land (*Erfahr. üb. d. Gebr. u. d. Kräfte d. salzs. Schwererde*, Berl. 1794: and *Vollst. Darstell. d. med. Kräfte u. d. Gebr. d. salzs. Schwererde*, Berl. 1794), with great benefit. The latter writer has employed it in all the forms of this disease, but especially in excited and inflamed conditions, (particularly of delicate and sensible parts, as of the lungs and eyes) in painful ulcers, indurations which are disposed to inflame, and cutaneous affections. It has also been administered as a resolvent, deobstruent, or alterative, in some other diseases: for example, *scirrhus* and *cancer*, *cutaneous diseases*, *bronchocele*, &c. As a local application, a solution of it has been used as a wash in herpetic eruptions, and as a collyrium in scrofulous ophthalmia.

In pharmacy and chemistry it is extensively employed as a test for sulphuric acid and the sulphates.

Administration.—It is used in the form of aqueous solution. The *Liquor Barii Chloridi*, Ph. L. consists of a drachm of the salt dissolved in an ounce of distilled water. The dose is ten drops gradually and cautiously increased until nausea or giddiness are experienced. The officinal solutions of the Edinburgh and Dublin Pharmacopœias are about $2\frac{1}{2}$ times stronger. Common water, and all liquids containing carbonates, phosphates, or sulphates, are incompatible with it.

Antidotes.—The antidotes for the barytic salts are the sulphates, which form therewith an insoluble sulphate of baryta. Hence sulphate of soda, sulphate of magnesia, or well or spring water (which contains sulphate of lime) should be copiously administered. Of course the poison should be removed from the stomach as speedily as possible. To appease any unpleasant symptoms caused by the continued use of large medicinal doses, opiates may be employed.

Order 13. Compounds of Calcium.

Calx.—Lime.

History.—Lime, and the mode of obtaining it by burning the carbonate, were known in the most remote periods of antiquity. Hippocrates (*Popularium*, ii. sect. 5) employed this earth in medicine. Dr. Black in 1755 first explained the nature of the process for making it. In 1808 Davy shewed that this substance was a metallic oxide, and hence it has been termed the *oxide of calcium*. To distinguish it from the hydrate of lime, it is termed *caustic* or *quicklime* (*calx viva*), or *burned lime* (*calx usta*.)

Natural History.—It occurs in both kingdoms of nature.

(*a*.) *In the inorganized kingdom.*—In the mineral kingdom lime is found in the form of carbonate, sulphate, phosphate, silicate, arseniate, tungstate, borate, and titanate. Its base, calcium, occurs in combination with fluorine. "Lime is also disseminated through sea water, though in small quantities; so that calcium is widely distributed in land and water, being principally abundant in the central and higher parts of the fossiliferous rocks, and widely dispersed, in small quantities, throughout the more ancient rocks, and in the waters of the ocean." (De la Beche, *Research. in Theor. Geol.* p. 21.)

(*b*.) *In the organized kingdom.*—In vegetables, lime (or calcium) is an invariable ingredient, except, it is said, in the case of *Salsola Kali*. (Decandolle, *Phys. Végét.* p. 382.) It is found combined with carbonic, sul-

phuric, phosphoric, nitric, and various organic acids (as oxalic, malic, citric, tartaric, and kinic): calcium occurs in combination with chlorine. In animals lime is found principally as carbonate and phosphate.

PREPARATION.—For use in the arts lime is usually obtained by burning the carbonate with coals, coak, or other fuel, in a kind of wind furnace called a *kiln* (vide Loudon's *Encycl. of Agricult.* 3d ed. p. 625; and Gray's *Operative Chemist.*) In the Dublin, Edinburgh, and United States Pharmacopœias, the officinal lime is the lime of commerce: but as this contains various impurities, the London Pharmacopœia directs lime to be prepared by exposing chalk to a very strong fire during an hour, by which the carbonic acid is expelled. White Carrara marble yields the purest lime.

PROPERTIES.—Lime (commonly termed *quicklime*) when pure is a white, or greyish white solid, having a sp. gr. of 2·3. It has an acrid, alkaline taste, and reacts powerfully on vegetable colours as an alkali. It is difficult of fusion: but by the oxy-hydrogen flame it may be both fused and volatilized. Exposed to the air it attracts water and carbonic acid. If a small portion of water be thrown on lime, part of it combines with the lime, and thereby causes the evolution of a considerable degree of heat, by which another portion of the water is vaporized. The lime swells up, cracks, and subsequently falls to powder: in this state it is called *slacked lime* (*calx extincta*), or the *hydrate of lime*. By heat the water may be again expelled.

Lime dissolves in water, forming *lime-water* or *aqua calcis*. It is prepared by first slacking lime and then adding more water: the proportions employed by the London College are half a pound of lime to three gallons of water. The solution should be kept in stopped glass vessels with the undissolved lime, and when used the clear liquor poured off. The solubility of lime in water is very remarkable; cold water dissolving more than hot. According to Mr. Phillips,

A pint of Water at	32°	dissolves	13·25 grains of lime.
Ditto . .	60° . . .	11·6	ditto.
Ditto . .	212° . . .	6·7	ditto.

So that water at 32° dissolves nearly twice as much lime as water at 212°. Lime water is colourless and transparent, but by exposure to the air becomes covered with a film of carbonate of lime, which precipitating to the bottom of the vessel is succeeded by another. Its taste is unpleasant and alkaline, and it has an alkaline reaction on vegetable colours. When a cold saturated solution of lime is heated, small crystals of hydrate of lime are deposited: the same are also produced by evaporating lime water in the exhausted receiver of the air-pump.

CHARACTERISTICS.—Lime water is recognized by its action on turmeric paper and on the infusion of red cabbage; by the milkiness produced in it on the addition of carbonic acid or a soluble carbonate, and by the white precipitate on the addition of a solution of oxalic acid or an oxalate. Sulphuric acid affords no precipitate with lime water. Solutions of the calcareous salts are known by the following characters:—The hydrosulphurets, ferrocyanides, and, if the solution be dilute, the sulphates, occasion neither a precipitate nor a change of colour: the soluble carbonates, phosphates, and oxalates, produce white precipitates. The calcareous salts (especially chloride of calcium) give an orange tinge to the flame of alcohol.

Composition.—The following is the composition of lime and its hydrate:—

	Eq.	Eq. Wt.	Per Cent.	Berzelius.		Eq.	Eq. Wt.	Per Cent.
Calcium	1	20	71·42	71·91	Lime	1	28	75·67
Oxygen	1	8	28·57	28·09	Water	1	9	24·32
Lime	1	28	99·99	100·00	Hydrate of Lime	1	37	99·99

Purity.—The lime used in the arts is never absolutely pure, but usually contains variable quantities of carbonate of lime, silica, alumina, and oxide of iron, and sometimes magnesia.

Physiological Effects. (*a.*) *On vegetables.*—Quicklime is poisonous to plants. Notwithstanding this, however, it is sometimes used as a manure, its efficacy depending on its decomposing and rendering soluble the vegetable matter of the soil, during which the lime attracts carbonic acid and becomes innocuous. (Davy, *Agricult. Chemistry.*)

(*b.*) *On animals.*—On dogs, Orfila (*Toxicol. Gén.*) found that quicklime acted as a caustic poison, but not very energetically; and that it occasions death by producing inflammation of the texture with which it comes in contact.

(*c.*) *On man.*—Quicklime is an escharotic. Its chemical action on the tissues is analogous to that of the fixed alkalies, to which must be added its powerful affinity for water. Its use in promoting the decomposition of the bodies of persons who have died of contagious diseases, or on the field of battle, and its employment by the tanner to separate the cuticle and hair from skins, sufficiently establish its causticity. Its escharotic and irritant action is well seen in the ophthalmia produced by the lodgment of small particles of lime in the eye.

When applied to suppurating or mucous surfaces, lime water checks or stops secretion, and produces dryness of the part: hence it is termed a desiccant.

When administered internally, it neutralizes the free acid of the gastric juice, diminishes the secretions of the gastro-intestinal membrane, and thereby occasions thirst and constipation. It frequently gives rise to uneasiness of stomach, disordered digestion, and not unfrequently to vomiting. After its absorption it increases the secretion of urine, and diminishes the excessive formation or deposition of uric acid and the urates. With this exception, it does not, as the alkalies, promote the action of the different secreting organs, but, on the other hand, diminishes it, and has in consequence been termed an astringent. But it does not possess the corrugating action of the astringent vegetables, or of many of the metallic salts: it is rather a drying remedy, and might be more correctly termed a *desiccant* than astringent. In this respect lime differs from the alkalies, but is analogous to the oxide of zinc. Vogt (*Pharmak.*) considers it to be intermediate between the two. Weickard and others have ascribed to lime an antispasmodic property; and if this be true, its relation to zinc is still further proved.

A power of exciting and changing the mode of action of the absorbent vessels and glands has been ascribed to lime water, and probably with foundation. At any rate, under the use of it, glandular enlargements have become softer and smaller. Sundelin (*Heilmittell.*) says that the excessive use of lime does not, as in the case of the alkalies, bring about a scorbutic diathesis, but a general drying and constriction, analogous to that caused by zinc.

Lime in large doses acts as a poison: the symptoms in one case were thirst, burning in the mouth, burning pain in the belly, obstinate constipation, and death in nine days. (Christison.)

Uses.—Quicklime has been employed as a *caustic*, but alone is now rarely resorted to. It is sometimes applied in the form of *potassa cum calce*, and is a constituent of the ordinary depilatories. As an *antidote*, lime water, in conjunction with milk, was recommended by Navier (*Contre-poison de l'arsenic*, &c. 1777, quoted by Richter, *ausf. Arzn.*) in poisoning by arsenious acid. In the absence of more appropriate antidotes, lime water may be administered in poisoning by the common mineral and oxalic acids. As a *lithontriptic* it possessed at one time considerable celebrity, partly from its being one of the active ingredients of Miss Joanna Stephens' *Receipt for the Stone and Gravel*, as well as from experiments and reports of professional men. As this lady had acquired no slight fame by her mode of treatment, a great desire was manifested to know the nature of her remedies, and she therefore offered to discover them on the payment of a suitable reward. A committee of professional men was appointed to examine the efficacy of her treatment, and her medicines were given to patients known to have calculi. The report made by the committee, as to the effects, was so favourable, that Parliament was induced to grant a reward of £5000, a notice of which appeared in the *London Gazette* of March 18, 1739! (D'Escherny, *A Treatise of the Causes and Symptoms of the Stone*, 1755.) The essential parts of her remedies were lime (prepared by calcining egg-shells and snails), soap, and some aromatic bitters; viz. camomile flowers, sweet fennel, parsley, and burdock leaves, &c. That the patients submitted to treatment obtained relief by the remedies employed cannot, I think, be doubted, but no cure was effected; that is, no calculus was dissolved, for in the bladder of each of the four persons whose cure was certified by the trustees, the stone was found after their death (Alston's *Lect. on the Mat. Med.* vol. i. p. 268). Notwithstanding the favourable reports to the contrary (Chevallier, *Med. Gaz.* vol. xx. p. 460), it appears to me that no rational ground of hope can now be entertained that lime water is capable of dissolving urinary calculi in the kidneys or bladder: but there is abundant evidence to prove that patients afflicted with the uric acid diathesis have sometimes experienced extraordinary benefit from its use (Van Swieten's *Commentaries upon Boerhaave's Aphorisms*, vol. xvi. p. 299). Its mode of action is analogous to that of the alkalies (*vide* pp. 9 & 279). Chevallier (*Med. Gaz.* vol. xx. p. 584) accounts for its efficacy in the treatment of gravel and stone by the circumstance of the combination of the lime with uric acid forming a very soluble salt, viz. urate of lime; and he even thinks that lime water may be useful in phosphatic calculi, either by depriving them of a portion of the uric acid which they contain, and thus rendering them less dense; by decomposing the ammoniacal salt which enters into the composition of some; or by acting on the animal matter which holds the molecules of these calculi together. As an *antacid* in dyspepsia accompanied by acidity of stomach, it is sometimes useful. "Mixed with an equal measure of milk, which completely covers its offensive taste, it is one of the best remedies in our possession for nausea and vomiting dependent on irritability of stomach. We have found a diet, exclusively of lime water and milk, to be more effectual than any other plan of treatment in dyspepsia, accom-

panied with vomiting of food. In this case one part of the solution to two or three of milk, is usually sufficient" (*United States Dispensatory*). In the dyspepsia of gouty and rheumatic subjects, and which is usually accompanied with a copious secretion of uric acid by the kidneys, I have seen lime water serviceable. As a *dessicant* or *astringent*, it is useful as a wash for ulcers attended with excessive secretion. In some scrofulous ulcers in which I have employed it, its power of checking secretion has been astonishing. In diarrhœa, when the mucous discharge is great, and the inflammatory symptoms have subsided, lime water is useful as an astringent. As an injection in leucorrhœa and gleet it sometimes succeeds where other remedies have failed. The internal use of lime water has also been serviceable in checking secretion from various other parts, as from the bronchial membranes, the bladder, &c.

Besides the above, lime water has been employed for various other purposes. Thus as an antispasmodic, in hypochondriasis and hysteria, with habitual excessive sensibility of the nervous system, it has been found useful by Weickard (Richter's *ausf. Arzneim.* iii. 585). It has also been given as an alterative in glandular enlargements and venereal affections, and to promote the deposit of bone earth in diseases accompanied with a deficiency of this substance. In skin diseases (tinea capitis, scabies, prurigo, &c.) it has been applied as a wash.

Administration.—From half an ounce to three or four ounces may be taken three times a day. As already mentioned, it may be conveniently administered in combination with milk.

Linimentum Calcis, Ph. Dub. & U. S.; *Oleum Lini cum Calce*, Ph. Ed. *Calcareous soap* or *oleo-margarate of lime* (lime water, linseed or olive oil āā. equal parts).—This compound has been celebrated as an application to burns and scalds. From being used at the Carron Iron-works, in cases of burns, it is called *Carron oil*. It is almost invariably prepared with linseed oil, though in the Dublin Pharmacopœia olive oil is ordered. Turpentine may be sometimes advantageously added to it.

Cal'cii Chlo'ridum.—Chlo'ride of Cal'cium.

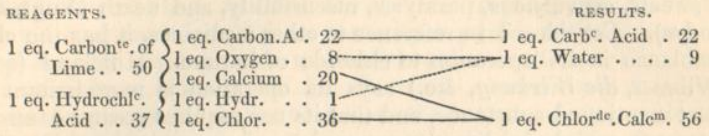
History.—This salt, obtained in the decomposition of sal ammoniac by lime, was known, according to Dulk (*Die Preuss. Pharm. übersetst*, &c. ii. 293) in the fifteenth century to the two Hollands, who called it *fixed sal ammoniac* (*sal ammoniacum fixum*). Its composition was not understood until the eighteenth century, when it was ascertained by Bergman, Kirwan, and Wenzel. It is commonly termed *muriate of lime*.

Natural History.—It is found, in small quantity, in sea and many mineral and well waters. It has also been detected, in a few instances, in vegetables: thus Pallas recognised it in the root of *Aconitum Lycoctonum*.

Preparation.—It is readily prepared by dissolving carbonate of lime in hydrochloric acid. The proportions ordered in the London Pharmacopœia are, five ounces of chalk, half a pint of hydrochloric acid, and the like quantity of water. When the effervescence has finished, the filtered solution is ordered to be evaporated to dryness, and the residue

fused in a crucible. While in the liquid state it is to be poured on a clean flat stone, and when cold broken into small pieces, and preserved in a well-stopped vessel.

In this process one equivalent or 37 parts of hydrochloric acid react on one equivalent or 50 parts of carbonate of lime, and produce one equivalent or 22 parts of carbonic acid, which escapes in a gaseous form, one equivalent or 9 parts of water, and one equivalent or 56 parts of chloride of calcium. By the subsequent evaporation and fusion, both the water used and that formed are expelled, leaving anhydrous chloride of calcium.



Chloride of calcium is a secondary product in the manufacture of the hydrated sesquicarbonate of ammonia (p. 174).

Properties.—Anhydrous chloride of calcium is a white translucent solid, of a crystalline texture. Its taste is bitter and acrid saline. It is fusible, but not volatile. It deliquesces in the air, and becomes what has been called *oil of lime* (*oleum calcis*). When put into water it evolves heat, and readily dissolves in a quarter of its weight of this fluid at 60° F., or in a much less quantity of hot water. By evaporation the solution yields striated crystals (*hydrated chloride of calcium*), having the form of regular six-sided prisms, and which, therefore, belong to the rhombohedic system (p. 61). These crystals undergo the watery fusion when heated, are deliquescent, readily dissolve in water with the production of great cold, and when mixed with ice or snow form a powerful frigorific mixture. Both anhydrous and hydrous chloride of calcium are readily soluble in alcohol.

Characteristics.—This salt is known to be a chloride by the tests for this class of salts before mentioned (p. 105). The nature of its base is ascertained by the tests for lime (p. 343).

Composition.—The composition of this salt is as follows:—

	Eq.	Eq.Wt.	Per Cent.	Ure.
Calcium	1	20	35·71	36·7
Chlorine	1	36	64·28	63·3
Chloride Calcium	1	56	99·99	100·0

	Eq.	Eq.Wt.
Chloride Calcium	1	56
Water	6	54
Cryˢ.Chlᵈᵉ.Calcᵐ.	1	110

Purity.—Chloride of calcium, when pure, is colourless, evolves no ammonia when mixed with lime, and undergoes no change of colour nor gives any precipitate with caustic ammonia, chloride of barium, hydrosulphuric acid, or ferrocyanide of potassium.

Physiological Effects. (*a.*) *On animals.*—Three drachms and a half given to a dog caused quick breathing and snorting, with convulsive but vain efforts to vomit, a profuse secretion of saliva, and death in six hours. The mucous membrane of the stomach and small intestines was very blood-shot, and in many places almost black, and converted into a gelatinous mass (Beddoes, *Duncan's Annals of Medicine*, vol. i. Lustr. ii. 208).

(*b.*) *On man.*—In *small doses* it promotes the secretions of mucus, urine, and perspiration. By continued use it appears to exercise a specific influence over the lymphatic vessels and glands, the activity of which it increases; for under its use glandular and other swellings and indurations have become smaller and softer, and ultimately disappeared altogether. In *larger doses* it excites nausea, vomiting, and sometimes purging; causes tenderness in the præcordium, quickens the pulse, and occasions faintness, weakness, anxiety, trembling, and giddiness. In *excessive doses* the disorder of the nervous system is manifested by failure and trembling of the limbs, giddiness, small contracted pulse, cold sweats, convulsions, paralysis, insensibility, and death (Vogt, *Pharmakodyn*). Considered in reference to other medicines, it has the closest resemblance in its operation to chloride of barium. Hufeland (quoted by Wibmer, *die Wirkung*, &c.) says its operation is more irritant than the last mentioned substance, and that its use requires greater caution,—a statement which is directly opposed to the experience of Dr. Wood (*Ed. Med. and Surg. Journ.* i. 147), and of most other practitioners.

Uses.—It has been principally employed in scrofulous affections, especially those attended with glandular enlargements. Beddoes (*op. cit.*) gave it to nearly a hundred patients, and he tells us there are few of the common forms of scrofula in which he has not had successful experience of it. Dr. Wood (*op. cit.*) tried it on an extensive scale, and with decided benefit. It has been found most efficacious in the treatment of tabes mesenterica, checking purging, diminishing the hectic fever, allaying the inordinate appetite, and ultimately restoring the patient to perfect health. It has also been recommended in chronic arthritic complaints, in bronchocele, in some chronic affections of the brain (as paralysis), and in other cases where the object was to excite the action of the absorbents.

Occasionally, though rarely, it has been employed externally. Thus a bath containing two or three ounces of it, either alone or with chloride of sodium, has been used in scrofula (Vogt, *Pharmakodyn.*)

In pharmacy chloride of calcium is used in the rectification of spirit, (p. 197), on account of its strong affinity for water. In chemistry it is employed in the drying of gases, and in the crystallized state, mixed with half or two-thirds of its weight of ice or snow, for producing an intense degree of cold.

Administration.—Chloride of calcium is always used in the form of aqueous solution. The *Liquor Calcii Chloridi*, Ph. L. consists of four ounces of the chloride dissolved in twelve fluidounces of distilled water. The dose of it is forty or fifty minims, gradually increased until slight nausea is produced.

Cal'cis Hypochlo'ris.—Hypochlo'rite of Lime.

History.—In 1798, Mr. Tennant, of Glasgow, took out a patent for the manufacture of this substance as a bleaching powder, which in consequence was long known as *Tennant's bleaching powder*. According to the views entertained of its composition, it has been successively termed *oxymuriate of lime*, *chloride of lime* or *chloruret of the oxide of calcium*, *chlorite of lime* (Berzelius), and *chlorinated lime* (*calx chlorinata*, Ph. L.)

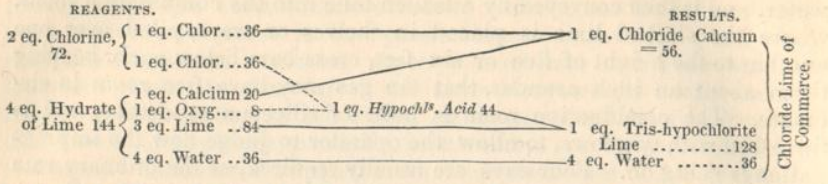
PREPARATION.—It is prepared by conveying chlorine gas into a vessel or chamber containing slacked lime. On the large scale the gas is generated in large, nearly spherical, leaden vessels heated by steam. The ingredients employed are binoxide of manganese, chloride of sodium, and diluted sulphuric acid. The gas is washed by passing it through water, and is then conveyed by a leaden tube into the combination room, where the slacked lime is placed in shelves or trays, piled over one another to the height of five or six feet, cross bars below each, keeping them about an inch asunder, that the gas may have free room to circulate. The combination room is built of siliceous sandstone, and is furnished with windows, to allow the operator to judge how the impregnation is going on. Four days are usually required, at the ordinary rate of working, for making good marketable chloride of lime (Ure, *Quart. Journ. of Science*, xiii. 1). At Mr. Tennant's manufactory at Glasgow, the lime is placed in shallow boxes at the bottom of the combination chambers, and is agitated during the process by iron rakes, the handles of which pass through boxes filled with lime, which serves as a valve (*American Journ. of Science*, vol. x. No. 2, Feb. 1826, and Dumas' *Traité de Chimie*, ii. 806). The theory of the process will be noticed when describing the composition of this substance.

PROPERTIES.—Chloride of lime, as met with in commerce, is a white or brownish white powder, having a feeble odour of chlorine, and a strong bitter and acrid taste. Exposed to the air it evolves chlorine, and attracts carbonic acid, and is thereby converted into a mixture of carbonate of lime and chloride of calcium, the latter of which deliquesces. Digested in water the chloride or hypochlorite of lime dissolves, as well as any chloride of calcium present, and a small portion of caustic lime: any carbonate and the excess of caustic lime remain undissolved. The solution, which has a slight yellow colour, first reacts on vegetable colours as an alkali, and afterwards bleaches them. Its bleaching and disinfecting properties depend on the oxidizement of the colouring or infectious matter: if an acid be employed in the process, chlorine is evolved, which produces oxygen at the expense of the elements of water, as before mentioned (p. 107): if, on the contrary, no acid be used, Balard (*Researches*, in Taylor's *Scientific Memoirs*, vol. i. p. 269) supposes that both the hypochlorous acid and lime give out their oxygen, and thereby become chloride of calcium. When chloride of lime is heated it evolves first chlorine and subsequently oxygen.

CHARACTERISTICS.—Its smell and bleaching properties are most characteristic of it. The acids (as sulphuric or hydrochloric) separate chlorine from it. An aqueous solution of it throws down white precipitates with nitrate of silver, the alkaline carbonates, and with oxalic acid or the oxalates. The supernatant liquor from which chloride of silver has been thrown down by nitrate of silver possesses a decolorizing property.

COMPOSITION.—Chemists are not agreed as to the nature of the substance called chloride of lime. By most English chemists (Dalton, Thomson, Brande, Turner, and Phillips), it is supposed that when chlorine comes in contact with slacked lime combination takes place, and that the lime undergoes no decomposition. By others (Berzelius, Souberain, and Balard), however, it is supposed that part of the lime is decomposed; one portion of the chlorine uniting with the calcium to form chloride of calcium, and another with the oxygen to become hypochlorous (*chlorous*,

Berzelius) acid, which combines with the undecomposed lime: so that the so-called chloride of lime is, according to this view, a mixture of chloride of calcium and hypochlorite (or rather a tris-hypochlorite) of lime and water. The following diagram illustrates the formation of these compounds according to the latter theory:—



When chloride of lime comes in contact with water, the tris-hypochlorite deposits two equivalents of hydrate of lime, while one equivalent of the chloride of calcium and one equivalent of the neutral hypochlorite of lime are dissolved.

The following table shews the composition of the so-called chloride of lime according to Soubeiran (*Nouv. Traité de Pharm.* ii. 365); Phillips, (*Transl.* 3d ed.); and Ure, (*op. cit.*)

Soubeiran.	Eq.	Eq. Wt.	Phillips.	Eq.	Eq. Wt.	Ure.	*Ure's.*	*Commer.*
Chloride of Calcium	1	56	Bihydrated Chloride of Lime	1	82	Chlorine....	40·31	23
Tris-hypochlorite of Lime	1	128	Lime	1	28	Lime	45·40	46
Water.....	4	36				Water	14·28	31
Dry Chloruret of Lime ..	1	220	Chlorinated Lime	1	110	Chloride of Lime	99·99	100

Chlorometry.—The chloride of lime of commerce varies in the quantity of hypochlorite which it contains, and hence some chlorometrical process is necessary in order to ascertain its goodness. The two principal methods are, to determine the quantity of chlorine gas which it evolves on the addition of hydrochloric acid (Ure, *Quart. Journ. of Science*, xiii. 21) and to observe what quantity of sulphate of indigo it is capable of decolorizing (Gay Lussac, in Alcock's *Essay*, p. 136.) Dr. Ure says 10 grains of good bleaching powder should yield 3 or 4 cubic inches of chlorine.

Physiological Effects.—The effects of chloride (hypochlorite) of lime on the system have not as yet been accurately ascertained. Its local action is that of an irritant and caustic. A solution of it applied to suppurating and mucous surfaces is a powerful desiccant, probably in part at least from the uncombined lime in solution. When the secretions are excessive and extremely fetid, it not only diminishes their quantity but much improves their quality; so that considered in reference to suppurating and mucous surfaces, it is not only a desiccant, but, in morbid conditions of these parts, a promoter of healthy secretion. Applied in the form of ointment (composed of a drachm of chloride to an ounce of fatty matter) to scrofulous swellings, Cima (Configliachi and Brugnatelli's *Giornale di Fisica*, 1825, quoted by Dierbach, *d. neust. Entd. in d. Mat. Med.* 1828, 2te. Abt. 597), found that it provoked suppuration, caused strong redness, promoted the suppurating process, and dispersed the surrounding hardness.

Taken internally in *small doses* (as from 3 to 6 grains dissolved in one or two ounces of water) it sometimes causes pain and heat in the stomach,

and occasionally, according to Cima, purging. Under the continued use of it, hard and enlarged absorbent glands have become softer and smaller, from which circumstance it has been supposed to exercise a specific influence over, and promote the healthy action of, the lymphatic system. During its employment, Cima says he did not find it necessary to give purgatives. Dr. Reid (*Trans. of the Associat. of Fellows and Licentiates of the College of Physicians in Ireland*, vol. v. 1828), gave it in the epidemic fever which raged in Ireland in 1826, and he tells that it rendered the tongue cleaner, abated the delirium, and promoted the cutaneous functions. In dysentery it soon put a stop to the bloody evacuations, the umbilical pain, and the tenesmus.

I am not acquainted with any facts respecting the effects of chloride of lime *in large or poisonous doses*. Analogy would lead us to expect that it would produce the combined effects of a caustic, and of an agent specifically affecting the nervous system.

Uses.—The chlorides (hypochlorites) of lime and soda are extensively employed as disinfectants and antiseptics. I have already stated (p 107) that chlorine gas stands unrivalled for its power of destroying putrid odours and checking putrefaction, and where uninhabited chambers or buildings are to be purified, fumigations with this gas should be adopted. But its powerful action on the organs of respiration precludes its use in inhabited places, and, in such cases, the alkaline chlorides (chloride of lime, on account of its cheapness) are to be substituted. When these substances are in contact with organic matter, it is supposed the hypochlorite gives out oxygen, and is converted into a metallic chloride: the oxygen being the effective disinfecting and antiseptic agent. When, however, the solution of the chloride (hypochlorite) is exposed to the air, carbonic acid is attracted by the lime, and hypochlorous acid set free: this is decomposed by the calcium of the chloride, lime is formed, which combines with carbonic acid of the air, and chlorine (from both the hypochlorous acid and chloride of calcium) is disengaged, and furnishes oxygen to the putrefying matter at the expense of some water, with the hydrogen of which it combines. Hence these chlorides (hypochlorites) when exposed to the air evolve chlorine so slowly and in such moderate quantities, as not to produce any noxious effects, though their action on organic matters is very powerful. Their most obvious effect is that of destroying the unpleasant odour of putrid matter. Their action on hydrosulphuric acid, ammonia, and hydrosulphate of ammonia (substances evolved by decomposing animal matters) can be readily and easily demonstrated. Other odorous principles given out by putrid matters are, by the experience of most persons, admitted to be destroyed by the alkaline chlorides, though Piorry (*Journ. Chim. Méd.* ii. 601) has asserted they are only overpowered by the stronger smell of the chlorine.

The alkaline chlorides (hypochlorites) possess another valuable property—that of stopping or checking the putrefactive process; and hence they are called antiseptics. For various facts in proof of this I must refer to the late Mr. Alcock's *Essay on the Uses of the Chlorurets*.

These two properties, viz. that of destroying offensive odours and that of preventing putrefaction, render the alkaline chlorides most valuable agents to the medical practitioner. We apply them to gangrenous parts, to ulcers of all kinds attended with foul secretions, to compound

fractures accompanied with offensive discharges, to the uterus in various diseases of this viscus attended with fetid evacuations; in a word, we apply them in all cases accompanied with offensive and fetid odours. As I have before remarked with respect to chloride of soda (p. 316) their efficacy is not confined to an action on dead parts, or on the discharges from wounds and ulcers: they are of the greatest benefit to living parts, in which they induce more healthy action, and the consequent secretion of less offensive matters. Furthermore, in the sick chamber, many other occasions present themselves on which the power of the chlorides to destroy offensive odours will be found of the highest value: as to counteract the unpleasant smell of dressings or bandages, of the urine in various diseases of the bladder, of the alvine evacuations, &c. In typhus fever, a handkerchief dipped in a weak solution of an alkaline chloride, and suspended in the sick chamber, will be often of considerable service both to the patient and the attendants.

The power of the chlorides (hypochlorites) to destroy infection or contagion, and to prevent the propagation of epidemic diseases, is less obviously and satisfactorily ascertained than their capability of destroying odour. Various statements have been made by Labarraque and others (vide Alcock's *Essay*, p. 55, *et seq.*) in order to prove the disinfecting power of the chlorides with respect to typhus and other infectious fevers. But, without denying the utility of these agents in destroying bad smells in the sick chamber, and in promoting the recovery of the patient by their influence over the general system, I may observe that I have met with no facts which are satisfactory to my mind as to the chemical powers of the chlorides to destroy the infectious matter of fever. Nor am I convinced by the experiments made by Pariset and his colleagues (*Bullet. des Sciences Méd.* xix. 233) that these medicines are preservative against the plague. Six individuals clothed themselves with impunity in the garments of men who had died of plague, but which garments had been plunged for six hours in a solution of chloride of soda. But, as Bouillaud (*Dict. de Méd. Prat.*, art. *Contagion*) has truly observed, the experiments, to be decisive, should have been made with clothing which had already communicated the plague to the wearers of it. In Moscow, chlorine was extensively tried and found unavailing, nay, apparently injurious, in cholera. "At the time," says Dr. Albers (*Lond. Med. Gaz.* viii. 410) "that the cholera hospital was filled with clouds of chlorine, then it was that the greatest number of the attendants were attacked." (See also Dierbach, *d. neust. Entd. in d. Mat. Med.* i. 411, 2te Ausg. 1837.) Some years ago chlorine was tried at the Small Pox Hospital, with a view of arresting the progress of erysipelas: all offensive smell, as usual, was overcome, but the power of communicating the disease remained behind. (*Lond. Med. Gaz.* viii. 472.) Bousquet (*Rev. Méd.* Fev. 1830, p. 264) mixed equal parts of a solution of chloride of soda and the vaccine lymph, and found that the latter still possessed the power of producing the usual cow-pock vesicle. These are a few of the facts which are adverse to the opinion that chlorine or the chlorurets possess the power of preventing the propagation of infectious, contagious, or epidemic diseases. In opposition to them there are but few positive facts to be adduced. Coster (Richter, *Auf. Arzneimittell.* Suppl. Band. 539) found that a solution of chloride of soda destroyed the infectious properties of the syphilitic poison, and of the poison of rabid animals.

The statements of Labarraque (Alcock's *Essay*, pp. 56, 58, &c.) and others as to the preservative powers of the chlorides in typhus, measles, &c. are too loose and general to enable us to attach much value to them.

Considered in reference to medical police, the power of the alkaline chlorides (hypochlorites) to destroy putrid odours and prevent putrefaction is of vast importance. Thus chloride of lime may be employed to prevent the putrefaction of corpses previously to interment, to destroy the odour of exhumed bodies during medico-legal investigations, to destroy bad smells, and prevent putrefaction in dissecting-rooms and workshops in which animal substances are employed (as cat-gut manufactories), to destroy the unpleasant odour from privies, sewers, drains, wells, docks, &c., to disinfect ships, hospitals, prisons, stables, &c. The various modes of applying it will readily suggest themselves. For disinfecting corpses, a sheet should be soaked in a pailful of water containing a pound of chloride, and then wrapped around the body. For destroying the smell of dissecting-rooms, &c. a solution of the chloride may be applied by means of a garden watering-pot. When it is considered desirable to cause the rapid evolution of chlorine gas, hydrochloric acid may be added to chloride of lime.

Chloride of lime (or chloride of soda) is the best *antidote* in poisoning by hydrosulphuric acid, hydrosulphuret of ammonia, sulphuret of potassium, and hydrocyanic acid. It decomposes and renders them inert. A solution should be administered by the stomach, and a sponge or handkerchief soaked in the solution, held near the nose, so that the vapour may be inspired. It was by breathing air impregnated with the vapour arising from chloride of lime that Mr. Roberts (the inventor of the miner's improved safety lamp), was enabled to enter and traverse with safety the sewer of the Bastile, which had not been cleansed for 37 years, and which was impregnated with hydrosulphuric acid. (Alcock's *Essay*.) If a person be required to enter a place suspected of containing hydrosulphuric acid, a handkerchief moistened with a solution of chloride of lime should be applied to the mouth and nostrils, so that the inspired air may be purified before it passes into the lungs.

A solution of chloride of lime has been used as a wash in some skin diseases. Derheims (*Journ. Chim. Méd.* iii. 575) used a strong solution with great success in scabies. This mode of curing itch is much cleaner, and more agreeable, than the ordinary method by sulphur frictions. It has likewise been found successful by Fantonetti (*Journ. de Chim. Méd.* ix. 305) in tinea capitis: where the discharge is copious, washes of the chloride may be used with advantage. In burns and scalds Lisfranc employed lotions of chloride of lime either immediately after the accident, or subsequent to the application of emollient poultices.

Solutions of chloride of lime have been employed with great benefit in ophthalmia. Dr. Varlez, surgeon to the military hospital at Brussels, (*Med. and Phys. Journ.* Nov. 1827) states that in 400 cases it never disappointed him once. Mr. Guthrie has also reported favourably of it in three cases; as have likewise MM. Colson, Delatte, and Raynaud. The solution used by Dr. Varlez was composed of from a scruple to three or four drachms of chloride, and an ounce of water. It was dropped into

the eye or injected by a syringe, or applied by means of a camel's hair pencil. Of course other means (bleeding, purging, cold, and, in chronic cases, blisters) should be conjoined. I have found a weak solution of the chloride very successful in the purulent ophthalmia of infants. Gubian (*Journ. de Chim. Méd.* vi. 315) proposed to apply a solution of chloride of lime to prevent the pitting from small-pox. The fully maturated pustules are to be opened and washed with a weak solution of this salt: desiccation takes place very promptly, and no marks or pits are said to be left behind.

Chloride of lime may be employed *internally* in the same cases that chloride of soda is administered (p. 316.) It has been used with great success by Dr. Reid (*Trans. of the King and Queen's College of Physicians in Ireland*, v. 266) in the epidemic fever of Ireland. In some of the very worst cases it acted most beneficially, causing warm perspiration, rendering the tongue cleaner and moister, checking diarrhœa, and inducing quiet sleep. I also can bear testimony to the good effects of this remedy in bad cases of fever. In disease of the pulmonary organs resulting from febrile excitement, Dr. Reid also found it advantageous. In dysentery likewise it was most valuable. He used it by the mouth and also in the form of glyster. It corrected the intolerable stench of the evacuations, and improved their appearance. Cima (Richter, *ausf. Arzneimitt.* iv. 305) used it both internally and externally in scrofula.

Administration.—*Internally*, chloride of lime may be given in doses of from one grain to five or six grains, dissolved in one or two ounces of water, sweetened with syrup. As the dry chloride of the shops deposits hydrate of lime when put into water, the solution (of the hypochlorite of lime and chloride of calcium) should be filtered, to get rid of this. To destroy the unpleasant smell of the breath, *lozenges of chloride of lime* have been used. (*Journ. de Chim. Méd.* iii. 496.)

For *external* use (lotions and gargles) it is also generally employed in the form of *solution*, the strength of which must vary according to the quality of the chloride, and the nature and seat of the disease to which we intend to apply it. The average proportions are from one to four drachms of chloride to a pint of water. In the cure of itch, Derheims employed a wash composed of three ounces of chloride to a pint of water. The solution is to be filtered to separate the hydrate of lime. Cima employed an *ointment of chloride of lime* (composed of from a scruple to a drachm of chloride, and an ounce of fresh butter) by way of friction, to reduce scrofulous enlargements of the lymphatic glands which had resisted the use of mercurial ointment. When the evacuations from the bowels are very offensive, chloride of lime may be used in the form of *enema*. For this purpose, ten or fifteen grains or more may be added to the common enema.

Antidotes.—Administer albuminous liquids (as eggs beat up with water) or milk, or flour and water, or oil, or mucilaginous drinks, and excite vomiting; combat the gastro-enteritis by the usual means. Carefully avoid the use of acids, which would cause the evolution of chlorine gas in the stomach.

Cal'cis Car'bonas.—Car'bonate of Lime.

HISTORY.—Some varieties of carbonate of lime were distinguished and employed in the most remote periods of antiquity. Marble was probably used for building 1050 years before Christ (1 Chron. xxix. 2.) Pliny (*Hist. Nat.* xxxvi.) tells us that Dipœnus and Scyllis were renowned as statuaries of marble in the 50th Olympiad (*i. e.* 557 years before Christ.) The *creta*, mentioned by Horace (*Sat.* iii. lib. 2), and Pliny (*Hist. Nat.* xxxvi. 58, Valp. ed.), was probably identical with our chalk. (On the chalk of the ancients, consult Beckmann's *Hist. of Invent.* i. 212)

NATURAL HISTORY.—Carbonate of lime occurs in both kingdoms of nature.

(*a.*) *In the inorganized kingdom.*—It forms a considerable portion of the known crust of the earth, and occurs in rocks of various ages. It is found in the inferior stratified rocks, but more abundantly in the different groups of the fossiliferous rocks, particularly towards the central and higher parts of the series (De la Beche, *Researches in Theoretical Geology*, 21.)

In the crystallized form it constitutes calcareous spar and arragonite. The first of these is most extensively distributed, and presents itself under many hundred varieties of shapes, the primitive form of all being the rhombohedron.

Granular carbonate of lime (the *granular limestone* of mineralogists) more commonly occurs in beds, but sometimes constitutes entire mountains. The whitest and most esteemed primitive limestone is that called *statuary marble*, or, from its resemblance to white sugar, *saccharoid carbonate of lime*. That from Carrara, on the eastern coast of the Gulf of Genoa, is the kind usually employed by the statuary, and being very pure, may be employed for pharmaceutical purposes.

Chalk constitutes the newest of the secondary rocks, and occurs abundantly in the southern parts of England. It lies in beds, and contains abundance of marine as well as terrestrial organic remains. The upper part of a considerable portion of the chalk of England contains numerous flints, which are supposed by some (Dr. Grant, *Lect. on Comp. Anat.* in the *Lancet*, Nov. 2, 1833) to have once belonged to poriferous animals.

There are various other native forms of carbonate of lime constituting the substances called by the mineralogist *schiefer spar*, *rock milk*, *earth foam*, *stalactitic carbonate of lime*, *anthraconite*, *oolite*, *pisolite*, *marl*, *tufa*, &c.

Carbonate of lime is an ordinary ingredient in mineral and common waters, being held in solution by carbonic acid, and, therefore, deposited when this is expelled by boiling or otherwise.

(*b.*) *In the organized kingdom.*—Carbonate of lime is a constituent of some plants, and is obtained from the ashes of most. It is an abundant constituent of animals, especially of the lower classes. Thus in the radiate animals we find it in the hard parts of corals, madrepores, &c.; in the molluscs, in the shells (as in the oyster). In the articulated animals it forms, with phosphate of lime, the crusts which envelop these

animals (as the crab and lobster); in the higher classes it is found in bone, but the quantity of it is very small.

Preparation.—In the Dublin Pharmacopœia, carbonate of lime (*calcis carbonas præcipitatum*, Ph. D.) is ordered to be prepared by adding a solution of carbonate of soda to a solution of chloride of calcium: double decomposition takes place, chloride of sodium is formed in solution, and carbonate of lime precipitated. Thus prepared, carbonate of lime is directed to be used in the preparation of *hydrargyrum cum cretâ*. By some druggists it is employed, instead of prepared chalk, in the manufacture of aromatic confection.

Marble (*marmor*, Ph. L., *marmor album*, Ph. D. & Ed.), or hard carbonate of lime (*carbonas calcis durus*, Ph. L.) is employed for the production of carbonic acid (*vide* p. 190); and, in some Pharmacopœias, for the preparation of chloride of calcium. For the latter purpose, especially, white or statuary marble should be selected, on account of its freedom from iron.

Chalk (*creta*, Ph. L., *creta alba*, Ph. Dub. & Ed.) or friable carbonate of lime (*calcis carbonas friabilis*, Ph. L., *carbonas calcis mollior*, Ph. Ed.) is found in great abundance in the southern parts of England. To reduce it to a fine state of division, and to deprive it of its coarser parts, it is submitted to the process of elutriation, and is then called *prepared chalk* (*creta præparata*, Ph. L. & Dub., *carbonas calcis præparatus*, Ph. Ed. & U. S.)

Carbonate of lime is prepared, for medical purposes, from several molluscous animals; as from the shell of the oyster (*Ostrea edulis*), the gastric concretions (called *crabs' eyes* or *stones*) of the crawfish (*Astacus fluviatilis*), and the crustaceous envelope of the claws of the crab (*Cancer pagurus*). The carbonate procured from these sources is called, respectively, *testæ præparatæ* (Ph. L.), *lapilli cancrorum*, and *chelæ cancrorum*, and will be described in a subsequent part of this work (*vide Animal Materia Medica*).

Properties.—Pure carbonate of lime is a tasteless, odourless solid. When heated to redness in a current of air its carbonic acid is expelled, leaving quicklime. It is almost insoluble in water; one part of carbonate requiring 1600 parts of water to dissolve it. It is much more soluble in carbonic acid water: the solution reddens litmus, but changes the yellow colour of turmeric paper to brown; and by boiling, or exposure to the air, gives out its carbonic acid, by which the carbonate of lime is deposited.

Carbonate of lime is a dimorphous substance; that is, it crystallizes in two distinct and incompatible series of forms,—viz. those of the rhombohedric system (calcareous spar), and those of the right rectangular prismatic system (arragonite). According to Gustav Rose (*Lond. & Ed. Phil. Mag.* June 1838), both calcareous spar and arragonite may be formed in the humid way, but the first at a lower, the latter at a higher temperature: in the dry way, calcareous spar alone is formed. Both minerals doubly refract the rays of light, and expand unequally in their different parts when heated; but calcareous spar has only one axis of no double refraction, whereas arragonite has two.

Single system of rings seen by looking through a slice of calcareous spar (cut perpendicular to the axis of the crystal) placed between two plates of tourmaline (cut parallel to the axis of the crystal).

FIG. 54.

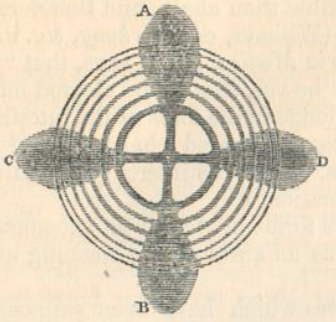


FIG. 55.

Fig. 54 is seen when the plane of the axis of the calcareous spar is parallel or perpendicular to the plane of polarization. Fig. 55 is seen when the calcareous spar is turned 45°.

Granular limestone (of which white marble is the purest kind) is massive, and consists of small grains or minute crystals, presenting a lamellar structure and brilliant lustre, but intersecting each other in every direction, and thereby giving a glimmering lustre to the mass.

Chalk is massive, opaque when pure white, and has an earthy fracture. It is usually soft to the touch, and adheres to the tongue.

CHARACTERISTICS.—Carbonate of lime is recognized as a carbonate by the tests already mentioned for this class of salts (p. 191). As a calcareous salt it is known by the characters before described (p. 343) for lime.

COMPOSITION.—Carbonate of lime has the following composition:—

	Eq.	Eq. Wt.	Per Cent.	Marcet.	Stromeyer.	Berzelius; Ure.
Lime	1	28	56	56·1	56·35	56·4
Carbonic Acid	1	22	44	43·9	43·65	43·6
Carbonate of Lime	1	50	100	100·0	100·00	100·0

PURITY.—Pure marble or chalk should be perfectly soluble, with effervescence, in hydrochloric acid, by which the absence of silica is shown. Ammonia should not cause any precipitate with this solution, by which its freedom from alumina, oxide of iron, &c. may be inferred: nor should a solution of sulphate of lime throw down any thing by which the absence of baryta and strontian is proved.

PHYSIOLOGICAL EFFECTS.—The local effects of chalk are those of an absorbent, antacid, and mild desiccant. When swallowed it neutralizes the free acid of the gastric juice, and in this way alone must, by continued use, injure the digestive functions. It causes constipation, an effect commonly observed from the use of a few doses in diarrhœa. By the action of the free acids (acetic and hydrochloric) of the alimentary canal, it is converted into two soluble calcareous salts (acetate of lime and chloride of calcium), which become absorbed. Hence the continued use of carbonate of lime is attended with the constitutional effects of the calcareous salts, and consequently the statements which have been made as to the influence of chalk over the lymphatic vessels and glands, and

its effect in diminishing excessive secretion, may be correct. Sundelin (*Heilmittellehre*, i. 179) thinks it may even promote the deposit of bone-earth in diseases attended with a deficiency of this substance. Carbonate of lime, prepared from animal matter, has been erroneously supposed to be more digestible than chalk, and therefore less likely to occasion dyspeptic symptoms (Wibmer, *die Wirkung*, &c. ii. 10). Dr. A. T. Thomson (*Elements of Materia Medica*, ii. 82) says, that "after chalk has been used for some time, the bowels should be cleared out, as it is apt to form into hard balls, and to lodge in the folds of the intestines."

Uses.—As an *absorbent* and *desiccant*, prepared chalk is used as a dusting powder in moist excoriations, ulcers, the intertrigo of children, burns and scalds, erysipelatous inflammation, &c.

As an *antacid* it is exhibited in those forms of dyspepsia accompanied with excessive secretion of acid; and as an antidote in poisoning by the mineral and oxalic acids.

It has also been used in some diseases which have been supposed to depend on, or be accompanied by, excess of acid in the system—as in gouty affections, which are usually attended with the excessive production of uric acid, and in rachitis, which some have ascribed to a preponderance of phosphoric acid, or to a deficiency of lime in the system.

To diminish alvine evacuations, it is employed in diarrhœa. Its efficacy can hardly be referred solely to its antacid properties; for other antacids are not equally successful. Moreover, in many cases of diarrhœa in which chalk is serviceable, no excess of acidity can be shown to exist in the bowels. Aromatics are useful adjuncts to chalk in most forms of diarrhœa. In old obstinate cases, astringents (as catechu or kino) may be conjoined with great advantage; and in severe cases, accompanied with griping pains, opium.

Administration.—Prepared chalk is given in the form of powder or mixture, in doses of from ten grains to one or two drachms. It enters into a considerable number of officinal preparations.

1. *Mistura Cretæ*, Ph. L. & Dub.; *Potio Carbonatis Calcis*, Ph. Ed.; *Mistura Calcis Carbonatis*, Ph. U. S. (Prepared chalk, ℥ss.; sugar, ʒiij.; mixture of acacia, f. ʒiss.; cinnamon water, ℥xviii. *Ph. L.*) In the other Pharmacopœias the proportions are somewhat different. This is a very convenient form for the exhibition of chalk, and is in common use in diarrhœa. Aromatics (as the aromatic confection), astringents (as kino or catechu), or narcotics (as opium), are frequently combined with it. The dose is from one to three table-spoonfuls.

2. *Pulvis Cretæ Compositus*, Ph. L. & Dub. (Prepared chalk, ℔ss.; cinnamon, ʒiv.; tormentil and acacia, āā. ʒiij.; long pepper, ʒss.):—This preparation is aromatic and astringent, and is used in diarrhœa. The dose is from 10 to 20 grains. The *pulvis carbonatis calcis compositus* (Ph. Ed.) consists of chalk flavoured with nutmegs and cinnamon.

3. *Confectio Aromatica*, Ph. L. & Dub. (Prepared chalk, ℥xvi.; cinnamon and nutmegs, āā. ʒij.; cloves, ʒj.; cardamoms, ʒss.; saffron, ʒij.; [water, ℔j., Ph. D.]) The London College order the water to be added when the preparation is used, in order to avoid fermentation, to which this compound is subject. Druggists sometimes substitute a strong infusion of saffron instead of the solid saffron here ordered; and those who are desirous of producing a very fine preparation, employ precipitated carbonate of lime instead of chalk. This preparation possesses the

combined properties of chalk and spices (p. 72). It is therefore antacid, aromatic, and stimulant. It is frequently added to the ordinary chalk mixture in diarrhœa, and is employed on various other occasions where spices are indicated. The dose of it is from 10 grains to a drachm.

Cal'cis Phos'phas.—Phos'phate of Lime.

History.—Scheele, in 1769, discovered phosphate of lime in bones.

Natural History.—Phosphate of lime is found in both kingdoms of nature.

(*a.*) *In the inorganized kingdom.*—It is a constituent of the mineral termed *Apatite*, and of some mineral waters; as those of Karlsbad Sprudel, and of Franzensbrunn, near Eger.

(*b.*) *In the organized kingdom.*—It has been found in some plants, and much more frequently and copiously in animals. Thus it constitutes the principal part of the earthy matter of the bones of the vertebrata, and a portion of the crusts of the articulata.

Preparation.—Phosphoric acid combines with lime in several proportions, forming *basic*, *neutral*, and *acid* salts. The compound used in medicine is a *sub-* or $\frac{2}{3}$ *phosphate of lime*. When obtained by calcining bones in an open vessel, it is called *earth of bones* (*terra ossium*) or *bone-ash* (*ossa usta ulba; o. deusta; o. ad albedinem usta; o. calcinata; spodium album*), and contains some carbonate of lime and other matters mixed with it. If bone-ash be digested in diluted hydrochloric acid, and caustic ammonia added to the filtered solution, phosphate of lime, free from carbonate, is thrown down in a very minute state of division, and when washed and dried, it constitutes the *precipitated phosphate of lime* (*calcis phosphas præcipitatum*) of the Dublin Pharmacopœia. When the horns (*cornua*) of the deer (*cervus*) are calcined in a an open vessel until they become perfectly white, and the residual ash (sub-phosphate of lime) prepared by elutriation (as creta præparata) we obtain *burnt hartshorn* (*cornu ustum*, Ph. L.; *cornu ustum præparatum*).

Properties.—Subsesquiphosphate of lime is white, tasteless, odourless, insoluble in water, but soluble in nitric, hydrochloric, and acetic acids, from which solutions it is thrown down unchanged, in composition, by ammonia, potash, and their carbonates. When exposed to a very intense heat, it fuses, and undergoes no other change. The primary form of the crystals of apatite (native subsesquiphosphate of lime) is the six-sided prism.

Characteristics.—It is known to be a phosphate by its solubility in hydrochloric acid, and its being again thrown down as a white precipitate when the acid solution is supersaturated with caustic ammonia. If it be digested in a mixture of sulphuric acid and alcohol, sulphate of lime is precipitated, and an alcoholic solution of phosphoric acid obtained. The acid may then be recognised by the tests for it already mentioned (p. 253). If the precipitated sulphate of lime be dissolved in water, the solution may be known to contain lime by the tests before described for the calcareous salts (p. 343). The subsesquiphosphate of lime of bones is distinguished from the neutral phosphate by its fusing with greater difficulty, and dissolving more readily in hydrochloric acid. A very delicate test of the neutral phosphate is its crystallizing from hydrochloric acid by evaporation (Wollaston, *Phil. Trans.* for 1797, p. 396 & 397).

Composition.—The composition of subsesquiphosphate of lime is as follows :—

	Eq.	Eq. Wt.	Per Cent.	Berzelius. (Artificial.)	Fuchs. (Artificial.)	Vauquelin. (Apatite.)
Lime	1½	42	53·85	51·68	54·74	54·28
Phosphoric Acid	1	36	46·15	48·32	45·26	45·72
Subsesquiphosphate of Lime	1	78	100·00	100·00	100·00	100·00

Bone-ash obtained from the bones of the ox consists of subsesquiphosphate of lime, carbonate of lime, phosphate of magnesia, and a trace of fluoride of calcium.

Physiological Effects.—Its effects are not very obvious. "As phosphate of lime is very difficultly soluble," observes Wibmer (*die Wirkung*, &c. ii. 9), "it is absorbed in small quantity only, and then acts more or less like lime, as a slight astringent on the tissues and the secretions, and increases, incontestibly, the presence of calcareous salts in the bones, the blood, and the urine. Large doses disorder the stomach and digestion by their difficult solubility."

Uses.—It has been administered in rickets, with the view of promoting the deposition of bone-earth in the bones. The sesquioxide of iron may be advantageously conjoined with it.

Administration.—The dose of subsesquiphosphate of lime is from ten grains to half a drachm. For internal use the preparation of the Dublin College is to be preferred.

Order 14. Compounds of Magnesium.

Magne'sia.—Magne'sia.

History.—It was first chemically distinguished from lime in 1755, by Dr. Black, who also shewed the difference between magnesia and its carbonate. From the mode of procuring it, it is frequently termed *calcined* or *burnt magnesia* (*magnesia calcinata* seu *usta*.) It is sometimes called *talc earth* (*Talkerde*), or *bitter earth* (*Bittersalzerde*.)

Natural History.—It occurs in both kingdoms of nature.

(*a*.) *In the inorganized kingdom.*—Magnesia is found native, in the solid state or in solution, in sea or some mineral waters, in combination with water and various acids (carbonic, sulphuric, boracic, silicic, and nitric.) Chloride of magnesium exists in sea water, as also in some springs.

(*b*.) *In the organized kingdom.*—Combined with acids it is found in some vegetables (as *Salsola Kali* and *Fucus vesiculosus*), and animals (as in the urine and some urinary calculi of man.)

Preparation.—Magnesia is obtained by exposing the subcarbonate to a full red heat for two hours in a crucible, so as to drive off the carbonic acid.

Properties.—It is a light, fine, white, colourless, odourless, and tasteless powder, having a sp. gr. 2·3. When moistened with water it reacts as an alkali on test papers. It is very slightly soluble in water, and like lime is more soluble in cold than in hot water. Dr. Fyffe states that it requires 5142 parts of cold, and 36000 parts of hot water to dissolve it. Unlike lime it evolves scarcely any heat when mixed with water. By the combined voltaic and oxy-hydrogen flames it has been fused by Mr. Brande (*Manual of Chemistry*.) It absorbs carbonic acid slowly from the atmosphere.