Order XV.—COMPOUNDS OF MAGNESIUM.

1. MAGNE'SIA, *L. E. D.* (U. S.)—MAGNESIA.

History.—It was first chemically distinguished from lime in 1755, by Dr. Black, who also showed 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.

α. 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.

β. 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.—It is prepared by submitting the common carbonate of magnesia to heat, whereby the carbonic acid is driven off.

The *Edinburgh College* gives the following directions for it:—"Take any convenient quantity of Carbonate of Magnesia, expose it in a crucible to a full red heat for two hours, or till the powder, when suspended in water, presents no effervescence on the addition of muriatic acid. Preserve the product in well-closed bottles."

The directions of the *London* and *Dublin Colleges* are essentially similar. [And so are those of the U. S. Pharmacopœia.]

The operation is usually conducted in large, porous, covered crucibles, placed in a furnace expressly devoted to this operation, and heated by coke.

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.

Characteristics.—It is soluble in the dilute mineral acids without effervescence. The dilute solution does not occasion any precipitate with the ferrocyanides, hydrosulphurets, oxalates, or bicarbonates. The neutral alkaline carbonates, when unmixed with any bicarbonate, throw down a white precipitate (*carbonate of magnesia.*) Ammonia with phosphate of soda causes a white precipitate (*ammoniacal-phosphate of magnesia.*) Magnesia is insoluble in alkaline solutions, and is thereby distinguished from alumina. Its solution in sulphuric acid is remarkable for its great bitterness.

Composition.—Magnesia has the following composition:—

	Atoms.	*Eq. Wt.*	*Per Cent.*	*Wollaston.*	*Gay-Lussac.*	*Berzelius.*
Magnesium	1	12	60	59·3	59·5	61·29
Oxygen	1	8	40	40·7	40·5	38·71
Magnesia	1	20	100	100·0	100·0	100·00

Purity.—Its freedom from any carbonate is shown by its dissolving in dilute mineral acids without effervescence. Its hydrochloric solution should occasion no precipitate with the oxalates, bicarbonates, and barytic salts, by which the absence of lime and sulphates may be inferred.

Dissolves in hydrochloric acid without effervescence. Neither bicarbonate of potash nor chloride of barium throws down any thing from the solution. It turns turmeric slightly brown. *Ph. Lond.*

"Fifty grains are entirely soluble, without effervescence, in a fluid ounce of [pure] muriatic acid: an excess of ammonia occasions in the solution only a scanty precipitate of alumina: the filtered fluid is not precipitated by solution of oxalate of ammonia."

The quantity of hydrochloric acid directed to be used by the Edinburgh College is unnecessarily large.

Physiological Effects.—When taken into the stomach, magnesia neutralizes the free acids contained in the stomach and intestines, and forms therewith soluble magnesian salts. In full doses it acts as a laxative; but as it occasions very little serous discharge, Dr. Paris (*Pharmacologia*, vol. i. art. *Cathartics.*) ranks it among purgatives "which urge the bowels to evacuate their contents by an imperceptible action upon the muscular fibres." Part of its laxative effect probably depends on the action of the soluble magnesian salts which it forms by union with the acids of the alimentary canal. Magnesia exercises an influence over the urine analogous to that of the alkalis: that is, it diminishes the quantity of uric acid in the urine, and when continued for too long a period occasions the deposite of the earthy phosphates in the form of white sand. (W. T. Brande, *Phil. Trans.* 1810, p. 136; and 1813, p. 213.) On account of its greater insolubility, it requires a longer time to produce these effects than the alkalis. When taken in too large quantities and for a long period it has sometimes accumulated in the bowels to an enormous extent, and being concreted by the mucus of the bowels, has created unpleasant effects. A lady took every night during two years and a half, from one to two tea-spoonsful of Henry's calcined magnesia (in all between 9 and 10 lbs. troy) for a nephritic attack, accompanied with the passage of gravel; subsequently she became sensible of a tenderness in the left side just above the groin, connected with a deep-seated tumour, obscurely to be felt on pressure, and subject to attacks of constipation, with painful spasmodic action of the bowels, tenesmus, and a highly irritable state of stomach. During one of these attacks she evacuated two pints of "sand;" and on another occasion voided soft light brown lumps, which were found to consist entirely of carbonate of magnesia concreted by the mucus of the bowels, in the proportion of 40 per cent. In another case a mass of a similar description, weighing from 4 to 6 lbs., was found imbedded in the head of the colon, six months after the patient had ceased to employ any magnesia. (E. Brande, *Quart. Journ. of Science*, i. 297.)

Uses.—As an *antacid* it is as efficacious as the alkalis, while it has an advantage over them in being less irritant, and thereby is not so apt to occasion disorder of the digestive organs. It may be employed to neutralize acids introduced into the stomach from without, (as in cases of poisoning by the mineral acids) or to prevent the excessive formation of, or to neutralize when formed, acid in the animal economy. Thus it is administered to relieve heartburn arising from, or connected with, the secretion of an abnormal quantity of acid by the stomach; its efficacy is best seen in persons of a gouty or rheumatic diathesis, in which the urine contains excess of uric acid. It often relieves the headach to which such individuals are not unfrequently subject. It is most efficacious in diminishing the quantity of uric acid in the urine, in calculous complaints, and according to Mr. W. T. Brande (*Phil. Trans.* 1813, p. 213.) it is sometimes effectual where the alkalis have failed. It will be found of great value in those urinary affections in which alkaline remedies are indicated, but in which potash and soda have created dyspeptic symptoms. It is a most valuable anti-emetic in cases of sympathetic vomiting, especially that which occurs during pregnancy.[1] It should be given in doses of from a scruple to a drachm in simple water or chicken broth.

As a *laxative*, magnesia is much employed in the treatment of the diseases of children. It is tasteless, mild in its operation, and antacid,—qualities which render it most valuable as an infant's purgative. Independently of these, Hufe-

[1] Dr. Watson, in the *Medical Observ. and Inquiries*, vol. iii. p. 335. Lond. 1769, 2d ed.

land ascribes to it a specific property of diminishing gastro-intestinal irritation by a directly sedative influence. In flatulency it is combined with some carminative water (dill or anise:) in diarrhœa, with rhubarb. It is employed as a purgative by adults in dyspeptic cases—in affections of the rectum, as piles and stricture—and in diarrhœa. It is associated with the carminative waters—with some neutral salts, as sulphate of magnesia, to increase its cathartic operation—or, in diarrhœa, with rhubarb.

Administration.—As a purgative, the dose, for adults, is from a scruple to a drachm; for infants, from two to ten grains. As an antacid, the dose is from ten to thirty grains twice a-day. It may be conveniently given in milk. It is sometimes administered in combination with lemon juice: the *citrate of magnesia* thus formed acts as a pleasant and mild aperient.

2. MAGNE'SIÆ CAR'BONAS, *L. E. D.* (U. S.)—CARBONATE OF MAGNESIA.

History.—Carbonate of magnesia, also called *Magnesia Alba* and *Subcarbonate of Magnesia*, was exposed for sale at Rome at the commencement of the 18th century, by Count di Palma, in consequence of which it was termed *Comitissæ Palmæ pulvis*. In 1707, Valentini informed the public how it might be prepared.

Natural History.—Native, anhydrous, neutral carbonate of magnesia is found in various parts of Europe, Asia, and America. Carbonate of magnesia is found in some mineral waters.

The native neutral carbonate of magnesia constitutes a range of low hills in Hindostan. Some years ago a cargo of it was brought over by Mr. Babington. Dr. Henry (*Annals of Philosophy*, N. S. vol. i. p. 252.) analyzed a sample of it, and found its constituents to be *magnesia*, 46; *carbonic acid*, 51; *insoluble matter*, 1·5; *water*, 0·5; and *loss*, 1· = 100.

Native carbonate of magnesia, from India, has been imported in considerable quantities into this country; but has been found, as I am informed, unsaleable here. The samples offered for sale in the year 1837 consisted of reniform, opaque, dull masses, adherent to the tongue, having a conchoidal fracture, and considerable hardness. Internally, they were whitish; externally, they were grayish, or yellowish white.

The same substance (I presume) was brought over in 1838 in the calcined state, and was offered for sale as *Indian Calcined Magnesia*. It was nearly white.

Preparation.—All the British Colleges give directions for the preparation of carbonate of magnesia.

The *London College* orders of Sulphate of Magnesia, lbiv.; Carbonate of Soda, lbiv. and ℥viij.; Distilled Water, *Cong.* iv. Dissolve separately the carbonate of soda and sulphate of magnesia in two gallons of the water, and strain; then mix and boil the liquors, stirring constantly with a spatula for a quarter of an hour; lastly, the liquor being poured off, wash the precipitated powder with boiling distilled water, and dry it.

The *Edinburgh College* employs the same proportions of ingredients, and gives similar directions for the preparation of this compound.

The *Dublin College* uses of Sulphate of Magnesia, *twenty five parts*; Carbonate of Potash, *twenty-four parts*; Boiling Water, *four hundred parts*.

Two kinds of carbonate of magnesia are known and kept in the shops;—the *light* and the *heavy*.

α. *Light Carbonate of Magnesia; Common Magnesia.*—This is manufactured in the northern parts of this island, and is commonly known as *Scotch Magnesia*. It is said to be prepared from the residuary liquor (*bittern*) of sea water, after the extraction of common salt (see p. 452.)

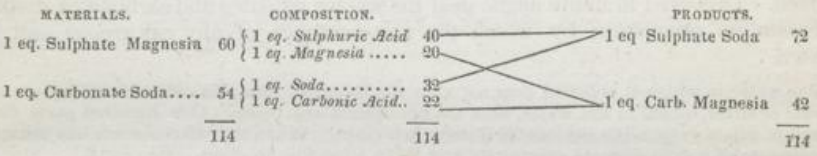
β. *Heavy Carbonate of Magnesia; Magnesia Ponderosa.*—The following is the method which I have seen followed in a large and esteemed manufactory:—Add one volume of a cold saturated solution of carbonate of soda to a boiling mixture of one volume of a saturated solution of sulphate magnesia, and three volumes of water. Boil until effervescence has ceased, constantly stirring with a spatula. Then dilute with boiling water, set aside, pour off the supernatant

liquor, and wash the precipitate with hot water on a linen cloth: afterwards dry it by heat in an iron pot.

A *heavy* and *gritty Carbonate of Magnesia* is prepared by separately dissolving twelve parts of sulphate magnesia and thirteen parts of crystallized carbonate of soda in as small a quantity of water as possible, mixing the hot solutions, and washing the precipitate.

When cold solutions of sulphate of magnesia and carbonate of soda are mixed, and no heat is employed, the product is apt to be gritty. According to Professor Graham, (*Elements of Chemistry*, p. 505.) carbonate of soda is not so suitable as carbonate of potash for precipitating magnesia, "as a portion of it is apt to go down in combination with the magnesian carbonate; but it may be used provided the quantity applied be less than is required to decompose the whole magnesian salt in solution."

By the mutual reaction of solutions of sulphate of magnesia and carbonate of soda, we obtain, by double decomposition, sulphate of soda and carbonate of magnesia.



During the ebullition, however, part of the carbonic acid escapes, and the product, therefore, is not a neutral carbonate, as will be shown presently.

Berzelius (*Traité de Chimie*, t. iv.) states, that the neutral carbonate is decomposed by cold water into bicarbonate, which is dissolved in the liquid, and a subsalt which is precipitated. Boiling water, he adds, causes the disengagement of carbonic acid without dissolving any thing. "The crystallized carbonate of magnesia loses a third of its carbonic acid, and two-thirds of its water, when it is decomposed by boiling water" (*Berzelius.*) The compound obtained by ebullition is fixed and unalterable.

Properties.—Carbonate of magnesia, as usually met with, is in the form of a white, inodorous, and almost tasteless powder. The *common* or *light* variety occurs in commerce as a very fine light powder, of which 48 grains lightly fill an ounce measure. (West, *Lond. Med. Gaz.* vol. ix. p. 356.) It is also met with in large rectangular masses with bevelled edges, or in smaller cubical cakes. The light powder mixes imperfectly with water. Its taste, in a copious draught, is somewhat disagreeable, owing probably to its having been imperfectly washed. The *heavy* carbonate is, as its name indicates, of greater specific gravity than the light. 160 grains of it lightly fill an ounce measure. It is tasteless, or nearly so. Both kinds mixed with water have a feebly alkaline reaction on test paper. Carbonate of magnesia is nearly insoluble in water: it readily dissolves in carbonic acid water.

Characteristics.—It is distinguished from caustic or calcined magnesia by the effervescence which takes place on the addition of a dilute mineral acid. Its other characteristics are the same as for the latter substance (vide p. 506.)

Composition.—The following is the composition of Carbonate of Magnesia of the shops:—

	Kirwan.	*Bergman.*	*Klaproth.*	*Bucholz*		*Berzelius.*	*Phillips.*
				Light.	Heavy.		
Magnesia	45	45	40	33	42	44·75	40·8
Carbonic Acid	34	25	33	32	35	35·77	36·0
Water	21	30	27	35	23	19·48	23·2
Magnesia alba	100	100	100	100	100	100·00	100·0

Several reasons have led chemists to reject the idea of this compound being an ordinary subsalt. (Vide Berzelius, *Traité de Chim.* vi. 101.)

Mr. Philips (*Translation of the Pharmacopœia*, 4th ed.) considers it to be probably a compound of

	Atoms.	*Eq. Wt.*			*Per Cent.*
Bihydrated Magnesia	1	38	or	Carbonic Acid	36·3
Hydrated Carbonate of Magnesia	4	204		Magnesia	41·3
				Water	22·4
Carbonate Magnesia, *Ph. L.*	1	242			100·0

Mr. Brande, (*Manual of Chemistry*, 5th edit. p. 714.) on the other hand, says that it probably consists "of 1 atom quadrihydrate and 1 atom of carbonate," or perhaps of 1 atom terhydrate and 1 atom of hydrated carbonate.

Purity.—Carbonate of magnesia should be perfectly white and tasteless. The water in which it has been boiled should have no alkaline reaction on turmeric paper, nor throw down any thing on the addition of chloride of barium or nitrate of silver: by which the absence of alkaline carbonates, sulphates, and chlorides, is proved. Dissolved in dilute acetic acid the soluble oxalates and carbonates should occasion no precipitate, by which the non-existence of any calcareous salt is shown.

The water in which it is boiled does not alter the colour of turmeric: chloride of barium or nitrate of silver, added to the water, does not precipitate any thing. One hundred parts dissolved in dilute sulphuric acid lose 36·6 parts in weight. When the effervescence has ceased, bicarbonate of potash does not precipitate any thing from this solution. *Ph. Lond.*

"When dissolved in an excess of muriatic acid, an excess of ammonia occasions only a scanty precipitate of alumina; and the filtered fluid is not precipitated by oxalate of ammonia." *Ph. Ed.*

Physiological Effects.—The effects of carbonate of magnesia are nearly the same as those of pure magnesia. We can readily conceive that the local operation of the first is somewhat milder than that of the latter (as in the case of the alkalis and their carbonates,) but the difference is hardly perceptible in practice. As the carbonate effervesces with acids it is more apt to create flatulence when swallowed.

Uses.—The uses of the carbonate are the same as those of calcined magnesia: except where the object is to neutralize acid in the alimentary canal (as in cardialgia and in poisoning by the mineral acids,) when the latter preparation is to be preferred on account of its not effervescing with acids, and thereby not causing flatulency. It is employed in the preparation of medicated waters (see p. 242.)

Administration.—The dose of carbonate of magnesia, as a purgative, is from ten grains to a drachm; as an antacid, from five grains to a scruple. It is sometimes given with citric acid in an effervescing form. I find that ℈j. of crystallized citric acid saturates about 14 grs. of either light or heavy magnesia. The product of their reaction is *citrate of magnesia.*

1. TROCHISCI MAGNESIÆ, E. *Magnesia Lozenges.* (Carbonate of Magnesia, ℥vj.; Pure Sugar, ℥iij.; Nutmeg, ℈j. Pulverize them, and, with mucilage of Tragacanth, beat them into a proper mass for making lozenges.)—Employed to counteract acidity of stomach.

2. AQUA MAGNESIÆ BICARBONATIS; *Carbonated Magnesia Water; Aerated Magnesia Water: Condensed Soution of Magnesia; Fluid Magnesia.*—This is a solution of carbonate of magnesia in carbonic acid water. Mr. Dinneford prepares it as follows:—Howard's heavy carbonate of magnesia and distilled water (in the proportion of 17½ grs. of the former to f℥j. of the latter) are introduced into a cylindrical tinned copper vessel, and carbonic acid (generated by the action of sulphuric acid on whiting) is forced into it, by means of steam power, for five hours and a half, during the whole of which time the cylinder is kept revolving. The

liquid, which is then perfectly clear and transparent, is drawn off, and preserved in cylindrical zinc canisters, each closed by a cork covered by a lid. When this solution is exposed for some time to the air, carbonic acid escapes, and minute prismatic crystals are deposited, which Dr. Davy (*Lond. and Edinb. Phil. Mag.* vol. xvii. p. 346. 1840.) analyzed, and found to consist of—

	Atoms.	*Eq. Wt.*	*Dr. Davy.*
Magnesia	1½	30	29·61
Carbonic Acid	1½	33	32·22
Water expelled at 212°	1	9	10·27
Ditto ditto by ignition	3	27	27·90
Hydrated Carbonate of Magnesia	1	99	100·00

An extemporaneous solution of carbonate of magnesia may be prepared by pouring the ordinary soda water (carbonic acid water) over the common carbonate of magnesia contained in a tumbler. Or a mixture of crystallized sulphate of magnesia and crystallized carbonate of soda, in powder, and in atomic proportions (viz. 123 parts of the former to 144 parts of the latter salt) may be substituted for the carbonate of magnesia.

Carbonated magnesia water is a very agreeable and effective form for the administration of magnesia.

3. MAGNE'SIÆ SUL'PHAS, *L. E. D.* (U. S.)—SULPHATE OF MAGNESIA.

History.—This salt was originally procured from the Epsom waters by Dr. Grew. (*A Treatise of the Nature and Use of the Bitter Purging Salt.* Lond. 1697.) It has had a variety of names, such as *Epsom* or the *Bitter Purging Salt*, *Sal Anglicum*, *Sal Seidlitzense*, *Sal Cathartícum*, and *Vitriolated Magnesia.*

Natural History.—It is a constituent of sea and many mineral waters: it occurs as an efflorescence on other minerals, forming the *Hair Salt* of mineralogists; and with sulphate of soda and a little chloride of magnesium, constitutes *Reussite.*

Preparation.—The two great sources of the sulphate of magnesia of English commerce are *Dolomite* and *Bittern*

α. **From Dolomite.**—Dolomite or Magnesian Limestone is a mixture or combination of the carbonates of magnesia and lime. It crystallizes in rhombohedrons. It occurs in enormous quantities in various counties of England (as those of Somerset, York, and Nottingham,) and is employed for building: York Minster and Westminster Hall are built of it.

Various methods of manufacturing sulphate of magnesia from dolomite have been proposed and practised. One method is to heat this mineral with dilute sulphuric acid: carbonic acid escapes, and a residue, composed of sulphate of magnesia and sulphate of lime, is obtained. These two salts are separated from each other by crystallization.

In 1816, Dr. William Henry, of Manchester, (*Repert. of Arts*, vol. xxx. p. 142, 2d Ser.) took out a patent for the following process:—Calcine magnesian limestone, so as to expel the carbonic acid; then convert the caustic lime and magnesia into hydrates by moistening them with water. Afterwards add a sufficient quantity of hydrochloric (or nitric or acetic) acid (or chlorine,) to dissolve the lime, but not the magnesia, which, after being washed, is converted into sulphate by sulphuric acid (or, where the cost of this is objectionable, by sulphate of iron, which is easily decomposed by magnesia.) Or the mixed hydrates of lime and magnesia are to be added to bittern: chloride of calcium is formed in solution, while two portions of magnesia (one from the bittern, the other from the magnesian lime) are left unacted on. Or hydrochlorate of ammonia may be used instead of bittern: by the reaction of this on the hydrated magnesian lime, chloride of calcium and caustic ammonia remain in solution, while magnesia

is left undissolved: the ammonia is separated from the decanted liquor by distillation.

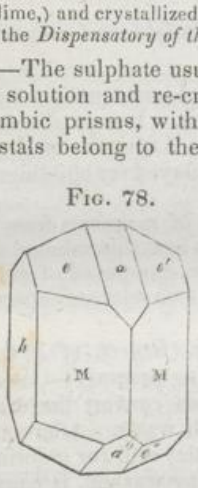
Carbonate of ammonia has also been employed to separate lime from magnesia: carbonate of lime is precipitated, and the magnesia remains in solution, from which it may be easily separated by ebullition. (*Journ. of Science*, iii. 217; vi. 313; ix. 177.)

β. **From Bittern.**—*Bittern* or the *Bitter Liquor* is the residual liquor of seawater, from which common salt (chloride of sodium) has been separated (see p. 452.) At Lymington, in Hampshire, sulphate of magnesia (called *physical salt*) is manufactured from bittern during the winter season. The liquor is boiled for some hours in the pans used during the summer for the preparation of common salt. During the ebullition some common salt is deposited. The lighter impurities are removed by skimming, and the concentrated solution is removed into wooden coolers, where in 24 hours one-eighth part of crystals of sulphate (called *Single Epsom Salts*, or simply *Singles*) are deposited. These are drained, dissolved, and recrystallized: they are then denominated *Double Epsom Salts*, or simply *Doubles*. Four or five tons of sulphate are obtained from brine which has yielded 100 tons of common salt and 1 ton of cat salt. (Henry, *Phil. Trans.* for 1810.) No sulphuric acid is employed in the process at Lymington; but, if this acid be added to the residual liquor, a farther quantity of sulphate may be obtained by the decomposition of the chloride of magnesium.

At Monte della Guardia, near Genoa, sulphate of magnesia is manufactured from schistose minerals, containing sulphur, magnesia, copper, and iron. After being roasted, and moistened to convert them into sulphates, they are lixiviated, and the solution is deprived, first, of copper by refuse of iron, and afterwards of iron by lime. (Dr. Holland, *Phil. Trans.* 1816, p. 294.) In Bohemia, sulphate of magnesia is procured, by evaporation, from the waters of Seidlitz and Saidschütz. Hermann (Poggendorff's *Annalen*. xi. 249.) extracts it from liquids containing chloride of magnesium, by means of sulphate of soda. At Baltimore, sulphate of magnesia is procured from the siliceous hydrate of magnesia or *marmolite*, by reducing the mineral to powder, saturating with sulphuric acid, and calcining the dried mass to peroxidize the iron. It is then re-dissolved in water (from which solution the remaining iron is separated by sulphuret of lime,) and crystallized. By a second crystallization it is obtained nearly pure. (D. B. Smith, in the *Dispensatory of the U. S. of America*.)

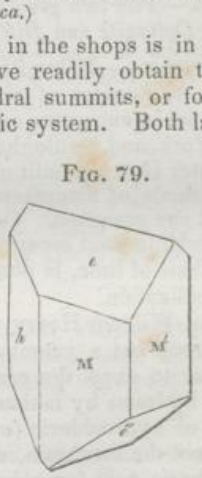
Properties.—The sulphate usually met with in the shops is in small acicular crystals. By solution and re-crystallization we readily obtain tolerably large four-sided rhombic prisms, with reversed diëdral summits, or four-sided pyramids: the crystals belong to the right prismatic system. Both large and small

Fig. 78.



Common Crystal.

Fig. 79.



Crystal with diëdral reversed summits.

crystals are colourless, transparent, and odourless, but have an extremely bitter taste. When heated they undergo the watery fusion, then give out their water of crystallization, become anhydrous, and at a high temperature undergo the igneous fusion, and run into a white enamel, but without suffering decomposition. Ex-

posed to the air they very slowly and slightly effloresce. They dissolve in their own weight of water at 60°, and in three-fourths of their weight of boiling water. They are insoluble in alcohol.

Characteristics.—Sulphate of magnesia is known to contain sulphuric acid by the tests for the sulphates already mentioned (p. 406.) The nature of its base is shown by the tests for magnesia before described (p. 506.)

Composition.—The following is the composition of crystallized sulphate of magnesia:—

	Atoms.	*Eq. Wt.*	*Per Cent.*	*Gay-Lussac.*	*Wenzel.*
Magnesia	1	20	16·26	16·04	16·86
Sulphuric Acid	1	40	32·52	32·53	30·64
Water	7	63	51·22	51·43	52·50
Crystald Sulphate of Magnesia	1	123	100·00	100·00	100·00

Purity.—The sulphate of magnesia met with in the shops is usually sufficiently pure for all medicinal and pharmaceutical purposes. It should be colourless, and its dilute solution should undergo no change when mixed with ferrocyanides or hydrosulphurets. When obtained from bittern it is sometimes contaminated with chloride of magnesium, which, by its affinity for water, keeps the sulphate in a damp state. By digestion in alcohol the chloride is dissolved; and, by evaporation, the spirituous solution may be obtained in the solid state. It is said, that occasionally small crystals of sulphate of soda are intermixed with those of sulphate of magnesia—a fraud I have never met with in English commerce, nor is it likely to occur at the present low price of the magnesian salt. Should such an adulteration be suspected, there are several methods of detecting it: the sophisticated salt would effloresce more rapidly than the pure salt, and would communicate a yellow tinge to the flame of alcohol. Boiled with caustic lime and water, all the magnesian sulphate would be decomposed, and the liquor being filtered (to separate the precipitated magnesia and sulphate of lime) would yield, on evaporation, sulphate of soda. If shaken in the cold with carbonate of baryta, a solution of carbonate of soda would be obtained, easily recognised by its alkaline properties.

Very readily dissolved by water. Sulphuric acid dropped into the solution does not expel any hydrochloric acid. 100 grs. dissolved in water, and mixed with a boiling solution of carbonate of soda, yield 34 grains of carbonate of magnesia when dried. *Ph. Lond.*

The evolution of hydrochloric acid gas would be a proof of the presence of a chloride. If less than 34 grs. of carbonate of magnesia be obtained, the presence of sulphate of soda may be suspected.

"Ten grains dissolved in a fluid-ounce of water, and treated with a solution of carbonate of ammonia, are not entirely precipitated by 280 minims of solution of phosphate of soda." *Ph. Ed.*

Physiological Effects.—Sulphate of magnesia is a mild and perfectly safe antiphlogistic purgative, which promotes the secretion as well as the peristaltic motion of the alimentary canal. It is very similar in its operation to sulphate of soda, than which it is less likely to nauseate, or otherwise disorder the digestive functions, while it acts somewhat more speedily on the bowels. It does not occasion nausea and griping, like some of the vegetable purgatives, nor has it any tendency to create febrile disorder or inflammatory symptoms; but, on the other hand, has a refrigerant influence: hence it is commonly termed a cooling purgative. In small doses, largely diluted with aqueous fluids, it slightly promotes the action of other emunctories: thus, if the skin be kept cool, and moderate exercise be conjoined, it acts as a diuretic; whereas, if the skin be warm, it operates as a diaphoretic. Dr. Christison (*Treatise on Poisons*, 3d edit. p. 603.) mentions a case of supposed poisoning, in a boy of ten years old, by two ounces of Epsom salts. The symptoms were staggering, imperceptible pulse, slow and difficult breathing, extreme debility, and death within ten minutes, without vo-

miting. It may, however, be fairly doubted whether the Epsom salts were chargeable with these effects.

Uses.—On account of the mildness and safety of its operation, its ready solubility, and its cheapness, sulphate of magnesia is by far the most commonly employed purgative, both by the public and the profession.[1] The only objection to its use is its bitter and unpleasant taste. To state all the cases in which it is administered, would be to enumerate nearly the whole catalogue of known diseases. It must, therefore, be sufficient to mention, that it is excellently well adapted as a purgative for febrile and inflammatory diseases, obstinate constipation, ileus, lead colic, even incarcerated hernia, narcotic poisoning, &c. It may be used as an antidote in poisoning by the salts of lead and baryta.

Administration.—As a purgative it is usually administered in doses of from half an ounce to an ounce and a-half; but if dissolved in a large quantity of water, a smaller dose will suffice. Thus, two drachms in half a pint or more of water, taken in the morning fasting, will act speedily, sufficiently, and mildly, in ordinary cases; and in delicate females, a drachm, or even less, in the above quantity of water, will usually produce the desired effect. Some carminative or aromatic (as peppermint water or tincture of ginger) is frequently conjoined, to obviate flatulency. In febrile and inflammatory diseases the solution may be acidulated with dilute sulphuric acid with great advantage; or the sulphate may be dissolved in the compound infusion of roses. It is frequently used as an adjunct to the compound infusion of senna, whose purgative effect it promotes, but whose griping tendency it is said to check. In dyspeptic cases, accompanied with constipation, it is conjoined with bitter infusions (as of quassia, gentian, calumba, &c.) As a purgative enema, an ounce or more of it may be added to the ordinary clyster. The *bitter* purging saline waters (see p. 252) contain sulphate of magnesia.

PULVIS SALINUS COMPOSITUS, E.; *Compound Saline Powder.* (Take of Pure Muriate of Soda, and Sulphate of Magnesia [of each,] ℥iv.; Sulphate of Potash, ℥iij. Dry the salts separately with a gentle heat, and pulverize each, then triturate them well together, and preserve the mixture in well-closed vessels.)—A mild, cooling, saline aperient. May be employed in habitual constipation. Dose, ℥ij. or ℥iij. It may be taken dissolved in half a pint of plain water, or in bottled soda water (carbonic acid water.)

Order XVI.—COMPOUNDS OF ALUMINUM.

ALU'MEN, *L. E. D.* (U. S.)—ALUM.

(Sulphas Aluminæ et Potassæ, *L. E. D.*)

History.—Although the term alum (*Alumen* of the Romans—στυπτηρία of the Greeks) occurs in the writings of Herodotus, (*Euterpe*, clxxx.) Hippocrates, (*De Fistulis De Ulceribus*, &c.) Pliny, (*Hist. Nat.* xxxv.) Dioscorides, (Lib. v. cap. 123.) and other ancient writers, yet it is not satisfactorily proved that our alum was the substance referred to. On the contrary, the learned Beckmann (*Hist. of Invent.* i. 288.) has asserted that the alum of the Greeks and Romans was sulphate of iron, and that the invention of our alum was certainly later than the 12th century. But Geber, (*Search of Perfection*, ch. iii.; and *Invention of Verity*, ch. iv.) who is supposed to have lived in the 8th century, was acquainted with three kinds of our alum, and describes the method of preparing burnt alum; and it is not, I think, improbable, that even Pliny was acquainted with our alum, but did not dis-

[1] Sulphate of magnesia is extensively used in the diseases of cattle. In a letter which I have received from Mr. Youatt, Veterinary Surgeon to the Zoological Gardens, he says—"For cattle we use the sulphate of magnesia or soda. The former is preferable, on account of its easier solution. I purge the larger elephant, whenever I please, by giving him a drachm of calomel at night, and a pound and a-half of Epsom salts in the morning."