underset{\text{Crocin.}}{(C_{16}H_{18}O_8)} + \underset{\text{Essential oil.}}{C_{10}H_{14}O} + \underset{\text{Sugar.}}{C_6H_{12}O_6}.$$

Crocin is a red powder, insoluble in ether, easily soluble in alcohol, and precipitable from this solution on addition of ether. (*Pharmacographia*, 2d ed., p. 667.) It is to the essential oil, which, according to M. Henry, is present to the amount of 10 per cent., that the medicine owes its activity. It may be partially separated by distillation. It is yellow, of a hot, acrid, bitterish taste, and heavier than water, in which it is slightly soluble.

Adulterations. The high price of this medicine gives rise to frequent adulterations. Water is said to be very often added in order to increase its weight. Oil or glycerin is also added for the same purpose, or to improve the appearance. Sometimes the flowers of other plants, particularly *Carthamus tinctorius* or safflower, *Calendula officinalis* or officinal marigold, and *arnica*, are fraudulently mixed with the genuine stigmas. They may be known by their shape, which is rendered obvious by throwing a portion of the suspected mass into hot water, which causes them to expand. (See *Carthamus.*) A specimen of this adulteration has been introduced into the American market, by the name of *African saffron.* (Maisch, *A. J. P.*, March, 1872, p. 110.) Other adulterations are the fibres of dried beef, the stamens of the Crocus distinguishable by their yellow color, the stigmas previously exhausted in the preparation of the infusion or tincture, and various mineral substances easily detected upon close examination. The flowers of a Brazilian plant, named *Fuminella*, have, according to M. J. L. Soubeiran, been employed for the adulteration of saffron. They may be detected by shaking gently but repeatedly a large pinch of the suspected saffron over a piece of paper. The flowers of Fuminella, being smaller and heavier, separate and fall, and may be seen to consist of very short fragments, with a color like that of saffron, but a rusty tint which the latter does not possess. (*Journ. de Pharm.*, Avril, 1855, p. 267.) J. Müller recommends concentrated sulphuric acid as the most certain test of saffron. It instantly changes the color of pure saffron to indigo blue. (*Chem. Gaz.*, May, 1845, p. 197.)

A very successful adulteration which has been largely practised appears to consist of yellow-colored chalk or sulphate of barium, made into a thin paste probably with honey, and attached to the stigmas, sometimes isolated, sometimes in groups of five or six, enveloping them almost completely. If this saffron be kept in a dry place, and often handled, the paste becomes partly broken up, and the colored powder spreads itself in the mass and the envelope. The chalk can at once be detected by shaking the suspected saffron with water, and treating the precipitated powder with hydrochloric acid, when effervescence will occur. A less than the ordinary brightness of color in the saffron should lead to suspicion of this adulteration. Much can be told as to the purity of saffron by agitating the suspected flowers in distilled water; if the drug be pure the liquid will remain clear, assuming a fine pure yellow tint; the saffron also will retain its red color for hours. Another excellent plan is to scatter a pinch of the flowers upon the surface of warm water, when the stigmas should spread out and display their proper form.

Attention has been called to a product of the Cape of Good Hope, named *Cape saffron*, which has a remarkable resemblance to genuine saffron, having a similar odor, and yielding a similar color to water, though the flowers themselves are differently colored. It is the flower of a small plant very abundant at the Cape, belonging to the family of *Scrophulariaceæ*, and is said by Dr. Pappé, of Cape Town, to possess medical virtues closely resembling those of true saffron. The flowers have been used successfully in the convulsions of children. (*P. J. Tr.*, vi. 462, 1865.)

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Choice of Saffron. Saffron should not be very moist, nor very dry, nor easily pulverized; nor should it emit an offensive smell when thrown upon live coals. The freshest is the best, and that which is less than a year old should, if possible, be selected. It should possess in a high degree the characteristic properties of color, taste, and smell. When agitated with water it should color it bright yellow, and it should not effervesce in the presence of a dilute acid. If it do not color the fingers when rubbed between them, or if it have an oily feel, or a musty flavor, or a black, yellow, or whitish color, it should be rejected. In the purchase of this medicine in cakes, those should be selected which are close, tough, and firm in tearing; and care should be taken to avoid *cakes of safflower.*

As its activity depends, partly at least, on a volatile ingredient, saffron should be kept in well-stopped vessels. Some recommend that it should be enclosed in a bladder, and introduced into a tin case.

Medical Properties and Uses. Saffron was formerly considered highly stimulant, antispasmodic, and even narcotic. It was thought also to act powerfully on the uterine system, promoting menstruation. The ancients employed it extensively, both as a medicine and condiment, under the name of *crocus.* It was also highly esteemed by the Arabians, and enjoyed considerable reputation among the physicians of modern Europe, till within a comparatively recent period. On the continent it is still much used as a stimulant and emmenagogue. But the experiments of Dr. Alexander have proved it to possess little activity; and in Great Britain and the United States it is seldom prescribed. In domestic practice saffron tea is occasionally used in exanthematous diseases, to promote the eruption. At present it is chiefly used to impart color and flavor. The dose is from ten to thirty grains (0·65–1·95 Gm.).*

Off. Prep. Decoctum Aloës Compositum, *Br.;* Pilulæ Aloës et Myrrhæ, *Br.;* Pulvis Cretæ Aromaticus, *Br.;* Tinct. Cinchonæ Comp., *Br.;* Tinct. Croci, *U. S., Br.;* Tinct. Opii Ammoniata, *Br.;* Tinct. Rhei, *Br.*

CUBEBA. *U. S., Br.* *Cubeba.* [*Cubeb.*]

(CŪ-BĒ′BA.)

"The unripe fruit of Cubeba officinalis. Miquel. (*Nat. Ord.* Piperaceæ.)" *U. S.*
"The dried unripe fruit of Cubeba officinalis." *Br.*†

Cubebs, Cubebæ, *P. G.;* Fructus (s. Baccæ) Cubebæ, Piper Caudatum; Cubebe, Cubèbe poivre à Queue, *Fr.;* Kubeben, *G.;* Cubebe, *It.;* Cubebas, *Sp.;* Kebabeh, *Ar.*

Gen. Ch. Calyx none. *Corolla* none. *Berry* one-seeded. *Willd.*

Cubeba officinalis. Miquel.—*Piper Cubeba.* Willd. *Sp. Plant.* i. 159; Woodv. *Med. Bot.*, 3d ed., v. 95. This is a climbing perennial plant, with a smooth, flexuous, jointed stem, and entire, petiolate, oblong or ovate-oblong, acuminate leaves, rounded or obliquely cordate at the base, strongly nerved, coriaceous, and very smooth. The flowers are dicœcious and in spikes, with peduncles about as long as the petioles. The fruit is a globose, pedicelled berry.

This species of Piper is a native of Java, Penang, and probably other parts of the

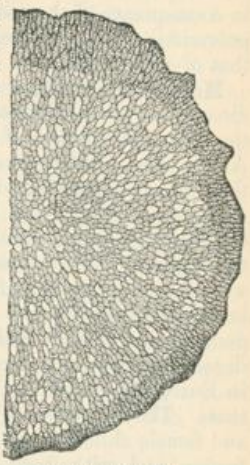
* *Syrupus Croci.* A *Syrup of Saffron* is sometimes called for, and would seem to be an appropriate preparation. The following formula is recommended by Mr. Geo. W. Kennedy, of Pottsville, as producing excellent results. Take of saffron ℥ss, glycerin ℥ij, water ℥vi. Macerate for a week, filter into a pint bottle, and add sufficient water through the filter to make ℥viij; then add 14 avoird. oz. of sugar, and dissolve without heat, frequently shaking. (*A. J. P.*, Feb. 1871, p. 54.)

† The fruit of the *Piper Afzelii* of Lindley, *Cubeba Clusii* of Miquel, figured in the *P. J. Tr.* (xiv. 201), is known in commerce as *African Cubebs, Ashantee Pepper, Guinea pepper,* or *African black pepper.* It was formerly taken to Europe in considerable quantities by the Portuguese, but has been superseded by the more agreeable products of the East Indies. The fruit is one-third smaller than the officinal cubebs, is more compact, and has a taste more analogous to that of ordinary black pepper. Dr. Stenhouse has also shown that it is chemically more analogous to black pepper than to cubebs, as it contains piperine and not cubebin. (*Ibid.*, xiv. 364.) A variety of cubebs from the Dutch East Indies differs essentially from genuine cubebs in being somewhat larger, with less distinct veins and somewhat flattened footstalks, of a less agreeable odor, and a less hot and pungent taste. It has been ascribed to *Piper anisatum.* (See *A. J. P.*, xxxv. 511.) According to the Pharmacographia, fruits of various other non-officinal Pipers appear in Eastern commerce under the name of cubebs. A product with the name of *African cubebs* has been sent to London, from Cape Coast Castle, in Africa, which is the fruit of a plant belonging to the *Xanthoxylaceæ,* probably either a *Toddalia* or *Vepris.* According to Prof. Archer, it is simply aromatic and stimulant, without any of the special virtues of cubebs. (*P. J. Tr.*, March, 1865, p. 463.)

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East Indies. It is extensively grown in the coffee plantations, supported by the trees which are used for shade, and has been introduced into Ceylon. The dried unripe fruit is the officinal portion.

Properties. Cubebs are round, about the size of a small pea, of a blackish or grayish brown color, and furnished with a short stalk, which is continuous with raised veins that run over the surface of the berry, and embrace it like a net-work. The shell is hard, almost ligneous, and contains within it a single loose seed, covered with a blackish coat, and internally white and oleaginous. "Globular, about one-sixth of an inch (4 mm.) in diameter, contracted at the base into a stipe nearly a quarter of an inch (6 mm.) long, reticulately wrinkled, blackish gray, internally whitish and hollow; odor strong, spicy; taste aromatic and pungent. Cubeb should not be mixed with the nearly inodorous rachis or stalks." *U. S.* The odor of the berry is agreeably aromatic; the taste warm, bitterish, and camphorous, leaving in the mouth a peculiar sensation of coolness, like that produced by oil of peppermint. The powder is dark colored and of an oily aspect. The most obvious constituent of cubebs is the volatile oil, the proportion of which yielded by the drug varies from 4 to 13 per cent. It is, as shown by Oglialoro, a mixture of an oil $C_{10}H_{16}$, boiling at 158°–163° C. (316·4°–325·4° F.), which is present in very small amount, and two oils of the formula $C_{15}H_{24}$, boiling at 262°–265° C. (503·6°–509° F.). One of these is strongly lævogyrate, and yields a crystallized compound, $C_{15}H_{24}$,2HCl, melting at 118° C., while the other is less lævogyrate, and does not combine with HCl.



Transverse section.

The oil distilled from old cubebs on cooling at length deposits large transparent inodorous octohedra of *camphor of cubebs*, $C_{30}H_{48} + 2H_2O$. Another constituent of cubebs is *cubebin*. This is an inodorous substance, crystallizing in small needles or scales, melting at 125° C. (257° F.), having a bitter taste in alcoholic solution; it dissolves freely in boiling alcohol, but deposits on cooling, and is abundantly soluble in chloroform. Its composition, according to Weidel (1877), is $C_{10}H_{10}O_3$. Fused with caustic potash it yields proto-catechuic acid. The resin extracted from cubebs consists of an indifferent portion, nearly 3 per cent., and of *cubebic acid*, amounting to about 1 per cent. (Pharmacographia, 2d ed., p. 587.)

By practical trial Bernatzike has satisfied himself that the peculiar virtues of cubebs, as a remedy in gonorrhœa, depend not on the cubebin or the volatile oil, but on the cubebic acid. (See *Am. Journ. of Med. Sci.*, Oct. 1867, p. 534.) According to MM. Capitaine and Soubeiran, *cubebin* is best obtained by expressing cubebs from which the oil has been distilled, preparing with them an alcoholic extract, treating this with a solution of potassa, washing the residue with water, and purifying it by repeated crystallizations in alcohol. It bears a close resemblance to piperine, but materially differs from it in composition, as it contains no nitrogen. (*Journ. de Pharm.*, xxv. 355.) In the officinal oleoresin of cubebs a deposit takes place consisting chiefly of cubebin, which may be obtained by washing the deposit with a small quantity of cold alcohol to remove adhering resin and oil, and then dissolving repeatedly in boiling alcohol, and crystallizing until the product is white. The volatile oil is officinal. (See *Oleum Cubebæ*.) When the ethereal extract of cubebs is deprived of its volatile oil by evaporation on a water-bath, and of cubebin and wax by deposition, a soft resin is left, the *cubebic acid* of Bernatzike, in which, according to Mr. F. V. Heydenreich, who experimented with it as a physiological agent, the diuretic properties reside; the cubebin being without apparent effect, and the volatile oil, though stimulant and carminative, having no diuretic action. The soft resin, which was of the consistence of honey, of a dark olive-green color, and some remaining odor of cubebs, when taken in the dose of ten grains every two hours, for six hours, acted as a laxative, and gave the urine a peculiar odor,

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without increasing its quantity; but in the dose of a drachm, once repeated at an interval of three hours, while it produced the same effects as the smaller dose, considerably augmented the urine. In still larger doses it produced decided irritation of the urinary passages. (*A. J. P.*, Jan. 1868.) Mr. Heydenreich's experiments are confirmatory of Bernatzike's conclusion as to the peculiar active principles of cubebs. Cubebs gradually deteriorate by age, and in powder become rapidly weaker, in consequence of the escape of their volatile oil. They should be kept whole, and pulverized when dispensed. The powder is said to be sometimes adulterated with that of pimento.

Medical Properties and Uses. Cubebs are generally stimulant, with a special direction to the urinary organs. In considerable quantities they excite the circulation, increase the heat of the body, and sometimes occasion headache and giddiness. At the same time they frequently produce an augmented flow of the urine, to which they impart a peculiar odor. Among their effects are also occasionally nausea and moderate purging; and they are said to cause a sense of coolness in the rectum during the passage of the fæces. We have no evidence that they were known to the ancients. They were probably first brought into Europe by the Arabians, and were formerly employed for similar purposes with black pepper; but they were found much less powerful and fell into disuse. In India they have long been used in gonorrhœa and gleet, and as a grateful stomachic and carminative in disorders of the digestive organs, and are at present very frequently given both in this country and in Europe in gonorrhœa, after the subsidence of the first active inflammatory symptoms. They have been given also in leucorrhœa, cystirrhœa, the urethritis of women and female children, abscess of the prostate gland, piles, chronic bronchial inflammation, and, with great asserted advantage, in connection with copaiba, in pseudomembranous croup, and diphtheritic affections of the fauces. In connection with copaiba they have been especially recommended in affections of the neck of the bladder and the prostatic portion of the urethra. They are best administered in powder, of which the dose in gonorrhœa is from one to three drachms (3·9–11·65 Gm.) three or four times a day. For other affections, the dose is sometimes reduced to ten grains (0·65 Gm.). The volatile oil may be substituted, in the dose of ten or twelve drops (0·6–0·72 C.c.), suspended in water by means of sugar; though, if the experiments of Bernatzike and Heydenreich are to be relied on, the oil is much less efficient than the soft resin as a remedy in gonorrhœa, and in diseases of the urinary passages generally. An ethereal extract is directed by the U. S. Pharmacopœia, and considerably used; and, as it contains the soft resin or cubebic acid, it is no doubt a very efficient preparation. (See *Oleoresina Cubebæ*.) An infusion, made in the proportion of an ounce of cubebs to a pint of water, has been employed as an injection in discharges from the vagina, with asserted advantage.

Off. Prep. Extractum Cubebæ Fluidum, *U. S.;* Oleoresina Cubebæ, *U. S.;* Oleum Cubebæ; Tinctura Cubebæ.

CUPRI ACETAS. *U. S.* *Acetate of Copper.*

Cu $(C_2 H_3 O_2)_2$. $H_2 O$; 199·2. (CŪ'PRĪ Ą-CĒ'TĂS.) Cu O, $C_4 H_3 O_3$. HO; 99·6.

Crystallized Verdigris, Crystals of Venus; Verdet, Cristaux de Vénus, *Fr.;* Essigsaures Kupfer, *G.*

This salt is now substituted for the impure subacetate of copper, formerly officinal. It may be prepared by dissolving verdigris in acetic acid, or by precipitating a concentrated solution of acetate of lead with sulphate of copper. It is the normal cupric acetate, as distinguished from the other basic salts.

Properties. "Deep green, prismatic crystals, yielding a bright green powder, efflorescent on exposure to air, odorless, having a nauseating, metallic taste and an acid reaction. Soluble in 15 parts of water and in 135 parts of alcohol at 15° C. (59° F.), in five parts of boiling water and in 14 parts of boiling alcohol. When heated above 100° C. (212° F.), the salt loses its water of crystallization, and at a temperature above 200° C. (392° F.), it is gradually decomposed. The aqueous solution of the salt has a bluish green color, which is rendered deep blue by an excess of ammonia. On heating the salt with sulphuric acid, acetous vapors are evolved. If the aqueous solution of the salt be treated with hydrosulphuric acid

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until all the copper is precipitated, the filtrate should leave no residue on evaporation (alkalies, alkaline earths and iron). If the aqueous solution be heated to boiling with solution of soda in excess, it will yield a filtrate which should not be clouded by hydrosulphuric acid (abs. of lead, zinc)." *U. S.* As its source is principally verdigris, it will be proper to consider this now.

VERDIGRIS (*Impure Subacetate of Copper*, U. S. 1870; *Aerugo*, P.G.; *Viride Æris, Subacetas cupricus; Verdigris; Ærugo*, Lat.; *Acetate de Cuivre brut, Vert-de-gris, Acétate basique de Cuivre, Verd-et-gris*, Fr.; *Grünspan, Spangrün, Basisches essigsaures Kupfer (Kupferoxyd)*, G.; *Verde rame*, It.; *Cardenillo*, Sp.) is prepared in large quantities in the south of France, more particularly in the neighborhood of Montpellier. It is also manufactured in Great Britain and Sweden. In France the process is conducted in the following manner. Sheets of copper are stratified with the residue of the grape after the expression of the juice in making wine, and are allowed to remain in this state for a month or six weeks. At the end of this time the plates are found coated with a considerable quantity of verdigris. This is scraped off, and the plates are then replaced as at first, to be further acted on. The scrapings thus obtained form a paste, which is afterwards well beaten with wooden mallets, and packed in oblong leathern sacks, about ten inches in length by eight in breadth, in which it is dried in the sun, until the loaf of verdigris, as it is called, attains the proper degree of hardness. The rationale of the process is easily understood. The juice of the grape refuse undergoes the acetous fermentation, and the acetic acid attacking the copper forms the subacetate. In England a purer verdigris is prepared by alternating copper plates with pieces of woollen cloth, steeped in pyroligneous acid.

Verdigris comes to this country exclusively from France, being imported principally from Bordeaux and Marseilles. The leathern packages in which it is put up, called sacks of verdigris, weigh generally from twenty-five to thirty pounds, and arrive in casks, each containing from thirty to forty sacks.

Properties. Verdigris is in masses of a pale green color, and composed of a multitude of minute silky crystals. Sometimes, however, it occurs of a bright blue color. Its taste is coppery. It is insoluble in alcohol, and, by the action of water, a portion of it is resolved into the neutral acetate which dissolves, and the trisacetate which remains behind in the form of a dark green powder, gradually becoming black. It is hence evident that, when verdigris is prepared by levigation with water, it is altered in its nature. When verdigris is acted on by sulphuric acid, it is decomposed, vapors of acetic acid being evolved, easily recognized by their vinegar odor. It is soluble almost entirely in ammonia, and dissolves in hydrochloric and dilute sulphuric acid, with the exception of impurities, which should not exceed 5 per cent. When of good quality, it has a lively green color, is free from black or white spots, and is dry and difficult to break. The green rust, called in popular language verdigris, which copper vessels are apt to contract when not kept clean, is a carbonate of copper, and should not be confounded with true verdigris.

Composition. Verdigris, apart from its impurities, is a variable mixture of the basic acetates of copper. The *blue* variety has approximately the composition $(C_2H_3O_2)_2Cu,Cu(OH)_2 + 5H_2O$. When treated with water it is gradually decomposed into two parts according to the reaction: $3(Cu(C_2H_3O_2)_2, Cu(OH)_2 = Cu(C_2H_3O_2)_2 + 2Cu(OH)_2$ and $2Cu(C_2H_3O_2)_2 + Cu(OH)_2$. The latter of these products constitutes the *green* variety of verdigris. (Flückiger, *Pharm. Chem.*, p. 758.)

Medical Properties. The local and general action of verdigris upon the animal economy and the treatment of its poisoning are the same as those of the sulphate of copper. It is never used internally.*

* *Linimentum Æruginis, Mel Egyptiacum.* This is a very old preparation, formerly recognized as officinal in Great Britain. The following is the process for it given in the old *London* Pharmacopœia. "Take of Verdigris (Subacetate of Copper), in powder, *an ounce*; Vinegar *seven fluid-ounces*; Honey *fourteen ounces*. Dissolve the Verdigris in the Vinegar, and strain through linen; then gradually add the Honey, and boil down to a proper consistence." The ounces used here are troyounces. It sometimes happens during the boiling of the acetic solution of the verdigris, that a red deposit rapidly forms, consisting of the red or suboxide of copper (cuprous oxide); and that

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CUPRI SULPHAS. *U.S., Br. Sulphate of Copper.*

$CuSO_4.5H_2O$; 249·2. (CŪ'PRĪ SŪL'PHĂS.) Cu O, SO_3. 5HO; 124·6.

"May be obtained by heating sulphuric acid and copper together, dissolving the soluble product in hot water, and evaporating the solution until crystallization takes place on cooling." *Br.*

Cuprum Sulfuricum Purum, *P.G.;* Sulfas Cupricus, Cuprum Vitriolatum; Blue Vitriol, Roman Vitriol, Blue Stone; Sulfate de Cuivre, Vitriol bleu, Couperose bleu, *Fr.;* Schwefelsaures Kupfer, Kupfervitriol, Blauervitriol, Blauer Galitzenstein, *G.;* Rame solfato, Vitriolo di Rame, *It.;* Sulfato de Cobre, Vitriolo azul, *Sp.*

Preparation, etc. Sulphate of copper occasionally exists in nature, in solution in the water which flows through copper-mines. In this case the salt is procured by merely evaporating the waters which naturally contain it. Another method of obtaining it is to roast the native sulphide in a reverberatory furnace, whereby it is made to pass, by absorbing oxygen, into the state of sulphate. The roasted mass is lixiviated, and the solution obtained evaporated that crystals may form. The salt, procured by either of these methods, contains a little ferric sulphate, from which it may be freed by adding either an excess of cuprous oxide, which precipitates the sesquioxide of iron, or recently precipitated subcarbonate of copper, which causes the deposition of the iron as a carbonate. (*A. J. P.*, xxxiv. 507.) A third method consists in wetting, and then sprinkling with sulphur, sheets of copper, which are next heated to redness, and while hot plunged into water. The same operation is repeated until the sheets are entirely corroded. At first a sulphide of the metal is formed, which, by the action of heat and air, gradually passes into the state of sulphate. This is dissolved by the water, and obtained in crystals by evaporation. A fourth method is to dissolve copper scales to saturation in sulphuric acid, contained in a wooden vessel, lined with sheet lead. The scales consist of metallic copper, mixed with oxide, and are produced in the process for annealing sheet copper. Sometimes sulphate of copper is obtained in pursuing one of the methods for separating silver from gold. The silver is dissolved by boiling the alloy in sulphuric acid. The sulphate of silver formed is then decomposed by the immersion of copper plates in its solution, with the effect of forming sulphate of copper and precipitating the silver.

In the U. S. Pharmacopœia, sulphate of copper is presumed to be obtained pure from the manufacturer; the British suggests the method in which it may be prepared, without entering into the details of the process.

Properties. Sulphate of copper has a rich deep blue color, and a strong metallic styptic taste. It reddens vegetable blues, and crystallizes in "large, translucent, deep blue, triclinic crystals, efflorescent, odorless, having a nauseous, metallic taste and an acid reaction. Soluble in 2·6 parts of water at 15° C. (59° F.), in 0·5 part of boiling water, and insoluble in alcohol. When heated to 100° C. (212° F.), the salt gradually loses 28·9 per cent. of its weight. At a temperature of about 230° C. (446° F.) it becomes anhydrous, and at a red heat it is decomposed, evolving sulphurous vapors and finally leaving black cupric oxide. The aqueous solution of the salt has a pale blue color, which is rendered deep blue by an excess of ammonia. With test-solution of chloride of barium it yields a white precipitate insoluble in hydrochloric acid. If a little hydrochloric and some diluted sulphuric acid be added to a 5 per cent. aqueous solution of the salt, and this be treated with hydrosulphuric acid until the copper is completely precipitated, the filtrate should leave no residue on evaporation (foreign metals, alkalies, and alkaline earths)." *U. S.* When heated, sulphate of copper first melts in its water of crystallization, and then dries and becomes white. If the heat be increased, it next undergoes the igneous fusion, and finally, at a high temperature, loses its acid, cupric oxide being left. Four of the

at the end of the process, little or none of the metallic salt remains in the preparation. This happens especially when granular honey is employed. (Harley, *P. J. Tr.*, xi. 357.) The change is owing to the decomposition of the cupric oxide by the grape sugar of the honey, converting it into cuprous oxide. The inference is that, in making the preparation, so as to fulfil the objects of the original prescription, simple syrup should be used. It was formerly employed, either undiluted, or mixed with some mild ointment, to destroy fungous granulations, or to repress their growth. In the latter state, it acts as a stimulant to flabby, indolent, and ill-conditioned ulcers: and, largely diluted with water, it has been used as a gargle in venereal ulcerations of the mouth and throat. It is sometimes also applied undiluted, by means of a camel's-hair brush.

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molecules of water of crystallization can be driven off at 100° C. (212° F.); but the fifth only goes off at a temperature of from 220° C. (428° F.) to 240° C. (464° F.), when the anhydrous salt remains. Potassa, soda, and ammonia throw down from it a bluish white precipitate of hydrated cupric oxide, which is immediately dissolved by an excess of the last-mentioned alkali, forming a rich deep blue solution, called *aqua sappharina*. It is decomposed by the alkaline carbonates, and by borax, acetate and subacetate of lead, acetate of iron, nitrate of silver, corrosive chloride of mercury, tartrate of potassium, and chloride of calcium; and it is precipitated by all astringent vegetable infusions. If it becomes very green on the surface by the action of the air, it contains sesquioxide of iron. This oxide may also be detected by ammonia, which will throw it down along with the oxide of copper, without taking it up when added in excess. When sulphate of copper is obtained from the *dipping liquid* of manufacturers of brass or German silver ware, it is always contaminated with sulphate of zinc, as pointed out by Mr. S. Piesse. This liquid is at first a mixture of sulphuric and nitric acids, but becomes, at last, nearly saturated with copper. When zinc is present in sulphate of copper, it will be taken up by solution of potassa, added in excess, from which it may be thrown down, in white flocks, by a solution of bicarbonated alkali.

Medical Properties and Uses. Sulphate of copper is irritant or mildly escharotic; and when in dilute solution, stimulant and astringent. At one time it was given in epilepsy and other nervous diseases; but at present it is never used internally, except for its influence upon the gastro-intestinal mucous membrane. In chronic diarrhœa with ulceration it is often a useful remedy. In doses of 5 grains it acts as a powerful, prompt emetic, without causing general depression or much nausea; hence it is preferred in narcotic poisoning, to dislodge false membrane or foreign bodies from the larynx and œsophagus, and for other similar purposes. Externally it is employed in solution as a stimulant to ill-conditioned ulcers, as an escharotic for destroying warts, fungous granulations, and callous edges, and as a styptic to bleeding surfaces. It is found, in not a few instances, to promote the cicatrization of ulcers, and is not unfrequently employed, with that view, as a wash for chancres. The preparation called *cuprum aluminatum* (*lapis divinus—pierre divine*) is made, according to the French Codex, by mixing, in powder, three ounces, each, of sulphate of copper, nitrate of potassium, and alum, heating the mixture in a crucible, so as to produce watery fusion, then mixing in a drachm of powdered camphor, and, finally, pouring out the whole on an oiled stone to congeal. The mass, when cold, is broken into pieces, and kept in a well-stopped bottle. It is often desirable to employ sulphate of copper, as a caustic, in the form of pencil. Its tendency to effloresce interferes with its use in this way in the pure state. M. Llovet recommends for the purpose a mixture of one part of potassa-alum and two of sulphate of copper, which are to be first powdered, and then gradually melted together in a porcelain vessel, and poured into moulds made of bronze. (*Gaz. des Hôp.*, Juillet 28, 1863.) Another mode of preparing *pencils of sulphate of copper* is to rub briskly together four parts of that salt and one of borax, and to mould the plastic mass which results into the desired form. (*A. J. P.*, March, 1864, p. 106.) The best form is that of an elongated cone, made by selecting suitable crystals, and turning them in a lathe until the desired form is secured; or they may be made by filing the crystals into nearly the proper shape, and finishing with sand-paper.

The dose of sulphate of copper, as an astringent or tonic, is a quarter of a grain (0·016 Gm.), gradually increased; as an emetic, five grains (0·13–0·33 Gm.), repeated in fifteen minutes if necessary, but oftener than once. As a stimulant wash, the solution may be made of the strength of two, four, or eight grains to the fluid-ounce of water. Orfila cautions against giving large doses of this salt as an emetic in cases of poisoning; as it is apt, from its poisonous effects, to increase the mischief when not expelled by vomiting. Upon the whole, such is the activity of sulphate of copper, that it should always be exhibited with caution. For its effects as a poison, see *Cuprum*.

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CUPRUM. *Br.* *Copper.*

Cu ; 63·2. (CŪ'PRŬM.) Cu ; 31·6.

"Fine Copper wire, about No. 25." *Br.*

Cupreum Filum ; Fil de Cuivre, Cuivre, *Fr.;* Kupfer, Kupferdraht, *G.;* Rame, *It.;* Cobre, *Sp.*

This metal is very generally diffused in nature, and exists principally in four states : as native copper, as an oxide, as a sulphide, and as a salt. Its principal native salts are the sulphate, carbonate, arseniate, and phosphate. In the United States it occurs in various localities, but especially in the neighborhood of Lake Superior and in East Tennessee. The principal copper-mines of Europe are those of the Pyrenees in France, Cornwall in England, and Fahlun in Sweden.

Properties. Copper is a brilliant, sonorous metal, of a reddish color, and very ductile, malleable, and tenacious. It has a slightly nauseous taste, and emits a disagreeable smell when rubbed. Its texture is granular, and its fracture hackly. Its sp. gr. is 8·92 to 8·95, and its fusing point 1398° C. (2538° F.) according to Daniell, being intermediate between the fusing points of silver and gold. Its atomic weight is 63·5, or, according to other determinations, 63·2. Exposed to the air it undergoes a slight tarnish. Its combinations are numerous and important. With oxygen it forms two well-characterized oxides, a red suboxide, better known as *cuprous* oxide, Cu_2O, and a black oxide, known as *cupric* oxide, CuO. While a cuprous chloride, iodide, and sulphide are known, it is the cupric oxide chiefly that unites with the common acids to form cupric salts. With metals copper forms numerous alloys, of which that with zinc, called brass, and that with tin, called bronze, are the most useful.

Characteristics. Copper is recognized by its color, and the effects of tests on the solution of its nitrate. This solution, with potassa, soda, and ammonia, yields a blue precipitate, soluble in excess of the latter alkali, with which it forms a deep azure blue liquid. Ferrocyanide of potassium occasions a brown precipitate of ferrocyanide of copper; and a bright plate of iron, immersed in the solution, immediately becomes covered with a film of metallic copper. The ferrocyanide of potassium is a very delicate test for minute portions of copper in solution. Another test, proposed by M. Verguin, is to precipitate the copper in the metallic state on platinum by electrochemical action. For this purpose a drop of the liquid to be examined is placed on a slip of platinum foil, and a slip of bright iron is brought in contact with the platinum and the liquid. If copper be present it will be instantly precipitated on the surface of the platinum.

Action on the Animal Economy. Copper, in its pure state, is perfectly inert, but in combination it is highly deleterious. Nevertheless a minute portion of the metal has been found in the human body. According to Millon, copper, when it exists in the blood, is, like the iron, attached to the red corpuscles. To bring the copper into a state favorable for ready detection, he advises that the blood, as it escapes from a vein, be received in about three times its bulk of water, and the mixture poured into a bottle of chlorine and agitated. The whole, upon being rapidly filtered, furnishes a liquid in which copper is readily detected. Wackenroder found copper in the blood of man, but does not consider it a constant and normal constituent. He also detected this metal in the blood of domestic animals living on a mixed diet, but not in their blood when nourished on vegetable food only. (*Chem. Gaz.*, May 1, 1854.) It has been found in the feathers of certain birds, as of a grass-green paroquet from Australia, which is said to frequent districts of the country where copper is found. (*Ibid.*, Oct. 24, 1873, p. 212.) The soluble combinations of copper, when taken in poisonous doses, produce a coppery taste in the mouth; nausea and vomiting; violent pain in the stomach and bowels; frequent black and bloody stools; small, irregular, sharp, and frequent pulse; faintings; burning thirst; difficulty of breathing; cold sweats; paucity of urine, and burning pain in voiding it; violent headache; cramps, convulsions, and finally death. The best antidote is the ferrocyanide of potassium, given freely, which forms, with the poison, the very insoluble ferrocyanide of copper. Soap and alkalies are also antidotal. Before the antidote can be procured, large quantities should be given of milk, and white of eggs mixed with water, which act favorably by forming the caseate and albuminate of copper;

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but these compounds should be evacuated as soon as possible by vomiting and purging. Should vomiting not take place, the stomach-pump may be employed. The symptoms of slow poisoning by copper are, according to Dr. Corrigan, of Dublin, a cachectic appearance, emaciation, loss of muscular strength, colicky pains, cough without physical signs, and retraction of the gum, with a persistent purple edge, quite distinct from the blue edge produced by lead. (*Braithwaite's Retrospect*, Am. ed., xxx. 303.) But there is much doubt whether these symptoms can be produced by the metal. (See H. C. Wood's Therapeutics.)

Dr. Horsley has detected sulphate of copper in bread and flour used in London, and presumes that it was added with the view of improving the appearance of the flour. (*Chem. News*, No. 63, p. 111, and No. 65, p. 142.)

In medico-legal examinations, where cupreous poisoning is suspected, Orfila recommends that the viscera be boiled in distilled water for an hour, and that the matter obtained by evaporating the filtered decoction to dryness be carbonized by nitric acid. The carbonized product will contain the copper. By proceeding in this way, there is no risk of obtaining the copper which may happen to pre-exist in the animal tissues. This method of search is preferable to that of examining the contents of the stomach and intestines, from which copper may be absent; while it may have penetrated the different organs by absorption, especially the abdominal viscera.

Vessels of copper which are not coated with tin should not be used in pharmaceutical or culinary operations; for, although the metal uncombined is inert, yet the risk is great that the vessels may be acted on and a poisonous salt formed.

The British Pharmacopœia uses copper in preparing Spiritus Ætheris Nitrosi.

The only officinal preparations of copper are Cupri Acetas, *U. S.*; Cupri Sulphas, *U. S.*, *Br.*

CUSPARIÆ CORTEX. *Br.* *Cusparia Bark.*

(CŪS-PĀ'RI-Æ CÖR'TĒX.)

"The bark of Galipea Cusparia." *Br.* (*Nat. Ord.* Rutaceæ.)

Angustura, *U. S.* 1870; Angusture, *Fr.*; Angusturarinde, *G.*; Corteccia dell' Angustura, *It.*; Corteza de Angostura, *Sp.*

This bark was formerly officinal in the U. S. Pharmacopœia of 1870 under the name of Angustura, but it was dropped at the last revision.

The subject of Angustura bark, in its botanical relations, has been involved in some confusion. The drug was at first supposed to be derived from a species of Magnolia, and was referred by some to *Magnolia glauca* of this country. Humboldt and Bonpland were the first to throw light upon its true source. When at Angostura, a South American city on the Orinoco, they received specimens of the foliage of the plant from which the bark was obtained; and afterwards believed that they had found the same plant in a tree growing in the vicinity of Cumana. This latter they had the opportunity of personally inspecting, and were therefore enabled to describe accurately. Unable to attach it to any known genus, they erected it into a new one with the title of *Cusparia*, a name of Indian origin, to which they added the specific appellation of *febrifuga*. On their authority, *Cusparia febrifuga* was generally believed to be the true source of the medicine, and was recognized as such by the London College. A specimen having in the mean time been sent by them to Willdenow, the name of *Bonplandia* was imposed on the new genus by that celebrated botanist; and it was subsequently adopted by Humboldt and Bonpland themselves, in their great work on equinoctial plants. Hence the title of *Bonplandia trifoliata*, by which the tree is described in many works on Materia Medica. De Candolle, however, having found in the description all the characters of the genus *Galipea* of Aublet, rejected both these titles, and substituted that of *Galipea Cusparia*, which was adopted by the London College, and has been retained in the British Pharmacopœia. But, after all these commutations, it appears from the researches of Dr. Hancock, who resided for several months in the country of the Angustura bark tree, that it is doubtful whether the plant described by Humboldt and Bonpland is that which yields the medicine, and is not another species of the same genus. Among other striking differences between them is that of their size; the tree de-

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scribed by Humboldt and Bonpland being at least sixty feet high, while that from which the bark is obtained is never more than twenty feet. Hancock proposed for the latter the title of *Galipea officinalis*, which was adopted in the U. S. P. 1870.

Gen. Ch. *Corolla* inferior, irregular, four or five cleft, hypocrateriform. *Stamens* four; two sterile. *Loudon's Encyc.*

Galipea officinalis. Hancock, *Trans. Lond. Medico-Bot. Soc.*—*Galipea Cusparia.* St. Hilaire, *B. & T.* 43. This is a small tree, irregularly branched, rising to the medium height of twelve or fifteen feet, with an erect stem from three to five inches in diameter, and covered with a smooth gray bark. The leaves are alternate, petiolate, and composed of three leaflets, which are oblong, pointed at each extremity, from six to ten inches in length, from two to four in breadth, and supported upon the common petiole by short leaf-stalks. They are very smooth and glossy, of a vivid green color, marked occasionally with small whitish round spots, and when fresh, of a strong odor resembling that of tobacco. The flowers are numerous, white, arranged in axillary and terminal peduncled racemes, and of a peculiar unpleasant odor. The fruit consists of five bivalve capsules, of which two or three are commonly abortive. The seeds, two of which are contained in each capsule, one often abortive, are round, black, and of the size of a pea. The tree grows abundantly on the mountains of Carony, between the 7th and 8th degrees of N. latitude, and is well known in the missions, near the Orinoco, upwards of 200 miles from the ocean. It flourishes at the height of from six hundred to one thousand feet above the level of the sea. Its elegant white blossoms, which appear in vast profusion in August and September, add greatly to the beauty of the scenery.

The bark is generally brought from the West Indies, packed in casks; but, according to Mr. Brande, the original package, as it comes from Angostura, consists of the leaves of a species of palm, surrounded by a net-work of sticks.

Properties. The pieces are of various lengths, for the most part slightly curved, rarely quilled, sometimes nearly flat, from half a line to a line or more in thickness, pared away towards the edges, covered externally with a light yellowish gray or whitish wrinkled epidermis, easily scraped by the nail, and internally of a yellowish fawn color. They are very fragile, breaking with a short, resinous fracture, and yield, on being pulverized, a pale yellow powder; but when macerated for a short time in water, swell up to two or three times their original thickness and become soft and tenacious, and may be cut into strips with scissors. The cut surface usually exhibits under the microscope numerous white points or minute lines. *Br.* Oxalate of calcium raphides are abundant in the bark, but the most characteristic peculiarity are numerous cells, a little larger than the other parenchymatous cells and completely filled with oil or a yellowish resin.* The smell of Angustura bark is peculiar and disagreeable when fresh, but becomes fainter with age; the taste is bitter and slightly aromatic, leaving a sense of pungency at the end of the tongue. According to Fischer, it contains volatile oil, bitter extractive, a hard and bitter resin, a soft resin, a substance analogous to caoutchouc, gum, lignin, and various salts. The volatile oil, which may be obtained by distillation with water, is of a pale yellowish color, lighter than water, of an acrid taste, and with the odor of the bark. Its formula is given as $C_{13}H_{24}O$ by Dr. C. Herzog, who states that its boiling point is 266·1° C. (511° F.), probably one of the highest of the volatile oils. (*Chem. Gaz.*, May 15, 1858.) *Cusparin* is the name given by Saladin to a principle, deposited in tetrahedral crystals, when an infusion of the bark is treated with absolute alcohol, at common temperatures, and allowed to evaporate spontaneously. It is neutral, fusible at a gentle heat, by which it loses 23·09 per cent. of its weight, soluble in 200 parts of cold and 100 parts of boiling water, soluble in the concentrated acids and in the alkalies, and precipitated by the infusion of galls. (*Journ. de Pharm.*, xxii. 662.) Herzog was unable to isolate this principle. The virtues of the bark reside in the volatile oil and bitter constituent, and are extracted by water and alcohol.

Dr. A. T. Thomson states that precipitates are produced with the infusion by the solutions of sulphate of iron, tartrate of antimony and potassium, sulphate of copper, acetate and subacetate of lead, bichloride of mercury, nitrate of silver, and pure

* For an elaborate microscopical study of the bark, see *Journ. de Pharm.*, xxviii. 230.

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potassa; by nitric and sulphuric acids; and by the infusions of galls and yellow cinchona; but how far these substances are medicinally incompatible with the bark, it would be difficult to determine.

False Angustura. Under this title, European writers describe a bark which was introduced on the continent mixed with true Angustura bark, and, being possessed of poisonous properties, produced in some instances unpleasant effects, when dispensed by mistake for that medicine. It is distinguished by its greater thickness, hardness, weight, and compactness; by its resinous fracture; by the appearance of its epidermis, which is sometimes covered with a ferruginous efflorescence, sometimes is yellowish gray, and marked with prominent white spots; by the brownish color and smoothness of its internal surface, which is not, like that of the genuine bark, separable into laminæ; by the white slightly yellow powder which it yields; by its total want of odor, and its intense tenacious bitterness. When steeped in water, it does not become soft, like the true Angustura. Analyzed by Pelletier and Caventou, it was found to contain a peculiar alkaline principle which they called *brucine*, and upon which its poisonous operation depends. (See *Nux Vomica*.) In consequence of the presence of this principle, a drop of nitric acid upon the internal surface of the bark produces a deep red spot. The same acid, applied to the external surface, renders it emerald-green. In true Angustura bark, a dull red color is produced by the acid on both surfaces. The *false Angustura* was at first supposed to be derived from *Brucea antidysenterica*, but at present is ascribed to *Strychnos Nux Vomica*, the bark of which, according to Dr. O'Shaughnessy, exactly corresponds with the description of false Angustura, and like it contains brucia.

Brazilian Angustura Bark, the product of *Esenbeckia febrifuga*, consists of slightly curved pieces 8 to 10 inches long, about $\frac{1}{16}$ of an inch in thickness, of a persistently bitter taste. The outer surface is usually ashen gray, and always marked with longitudinal red or black spots on a yellow ground; the inner surface is reddish, with paler, distinct, elongated fibres. On maceration the bark does not swell. (Oberlin and Schlagdenhauffen, *Journ. de Pharm.*, xxviii. 242.)

Medical Properties and Uses. Angustura bark had been long used by the natives of the countries where it grows, before it became known elsewhere. From the continent its employment extended to the West Indies, where it acquired considerable reputation, and about eighty years since it was introduced into Europe. Its operation is that of a stimulant tonic. In large doses it also evacuates the stomach and bowels, and is often employed for this purpose in South America. It is said to be peculiarly efficacious in bilious diarrhœas and dysenteries, and has been recommended in dyspepsia and other diseases requiring a tonic treatment. The testimony, however, of practitioners in Europe and the United States is not strongly in its favor; and it is probably better adapted to tropical diseases than to those of temperate climates. Hancock employed it extensively in the malignant bilious intermittent fevers, dysenteries, and dropsies of Angustura and Demerara, and speaks in strong terms of its efficacy in these complaints. He used it in the form of fermented infusion, as recommended by the native practitioners.

It may be given in powder, infusion, tincture, or extract. The dose in substance is from ten to thirty grains (0·65–1·95 Gm.). In larger quantities it is apt to produce nausea. From five to fifteen grains (0·33–1 Gm.) is the dose of the extract, which, however, according to Dr. Hancock, is inferior to the powder or infusion. To obviate nausea, it is frequently combined with aromatics.

Off. Prep. Infusum Cuspariæ, *Br.*

CYDONIUM. *U. S.* *Cydonium.* [*Quince Seed.*]

(CŸ-DŌ'NI-ŬM.)

"The seed of Cydonia vulgaris. Persoon. (*Nat. Ord.* Rosaceæ, Pomeæ.)" *U. S.*

Semen Cydoniæ, *P.G.*; Semences (Pépins) des Coing, Semences de Coing, *Fr.*; Quittenkerne, Quittensamen, *G.*; Semi di Cotogno, *It.*; Semiente de Membrillo, *Sp.*

The quince-tree has been separated from the genus *Pyrus*, and erected into a new one called *Cydonia*, which differs in the circumstance that the cells of its fruit contain many seeds, instead of two only as in Pyrus.

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Gen. Ch. Calyx five-parted, with leafy divisions. *Apple* closed, many-seeded. *Testa* mucilaginous. *Loudon's Encyc.*

Cydonia vulgaris. Persoon, *Enchir.* ii. 40.—*Pyrus Cydonia.* Willd. *Sp. Plant.* ii. 1020; Woodv. *Med. Bot.* p. 505, t. 182. The common quince-tree is characterized as a species by its downy deciduous leaves. It is supposed to be a native of Crete, but grows wild in Austria, on the banks of the Danube. It is abundantly cultivated in this country. The fruit is about the size of a pear, yellow, downy, of an agreeable odor, and a rough, astringent, acidulous taste; and in each of its five cells contains from eight to fourteen seeds. Though not eaten raw, it forms a very pleasant confection; and a syrup prepared from it may be used as a grateful addition to drinks in sickness, especially in looseness of the bowels, which it is supposed to restrain by its astringency. The seeds are the officinal portion.

They are ovate, angled, reddish brown externally, white within, inodorous, and nearly insipid, being slightly bitter when long chewed. Their coriaceous envelope abounds in mucilage, which is extracted by boiling water. "About a quarter of an inch (6 mm.) long, oval or oblong, triangularly compressed, brown, covered with a whitish, mucilaginous epithelium, causing the seeds of each cell to adhere. With water the seeds swell up, and form a mucilaginous mass. The unbroken seeds have an insipid taste." *U. S.* Two drachms of the seeds will render a pint of water thick and ropy. (*A. J. P.*, 1876, p. 35.) It has been proposed to evaporate the decoction to dryness, and powder the residue. Three grains of this powder form a sufficiently consistent mucilage with an ounce of water. According to M. Garot, one part communicates to a thousand parts of water a semi-syrupy consistence. (*Journ. de Pharm.*, 3e sér., iii. 298.) Dr. Pereira considers the mucilage as peculiar, and proposes to call it *cydonin*. It differs from arabin in not yielding a precipitate with silicate of potassium, and from bassorin and cerasin in being soluble in water both hot and cold. Tollens and Kirchner (*Ann. d. Chemie*, clxxv. 205–226) assign to it the formula $C_{18}H_{28}O_{14}$, regarding it as a compound of gum, $C_{12}H_{20}O_{10}$, and cellulose, $C_6H_{10}O_5$, less one molecule of water.

Medical Properties, etc. Quince mucilage may be used for the same purposes as other mucilaginous liquids. It is preferred as a local application in conjunctival ophthalmia, but in this country is less used than the infusion of sassafras pith.

Off. Prep. Mucilago Cydonii, *U. S.*

CYPRIPEDIUM. *U. S. Cypripedium.* [*Ladies' Slipper.*]

(ÇŸP-RĮ-PĒ'DĮ-ŬM.)

"The rhizome and rootlets of Cypripedium pubescens, Willdenow, and of Cypripedium parviflorum, Salisbury. (*Nat. Ord.* Orchidaceæ.)" *U. S.*

Rhizoma Cypripedii; Ladies' Slipper Root; Racine de Cypripède jaune, Valeriane américaine, *Fr.*; Gelbfrauenschuh-Wurzel, *G.*

Gen. Ch. Sepals spreading; the two anterior generally united into one under the lip. *Petals* similar but usually narrower, spreading. *Lip* a large inflated sac, somewhat slipper-shaped. *Column* short, three-lobed; the lateral lobes bearing an anther under each, the middle dilated and petal-like. *Gray.*

Under the common name of *ladies' slipper*, or *moccasin plant*, several species of Cypripedium inhabit the woods in different parts of the United States. They are small plants, with large, many-nerved, plaited leaves, sheathing at the base, and large often beautiful flowers, of a shape not unlike the Indian moccasin, whence they derive one of their common names. Their generic name of Cypripedium (*Κύπρις*, Venus, and *πόδιον*, sock) had a similar origin. Several of them have been used by American physicians, the root being the part employed. Dr. R. P. Stevens, of Ceres, Pennsylvania, says of them, that he has found the *C. spectabile* and *C. acaule*, especially when growing in dark swamps, to be possessed of narcotic properties, and to be less safe than the *C. parviflorum*, which is gently stimulant with a tendency to the nervous system, and is quite equal to valerian. He has employed it advantageously in hysteria, and in the pains of the joints following scarlet fever. (*N. Y. Journ. of Med.*, iv. 359.) Dr. E. Ives considers *C. pubescens*, *spectabile*, and *humile* identical in their effects, but *C. pubescens* the most powerful. (*Trans. of Amer.*

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Med. Assoc., iii. 312.) The roots of the two species *C. pubescens* and *C. parviflorum* are indiscriminately kept in the shops and sold by the same name.

Cypripedium pubescens. Willd. *Sp. Plant.* iv. 142. The *yellow ladies' slipper*, as this plant is called from the color of its flowers, has a simple often flexuous, pubescent, leafy stem, from one to two feet high. The leaves are pubescent, ovate-lanceolate, acuminate, narrowing at the base, about four or five inches long by two in breadth, alternate, sessile, and sheathing. The flower is usually solitary and terminal; with four divisions of the perianth, the two outer cohering nearly to the apex, the inner longer, narrower, undulatory or twisted, and the lip an inch or two in length, swelling sac-like, and of a yellow color. The fruit is an oblong capsule, tapering at each end, recurved, pubescent, and peduncled. The plant is indigenous, growing abundantly in rich, moist woods throughout the United States.

Cypripedium parviflorum. (Salisbury.) *Common Ladies' Slipper. Small-flowered Ladies' Slipper.* This is a perennial plant with a leafy stem, a foot or two in height, and comparatively small yellowish green flowers, appearing in May. The specific character of the flower, which is that also of the plant, is, that the lobe of the style is triangular and acute; the outer petals are oblong-ovate and acuminate; the inner linear and contorted; the lips shorter than the petals and compressed. This species grows extensively through the United States south of the Potomac, east and west of the Alleghanies, and in several of the Northern States, particularly New York, Michigan, Connecticut, and Vermont. In Pennsylvania, especially near Philadelphia, it does not appear to prevail, and it is not mentioned in Darlington's *Flora Cestrica* as among the plants of Chester County.

The root, in both species, is the officinal portion. This consists of a rhizome, from two to four inches long, with numerous rootlets attached. "Horizontal, bent, four inches (10 cm.) or less, long; about one-eighth of an inch (3 mm.) thick; on the upper side beset with numerous, circular, cup-shaped scars; closely covered below with simple, wiry rootlets varying from four to twenty inches (10 to 50 cm.) in length; brittle, dark brown, or orange brown; fracture short, white; odor faint but heavy; taste sweetish, bitter and somewhat pungent." *U. S.* Prof. Maisch gives a distinctive description of the roots of the two species, of which the followjng is a condensed account. Of *C. pubescens* the rhizome is almost horizontal, in its greatest length nearly four inches, slightly bent with a shallow downward curve, from $\frac{1}{8}$ to $\frac{3}{16}$ of an inch thick, with numerous deeply concave scars left by the stems, having fully the width of the rhizome. The rootlets are numerous, several inches in length, sometimes even nine inches or more, about $\frac{1}{14}$ of an inch thick, without branches, somewhat undulate, and, though attached to the rhizome on all sides, are abruptly turned downward, owing to its horizontal position in the ground. Their color is yellowish brown, becoming much darker on drying, which causes longitudinal wrinkles. The cortical part of both species is colored blue by iodine. The rhizome of *C. parviflorum* is altogether different from the former, being bent nearly at right angles, three or four times, each section about $\frac{3}{4}$ of an inch long; and the whole length, while only about two inches in a straight line, from end to end, is yet actually three inches along the course of the rhizome. This is about $\frac{1}{8}$ of an inch thick, and has stem-scars, about the same in width, with about three in each bend. The rootlets, which are attached to all sides of the rhizome, are numerous, four to six inches long, less undular than those of *C. pubescens*, and of a brighter color, being a decided orange brown when fresh, and changing little on drying. (*A. J. P.*, 1872, p. 297.)

The roots of the Cypripedia are sometimes mixed, as brought into the market, with those of *Hydrastis Canadensis*, from the plants occasionally growing in close contiguity. (See *Hydrastis.*) Roots of seneka have also been noticed in specimens of Cypripedium; but there can be no difficulty in distinguishing them.

Properties. Cypripedium has a somewhat aromatic odor which diminishes by time, and a bitter, sweetish, peculiar, and in the end somewhat pungent taste. It yields its virtues to water and alcohol. The root has been analyzed by Mr. Henry C. Blair, who found it to contain a volatile oil, a volatile acid, tannic and gallic acids, two resins, gum, glucose, starch, and lignin. (*A. J. P.*, 1866, p. 494.) The so-called eclectics prepare what they improperly call *cypripedin* by precipitating with

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water a concentrated tincture of the root. The substance thus obtained is complex, and has no claim to the name given it, which ought to be reserved for the active principle when discovered. It is probable that the virtues of the root reside in a volatile oil and bitter principle.

Medical Uses. Cypripedium appears to be a gentle nervous stimulant or antispasmodic, and has been used for the same purposes as valerian, though less powerful. Dr. E. Ives, of New Haven, Conn., has employed the remedy in a variety of nervous diseases with advantage, and has known it even to cure epilepsy. The other complaints mentioned by him are hypochondriasis, neuralgia, and morbid sensitiveness of the nervous system generally, and especially of the eye. The medicine may be used in powder, infusion, or tincture. The dose of the powder given by Dr. Ives was fifteen grains (1 Gm.) three times a day. The oleoresin, obtained by precipitating the tincture, has been given in doses varying from half a grain to three grains (0·03–0·20 Gm.).

Off. Prep. Extractum Cypripedii Fluidum, *U. S.*

DECOCTA. *Decoctions.*

(DĒ-CŎC'TĂ.)

Décoctions, *Fr.*; Abkochungen, *G.*

Decoctions are solutions of vegetable principles, obtained by *boiling* the substances containing these principles in water. Vegetables generally yield their soluble ingredients more readily, and in larger proportion, to water maintained at the point of ebullition, than to the same liquid at a lower temperature. Hence decoction is occasionally preferred to infusion as a mode of extracting the virtues of plants, when the call for the remedy is urgent, and the greatest possible activity in the preparation is desirable. The process should be conducted in a covered vessel, so as to confine the vapor over the surface of the liquid, and thus prevent the access of atmospheric air, which sometimes exerts an injurious agency upon the active principle. The boiling, moreover, should not, as a general rule, be long continued; as the ingredients of the vegetable are apt to react on each other, and thus lose, to a greater or less extent, their original character. The substance submitted to decoction should if dry be either powdered or well bruised, if fresh, should be sliced, so that it may present an extensive surface to the action of the solvent; and previous maceration for some time in water is occasionally useful by overcoming the cohesion of the vegetable fibre. Should the physician not happen to prescribe this preliminary comminution, the pharmacist should not omit it.

All vegetable substances are not proper objects for decoction. In many, the active principle is volatile at a boiling heat, in others, it undergoes some change unfavorable to its activity, and in a third set is associated with inefficient or nauseous principles, which, though insoluble or but slightly soluble in cool water, are abundantly extracted by that liquid at the boiling temperature, and thus encumber, if they do not positively injure, the preparation. In all these instances, infusion is preferable to decoction. Besides, by the latter process, more matter is often dissolved than the water can retain, so that upon cooling a precipitation takes place, and the liquid is rendered turbid, and this constitutes the greatest objection to this class of preparations. When the active principle is thus dissolved in excess, the decoction should always be strained while hot; so that the matter which separates on cooling may be mixed again with the fluid by agitation at the time of administering the remedy.

In compound decoctions, the ingredients may be advantageously added at different periods of the process, according to the length of boiling requisite for extracting their virtues; and, should one of them owe its activity to a volatile principle, the proper plan is, at the close of the process, to pour upon it the boiling decoction, and allow the liquor to cool in a covered vessel.

As a general rule, glass or earthenware vessels should be preferred; as those made of metal are sometimes corroded by the ingredients of the decoction, which thus become contaminated. Vessels of clean cast-iron or common tin, or of block tin, are preferable to those of copper, brass, or zinc; but iron pots should not be used when astringent vegetables are concerned.

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