## ORDER XII.—COMPOUNDS OF SODIUM.

### 1. SO'DII CHLO'RIDUM, *L.* (U. S.)—CHLORIDE OF SODIUM.

(Sodæ Murias, *E. D.*)

HISTORY.—As this salt is a necessary and indispensable seasoning to our food, it doubtless must have been known to, and employed by, the first individuals of our race. The earliest notice of it occurs in the writings of Moses, (*Gen.* xix. 26; *Lev.* ii. 13.) and Homer. (*Iliad*, lib. ix. 214.) It has received various names, such as *Common Salt*, *Culinary Salt*, and *Muriate* or *Hydrochlorate of Soda.*

NATURAL HISTORY.—It occurs in both kingdoms of nature.

α. IN THE INORGANIZED KINGDOM.—An enormous quantity of this salt is contained in the waters of the ocean. At an average calculation sea water contains 2·5 per cent. of chloride of sodium. (Vide p. 246.) It is found also in great abundance in mineral waters. (Gairdner, *On Mineral Springs*, p. 12.) It has not hitherto been found in the oldest stratified rocks, (De la Bache, *Researches in Theoret. Geol.* p. 31.) but is met with in all the later formations. Thus Mr. Featherstonhaugh (*Phil. Mag.* N. S. vol. v. p. 139; vol. vi. p. 75; and vol. vii. p. 198.) states, that salt or brine springs occur in certain parts of the United States,[1] in the *old transition slate rocks.* Salt springs occur in various parts of England, in the *coal measures.* (Bakewell, *Introd. to Geology*, 4th ed. p. 252.) The rock salt of Cheshire, and the brine springs of Worcestershire, occur in the *old red sandstone group.* (*Trans. Geol. Society*, vol. i. p. 38, and vol. ii. p. 94.) The salt of Ischel, in the Austrian Alps, belongs to the *oolitic group*, (Sedgwick and Murchison, *Phil. Mag.* N. S. vol. viii. p. 102.) as does also that found in the lias in Switzerland. (Bakewell, *op. cit.* p. 253.) The immense mass or bed of salt near Cardona, in Spain, and which has been described by Dr. Traill, (*Trans. Geolog. Society*, vol. iii. p. 404.) occurs in the *cretaceous group.* (De la Bache, *op. cit.* p. 293.) The salt deposite of Wieliczka, near Cracow, belongs to the *supracretaceous group.* (Ibid, p. 270.) Lastly, in the Crimea, salt is said to be daily accumulating in the inland lakes.

β. IN THE ORGANIZED KIDGDOM.—It is found in plants which grow by the sea side, in the blood and urine of man, &c.

PREPARATION.—The salt consumed in this country is procured by the evaporation of the water of brine springs. The salt districts are, Northwich, Middlewich, and Nantwich, in Cheshire; Shirleywich, in Staffordshire; and droitwich, in Worcestershire. In Cheshire the rock salt (called also *Fossil Salt*, *Sal Fossilis* or *Sal Gemmæ*) constitutes two beds, which vary in thickness from 4 to 130 feet, and are separated by a bed of clay, 10 or 12 feet thick; the uppermost bed of salt being 30 or more feet from the surface of the earth. It is for the most part of a reddish colour, but is also met with in transparent colourless masses. It is called in commerce, *Prussia rock*, and is largely exported for purification. Brine springs are met with both above and below the level of the beds of rock salt.

The brine is pumped up into cisterns or reservoirs, from which it is drawn when wanted into large oblong wrought-iron evaporating pans, which are usually worked with four or more fires. If the brine be not completely saturated with chloride of sodium, a little rock salt is added to it. By the evaporation of the water the salt deposites in crystals. The impurities separate in the form of a scum (which is removed by a skimming-dish,) and of a sediment called *pan-scale*, *pan-scratch*, or *pan-bake*. The grains or crystals of salt vary in size, according to the degree of heat employed in their preparation. The small-grained salt is formed by the strongest heat, and constitutes the *butter*, *stoved*, *lump*, or *basket salt* of commerce; while the larger crystals, forming the *bay* and *fishery salts* of commerce, are formed at a lower temperature.[2]

In some parts of the world chloride of sodium is obtained from sea water: but

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[1] For an account of the American salt formation, consult J. Van Rensselaer's *Essay on Salt, containing Notices of its origin, Formation, Geological Position, and principal Localities, embracing a particular Description of the American Salines.* New York, 1823.—This author states that the American salt formation occurs in the old red sand stone.

[2] For farther information on the manufacture of common salt, consult Aikin's *Dictionary of Chemistry*, vol. ii. p. 118; Holland's *Agricultural Survey of Cheshire;* Dr. Henry, *Phil. Trans.* 1810; Mr. Purnival's *Wharton and Marston Patent Salt Refineries*, 1836; Dr. Brownrigg's *Art of making Common Salt*, 1748; and Dr. Jackson, *Phil. Trans.* No. 53, p. 1060.

the mode of extracting it varies according to circumstances. In France and on the shores of the Mediterranean, it is procured by solar evaporation, and is then called *Bay Salt*.

The French *salt marshes* are shallow basins or pans of clay, excavated along the sea shore. The water is admitted, by a sluice, into a reservoir, where evaporation goes on while mechanical impurities are deposited. It then passes by a subterraneous communication into a series of rectangular pans, and proceeds by a very circuitous route through them to another subterranean gutter, by which it is conveyed into a long, narrow, circuitous canal. From this it passes into a second, and subsequently into a third series of salt pans. During the whole of this time it is undergoing evaporation, and when it arrives at the third series of pans it is so far concentrated that crystallization is soon effected. The salt is known to be on the point of crystallizing when the liquid assumes a reddish tint. It is then withdrawn from the pans, and collected upon the borders, in conical or pyramidal heaps, when it drains and dries. These operations begin in March and finish in September.[1]

At Lymington,[2] in Hampshire, salt is prepared from the sea water, which is admited into a reservoir or pond, and from this successively into three series of brine-pits or salt-pans, where the water is partly evaporated by solar heat. When the liquid has acquired a sufficient density, it is conveyed into rectangular iron pans, where it is evaporated. Eight hours are required to boil each charge to dryness. The salt is then removed into wooden troughs or cisterns, perforated by holes in the bottom, where it is allowed to drain, and is afterwards removed to the warehouse, where it also drains. The drainings from the wooden trough drop on upright stakes (old broom handles, &c.,) and on these the salt concretes, in the course of ten or twelve days, forming large stalactitic masses called *salt-cats*, each weighing 60 or 80 lbs. The residual liquor (*bittern* or *the bitter liquor*) is received into underground pits, and during the winter season is used in the manufacture of Epsom salt (see *Sulphate of Magnesia*.)

In cold countries, congelation is resorted to as a means of concentrating sea water; for when a weak saline solution is exposed to great cold, it separates into two parts: one almost pure water, which freezes, and the other which remains liquid, and contains the larger proportion of salt. Another method of concentration is by *graduating houses:* these are skeletons of houses, in which the water is pumped up, and allowed to fall on heaps of brushwood, thorns, &c., by which it is divided and agitated with the air, and evaporation promoted. The farther concentration is effected by heat.

PURIFICATION.—The *Edinburgh College* gives the following directions for the preparation of *Pure Chloride of Sodium*, (*Sodæ Murias purum*, E.)

> "Take any convenient quantity of Muriate of Soda; dissolve it in boiling water; filter the solution, and boil it down over the fire, skimming off the crystals which form; wash the crystals quickly with cold water and dry them."
>
> A solution of this pure salt "is not precipitated by solution of carbonate of ammonia followed by solution of phosphate of soda: a solution of 9 grains in distilled water, is not entirely precipitated by a solution of 26 grains of nitrate of silver."

The carbonate of ammonia and phosphate of soda are employed to detect the presence of any magnesian salt.

PROPERTIES.—It crystallizes in colourless cubes, or more rarely in regular octohedrons. In the salt pans the little cubes are frequently so aggregated as to form hollow, four-sided pyramids, whose sides have some resemblance to a series of steps: these are technically called *hoppers*. The specific weight of salt is 2·17. The

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[1] For farther details, see *Phil. Trans.* No. 51, p. 1025; and Dumas, *Traité de Chimie*, t. ii.

[2] Dr. Henry (*Phil. Trans.* 1810) has described the method of manufacture. In the summer of 1840, I visited the Salterns at Lymington, and can confirm the accuracy of Dr. Henry's statements. I found *Salicornia herbacea* growing abundantly in the salt-pans. The sp. gr. of the liquor in the pans is ascertained by glass bulbs (on the principle of Lovi's beads) placed in a wicker basket, which is immersed in the water by a long handle.

taste is pure saline. When free from all foreign matters, chloride of sodium is permanent in the air, but ordinary salt is slightly deliquescent, owing to the presence of small quantities of chloride of magnesium. When heated it decrepitates (more especially the coarse-grained or bay salt,) at a red heat fuses, and at a still higher temperature volatilizes. Rock salt is transcalent or diathermanous: that is, it transmits radiant heat much more readily than many other transparent bodies, as glass (see p. 45.) It is soluble in water, and slightly so in alcohol. Hot and even boiling water dissolves very little more salt than cold water. At 60° it requires about twice and a-half its weight of water to dissolve it.

*Characteristics.*—Its characters as a soda salt are the following:—

Its solution produces no precipitate with the hydrosulphurets, ferrocyanides, phosphates, or carbonates. From the salts of potash it is distinguished by causing no precipitate with perchloric or tartaric acid, or with bichloride of platinum, and by the yellow tinge which it communicates to the flame of alcohol. As a chloride it is known by nitrate of silver throwing down a white precipitate (*chloride of silver,*) soluble in ammonia, but insoluble in nitric acid. Lastly, chloride of sodium is odourless, and devoid of bleaching properties.

Composition.—Pure chloride of sodium has the following composition :—

| | *Atoms.* | *Eq. Wt.* | *Per Cent.* | *Ure.* |
|---|---|---|---|---|
| Sodium | 1 | 24 | 40 | 39·98 |
| Chlorine | 1 | 36 | 60 | 60·02 |
| Chloride of Sodium | 1 | 60 | 100 | 100·00 |

The crystals contain no water in chemical combination with them, but a little is frequently mechanically lodged between their plates.

Impurities.—The commercial salt of this country is sufficiently pure for all dietetical and therapeutical purposes; and its low price is a sufficient guarantee against adulteration. In France, however, serious accidents have happened in consequence of the use of sophisticated salt. (Christison's *Treatise on Poisons*, 3d ed. p. 604; and Devergie, *Méd. Lég.* t. ii. p. 876.)

COMPOSITION OF VARIOUS KINDS OF SALT (HENRY.)

1000 *Parts by Weight consist of*

| | Kind of Salt. | Pure Muriate of Soda. | Muriate of Lime. | Muriate of Magnesia. | Total Earthy Muriates. | Sulphate of Lime. | Sulphate of Magnesia. | Total Sulphates. | Insoluble Matter. | Total Impurity. |
|---|---|---|---|---|---|---|---|---|---|---|
| Fro. Bay Salt. | St. Ube's | 960 | trace | 3 | 3 | 23½ | 4½ | 28 | 9 | 40 |
| | St. Martin's | 959½ | do. | 3½ | 3½ | 19 | 6 | 25 | 12 | 40½ |
| | Oleron | 964¼ | do. | 2 | 2 | 19¼ | 4½ | 23¾ | 10 | 35¾ |
| Brit. Salt fr. Sea-water. | Scotch (common) | 935½ | — | 28 | 28 | 15 | 17½ | 32½ | 4 | 64½ |
| | Scotch (Sunday) | 971 | — | 11½ | 11½ | 12 | 4½ | 16½ | 1 | 29 |
| | Lymington (common) | 937 | — | 11 | 11 | 15 | 35 | 50 | 2 | 63 |
| | Ditto (cat) | 988 | — | 5 | 5 | 1 | 5 | 6 | 1 | 12 |
| Cheshire Salt. | Crushed rock | 983¼ | 0·1/16 | 0·3/16 | 0·¼ | 6½ | — | 6½ | 10 | 16¾ |
| | Fishery | 986 | 0·¼ | 0·¾ | 1 | 11½ | — | 11½ | 1 | 13½ |
| | Common | 983½ | 0·¼ | 0·¾ | 1 | 14½ | — | 14½ | 1 | 16½ |
| | Stoved | 982½ | 0·¼ | 0·¾ | 1 | 15½ | — | 15½ | 1 | 17½ |

Physiological Effects α. *On Vegetables.*—In minute quantity chloride of sodium is injurious to very few, if any, plants, and to some it appears to be beneficial. Used moderately it is a most excellent manure to certain soils. In large quantities it is injurious, though unequally so, to all plants. (Davy, *Agricult. Chem.*; and De Candolle, *Phys. Vég.* pp. 1262 and 1343.)

β. *On Animals.*—To marine animals, common salt is a necessary constituent of their drink. It is relished by most land animals. "The eagerness with which many quadrupeds and birds press towards salt springs and lakes, situated in inland districts, for the purpose of tasting their contents, indicates," says Dr. Fleming, (*Philosophy of Zoology*, vol. i. p. 316.) "a constitutional fondness for salt." In the *Ruminantia* the salutary effects of salt are especially observed. "They contribute powerfully," observes Moiroud, (*Pharmac. Vétérin.* p. 410.) "to prevent, in these animals, the influence of rainy seasons and wet pasturage, as well as damaged fodder. Given to animals intended for fattening, it gives more consistence to the fat and more taste to the meat." It appears to be offensive and injurious to many of the lower animals: hence when rubbed on meat, it prevents the attack of insects, and when applied to the skin of leeches causes vomiting.

γ. *On Man.*—Chloride of sodium serves some important and essential uses in the animal economy. It is employed, on account of its agreeable taste, by the people of all nations, from the most refined to the most barbarous; but the quantity taken varies with different individuals (see the Dietetical Effects of Salt at p. 97.) It is an invariable constituent of the healthy blood. Dr. Stevens (*On the Blood.*) has shown that in certain states of disease (as cholera) there is a deficiency of the saline matter in the blood, and in those cases the blood has a very dark or black appearance. Some of the properties of the sanguineous fluid, such as its fluidity, its stimulating qualities, and its power of self-preservation, are probably more or less connected with its saline constituents. The chloride of sodium found in some of the secretions, as the bile and tears, doubtless serves some important purposes.

It is said that persons who take little or no salt with their food are very subject to intestinal worms. Lord Somerville, in his address to the Board of Agriculture, states that the ancient laws of Holland "ordained men to be kept on bread alone *unmixed with salt*, as the severest punishment that could be inflicted upon them in their moist climate; the effect was horrible: these wretched criminals are said to have been *devoured by worms* engendered in their own stomachs." Mr. Marshall (*Med. and Phys. Journal*, vol. xxxix.) tells us of a lady who had a natural aversion to salt: she was most dreadfully affected with worms during the whole of her life.

Considered in a therapeutical point of view, it is an irritant in its local operation. Thus, applied to the skin and the mucous membranes, it causes redness. Taken into the stomach in large quantity (as in the dose of a table-spoonful or more) it excites vomiting; and, when thrown into the large intestines, produces purging. In moderate quantities it promotes the appetite, and assists digestion and assimilation. If used too freely it occasions thirst. The long-continued employment of salted provisions occasions scurvy: of the correctness of this statement there cannot exist, I think, a shadow of doubt, notwithstanding the bold denial given to it by Dr. Stevens; (*Op. cit.* p. 262.) a denial the more remarkable, since Dr. Stevens admits he has never seen a single case of the disease! His opinion is evidently founded on hypothetical grounds, and is in direct opposition to the best medical testimony we possess. In large doses it operates as an irritant poison. A man swallowed a pound of it in a pint of ale, and died within twenty-four hours, with all the symptoms of irritant poisoning. His stomach and intestines were found excessively inflamed. (Christison, *Treatise on Poisons.*)

In some diseases the moderate use of salt produces the effects of a tonic. It acts as a stimulant to the mucous membranes, the absorbent vessels, and glands. Occasionally, it seems to merit the designation of liquefacient, alterative, and resolvent (see p. 194.) I have already explained (see p. 123) Liebig's notion of the action of the alkaline salts on the tissues.

Properly diluted and injected into the veins, in cholera, it acts as a powerful stimulant and restorative; the pulse, which was before imperceptible, usually becomes almost immediately restored, and, in some cases, reaction and recovery follow. A solution of common salt produces no change in the size and form of the sanguineous particles out of the body. (Müller's *Physiology*.) Dr. Macleod injected a solution of common salt into the jugular vein of a rabbit which had been asphyxied, but without restoring or producing resuscitation. (*Lond. Med. Gaz.* vol. ix. p. 358.)

USES.—The following are some of the most important therapeutical uses of chloride of sodium.

As *a vomit* it has been recommended in malignant cholera, in preference to other emetics.[1] In narcotic poisoning, in the absence of the stomach-pump and the ordinary emetic substances, it may also be employed. The dose of it is one or two table-spoonsful in a tumblerful of water. A tea-spoonful of flour of mustard assists its action. As a *purgative* it is seldom employed except in the form of enema. One or two table-spoonsful of common salt dissolved in a pint of gruel form a very useful clyster for promoting evacuations from the bowels.

It has been used, in some diseases, with the view of *restoring the saline qualities of the blood*. In cholera the blood is remarkably black, incapable of coagulating, and contains more albumen and hematosine, but less water and saline parts, than natural; while the enormous discharges from the bowels consist of a weak solution of albumen containing the salts of the blood.[2] The obvious indications, therefore, in the treatment of this disease, are to restore the water and saline matters to the blood. Hence originated what has been called the *saline treatment* of cholera. This, at first, consisted in the exhibition of certain alkaline salts by the mouth, and in the form of enemata. The following are formulæ which have been recommended:—

| | |
|---|---|
| Take of Carbonate of soda | half a drachm. |
| Chloride of Sodium | a scruple. |
| Chlorate of Potash | seven grains. |

Dissolve in half a tumblerful of water.

This to be repeated at intervals of from 15 minutes to an hour, according to circumstances. (Dr. Stevens, *op. cit.* p. 459.)

| | |
|---|---|
| Take of Phosphate of Soda | 10 grains. |
| Chloride of Sodium | 10 grains. |
| Carbonate of Soda | 5 grains. |
| Sulphate of Soda | 10 grains. |

Dissolve in six ounces of water.

The mixture to be repeated every second hour. (Dr. O'Shaughnessy, *op. cit.* p. 54.)

This plan, however, was followed by that of injecting saline solutions into the veins: which was, I believe, first practised by Dr. Latta. (*Lond. Med. Gaz.* vol. x. p. 257.) The quantity of saline solution which has been in some cases injected is enormous, and almost incredible. In one case "120 ounces were injected at once, and repeated to the amount of 330 ounces in twelve hours. In another, 376 ounces were thrown into the veins between Sunday at 11 o'clock, A. M., and Tuesday at 4, P. M.: that is, in the course of fifty-three hours, upwards of thirty-one pounds. The solution that was used consisted of two drachms of muriate and two scruples of carbonate of soda to sixty ounces of water. It was at the temperature of 108 or 110 deg. F." (*Lond. Med. Gaz.* vol. x. p. 257.) In another series of cases 40 lbs. were injected in twenty hours: 132 ounces in the first two hours; 8 lbs. in half an hour! (*Lond. Med. Gaz.* vol. x. pp. 379–80.) The *immediate* effects of these injections, in a large majority of cases, were most astonishing: restoration of pulse, improvement in the respiration, voice, and general appearance, return of consciousness, and a feeling of comfort. In many instances, however, these effects were only temporary, and were followed by collapse and death. In some, injurious consequences resulted, as phlebitis,

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[1] Searle, *Lond. Med. Gaz.* vol. viii. p. 538; Sir D. Barry, *ibid.* vol. ix. pp. 321 and 407; Brailoff and Isenbeck, *ibid.* p. 490.*

[2] Dr. O'Shaughnessy, *Report on the Chemical Pathology of the Malignant Cholera*, 1832.

(*Lond. Med. Gaz.* vol. x. p. 453.) drowsiness, &c. (*Lond. Med. Gaz.* p. 447.) The reports as to the ultimate benefit of the saline treatment in cholera are so contradictory, that it is exceedingly difficult to offer the student a correct and impartial estimate of its value. That it failed in a large proportion of cases after an extensive trial, and greatly disappointed some of its staunchest supporters, cannot be doubted. (*Lond. Med. Gaz.* vol. x. p. 717.) Dr. Griffin (Dr. Griffin, *Recollections of Cholera*, in *Lond. Med. Gaz.* vol. xxii. p. 319.) states, that all the published cases of injection which he can find recorded amount to 282, of which 221 died, while 61 only recovered: but he thinks that the average recoveries from collapse by this method of treatment "far exceeded the amount of any other treatment in the same disease and under the same circumstances."

Common salt has been employed as an *anthelmintic*. For this purpose it is exhibited in large doses by the mouth, or, when the worms are lodged in the rectum, a strong solution is administered in the form of enema. When leeches have crept into the rectum, or have been accidentally swallowed, a solution of salt should be immediately used. As a *chemical antidote* chloride of sodium may be administered in poisoning by nitrate of silver. As an *alterative and tonic* it is useful in scrofula and glandular diseases. As an *astringent*, in hemorrhages, dysentery, and diarrhœa, it has been administered in combination with lime juice or lemon juice. (*Memoir of the late Dr. Wright*, p. 322.) It is frequently used as a *dentifrice* (see p. 212.)

As an *external application* salt has been used for various purposes. Thus, a saturated solution, applied with friction, is employed, as a counter-irritant and discutient, in glandular enlargements and chronic diseases of the joint; as a stimulant, it is rubbed on the chest in fainting and asphyxia. A solution of salt is employed for baths, (cold and warm,) affusion, the douche, &c. (See *Sea Water*, p. 247.)

ADMINISTRATION.—As a tonic and alterative, the dose of salt is from ten grains to a drachm. As an emetic, from two to three table-spoonsful in five or six ounces of warm water. As a cathartic, from half an ounce to an ounce. In the form of clyster, it is used to the extent of two or even three table-spoonsful. (See *Saline or Brine Waters*, p. 252.)

## 2. SO'DÆ HYPOCHLO'RIS.—HYPOCHLORITE OF SODA.

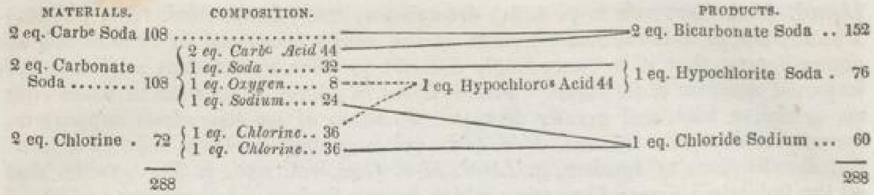
(Liquor Sodæ Chlorinatæ, *L.*) (U. S.)

HISTORY.—The disinfecting power of this substance was discovered by Labarraque about 1820. (Alcock, *Essay on the Use of the Chlorurets*, p. vi. Lond. 1827.) In the French Codex this solution is called *Hypochloris Sodicus Aquâ solutus*. It is commonly known in the shops under the name of *Chloride of Soda*, *Liqueur de Labarraque*, or *Labarraque's Soda Disinfecting Liquid*. Other synonymes for it are *Chloruret of the Oxide of Sodium*, and *Oxymuriate of Soda*.

PREPARATION.—There are two methods in use for preparing a solution of hypochlorite of soda.

The following is the process of the *London Pharmacopœia*:—Take of Carbonate of Soda, lbj.; Distilled Water, f℥xlviij.; Chloride of Sodium, ℥iv.; Binoxide of Manganese, ℥iij.; Sulphuric Acid, ℥iv. Dissolve the Carbonate of Soda in two pints of Water; then put the Chloride of Sodium and Binoxide of Manganese, rubbed to powder, into a retort; and add to them the Sulphuric Acid, previously mixed with three fluid-ounces of the Water, and cooled. Heat, (the mixture,) and pass the Chlorine first through five fluid-ounces of the Water, and afterwards into the solution of the Carbonate of Soda above directed.

When chlorine gas comes in contact with a solution of carbonate of soda, three salts are formed: chloride of sodium, hypochlorite of soda, and bicarbonate of soda.



The essential and characteristic properties of this solution depend on the hypochlorite of soda. The changes which take place in the manufacture of chlorine have been already explained (p. 217.)

In the *French Codex* this solution is directed to be prepared as follows:—Diffuse one part of dry chloride of lime (hypochlorite of lime) through 30 parts of water. Then add two parts of crystallized carbonate of soda, previously dissolved in 15 parts of water. Filter the mixture.

[The formula of the U. S. Pharmacopœia is as follows:—Take of Chlorinated Lime, a pound; Carbonate of Soda, two pounds; Water, a gallon and a-half. Dissolve the Carbonate of Soda in three pints of Water with the aid of heat. To the remainder of the Water add by small portions at a time the Chlorinated Lime previously well triturated, stirring the mixture after each addition. Set the mixture by for several hours, that the dregs may subside, then decant the clear liquid, and mix with the solution of Carbonate of Soda. Lastly, decant the clear liquor from the precipitated Carbonate of Lime, pass it through a linen cloth, and keep it in bottles secluded from the light.]

In this process a double decomposition is effected; hypochlorite of soda is formed in solution, while carbonate of lime precipitates. This process is more easy of execution than the previous one. By using the proportions here directed the solution is weaker than that prepared by the process of the London Pharmacopœia.

Properties.—The solution of hypochlorite of soda (*Liquor Sodæ Chlorinatæ*, L.) has a yellowish colour, an astringent taste, and an odour of hypochlorous acid. It destroys the colour of vegetable substances; as litmus, turmeric, and sulphate of indigo. Previous to bleaching them, it reacts as an alkali on turmeric paper, and infusion of red cabbage. By evaporation, crystals are obtained, which by resolution in water re-produce the disinfecting liquid. By exposure to the air the solution undergoes decomposition, and crystals of carbonate of soda are formed.

*Characteristics.*—The following are the essential characters of this solution:—It decolourizes sulphate of indigo. On the addition of hydrochloric acid it evolves chlorine and carbonic acid. A solution of nitrate of silver throws down a white precipitate (*chloride of silver*,) soluble in ammonia, but insoluble in nitric acid. Lime water causes a white precipitate (*carbonate of lime.*) Oxalate of ammonia occasions no precipitate, showing the absence of lime. Bichloride of plantinum produces no yellow precipitate, proving the absence of potash and ammonia. That the base of the solution is soda may be shown in two ways: evaporated to dryness, we obtain a residuum which renders the outer cone of the flame of a candle, or the flame of a spirit lamp, yellow; saturated with hydrochloric acid and evaporated to dryness, common salt is procured: this may be recognised by the characters before mentioned (p. 456.)

Composition.—Some chemists regard this compound as a mixture of chloride of soda and bicarbonate of soda. But the view usually taken of it is that it consists the *hypochlorite of soda*, *chloride of sodium*, and *bicarbonate of soda*.

Physiological Effects. *α. On Animals.*—A solution of the chloride of soda acts more or less powerfully as a local irritant, according to the degree of its concentration. From the experiments of Segalas (*Journ. de Chim. Méd*, t. $1^{er}$, p. 271.) it appears, that, besides the irritant operation, and its direct and sympathetic action on the organic solids, it exercises an evident influence over the blood, and, in consequence, over the whole economy, by means of absorption. In an experiment referred to by Dr. Christison, (*Treatise on Poisons*, 3d edit. p. 221.) two ounces of Labarraque's solution introduced into the peritoneum of a dog excited palpitation, oppressed breathing, constant restlessness, and death in ten minutes.

β. *On Man.*—I am unacquainted with any experiments made to determine the physiological effects of chloride of soda on man. That it would, *in large doses*, act as a powerful local irritant, and if swallowed give rise to symptoms of gastro-enteritis, cannot, I think, be doubted. Mérat and De Lens (*Dict. Mat. Méd.* t. ii. p. 257.) state that the immediate consequence of, and predominating symptom produced by, a glassful of *Eau de Javelle* (a solution of chloride of potash) was general rigidity, which gave way to demulcent drinks. This observation agrees with one made by Segalas (Christison, *op. cit.* p. 221.) in his experiments on dogs, namely, that chloride of soda caused tetanic spasms. It is probable, therefore, that the chlorides (hypochlorites) of the alkalis exercise a specific influence over the nervous system.

Chloride of soda, in *moderate or small doses*, has been denominated stimulant, tonic, astringent, antiseptic, and febrifuge. But these terms give no real explanation of the nature of those organic changes produced by it, whereby we obtain such benefit from its employment in various diseases. In fever, I have seen dampness of the skin follow its use. Increased secretion of urine is a common effect of it. In fevers it improves the qualities of the evacuations. Under the continued employment of it, glandular enlargements and chronic mucous discharges have disappeared, from which circumstance chloride of soda has been denominated alterative and resolvent. All these effects depend probably on the alteration which the chloride gives rise to in the condition of the blood, and the change thereby produced in the action of the different organs. We must not overlook the important fact that the solution of chloride of soda used in medicine contains bicarbonate of soda, to which perhaps in many cases its beneficial effects, are, in part at least, to be referred.

USES.—The solution of chloride of soda is employed as a *disinfectant*, *antiseptic*, and *antidote* (in cases of poisoning by the hydrosulphurets, and hydrosulphuric and hydrocyanic acids.) But for most of these purposes the chloride of lime is employed instead of chloride of soda, since its properties are analogous, and being manufactured on a very extensive scale for the use of bleachers, it can be obtained more conveniently and cheaply. On this account, therefore, and to avoid repetition, I must refer to the article *Hypochlorite of Lime* for information respecting the above uses of chloride (hypochlorite) of soda. I would remark, however, that in several cases where I have carefully tried and compared the two chlorides (hypochlorites,) I give the decided preference to the chloride of soda. As an antiseptic, Lebarraque also preferred the latter preparation, on the ground that by the process of disinfection it becomes chloride of sodium, which is not a deliquescent salt; whereas the chloride of calcium generated by chloride (hypochlorite) of lime, attracts water from the atmosphere, and thereby furnishes one of the conditions (viz. moisture) necessary to the putrefactive process. Hence, in his opinion, while chloride of lime will serve equally well for mere disinfection, chloride of soda is preferable where we wish at the same time to prevent a renewal of putrefaction.

Chloride of soda is employed internally in all diseases commonly termed *putrid* or *malignant*, as typhus fever, scarlatina maligna, &c. It is indicated where there are great prostration of strength, fetid evacuations, and a dry and furred tongue. In such cases I have seen it of essential service, improving the quality of the secretions, producing a moist state of the skin, preventing collapse, and altogether acting most beneficially. It may be administered both by the mouth and the rectum.

There are many other diseases in which it has been administered internally with apparent success, but in which a more extended experience of its effects is required to enable us to place confidence in the results. I refer now to its employment as a substitute for the disulphate of quinia, in intermittents, recommended by Lalesque and Gouzée; (*Brit. and For. Med. Rev.* April, 1838.) to its use in the treatment of secondary syphilis, as practised by Dr. Scott, (*Lond. Med. Rep.* N. S. vol. ii. 1836, p. 139.) and by Cazenove: (*Journ. de Chim. Méd.* t. iv. p. 140.) to its administration in chronic skin diseases, and as a substitute for chlorine in bilious disorders, by Dr. Darling; (*Lond. Med. Rep.* N. S. vol. ii.) in scrofula, by Godier; (*Journ. Gén. de Méd.* 1829.) and in plague, by Neljoubin. (Richter, *Ausf. Arzneim.* Suppl.-Bd. p. 539.) In some of these cases (as in syphilis and scrofula) the benefit obtained may have resulted from the bicarbonate of soda present in the chloride of the shops.

As a *local* remedy, we employ chloride of soda in all cases attended with fetid discharges, not merely as a disinfectant and antiseptic—that is, as a chemical agent destroying fetor, and preventing the putrefaction of dead matters (as gangrenous parts, the discharges from wounds and ulcers, &c.,) though in these respects it is most valuable—but as a means of stopping or relieving morbid action by an impression produced on the living tissues. It frequently puts a stop to the farther progress of gangrene; promotes the separation of the dead from the living parts; improves the quality of the secretions; and, at the same time, diminishes their quantity, when this is excessive. We apply it to ulcers of all kinds (whether common, phagedenic, cancerous, syphilitic, or scrofulous) when attended with foul discharges or a disposition to slough. We employ it with the greatest benefit in affections of the mucous surfaces. Thus it is used as a gargle to check ptyalism and ulceration of the mouth, whether arising from mercury or other causes. In scarlatina maligna we apply it to check ulceration and sloughing of the throat. In coryza and ozœna it has been injected into the nostrils with considerable benefit. In fetid and excessive discharges from the vagina, and neck of the uterus or bladder, it is employed as an injection with, at least, temporary relief. It has also been applied in some skin diseases, as tinea capitis, eczema, scabies, prurigo pudendi muliebris, &c. The above are only a few of the cases in which chloride of soda has been used with most marked benefit. In conclusion, I may add, that there are few, if any, remedies the uses of which, as local agents, are so valuable and extensive as the chlorides of soda and lime.

ADMINISTRATION.—The *liquor sodæ chlorinatæ*, Ph. L. may be administered internally in doses of twenty drops or more, diluted with three or four ounces of some mild aqueous liquid. When used as a *gargle*, it should be diluted with eight or ten parts of water: as an *injection* into the vagina, it is to be mixed with from fifteen to thirty parts of water: as a *lotion*, its strength must vary according to circumstances. In some sloughing ulcers I have used it mixed with its own volume of water, but in most cases it should, at the commencement of its use, be largely diluted, as with five or six parts of water. A *cataplasm* of chlorinated soda is prepared with linseed meal and equal parts of the liquor sodæ chlorinatæ and water.

ANTIDOTE.—(See *Calcis Hypochloris.*)

### 3. SO'DÆ SUL'PHAS, *L. E. D.* (U. S.)—SULPHATE OF SODA.

HISTORY.—Sulphate of soda (also called *Natron Vitriolatum*, *Glauber's Salt*, *Sal Catharticus Glauberi*, or *Sal Mirabile Glauberi*,) was discovered in 1658 by Glauber.

NATURAL HISTORY.—It occurs in both kingdoms of nature.

α. IN THE INORGANIZED KINGDOM.—As an efflorescence, the hydrous sulphate of soda is met with in various parts of the world. In the anhydrous state, mixed with a minute portion of carbonate of soda, it constitutes the mineral called *Thenardite*. Sulphate of soda is a constituent of many mineral waters; as those of Cheltenham, Leamington, and Spital (See p. 252.)

β. IN THE ORGANIZED KINGDOM.—It is found in the ashes of some plants which grow by the sea-shore; as the *Tamarix gallica*. Lastly, it is found in some of the animal fluids; as the blood and urine.

PREPARATION.—Sulphate of soda is a product of several processes, especially of the manufacture of hydrochloric acid.

The *London College* order of the salt which remains after the distillation of Hydrochloric Acid, lbij.; Boiling Water, Oij.; Carbonate of Soda as much as is necessary. Dissolve the salt in the water, add the carbonate of soda so long as effervescence takes place, boil the liquid, and when neutral filter it; wash the insoluble matter with boiling water, adding the water to the original liquid; concentrate till a pellicle begins to form, and then let the liquid cool and crystallize.

The *Edinburgh Collge* order of the salt which remains, after preparing Pure Muriatic Acid, lbij.; Boiling Water, Oiij.; White Marble, in powder, a sufficiency. Dissolve the Salt in the Water, then gradually add as much Carbonate of Soda as is sufficient to saturate the Acid. Boil down until a pellicle appears, and the solution being strained, set it aside that the crystals may be formed. The liquor being poured off, dry them.

The directions of the *Dublin College* are as follows:—Let the salt which remains after the distillation of Muriatic Acid be dissolved in a sufficient quantity of hot water. Put aside the filtered liquor, that, after due evaporation, crystals may be formed by slow cooling.

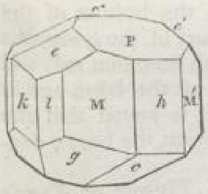
The salt which remains after the distillation of hydrochloric acid is sulphate of soda usually contaminated with some free sulphuric acid, to neutralize which the London College uses Carbonate of Soda, the Edinburgh College, Marble (carbonate of lime.)

In consequence of the enormous consumption of sulphate of soda in the manufacture of carbonate of soda, makers of the latter article are obliged to procure sulphate purposely, by the addition of sulphuric acid to chloride of sodium.

PROPERTIES.—It crystallizes in oblique rhombic prisms, which belong to the oblique prismatic system. To the taste this salt is cooling, and bitterish saline. By exposure to the air it effloresces. When heated it undergoes the watery fusion, gives out its water of crystallization, and thereby becomes a white solid, and at a red heat it again becomes liquid. One part of it dissolves in three parts of water at 60°, or one part of water at 212°. It is insoluble in alcohol.

*Characteristics*.—Its constituents, sulphuric acid and soda, may be detected by the tests of these substances before mentioned (pp. 406 and 456.) From the bisulphate of soda it is distinguished by its not reddening litmus, and by its less solubility. Crystals of anhydrous sulphate of soda are distinguished by their form being the rhombic octahedron, and by their not losing weight when heated.

FIG. 72.



*Prism of Sulphate of Soda.*

COMPOSITION.—The ordinary crystals of sulphate of soda have the following composition:—

| | *Atoms.* | *Eq. Wt.* | *Per Cent.* | *Berzelius.* | *Wenzel.* |
|---|---|---|---|---|---|
| Soda | 1 | 32 | 19·75 | 19·24 | 19·5 |
| Sulphuric Acid | 1 | 40 | 24·69 | 24·76 | 24·3 |
| Water | 10 | 90 | 55·56 | 56·00 | 55·2 |
| Ordinary Crystals of Sulphate of Soda | 1 | 162 | 100 00 | 100·00 | 99·0 |

PURITY.—The crystallized sulphate of soda of the shops is usually sufficiently pure for medical purposes. The presence of chlorides in it may be detected by nitrate of silver.

Exposed to the air it falls to powder. Totally dissolved by water; very slightly by alcohol. It does not alter the colour of litmus or turmeric. Nitrate of silver throws down scarcely any thing from a dilute solution; nitrate of barytes more, which is not dissolved by nitric acid. 100 parts of this salt lose 55·5 parts by a strong heat.—*Ph. L.*

PHYSIOLOGICAL EFFECTS.—It is a mild but efficient cooling laxative or purgative salt, promoting secretion and exhalation from the mucous membrane of the stomach and bowels, without causing inflammation or fever.

USES.—It is employed as a common purgative, either alone or added to other purgatives. It is applicable in fevers and inflammatory affections, where we want to evacuate the bowels without increasing or causing febrile disorder.

Administration.—The usual dose of it is from six to eight drachms. When dried so as to expel the water of crystallization, three and a-half drachms act as an efficient purgative.

### 4. SO'DÆ BIBO'RAS, *L.*—BIBORATE OF SODA OR BORAX.

(Sodæ Boras, *E. D.*) (U. S.)

History.—Pliny (*Hist. Nat.* lib. xxxiii.) describes a substance under the name of *Chrysocolla*, which has been supposed by some to be biborate of soda. The term *Bauracon* or *Baurach* (from which our word *Borax* is derived) first occurs in the writings of the Arabians. By some of these authors (as Mesue and Avicenna) it was applied to nitre: (Beckmann, *Hist. of Invent. and Discov.* vol. iv. p. 539.) it is not improbable, however, that Geber (*Search of Perfection*, ch. iii.) used it to indicate our borax. By modern chemists the salt has been termed *Biborate*, *Borate*, or *Sub-borate of Soda.*

Natural History.—Borax is a substance peculiar to the mineral kingdom. It has been found in some mineral waters; as those of San Restituta, in Ischia. (Gairdner, *On Mineral Springs*, p. 414.) It occurs also in the waters of certain lakes, especially those of Thibet and Persia.

Preparation.—Borax is obtained in two ways:—1st, by refining native borax; 2dly, by saturating native boracic acid with soda.

α. *By refining Tincal.*—About fifteen days' journey north from Teeshoo Lomboo [Tissoolumboo,] in Thibet, is a lake, said to be about twenty miles in circumference, and supplied by brackish springs rising from the bottom of the lake itself. In consequence of its high situation, during a part of the year this lake is frozen over. The water of it contains, in solution, both common salt and borax. The latter crystallizes on the edges and shallows of the lake, and is taken up in large masses, which are broken and dried.[1] It is stated that the natives mix it with an earth thinly covered with butter, to prevent the borax evaporating![2]

It is imported, usually from Calcutta, under the name of *Tincal*[3] or *Crude Borax* (*Borax cruda* seu *nativa*,) in the form of flattened six-sided prisms, coloured with a greasy unctuous substance, said, by Vauquelin, to be a fatty matter, saponified by soda; the colour is yellowish, bluish, or greenish. Mojon states that the greenish gray matter which surrounds some kinds of rough borax, contains native boron. Various methods have been contrived for refining borax: some calcine it, to destroy the fatty matter, others wash it with an alkaline solution (soda or lime,) and then dissolve and crystallize. The product is called *Refined Borax* (*Borax depurata* seu *purificata*.)

β. *By saturating Native Boracic Acid with Soda.*—The mode of preparing boracic acid in Tuscany has been already described (see p. 391.) The rough acid usually contains from 17 to 20 per cent. of impurities (water, sulphates of ammonia, magnesia, lime, and alumina, chloride of iron, sal ammoniac, traces of sulphuretted hydrogen, clay, sand, sulphur, a yellow colouring matter, and an azotized matter soluble in alcohol.) It is converted into borax in the following way:—Dissolve carbonate of soda in water contained in tubs, lined with lead, and heated by steam. Add greatly pulverulent boracic acid. The evolved gas is passed through sulphuric acid to detain any carbonate of ammonia which may be contained in it. Boil the liquor, and let it stand for 10 or 12 hours. Then draw it off into wooden crystallizing vessels lined with lead. Here *Rough* or *Crude Borax* is deposited. This is refined by dissolving it in water, contained

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[1] Turner's *Account of an Embassy to the Court of Teshoo Lama, in Thibet*, p. 406. Lond. 1800.

[2] Anderson's periodical called *The Bee*, vol. xvii. p. 22. Edinb. 1793.

[3] From *Tincana*, the Sancrit name for borax; Royle's *Essay on Medicine*, p. 97.

in a tub lined with lead, and heated by steam; add carbonate of soda, and crystallize. The crystals are allowed to drain, and, when dry, are packed in chests. *Octohedral borax* is obtained by employing more concentrated solutions: it deposites at from 174 to 133 deg. F.[1]

Properties.—It usually occurs in large, colourless, transparent prisms, belonging to the oblique prismatic system (*Prismatic Borax.*) It also occurs in octohedrons (*Octohedral Borax.*) In commerce we frequently meet with it in irregular shaped masses. Its taste is saline, cooling, and somewhat alkaline. It reacts on turmeric paper like an alkali. By exposure to the air it effloresces slowly and slightly. When heated it melts in its water of crystallization, swells up, and forms a light, white, porous substance, called *Calcined Borax* (*Borax usta* seu *calcinata.*) At a higher temperature it fuses into a transparent glass (*Glass of Borax,*) which is anhydrous borax. It is soluble in twelve parts of cold, or in two parts of hot water.

*Characteristics.*—Borax may be recognised by the following characters: it reddens turmeric paper; it fuses before the blow-pipe into a glass, which may be readily tinged by various metallic solutions—thus, rose red by terchloride of gold, and blue by solutions of cobalt: if a few drops of sulphuric acid be added to powdered borax, and then spirit of wine, the latter will, when fired, burn with a green-coloured flame; lastly, if, to a strong hot solution of borax, sulphuric acid be added, boracic acid will be deposited in crystals as the liquid cools. The tests now mentioned for the most part only prove the salt to be a borate: the nature of the base is determinable by the tests for soda before described (p. 456.)

Composition.—The following is the composition of borax:—

| | *Atoms.* | *Eq. Wt.* | *Per Cent.* | *L. Gmelin.* | *Kirwan.* | *Berzelius.* |
|---|---|---|---|---|---|---|
| Soda | 1 | 32 | 16·84 | 17·8 | 17 | 16·31 |
| Boracic Acid | 2 | 68 | 35·79 | 35·6 | 34 | 36·59 |
| Water | 10 | 90 | 47·37 | 46·6 | 49 | 47·10 |
| Crystal$^{d}$. Prismatic Borax | 1 | 190 | 100·00 | 100·0 | 100 | 100·00 |

*Octohedral borax* contains only five equivalents of water. It offers several advantages in the arts over the prismatic variety. (Guibourt, *Hist. des Drog.* t. i. p. 191, ed. $3^{me}$.)

Physiological Effects.—The effects of borax have been imperfectly ascertained. Its *local* action is that of a mild irritant: applied to sores it excites smarting, and, taken into the stomach in large doses, causes vomiting.

The *constitutional effects* are probably those of a mild refrigerant and diuretic. Wöhler and Stehberger detected it in the urine, so that it passes out of the system unchanged.

By some writers it is regarded as an agent exercising a specific influence over the uterus; promoting menstruation, alleviating the pain which sometimes attends this process, facilitating parturition, diminishing the pain of accouchement, and favouring the expulsion of the placenta and lochia. (Vogt's *Pharmacodinamik.*) Farther evidence, however, is wanting to enable us either to admit or deny the supposed uterine influence of borax. Some recent English writers seem to entertain no doubt as to its promoting uterine contractions.[2]

Borax has also been regarded as producing the effects of alkalis on the system; principally, I believe, from an erroneous notion that it was a sub-salt. (Vogt, *op. cit.;* and Sundelin, *Heilmittellehre.*) When Homberg asserted that boracic acid was a sedative, borax was supposed to possess similar properties.

Uses.—As a *local agent*, borax is employed, as a detergent, in aphthæ and ulceration of the mouth. In some skin diseases it has been used with benefit: as

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[1] Payen, *Ann. de Chém. et de Physique*, $3^{me}$ Sér. tome ii. p. 322. Juillet, 1841.

[2] Dr. Copland, *Dict. of Pract. Med.* art. *Abortion;* and an anonymous reviewer in the *Brit. and For. Med. Rev.* for July, 1838, p. 86.

pityriasis versicolor (called also *liver spots* or *chloasma.*) A solution of it in rose-water is employed as a cosmetic. In gonorrhœa and leucorrhœa an aqueous solution has been occasionally used, as an injection, with success. Lastly, in the form of ointment, (composed of ʒj. of borax to ℥j. of lard,) it has been applied to inflamed and painful hemorrhoidal tumours.

*Internally*, it has been used to diminish the secretion of uric acid; to act as a diuretic in dropical affections; and to influence the uterus in the cases before mentioned. Dr. Copland recommends it, in conjunction with ergot of rye, to promote uterine contractions.

Administration.—The dose of it is from half a drachm to a drachm. As a detergent in aphthæ it may be used in powder, mixed with sugar or with honey.

**MEL BORACIS**, L. E. D. *Honey of Borax; Mellite of Borax.* (Borax, powdered, ʒj.; Honey, [clarified, *L. D.*] ℥j.; Mix.) A convenient form for the employment of borax in the aphthæ of children. Dissolved in water it may be employed as a gargle in ulceration of the mouth and throat.

## 5. SO′DÆ NI′TRAS.—NITRATE OF SODA.

History.—Duhamel, (*Mémoires de l'Academie Royale de Sciences*, 1736, p. 215.) probably, was the discoverer of this salt, in 1736. It was first analyzed by Margraff (*Opusc.* ii. 331.) in 1761. It has been termed *Cubic*, *Quadrangular* or *Rhomboidal Nitre* (*Nitrum cubicum*, *quadrangulare* vel *rhomboidale.*)

Natural History.—It is peculiar to the mineral kingdom.

Native nitrate of soda is found in South Peru. It exists in large beds, a few feet below the saline soil, or forming that soil in various places, from Arica on the north and west, to the course of the river Loa on the south. It is found in distinct strata, a thin layer of brown loam separating the parts.[1]

Native nitrate of soda, in fractured masses, has a granular structure, arising from the aggregation of irregular rhombic crystals, varying from fine grained to coarse grained. Colour, from snow white to reddish brown or gray. Odour peculiar; and, when warmed, resembling chloride of iodine dissolved in water. Its average composition is *nitrate of soda*, 64·98; *sulphate of soda*, 3·00; *chloride of sodium*, 28·69; *iodic salts*, 0·63; *shells and marl*, 2·68 = 99·90. (*Ibid.*)

Extraction.—"The richest masses of the native salt are blasted or broken, and divided into small portions; with these copper kettles are in part filled, and water, or the mother water of former operations, is added, and heat applied, until a boiling and saturated solution is obtained. The solution is transferred to wooden coolers, where the nitrate of soda crystallizes. The undissolved salt remaining in the kettles is thrown aside, fresh salt being used each time, although not one half of the nitrate of soda is dissolved. The coolers are emptied after the crystals of nitrate have ceased to form: it is dried, packed in bags, and sent to the coast on mules."

Commerce.—In 1839, duty (6d. per cwt.) was paid on 107,922 cwts. In 1840, on 130,211 cwts. (*Trade List*, Jan. 5, 1841.)

Purification.—*Rough nitrate of soda* is purified, after its arrival in this country, by solution and re-crystallization.

Properties.—It usually crystallizes in obtuse rhombohedral crystals, which belong to the rhombohedral system. Its taste is somewhat bitter. In moist air it is slightly deliquescent. It is soluble in about two parts of cold water, and in less than its own weight at 212°. It fuses by heat.

*Characteristics.*—As a nitrate it is known by the characters of this class of salts already stated (p. 267.) The nature of its base is recognised by the tests for soda already described (p. 456.) The yellow colour which it communicates to flame, as well as the shape of its crystals, readily distinguish it from nitrate of potash.

Composition.—Crystallized nitrate of soda is anhydrous.

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[1] Hayes, in Silliman's *Journal*; also in *The Chemist*, for February, 1841, No. xiv. p. 43. Rivero, in the *Edinb. Phil. Journ.* vol. vii. p. 184. Edinb. 1822.

| | *Atoms.* | *Eq. Wt.* | *Per Cent.* | *Wenzel.* | *Longchamp.* |
|---|---|---|---|---|---|
| Soda | 1 | 32 | 37·2 | 37·5 | 37·65 |
| Nitric Acid | 1 | 54 | 62·8 | 62·5 | 63·25 |
| Crystallized Nitrate of Soda | 1 | 86 | 100·0 | 100·0 | 100·00 |

Physiological Effects.—Its effects are similar to those of nitrate of potash. According to Wolfers, (Richter, *Ausführ. Arzneim.* Bd. iv. S. 251.) from two to four drachms of it may be taken daily without any hurtful effect. Velsen states, that it does not so readily disturb digestion as nitrate of potash.

Uses.—It is not employed in medicine in this country. As a substitute for nitrate of potash, it is used in the manufacture of nitric and sulphuric acids. It is employed by fire-work makers; and also as a manure, especially for wheat. (*Journal of the Royal Agricultural Society of England*, for 1840 and 1841.)

### 6. SO'DÆ PHOS'PHAS, *L. E. D.* (U. S.)—PHOSPHATE OF SODA.

History.—This salt was long known before its true nature was understood. In 1737, Hellot found it in the urine. It has been known by various names, such as *Alcali Minerale* and *Sal Mirabile Perlatum.* In the shops it is sold as *Tasteless Purging Salts.* Dr. Turner calls it *Triphosphate of Soda and Basic Water.* It is sometimes termed the *Rhombic Phosphate of Soda*, and not unfrequently *Neutral Phosphate of Soda.*

Natural History.—Phosphate of soda occurs in both kingdoms of nature.

α. In the Inorganized Kingdom.—It is a constituent of some mineral waters, viz. those of Steinbad at Toplitz, of Geilnau, Fachingen, Selters, and Neundorf. (Gairdner, *On Mineral Springs*, p. 19.)

β. In the Organized Kingdom.—It is a constituent of some animal fluids, as human urine.

Preparation.—The Edinburgh and Dublin Colleges give each a formula for its preparation. The London College admits it as an article of the Materia Medica; that is, to be bought ready prepared.

The *Edinburgh College* orders of Bones burnt to whiteness, lbx.; Sulphuric Acid, Oij. and f℥iv.; Carbonate of Soda, a sufficiency; Pulverize the bones and mix them with the acid; add gradually six pints of water; digest for three days, replacing the water which evaporates; add six pints of boiling water, and strain through strong linen; pass more boiling water through the mass on the filter till it comes away nearly tasteless. Let the impurities subside in the united liquors, pour off the clear fluid, and concentrate to six pints. Let the impurities again settle; and to the clear liquor, which is to be poured off and heated to ebullition, add carbonate of soda, previously dissolved in boiling water, until the acid is completely neutralized. Set the solution aside to cool and crystallize. More crystals will be obtained by successively evaporating, adding a little carbonate of soda till the liquid exerts a feeble alkaline reaction on [reddened] litmus paper, and then allowing it to cool. Preserve the crystals in well-closed vessels.

The *Dublin College* orders of Bone Ashes, reduced to powder, *ten parts;* Sulphuric Acid, of commerce *seven parts;* and carbonate of soda, dissolved in hot water, *eight parts.* The directions for conducting the process are essentially the same as those of the Edinburgh College.

[The directions of the U. S. P. are similar to those of the Edinburgh College.]

The products obtained by the mutual reaction of sulphuric acid and bone-ash are sulphate of lime and superphosphate of lime; the latter remains in solution, while the former is, for the most part, precipitated. On the addition of carbonate of soda to the liquor, phosphate of soda is formed in solution, subphosphate of lime is precipitated, and carbonic acid gas escapes. A slight excess of carbonate of soda promotes the formation of crystals of phosphate.

Properties.—This salt crystallizes in oblique rhombic prisms, which are transparent, but by exposure to the air effloresce and become opaque. Their taste is cooling saline. They react feebly on vegetable colours like alkalis. When heated, they undergo the watery fusion, give out water, and form a white mass called *pyrophosphate of soda:* at a red heat this melts into a transparent glass, called *metaphosphate of soda.* The crystals of phosphate of soda require, for their solution, four times their weight of cold or twice their weight of hot water: they are nearly insoluble in alcohol.

*Characteristics.*—The presence of soda in this salt is known by the tests for this base before mentioned (p. 456.) The phosphoric acid in it is recognised as follows: a solution of the phosphate throws down a white precipitate with acetate of lead, as well as with chloride of barium: the precipitate in both cases is a phosphate, and dissolves in nitric acid without effervescence: with nitrate of silver, the phosphate of soda occasions a yellow precipitate (*subsesquiphosphate of silver*, called by Graham *tribasic phosphate of silver*) soluble both in nitric acid and ammonia: pyrophosphate of soda, obtained by heating the phosphate, produces, with nitrate of silver, a white precipitate (*neutral phosphate of silver; pyrophosphate of silver; dipyrophosphate of oxide of silver:*) hydrosulphuric acid, as well as the hydrosulphates, occasion no change in a solution of phosphate of soda. Phosphate of soda fuses upon charcoal, in the outer flame of the blowpipe, and becomes distinctly crystalline upon cooling.

Composition.—The following is the composition of this salt:—

| | *Atoms.* | *Eq. Wt.* | *Per Cent.* | *Berzelius.* |
|---|---|---|---|---|
| Soda | 1 | 32 | 17·73 | 17·67 |
| Phosphoric Acid | 1 | 36 | 19·94 | 20·33 |
| Water | 12½ | 112·5 | 62·33 | 62·00 |
| Crystallized Phosphate Soda. | 1 | 180·5 | 100·00 | 100·00 |

By Graham, (The equivalent of phosphorus is, according to Graham, 31·44.) Turner, and some other chemists, the equivalent weight of phosphoric acid is assumed to be about double (viz. 71·44) that which I have adopted. On this hypothesis, the above salt contains 2 equivalents of soda, and 25 equivalents of water. Of this quantity of water, 1 equivalent is assumed to be basic, and the remaining 24 equivalents to be water of crystallization: so that the following is the constitution of the salt: $HO, 2\,NaO, P^2\,O^5 + 24\,HO$.

Impurity.—As met with in commerce, this salt is usually tolerably pure.

Exposed to the air it slightly effloresces. It is totally dissolved by water, but not by alcohol. What is thrown down from the solution by chloride of barium is white: the precipitate by nitrate of silver is yellow, unless the phosphate has been previously made red hot. Both precipitates are soluble in nitric acid. *Ph. Lond.*

If the precipitate caused by the chloride of barium be not totally soluble in nitric acid, a sulphate is present. If that caused by nitrate of silver do not entirely dissolve in nitric acid, a chloride is present.

"An efflorescent salt: 45 grains dissolved in two fluid ounces of boiling distilled water, and precipitated by a solution of 50 grains of carbonate of lead in a fluid ounce of pyroligneous acid, will remain precipitable by solution of acetate of lead." *Ph. Ed.*

Physiological Effects.—In doses of an ounce, or an ounce and a half, it acts as a mild antiphlogistic purgative, like sulphate of soda. In small and continued doses it has been used with the view of altering the composition of the blood, and of promoting the deposition of phosphate of lime in the bones.

Uses.—As a purgative it is employed in the diseases of children and delicate persons, in preference to other saline substances, on account of its slight taste and mild action on the stomach. It is well adapted for febrile and inflammatory disorders.

It is one of the substances which have been employed in cholera, to restore to the blood its deficient saline matters. (Dr. O'Shaughnessy, *Report on the Chemical Pathology of the Malignant Cholera*, p. 54.) On account of the phosphoric acid which it contains it has been supposed to be particularly applicable in those diseases in which there is a deficiency of phosphate of lime in the bones. It has also been administered in diabetes.

Administration.—As a purgative it is given in doses of from six to twelve drachms. It is best taken in broth or soup. As an alterative the dose is one or two scruples three or four times a day.

**SOLUTIO SODÆ PHOSPHATIS**, E. *Solution of Phosphate of Soda.* (Phosphate of Soda, [free of efflorescence,] grs. clxxv.; distilled Water, f℥viij. Dissolve the salt in the water, and keep the solution in well-closed bottles.)—Used only as a test (see *Lithargyrum*, *Plumbi Acetas*, *Plumbi Carbonas* and *Magnesiæ Sulphas.*)

### 7. SO'DÆ CAR'BONAS. (U. S.)—CARBONATE OF SODA.

History.—This salt, as well as the sesquicarbonate of soda, was probably known to the ancients under the term of *νιτρον* or *nitrum*. (Vide *Potassæ Nitras*, p. 434; also *Sodæ Sesquicarbonas*.) The *Salt Alkali*, or *Sagimen Vitri* of Geber (*Invent. of Verity*, ch. iv.; and *Search of Perfection*, ch. iii.) was a carbonate of soda: the word *Sagimen* is a corruption of the Hindee term *Sajjiloon*. (Dr. Royle, *Essay on Hindoo Medicine*, p. 41.) In modern times this salt has had various appellations, such as *Mild Mineral* or *Fossil Alkali*, *Aërated Mineral Alkali*, *Subcarbonate of Soda*, and *Nitrum Carbonicum*.

Natural History.—This salt is peculiar to the inorganized kingdom.

It is found in crystals, or in the form of an efflorescent powder, in several parts of the world. According to Klaproth (Dr. Thomson, *Outlines of Mineralogy*, vol. i. p. 96.) it occurs at Debrezin, in Hungary, and Montenuovo, near Naples. Beudant (Necker, in his *Règne Minéral*, t. 2nde, p. 667.) has analyzed three native carbonates of soda; one fron Lac Blanc, in Hungary; a second from Egypt; and a third from Vesuvius. Carbonate of soda is a constituent of some mineral waters, which are in consequence, termed *alkaline*, or, when they also contain a large excess of carbonic acid, *acidulo alkaline*. (See pp. 250 and 253.)

Preparation.—It may be procured from *Barilla*, from *Kelp*, or from *Sulphate of Soda*.

**1. Preparation of Barilla.**—The substance called *Barilla*, (*Sodæ Carbonas venale*, *Barilla*, D.) is an ash usually obtained by the combustion of plants belonging to the order *Chenopodiaceæ;* as the Salsolas, Salicornias, and Chenopodiums. These are cultivated on the coasts, and when ripe are cut, dried, and burned in heaps: the resulting ash is barilla. It is a hard grayish or bluish mass, not deliquescent, having an alkaline acrid taste, and a peculiar odour. It consists of *Carbonate* and *Sulphate of Soda*, *Sulphuret* and *Chloride of Sodium*, *Carbonate of Lime*, *Alumina*, *Silica*, *Oxide of Iron*, and *Carbonaceous matter* which has escaped combustion. The carbonate of soda is produced by the decomposition of the oxalate and other organic salts of soda contained in the plants before combustion. Several varieties of barilla are known in the market: they are distinguished by the names of the places from whence they are imported; namely, the Grand Canary and Teneriffe Islands, Alicant, Sicily, Carthagena, and the East Indies. *Canary Barilla* is procured from *Salsola Kali;* (Loudon *Encyclopædia of Agriculture.*) *Alicant Barilla* (*Soda Hispanica; Soda Alicantina*) is obtained from *Salsola sativa*, *Chenopodium setigerum*, and other species. (Lagasca, quoted in De Candolle's *Phys. Vég.* p. 388.) It yields from 25 to 40 per cent. of carbonate of soda. *Sicily Barilla* is procured principally from *Salsola sativa:* it furnishes, according to Fée, (*Cours d'Hist. Nat.* t. 2nd, p. 488.) 55 per cent. of carbonate of soda. Of the *French Barillas* two only deserve notice; namely, that of Narbonne, obtained from *Salicornia herbacea*, and which yields 14 or 15 per cent. of carbonate; and that of Aiguemortes, called *Blanquette*, and which contains from 3 to 8 per cent. only of alkaline carbonate.

The importation of barilla has very much fallen off of late years, in consequence of the extraction of carbonate of soda from sulphate of soda. In 1827 the quantity imported was 326,239 cwts.;[1] whereas, in 1840, it was only 284 tons. (*Trade List*, Jan. 5, 1841.)

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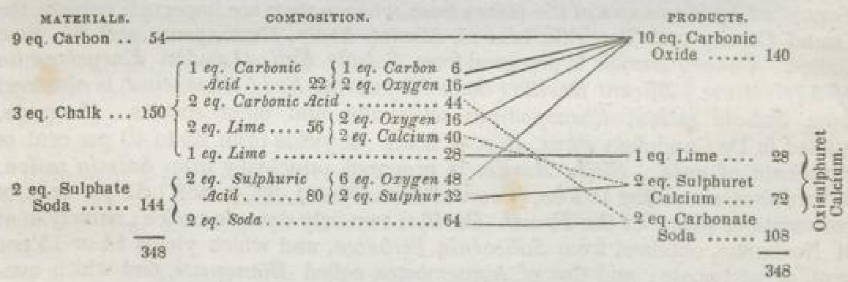
[1] *A General Statement of the Imports and Exports*, printed by order of the House of Commons, 24th Feb. 1829.

**2. Preparation of Kelp.**—Kelp (called by the French *Varec* or *Normandy Soda*) is procured by the combustion of cryptogamic plants of the order *Algaceæ*. According to Dr. Greville, (*Algæ Britannicæ*, p. xxi.) the species most valued for this purpose are *Fucus vesiculosus nodosus* and *serratus*, *Laminaria digitata* (see fig. 47, p. 223) and *bulbosa*, *Himanthalia lorea*, and *Chorda Filum*. These are burned in coffers of stone or in kilns. About 24 tons of sea-weed are required to produce one ton of kelp. (Macculloch's *Western Islands*, vol. i. p. 123.) The resulting ash is kelp. As met with in commerce, it consists of hard, dark gray or bluish masses, which have an acrid caustic taste, and are composed of *Chloride of Sodium*, about five per cent. of *Carbonate of Soda*, (formed by the decomposition of the oxalate and other organic salts of soda,) *Sulphates of Soda* and *Potash*, *Chloride of Potassium*, *Iodide of Potassium* or *Sodium*, and *Insoluble* and *Colouring Matters*. By digesting kelp in a small quantity of water, and filtering and evaporating the solution, crystals of carbonate of soda may be procured. But as this salt can be procured at a lower price and of finer quality from artificial soda, kelp is now of little value as a source of soda. In the Orkney islands, about 20,000 persons were, a few years since, occupied in the manufacture of kelp. (Greville, *op. cit.*)

**3. Preparation of Soda-Ash from Sulphate of Soda.**—The principal manufactories are situated in the northern parts of the kingdom, and are conducted on a most extensive scale. The process adopted varies in some of its details in different places.

The sulphate of soda employed is, in part, obtained from manufacturers of chloride of lime, who procure a considerable quantity in the process for generating chlorine. But the greater part of it is made expressly, by adding sulphuric acid to common salt (chloride of sodium.) The hydrochloric acid gas evolved in this process is highly injurious to vegetable and animal life,[1] and various contrivances have been resorted to, to prevent its escape into the atmosphere, as by absorbing it by water or lime. The sulphate of soda, reduced to powder, is usually decomposed by mixing it with an equal weight of ground chalk and half its weight of small coal ground and sifted, and heating the mixture in a very hot reverberatory furnace. During the operation it is frequently stirred. The product has a dark gray or blackish appearance, and is called *British Barilla* or *Ball Alkali*.

It consists of carbonate of soda and oxisulphuret of calcium. During the operation carbonic oxide gas escapes. The following diagram explains the reactions:—



By theory, the ball alkali should contain about 30 per cent. of carbonate of soda; but the quantity is in general only 22 per cent.

Ball alkali is lixiviated with water, and the carbonate of soda thereby separated from the more difficultly soluble oxisulphuret of calcium. The solution, by evaporation, yields a dark crystalline mass, composed of carbonate of soda,

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[1] See p. 257 et seq.—A very humorous account of the unpleasant effects of this gas is contained in the report of a trial at Lancaster, March 21, 1838, the Queen *v.* Airey, in the *Times* newspaper.

caustic soda, and some sulphuret of sodium. This is roasted in a reverberatory furnace, to get rid of the sulphur. Or it is calcined with saw-dust. The product is called *soda-ash* or *soda-salt*, and contains about 50 per cent. of alkali.[1]

PURIFICATION.—The London and Dublin Colleges give directions for the purification of the impure carbonate of soda of commerce.

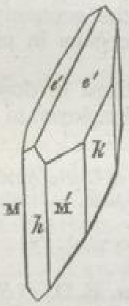
The *London College* orders of impure Carbonate of Soda, lb. ij.; Distilled Water, Oiv. Boil the impure carbonate of soda in the water, and strain it while hot. Lastly, set it by, that crystals may be formed.

The *Dublin College* directs Carbonate of Soda to be prepared from Barilla, in the same way. The operations are to be repeated until the crystals are sufficiently pure.

On the large scale crystallized carbonate of soda is obtained from Soda-ash by lixiviating the latter with water, straining the solution, and evaporating. The salt is usually crystallized in iron pans.

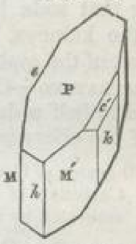
PROPERTIES.—Carbonate of soda usually forms large crystals, which are oblique rhombic prisms. They are transparent, and have a cooling alkaline taste. By exposure to the air they effloresce. When heated they undergo the watery fusion, and give out their water of crystallization: at a red heat, the whole of the water is expelled. Carbonate of soda is insoluble in alcohol. It dissolves in twice its weight of water at 60°, and in less than its own weight at 212° F. The solution reacts as an alkali on vegetable colours.

FIG. 73.



*Ordinary Crystal.*

FIG. 74.



*Crystal reduced in height.*

*Characteristics.*—As a carbonate it is known by the tests for this class of salts already stated (vide p. 302.) From the bicarbonate it is distinguished by the brick-red precipitate which it throws down with bichloride of mercury. Sulphate of magnesia causes a white precipitate with it. As a soda salt it is recognised by the tests for this class of salts already stated (p. 456.)

COMPOSITION.—The perfect crystals of the ordinary carbonate of soda of commerce have the following composition:—

| | *Atoms.* | *Eq. Wt.* | *Per Cent.* | *Klaproth.* |
|---|---|---|---|---|
| Soda | 1 | 32 | 22·25 | 22 |
| Carbonic Acid | 1 | 22 | 15·25 | 16 |
| Water | 10 | 90 | 62·5 | 62 |
| Crystallized Carbonate of Soda | 1 | 144 | 100·00 | 100 |

IMPURITY.—The ordinary impurities of this salt are sulphates and chlorides. These are detected as follows:—Supersaturate with nitric acid, and then add, to separate portions of the diluted solution, chloride of barium and nitrate of silver: if the first occasion a white precipitate, it indicates the presence of a sulphate—if the

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[1] For farther details consult Dumas, *Traité de Chimie*, t. ii.; Graham, *Elements of Chemistry*; Brande, *Manual of Chemistry*; Duncan, *Edinburgh Dispensatory*; and Ure's *Dictionary of Arts*.

second also produce a white precipitate, soluble in ammonia, but insoluble in nitric acid, it shows the presence of a chloride.

When freshly prepared it [Crystallized Carbonate of Soda] is translucent, but in an open vessel it in a short time falls to powder. It is totally soluble in water, but not at all in alcohol. It alters the colour of turmeric like an alkali. *Ph. L.*

"A solution of 21 grains in a fluid ounce of distilled water, precipitated by 19 grains of nitrate of baryta, remains precipitable by more of the test; and the precipitate is entirely soluble in nitric acid. Little subject to adulteration." *Ph. Ed.*

Physiological Effects.—Carbonate of soda is less acrid, and has a milder and less unpleasant taste, than carbonate of potash; but in other respects the effects of these two salts on both vegetables and animals are the same.

Uses.—Carbonate of soda is used in the same cases as carbonate of potash, over which it has the advantage of a less disagreeable taste. Fourcroy imagined that as soda is contained in animals in larger proportion than potash, it was a better agent for medicinal use. Experience, however, has not confirmed this opinion, but has proved the reverse; for both Sir G. Blane[1] and Mr. Brande[2] state that they obtained beneficial effects, in calculous complaints, from the use of potash, where soda failed to give any relief. Sir G. Blane accounted for this by assuming that soda becomes applied to the purposes of the economy before it reaches the kidneys, whereas potash is carried to these organs in order to be thrown out of the system.

Administration.—Crystallized carbonate of soda is exhibited in doses of from ten grains to half a drachm or a drachm. It is sometimes employed in the manufacture of the effervescing draught.

20 grains of Crystallized Carbonate of Soda are saturated by about . . {
9¼ grs. of Commercial Crystals of Citric Acid.
10½ grs. of Crystals of Tartaric Acid.
f℥ijss. of Lemon Juice.

Antidotes.—See *Potassa*, p. 414.

**SODÆ CARBONAS EXSICCATA**, L. *Sodæ Carbonas siccatum*, E. D. [*Sodæ Carbonas Exsiccatus*, U. S.] *Dried Carbonate of Soda.* Carbonate of Soda, lbj. Apply heat to the Carbonate of Soda in a proper vessel, until it is dried, and afterwards heat it to redness. Lastly, rub it to powder, *L.*—The processes of the *Edinburgh* and *Dublin Colleges* are essentially the same. Fifty-four grains of this preparation are equal to one hundred and forty-four grains of the crystallized carbonate. It may be exhibited either in powder or pills. Dose from grs. v. to ℈j.

### 8. SO'DÆ SESQUICAR'BONAS, *L.*—SESQUICARBONATE OF SODA.

In the province of Sukena, near Tripoli, is found a substance which the Africans call *Trona*—a word from which are probably derived the terms νιτρον, *nitrum*, and *nitron*. (Vide *Potassæ Nitras* and *Sodæ Carbonas*.) But the analyses of Klaproth, (*Beitrage*, iii. 83.) Phillips, (*Quarterly Journal of Science*, vol. vii. 297.) and Beudant, (Quoted by Necker, *Règne Minéral*, ii. 668.) show that the proportion of carbonic acid which it contains is that of a sesquicarbonate. From the analysis of MM. Mariano de Rivero and Boussingault (*Ann. de Chim. et Phys.* xxix. 110.) it appears that the substance termed *Urao*, and which occurs at the bottom of a lake at Lagunillas, near Marida, in South America, has a similar composition. (For an account of this lake, see *Quarterly Journal of Science*, vol. i. p. 188.)

The white powder sold in the shops of this country for making *Soda Powders*, and which is denominated *Carbonate*, *Bicarbonate*, or *Sesquicarbonate of Soda* (*Sodæ Sesquicarbonas*, Ph. L.) consists either of bicarbonate of soda or of

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[1] *Transactions of a Society for the Improvement of Med. and Chirurg. Knowledge*, iii. 347

[2] *Quarterly Journal of Science*, vol. vi. p. 205.

a mixture of carbonate and bicarbonate of soda, in varying proportions. The latter two substances may be detected as follows:—Wash the so-called sesquicarbonate with a small quantity of distilled water, and filter: the solution usually contains carbonate of soda (known by its throwing down a brick-red precipitate on the addition of a solution of bichloride of mercury)—while there remains on the filter bicarbonate of soda (recognised by its causing a white precipitate, or a slight milkiness or opalescence with a solution of bichloride of mercury.) Sometimes the substance sold as sesquicarbonate of soda (For farther details, see *Sodæ Bicarbonas.*) consists wholly of bicarbonate.

The composition of native crystallized sesquicarbonate of soda is as follows:—

| | *Atoms.* | *Eq. Wt.* | *Per Cent.* | *Boussingault.* Urao. | *Klaproth.* Trona. |
|---|---|---|---|---|---|
| Soda | 1 | 32 | 38·55 | 38·62 | 37·0 |
| Carbonic Acid | 1¼ | 33 | 39·76 | 40·13 | 38·0 |
| Water | 2 | 18 | 21·69 | 21·24 | 22·5 |
| Sulphate Soda | — | — | — | — | 2·5 |
| Native Sesquicarbonate Soda | 1 | 83 | 100·00 | 99·99 | 100·0 |

Like the so-called hydrated sesquicarbonate of ammonia (pp. 284 and 285) it is probably a double salt, composed of one equivalent of the carbonate and one equivalent of the bicarbonate of soda.

### 9. SO'DÆ BICAR'BONAS, *E. D.* (U. S.)—BICARBONATE OF SODA.

History.—This salt was discovered by Valentine Rose. In some works it is termed *Natron Carbonicum perfecte saturatum seu acidulum.* Alone or mixed with carbonate of soda it constitutes the *Sodæ Sesquicarbonas* of the London Pharmacopœia,—the *Carbonate* or *Bicarbonate of Soda* of the shops.

Natural History.—It is a constituent of the mineral waters called *acidulo-alkaline*, as those of Carlsbad and Seltzer (see pp. 268 and 271.)

Preparation.—All the British Colleges give formulæ for the preparation of bicarbonate or sesquicarbonate of soda.

The *London College* orders the sesquicarbonate to be prepared with Carbonate of Soda, lbvij.; Distilled Water, *Cong.* j. Dissolve the Carbonate of Soda in the Water, and strain; then pass Carbonic Acid into the solution to saturation, that the salt may subside. Wrapped and pressed in cloth, dry this with a gentle heat.

The *Edinburgh College* orders the bicarbonate to be prepared as follows:—Fill with fragments of marble a glass jar, open at the bottom and tubulated at the top; close the bottom in such a way as to keep in the marble without preventing the free passage of a fluid; connect the tubulature closely by a bent tube and corks with an empty bottle, and this in like manner with another bottle filled with one part of Carbonate of Soda, and two parts of Dried Carbonate of Soda, well triturated together; and let the tube be long enough to reach the bottom of the bottle. Before closing the last cork closely, immerse the jar to the top in diluted muriatic acid contained in any convenient vessel; when the whole apparatus is thus filled with carbonic acid gas, secure the last cork tightly, and let the action go on till next morning, or till gas is no longer absorbed by the salt. Remove the damp salt which is formed, and dry it, either in the air without heat, or at a temperature not above 120°.

The *Dublin College* orders of Carbonate of Soda, *two parts;* Water, *five parts.* Dissolve. Let the liquor be exposed in a suitable apparatus to the stream of Carbonic Acid Gas, which escapes during the solution of white marble in diluted Muriatic Acid, until it shall have ceased to absorb gas, and let it rest until crystals form: then, with a heat not exceeding 120°, let the liquor evaporate and crystals be formed by cooling; these are to be mixed with the former, dried and preserved in a close vessel.

[The mode of preparing this salt, according to the U. S. P., is the following. Take of Carbonate of Soda, in crystals, a convenient quantity. Break the crystals in pieces, and put them into a wooden box, having a transverse partition near the bottom pierced with numerous small holes, and a cover which can be tightly fitted on. To a bottle having two tubulures, and half filled with water, adapt two tubes, one connected with an apparatus for generating Carbonic Acid and terminating under the water in the bottle, the other commencing at the tubulure in which it is inserted, and entering the box by an opening near the bottom, beneath the partition. Then lute all the joints and cause a stream of Carbonic Acid to pass through the water into the box until the Carbonate of Soda is fully saturated. Carbonic Acid is obtained from marble by the addition of dilute Sulphuric Acid.

This process is the one adopted in Philadelphia and is "economical, efficient, and to be relied on."—*Report of Committee of Philadelphia College of Pharmacy.*]

"In the manufacture of this bicarbonate for the purpose of commerce, 160 lbs. of carbonate may be dissolved in 13 gallons of water, and carbonic acid thrown into the solution in a proper apparatus. The bicarbonate falls, as it forms, to the amount of about 50 lbs., and being separated from the solution, may be conveniently dried by pressure in an hydraulic press. A fresh portion of carbonate is dissolved in the mother liquor, and the operation repeated as before." (Brande, *Manual of Chemistry*, 5th edit. 1841.)

The carbonic acid used in this process is usually procured artificially, by the action of diluted sulphuric acid on carbonate of lime. In some countries, however, it is obtained from natural sources; as at Vichy, where it is collected from the mineral waters.[1]

*Smith's process* for the preparation of bicarbonate of soda consists in placing the ordinary carbonate of soda in a box, and surrounding it by an atmosphere of carbonic acid gas under pressure. As the bicarbonate combines with much less water of crystallization than is contained in the carbonate, a considerable portion of water is liberated, which, saturated with part of the salt, is allowed to drain off: when the gas ceases to be absorbed, the salt is taken out and dried. On examination it is found to have retained the original form of the pieces; but they have become of a porous and loose texture, presenting the appearance of numerous crystalline grains, aggregated together, and having a snow-white colour.[2]

At Glasgow, sesquicarbonate [bicarbonate?] of soda is prepared by exposing the carbonate, dry, and in powder, to an atmosphere of carbonic acid gas: it absorbs the requisite quantity to be converted into a sesquicarbonate. (Dr. T. Thomson, *Athenæum* for 1840, p. 771.) In the London Pharmacopœia for 1809, it was ordered to be prepared by adding the hydrated sesquicarbonate of ammonia to a solution of carbonate of soda, and applying a heat of about 100° F., to drive off the ammonia: the solution is then to be set aside to crystallize. The proportions of the ingredients employed were a pound of carbonate of soda, three ounces of sesquicarbonate of ammonia, and a pint of distilled water. Winckler (*Lehrb. d. Pharm. Chemie*, 1er Th. S. 292.) directs 4 parts of crystallized carbonate of soda, 1½ parts of sesquicarbonate of ammonia, and 10 parts of water. The proportions ordered by MM. Henry and Guibourt (*Pharm. Raisonnée*, t. 2nd, p. 409, éd. 2nde.) are 6 parts of the crystallized carbonate of soda, 2 parts of sesquicarbonate of ammonia, and 4 parts of water.

PROPERTIES.—Perfect crystals of bicarbonate of soda are, according to Dr. Thomson, (*Chem. of Inorg. Bodies*, vol. ii. p. 54.) oblique rectangular prisms. As usually met with, this salt constitutes a white crystalline mass, or a whitish powder. In the latter state it is usually contaminated with a small portion of the carbonate. The taste of this salt, and its reaction on vegetable colours, are slightly alkaline. By exposure to the air it effloresces superficially. When heated it evolves carbonic acid and water, and becomes the anhydrous carbonate. It dissolves in 13 parts, according to Rose, or 8 parts, according to Berthollet, of cold water. By heat the solution loses first one quarter, and subsequently one-half of its carbonic acid.

*Characteristics.*—To recognise the carbonic acid and soda of this salt, the tests are the same as before described (vide p. 456) for the carbonate of soda. From the latter salt the bicarbonate of soda is distinguished by its more difficult solu-

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[1] For a description and sketch of the apparatus used in the collection of the gas by D'Arcet, see *Dict. de l'Indust.* 3me. t. p. 61.

[2] *Journ. of the Philadelphia College of Pharm.* vol. i., quoted by Dr. Bache, in the *United States' Dispensatory.* For a sketch of the apparatus employed by Souberain, in performing Smith's process, see his *Nouv. Traité de Pharm.* t. 2me, pp. 289 and 284, 2nde ed. Paris, 1840.

bility in water, by its causing neither a brick-red precipitate with the bichloride of mercury, nor a white precipitate with the sulphate of magnesia of the shops.

COMPOSITION.—Crystallized bicarbonate of soda has the following composition:—

| | *Atoms.* | *Eq. Wt.* | *Per Cent.* | *Rose.* | *Berthollet.* | *Bérard.* |
|---|---|---|---|---|---|---|
| Soda | 1 | 32 | 34·04 | 37 | 31·75 | 29·85 |
| Carbonic Acid | 2 | 44 | 46·80 | 49 | 44·40 | 49·95 |
| Water | 2 | 18 | 19·14 | 14 | 23·85 | 20·20 |
| Cryst. Bicarb. Soda | 1 | 94 | 99·98 | 100 | 100·00 | 100·00 |

According to Dr. Thomson (*First Principles of Chemistry*, vol. ii. p. 268.) this salt contains only one equivalent of water of crystallization.

PURITY.—When quite pure this salt occasions no precipitate with bichloride of platinum, perchloric acid, or tartaric acid, by which its freedom from potash is demonstrated. When supersaturated with pure nitric acid, it gives no precipitate with either chloride of barium or nitrate of silver, by which the absence of sulphates and chlorides is shown. Lastly, it occasions a white precipitate, or opalescence, with bichloride of mercury, by which the freedom from a simple or mono-carbonate is shown.

It is totally dissolved by water. Neither chloride of platina nor sulphate of magnesia, unless heated, throws down any thing from this solution. By a strong fire it is converted into anhydrous carbonate of soda. *Ph. Lond.*

"A solution in 40 parts of water does not give an orange precipitate with solution of corrosive sublimate." *Ph. Ed.*

PHYSIOLOGICAL EFFECTS.—The effects of this salt are analogous to those of bicarbonate of potash, than which it is regarded as having a somewhat less disagreeable taste and a slighter local action. It is less caustic and irritant than the carbonate of soda. Its remote or constitutional effects are analogous to those of the caustic alkalis. (Vide *Potassa*, p. 416.)

USES.—It is employed as an *antacid* in those forms of dyspepsia which are attended with an inordinate quantity of acid in the stomach; as a *lithontriptic* in those kinds of lithiasis which are accompanied with an excessive secretion of uric acid and the urates; as a *resolvent* or *alterative* in certain forms of inflammation, in glandular affections, in syphilis, and scrofula; and as a *diuretic* in some dropsical complaints. (See *Potash*, p. 416, and *Carbonate of Soda*, p. 467.)

The principal consumption of bicarbonate of soda (*Sodæ Sesquicarbonas*, Ph. L.) is in the preparation of the effervescing draught, soda-powders, and Seidlitz powders: in these the bicarbonate is mixed with a vegetable acid (either citric or tartaric, usually the latter.) Taken in a state of effervescence, a solution of this kind is an agreeable and refreshing drink for allaying thirst, checking sickness, and diminishing febrile heat, as I have before mentioned (see pp. 304, 359, and 362.) The resulting soda-salt (tartrate or citrate) undergoes partial digestion in its passage through the system, and is converted into carbonate, which is found in the urine. Hence, therefore, these effervescing preparations may be employed as diuretics and lithontriptics, instead of the simple carbonate or bicarbonate of soda, than which they are more agreeable. On the other hand they are highly objectionable, and are to be carefully avoided, in the treatment of phosphatic deposites in the urine. Alluding to these cases, Dr. Prout[1] observes, "were I required to name the remedy calculated to do the most mischief, I should name the common saline draught, formed of potash or soda, and *some vegetable acid*."

ADMINISTRATION.—The dose of this salt is from ten grains to a drachm. In the preparation of effervescing draughts, a scruple of the powder sold in the shops as bicarbonate of soda (*Sodæ Sesquicarbonas*, Ph. L.) usually requires about 18

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[1] *Inquiry into the Nature and Treatment of Affections of the Urinary Organs*, 2d ed. p. 145.

grains of crystallized tartaric acid, or about 17 grains of the ordinary crystals of citric acid, or four fluid-drachms of lemon juice, to saturate it.

1. **PULVERES EFFERVESCENTES**, E. *Effervescing Powders*. (Tartaric Acid, ℥j.; Bicarbonate of Soda, ℥j. and grs. liv.; or, Bicarbonate of Potash, ℥j. and grs. clx. Reduce the acid and either bicarbonate separately to fine powder, and divide each into sixteen powders; preserve the acid and alkaline powders in separate papers of different colours.)—The *Soda Powders* of the shops consist of 30 grains of bicarbonate of soda, contained in a blue paper, and 25 grains of tartaric acid, in a white paper. When taken they should be dissolved in half a pint of water. The flavour of the solution is improved by adding to the water, before dissolving the acid, one or two drachms of simple syrup, and either half a drachm of the tincture of orange-peel, or two or three drops of the essence of lemon. *Ginger-beer Powders* are made in the same way as soda powders, except that five grains of powdered ginger and a drachm of white sugar are mixed with the bicarbonate of soda.

2. **SEIDLITZ POWDERS.**—These consist of two drachms of Tartarized Soda and two scruples of Bicarbonate of soda contained in a blue paper, and half a drachm of powdered Tartaric Acid in a white paper. These are to be taken dissolved in half a pint of water, while the liquid is in a state of effervescence. These form an agreeable and mild aperient. Why they are called *Seidlitz* powders I cannot divine, as they have no analogy to Seidlitz water.

3. **LIQUOR SODÆ EFFERVESCENS**, L. *Sodæ Aqua Effervescens*, E.; *Aqua Carbonatis Sodæ Acidula*, D.; *Effervescing Solution of Supercarbonate of Soda; Soda Water, properly so called.* (Sesquicarbonate [Bicarbonate, *E.*] of Soda, ʒj.; Distilled Water, Oj. Dissolve the carbonate in the water, and pass into it, compressed by force, more carbonic acid than is sufficient for saturation. Keep the solution in a well-stoppered vessel, *L. E.*—The process of the Dublin Pharmacopœia is essentially similar, except that carbonate of soda is substituted for the bicarbonate.)—This solution is employed in the same cases as bicarbonate of soda. The additional quantity of carbonic acid contained in it renders it more agreeable, and not less effectual, as an alkaline agent, in its operation on the system generally. It is employed to counteract or prevent the inordinate secretion of uric acid and the urates; but both this and soda water powders are highly injurious in phosphatic deposites (see p. 473.)

The *Bottled Soda Water* of the shops is in general only carbonic acid water (see p. 306.) If, after it has ceased to effervesce, tartaric acid be added, the effervescence is not renewed unless an alkaline carbonate be present.

*Liquor sodæ effervescens* may be extemporaneously made, by pouring carbonic acid water into a tumbler containing half a drachm of bicarbonate of soda.

A fraudulent imitation of soda water is said to have been practised, by adding a few drops of sulphuric acid to a solution of carbonate of soda in water, and instantly corking the bottle. The fraud may be detected by chloride of barium, which throws down a white precipitate insoluble in nitric acid.

4. **SODÆ CARBONATIS AQUA**, D. *Solution of Carbonate of Soda.* (Take of Carbonate of Soda any required quantity; dissolve in water, and let the specific gravity of the liquor be to that of distilled water as 1024 to 1000. A liquor of the same specific gravity is prepared by dissolving an ounce of [crystallized] carbonate of soda in a [wine] pint of distilled water.) Dose from fʒiij. to fʒij.

5. **TROCHISCI SODÆ BICARBONATIS**, E. *Soda Lozenges*. (Bicarbonate of Soda, ℥j.; Pure Sugar, ℥iij.; Gum Arabic, ʒss. Pulverize them, and, with mucilage, beat them into a proper mass for making lozenges.) Employed to relieve too great acidity of stomach.

## POTAS'SÆ ET SO'DÆ TAR'TRAS, *E. D.*—TARTRATE OF POTASH AND SODA

(Sodæ Potassio-Tartras, *L.*) (Sodæ et Potassæ Tartras, U. S.)

History.—This salt was discovered by Seignette, an apothecary at Rochelle, in 1672, and hence it is frequently termed *Seignette's Salt*, or *Sel de Seignette.* (Beckmann's *Hist. of Invent.* vol. iv. p. 616.) He called it *Alkaline Salt*, *Sal Polychrest*, and *Rochelle Salt* (*Sal Rupellensis.*) To distinguish it from the sal polychrest (sulphate of potash) of other writers, it is sometimes denominated *Sal Polychrestum Seignetti.* It is often called *Tartarized Soda* (*Soda Tartarizata* seu *Natron Tartarizatum.*)

Preparation.—All the British Colleges give directions for its preparation.

The *London College* orders of Bitartrate of Potash, powdered, ℥xvj.; Carbonate of Soda, ℥xij.; Boiling Water, Oiv. Dissolve the carbonate of soda in the boiling water, and add gradually the bitartrate of potash. Strain the liquor; then apply a gentle heat until a pellicle floats, and set it aside that crystals may be formed. The liquor being poured off, dry them. Evaporate the liquor again that it may yield crystals. [The Formula of the U. S. Pharmacopœia is the same.]

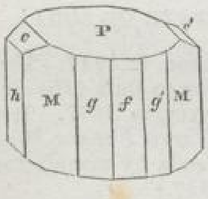
The *Edinburgh College* orders the same quantities.

The *Dublin College* employs Carbonate of Soda, *five parts;* Bitartrate of Potash, reduced to the finest powder, *seven parts;* Hot Water, *fifty parts.*

In this process the excess of acid in the bitartrate of potash is saturated by the soda of the carbonate, while the carbonic acid of the latter is disengaged.

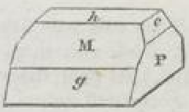
Properties.—This salt is met with in large, transparent, and regularly-shaped right rhombic prisms; but curiously enough, the crystals are frequently produced in halves (as in fig. 76.) Their taste is mildly saline and bitter. Exposed to the air they slightly effloresce. When heated they undergo the watery fusion, evolve their water of crystallization, and are decomposed: the residue consists of charcoal and the carbonates of potash and soda. They are readily soluble in cold, and still more so in hot water.

Fig. 75.



*Prism of Rochelle Salt.*

Fig. 76.



*Natural Half of ditto.*

*Characteristics.*—This salt may be recognised by the shape and size of the crystals. Sulphuric acid added to the aqueous solution throws down small crystals of bitartrate of potash; perchloric acid throws down perchlorate of potash: the chlorides of barium and calcium occasion white precipitates, soluble in excess of water, and composed of soda, tartaric acid, and, in the one case, baryta, in the other, lime: bichloride of platinum produces a yellow precipitate of the platinum-chloride of potassium. Heated with the bichloride of platinum it yields a black precipitate. Nitrate of silver occasions a white precipitate, (*tartrate of silver*,) soluble in excess of water. When heated, Rochelle salt is decomposed, various volatile substances are evolved, and the odour of caramel is given out (see p. 361.) If the residuum be digested in hydrochloric acid, we obtain a solution of the chlorides of sodium and potassium: the chloride of potassium may be precipitated by bichloride of platinum, leaving chloride of sodium in solution, which may be detected by the tests already mentioned for this salt (p. 456.)

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

| | *Atoms.* | *Eq. Wt.* | *Per Cent.* | *Schulze.* | | | *Ats.* | *Eq. Wt.* |
|---|---|---|---|---|---|---|---|---|
| Soda | 1 | 32 | 10·6 | 13·3 | or | Tartrate Potash | 1 | 114 |
| Potash | 1 | 48 | 15·6 | 14·3 | | Tartrate Soda | 1 | 98 |
| Tartaric Acid | 2 | 132 | 43·7 | 41·3 | | Water | 10 | 90 |
| Water | 10 | 90 | 29·8 | 31·1 | | | | |
| Crystd Tartc of Potash & Soda | 1 | 302 | 99·7 | 100·0 | | | 1 | 302 |

Dr. Thomson (*First Principles*, ii. 440.) says, that when the crystals are free from all adhering moisture, they contain only eight equivalents of water of crystallization, and their atomic weight is then 284.

Physiological Effects.—It is a mild, laxative, cooling salt, very analogous in its effects to the tartrate of potash. Sundelin (*Hand. d. Heilmittellehre.*) says it is uncertain as a purgative, sometimes failing, at others acting very slowly, but strongly, and with violent abdominal pain. He thinks it may be completely replaced in practice by a mixture of magnesia and sulphate of magnesia. Like the other vegetable alkaline salts, it undergoes partial decomposition in the system, and is converted into the carbonate, in which state it is found in the urine. Hence its use should be carefully avoided in persons suffering with phosphatic deposites in the urine.

Uses.—It is commonly employed as a mild aperient for females and other delicate persons. It may be used with advantage by those who are subject to excessive secretion of uric acid or the urates.

Administration.—It is given in doses of from ʒij. to ʒvj. or ℥j. It should be exhibited largely diluted with water. A very convenient mode of exhibition is in combination with bicarbonate of soda and tartaric acid in an effervescing condition (vide *Seidlitz Powders*, p. 474.)

## 11. SO′DÆ ACE′TAS, *L. D.*—ACETATE OF SODA.

History.—This salt was first described by Baron, in 1747: (Thomson's *Chemist. of Inorg. Bod.* vol. ii. p. 464.) but according to Dulk (*Die Preuss. Pharm. übers. u. erläut.*) its real discoverer was F. Meyer, in 1677. It was formerly called *Terra Foliata Tartari Crystallisata*, or *Terra Foliata Mineralis*.

Preparation.—The preparation of acetate of soda by manufacturers of pyroligneous acid has been before described (see p. 347.)

The *Dublin College* orders it to be prepared by saturating Carbonate of Soda with Distilled Vinegar. The filtered liquor is to be evaporated until it has attained the sp. gr. of 1·276. By cooling, crystals are formed, which are to be cautiously dried and kept in a close vessel.

Properties.—This salt crystallizes in oblique rhombic prisms. Geiger (*Handb. d. Pharm.* 1 Bd. 150, 3 Aufl.) says that a saturated solution of this salt does not readily crystallize when cooled in a tall glass vessel, unless some pointed or angular body be introduced. Its taste is cooling, saline, and bitterish. Exposed to the air, at ordinary temperatures, the crystals undergo little change; but in dry and warm air they effloresce and become anhydrous. When heated they first undergo the watery fusion, then give out their water of crystallization, and afterwards undergo the igneous fusion. At a red heat they are decomposed, and yield, as a residue, a mixture of charcoal and carbonate of soda. They are soluble in about three parts of cold water; and are slightly soluble in alcohol.

*Characteristics.*—As an acetate it is recognised by the tests before mentioned (p. 347) for this class of salts. That the base is soda is shown by the characters already described (p. 533) for the soda salts.

Composition.—The following is the composition of this salt:—

| | *Atoms.* | *Eq. Wt.* | *Per Cent.* | *Berzelius.* |
|---|---|---|---|---|
| Soda | 1 | 32 | 23·36 | 22·94 |
| Acetic Acid | 1 | 51 | 37·22 | 36·95 |
| Water | 6 | 54 | 39·41 | 40·11 |
| Crystallized Acetate of Soda | 1 | 137 | 99·99 | 100·00 |

Purity.—It should be white and perfectly neutral to test-papers (litmus and turmeric.) The presence of sulphuric acid may be recognised by chloride of barium, which occasions, with this acid, a white precipitate insoluble in nitric acid. If nitrate of silver cause a white precipitate insoluble in both water and nitric acid, but soluble in ammonia, the presence of a chloride is to be inferred. Potash may be recognised by the before-mentioned tests for this base (p. 415,) as well as by the deliquescence of the suspected acetate.

Physiological Effects.—Acetate of soda operates on the body like acetate of potash, but is probably somewhat milder in its action.

Uses.—It is rarely employed for medicinal purposes. It may, however, be used as a substitute for acetate of potash, over which it has the advantage of not being deliquescent.

In pharmacy and the arts it is largely employed in the manufacture of acetic acid (vide p. 348,) and on this account has been introduced into the Pharmacopœia, as the officinal source of this acid.

Administration.—The dose of it, as a diuretic, is from a scruple to two drachms.

## 12. SA'PO.—SOAP.

1. Sapo. Sapo ex olivæ oleo et sodâ confectus, *L.*—Sapo durus. Spanish or Castile Soap made with olive oil and soda, *E.*—Sapo durus, *D.*—[Sapo, U. S.]
2. Sapo mollis. Sapo ex olivæ oleo et potassa confectus, *L.*—Sapo mollis. Soft soap made with olive oil and potash, *E.*—Sapo mollis, *D.*—[Sapo vulgaris, U. S.]

History.—The Hebrew word *Borith*, translated in our version of the Bible (*Jer.* ii. 22, and *Mal.* iii. 2.) *Soap*, is, by most commentators, supposed to refer to a plant, or to the alkaline ashes of some plant. Pliny,[1] who mentions soap, says it is made of tallow and ashes, ascribes its invention to the Gauls, and adds, that the Germans employed both thick and liquid soap (hard and soft soap?) In the excavations made at Pompeii, a complete soap-boiler's shop was discovered, with the soap still perfect, though it must have been manufactured for more than 1700 years? (Parkes, *Chem. Essays*, ii. 5, 2nd ed.)

The term *Soap* is usually applied to the product of the action of alkalis on fixed oils and fats: while the term *Plaster* is commonly applied to the product of the action of oxide of lead on fixed oils and fats. The former is frequently termed *a soluble soap*, while a plaster is denominated *an insoluble soap*. The term soap is also applied to alkaline resinates.

Natural History.—Soap is always an artificial product, unless the spontaneous formation of *adipocire*, from dead animal matter, be considered an exception to this statement. This substance appears, from the analysis of Chevreul, to consist of a small quantity of ammonia, of potash, and lime, united to much margaric acid, and a very little oleic acid.

Preparation.—The following is a concise account of the principles of soap-making:—"In order to form soap, the oil or fat is boiled with a solution of caustic potash or soda, till the whole forms a thick viscid emulsion, which can be drawn out into long clear threads. If not clear, either water or alkali must be added, according as the turbidity depends on undecomposed oil, or on a deficiency of water. When the saponification is complete, the next step is to separate the soap from the excess of alkali, the glycerine, and the superfluous water. This may be effected by boiling down till the alkaline ley becomes very concentrated, when the soap becomes insoluble, and rises to the surface. The same end is attained by adding very strong ley, or common salt, both of which render the soap insoluble when added in sufficient quantity; soap being absolutely insoluble in alkaline ley of a certain strength, as well as in a saturated solution of common salt. The separation is known to be complete when the liquid ceases

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[1] *Historia Naturalis*, lib. xxviii. cap. 51, ed. Valp. "Fit ex sevo et cinere." "Duobus modis, spissus ac liquidus."

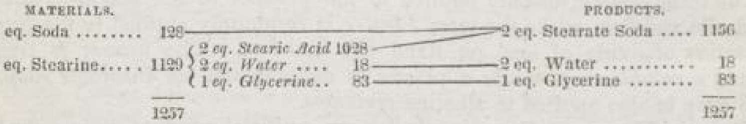
to froth in boiling; and the soap is ladled off into moulds, where it is well stirred to favour the separation of the liquid, which should run off from its surface like water from fat. The soap brought to this state in the first operation is called *grain soap*, from its separating in grainy particles at first. It may be farther purified by repeating the process of dissolving in alkaline ley, and separating it by the addition of salt. In this process the impurities subside, and the soap generally takes up more water: so that although whiter it is less strong. White soap, for example, commonly contains 45 to 60 per cent. of water, while grain soap contains 25 to 30 per cent. No doubt it may be again procured with as little water as at first; but it is the fluidity caused by the additional water that allows the impurities to subside, and the soap to become white. What is called marbled soap is grain soap which has not been subjected to purification; and the gray, blue, and green colours in it arise principally from the presence of insoluble soaps of oxide of iron or of copper." (Liebig, in Turner's *Elements of Chemistry*, 7th edit. p. 1076.)

THEORY OF SAPONIFICATION.—The fixed oils and fats, as they occur in nature, are for the most part mixtures or compounds of two or more fatty salts. *Stearine, Margarine*, and *Oleine*, are the fatty salts of most frequent occurrence. They are each composed of a sweet basic substance, called *Glycerine* ($C^{6} H^{7} O^{5} + Aq.$,) and a fatty acid. Stearine contains *Stearic Acid* ($C^{68} H^{66} O^{5}$;) while Margarine contains *Margaric Acid* ($C^{68} H^{66} O^{6}$;) and Oleine, *Oleic Acid* ($C^{44} H^{39} O^{4}$)

*Tallow* consists chiefly of Stearine with a little Oleine. *Olive Oil* is composed of Margarine and Oleine. *Almond Oil* contains less Margarine than Olive Oil. *Palm Oil* contains Oleine, Margarine (?), and about two-thirds of its weight of a white solid fat, which is Palmitine, and which contains Palmitic Acid.

When the oils and fats are acted on by a solution of the caustic alkali, the latter unites with the fatty acid, forming a soap, and disengages the glycerine which combines with water.

The following diagram illustrates the action of soda on stearine:—



In the conversion of resin into soap the phenomena are different. Resins usually consist of one or more acids, which combine with alkalis to form resinous salts or soaps. Thus, ordinary Yellow Resin (or Rosin) consists of two acids, called respectively Pinic and Silvic acids; and a soda soap made of this substance would, therefore, be a mixture of pinate and silvate of soda.

PROPERTIES.—The consistence, colour, odour, and sp. gr. of soap vary in the different varieties of this substance. The taste of all is slightly alkaline. All the alkaline soaps are soluble both in water and alcohol. The substance called *transparent soap* is prepared by evaporating an alcoholic solution of pure soap. When heated, soap fuses, swells up, and is decomposed, leaving a residuum of charcoal and alkaline carbonate. Most of the acids decompose soap: they unite with the alkaline base, and separate the fatty acids. The earthy salts (as sulphate of lime, sulphate of magnesia, alum, &c.) also decompose soap: the fatty acids unite with the earth to form an insoluble earthy soap, while the alkali of the soap combines with the acid of the salt. The *hardness* of sea, spring, and well water, depends on the earthy salts, (principally sulphate of lime,) which decompose soap: (see p. 244) hence tincture of soap may be used as a test of the hardness or softness of common waters. The metallic salts decompose soap, and give rise to metalline insoluble soaps.

*Characterestics.*—Soap may be partly recognised by its physical properties, especially by its feel, which is so well known that it is usually called *soapy.* The solubility of soap in water and alcohol is an important character, as well as its detergent quality, which depends on its power of rendering fatty and other matters soluble in water. The effect of heat on it also deserves notice: if the carbonaceous residuum be digested in weak hydrochloric acid, and the solution filtered and concentrated by evaporation, the nature of the alkaline base may be ascertained by applying the tests for potash and soda before mentioned (pp. 415 and 456.) Lastly, the action of acids and earthy and metallic salts on a solution of soap, as already noticed, serves to recognise soap.

Varieties.—A considerable number of soaps are met with in commerce. Of these, however, two[1] only are employed in medicine, viz. Castile Soap and Soft Soap.

The soaps of commerce are either *hard* or *soft;* the former are prepared with soda, the latter with potash. This circumstance, therefore, forms the ground of their division into two classes.

**Class 1. Hard or Soda Soaps;** *Sapo Sodiacus; Sapo natrinus; Sapo durus; Sapo spissus*, Pliny?—The qualities of the hard or soda soaps vary according to the nature of the fatty or resinous matters with which these substances are prepared.

1. Castile or Spanish Soap; *Sapo*, L.; *Sapo durus*, E. D.; *Sapo Hispanicus; Marseilles Soap; Olive Oil Soda Soap.*—This is prepared with olive oil and a solution of caustic soda. When pure it has very little odour. It is hard, but in the fresh state may be easily worked or kneaded between the fingers: by keeping in warm air it becomes dry and pulverizable. It should not feel greasy, have a rancid odour, communicate an oily stain to paper, nor be covered with a saline efflorescence; but should dissolve completely and readily in both water and alcohol.

Two varieties of it are known in commerce—the *white*, and the *marbled*.

α. *White Castile Soap.*—This is purer than the following variety, but it is a weaker soap (*i. e.* it contains more water.)

β. *Marbled Castile Soap.*—This variety is harder than the white kind. The marbled appearance is produced by adding to the soap, as soon as it is completely made and separated from the spent ley, a fresh quantity of ley, and immediately after a solution of sulphate of iron. The black oxide of iron is precipitated, and gives the dark-coloured streaks to the soap. By exposure to the air these streaks become red, in consequence of the conversion of the black oxide into the red or sesquioxide of iron.

2. Almond Soap; *Almond-oil Soda-soap; Sapo amygdalinus*, French Codex.—This is the medicinal soap of the French. It is prepared with ten parts of soap-boilers' ley (a solution of caustic soda) and twenty-one parts of almond oil. (Soubeiran, *Nouveau Traité de Pharmacie*, t. ii. p. 582, 2nde edit.) In this country it is used as a toilet soap.

3. Common Soap; *Sapo vulgaris*, United States Pharmacopœia; *Sapo sebaceus*, Geiger; *Animal-oil Soda-soap.*—This is prepared with tallow and soda. Two kinds of it are in common use, *curd soap* and *mottled soap*.

α. *White Curd Soap.*—This is made with pure or white tallow or curd soap. *Windsor Soap* is made with one part of olive oil and nine parts of tallow, and scented.

β. *Mottled Soap.*—This is the common or domestic soap. Refuse kitchen grease, called *kitchen stuff*, is used in its preparation.

4. Yellow Soap; *Rosin Soap; Resin Soda soap.*—This is prepared with tallow, rosin, and caustic soda. Palm oil is frequently employed in its manufacture.

In addition to the above there are many varieties of soap, termed *Fancy* or *Toilet Soaps*, which are sold by perfumers. The patent *Silica Soap* is hard soap mixed with silicate of soda.

**2. Of Soft or Potash Soaps;** *Sapo potassicus; Sapo kalinus; Sapo mollis; Sapo liquidus*, Pliny?—This kind of soap is made with caustic potash and acid oil or fat.

1. Common Soft Soap.—*Sapo mollis*, D.; *Animal-oil Potash Soap.*—This is prepared with fish oil, (whale, seal, or cod,) tallow, and potash. Its colour is brownish or yellowish; transparent, interspersed with white specks or grains of stearic soap formed by the tallow, and which give the soap a granular texture like that of the fig.

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[1] *Linimentum Ammoniæ* (p. 286) is an ammoniacal saponaceous liquid. *Linimentum Calcis*, hereafter to be described, is sometimes termed a calcareous soap (see *Calx.*) *Emplastrum Plumbi* has also been called a soap.

2. Olive-Oil Potash Soap.—*Sapo mollis*, L. E.—Though ordered in the London and Edinburgh Pharmacopœias, I have not been able to meet with it; and Messrs. Rowe, soap manufacturers, of Brentford, inform me they are unacquainted with it.[1]

Composition.—The following is the composition of several varieties of soap:—(See Gmelin's *Handbuch der Chemie.*)

| OLIVE OIL SODA SOAP. | | | | | | ANIMAL OIL POTASH SOAP. | |
|---|---|---|---|---|---|---|---|
| Marsailles white. | | | Marsailles marbled. | Foreign Castile, very dry. | London-made Castile, very dry. | Glasgow soft soap. | |
| Soda | 10·24 | 6 | 6 | 9·0 | 10·5 | Potash | 9·0 |
| Margaric Acid | 9·20 | 60 | 64 | 76·5 | 75·2 | Fatty Acids | 43·7 |
| Oleic Acid | 59·20 | | | | | | |
| Water | 21·36 | 34 | 30 | 14·5 | 14·3 | Water | 47·3 |
| Olive oil soda soap | 100·00<br>(Braconnot.) | 100<br>(D'Arcet. | 100<br>(Thenard.) | 100·0<br>(Ure.) | 100·0<br>(Ure.) | Animal oil potash soap | 100·0<br>(Ure.) |

Purity.—The adulterations of soap are excess of water, lime, gypsum, or pipeclay. The first may be known by the consistence of the soap, and the great loss of weight which this substance undergoes in dry air. The other impurities may be detected by alcohol, which leaves them undissolved.

Physiological Effects. *α. On Vegetables.*—Soap, used as a manure, appears to promote vegetation. (De Candolle, *Physiol. Végét.* p. 1343.)

*β. On Animals.*—It does not appear to be poisonous to animals. Veterinarians employ it as a diuretic, and, in large doses, as a purgative.

*γ. On Man.*—Soap acts very much like the alkalis (*vide* pp. 194, 207, and 416.) Its local operation, however, is much less energetic than either the caustic or even the carbonated alkalis. Hence, it may be administered in considerable doses without causing irritation or inflammation. When swallowed it very readily palls the appetite and disturbs the digestive functions, and in these qualities it is more powerful than the alkalis. Perhaps these effects depend on the fatty acids which must be disengaged in the stomach, in consequence of the union of the alkali of the soap with the free acids of the gastric juice. Probably the fatty acids become more or less completely digested, for soap acts on the general system like the alkalis; it promotes the secretion of urine, and communicates alkaline properties to this fluid. In large doses it acts as a purgative. I knew an idiot who had frequently eaten large lumps of soap without any ill effects; and I have heard of a pound of it being swallowed for a wager!

Uses.—As an *antacid*, soap is employed in poisoning by the mineral acids: it should be administered in the form of a strong solution, which effectually neutralizes the acid without acting as an irritant. So also in those forms of dyspepsia which are attended with an excessive formation of acid, soap may be usefully employed to neutralize it. External parts burnt with the strong mineral acids, or with phosphorus, should be washed with a solution of soap. As a *lithontriptic*, soap has been used in those forms of lithiasis in which uric acid or the urates prevail. A mixture of soap and lime-water was once considered a most powerful solvent for urinary calculi. The Hon. Horace Walpole (*Philosophical Transactions*, xlvii. 43 & 472.) gained great relief from it. By the action of lime-water on it, an insoluble calcareous soap and a solution of caustic soda are formed. As a *purgative*, soap is rarely exhibited alone: in combination with rhubarb it may be

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[1] Druggists generally substitute common soft soap for olive-oil potash-soap. At Apothecaries' Hall, London, a white soft soap is employed in the preparation of the *Unguentum Sulphuris Compositum*, L. This soap is prepared by Mr. Taylor, 13, Newington Causeway, who tells me there is very little demand for it, the principal consumption being at Apothecaries' Hall. He also informed me that it was made from three fatty substances, (olive oil, tallow, and some other oil.) and two alkalis (potash and soda.) Its consistence is that of butter, but by keeping it becomes harder. I have been informed that olive-oil potash-soap is prepared at Liverpool.

employed with considerable benefit in habitual constipation and disordered conditions of the biliary functions. In the form of enema, a strong solution of it is sometimes used with great relief to dissolve hardened fæces, and to relieve obstinate constipation. As a *resolvent* or *alterative*, it was once much esteemed in enlargements and various chronic disorders of the viscera and glands; and as the alkalis have been found useful in the same diseases, any good effects which may have been obtained by it are probably referrible to its alkaline base.

Externally, soap is frequently employed on account of its detergent, lubricating, and discutient qualities. Thus, in tinea capitis, scabies, and various other skin diseases, ablution night and morning with soap-water greatly contributes to the cure. On account of its lubricating qualities it is a most convenient adjunct to liniments. The uses of the liniment, cerate, and plaster of soap, are noticed below.

Lastly, soap is useful in pharmacy to render other medicines more soluble, or to give a proper consistence to various substances for the making of pills. Thus it is a constituent of various pills (e. g. *Pilulæ Rhei compositæ; Pilulæ Saponis compositæ;* and *Pilulæ Scillæ compositæ.*) In some cases it acts as the *adjuvans*, assisting and promoting the operation of other medicines; as a *corrigens*, correcting their operation; and, as a *constituens*, imparting an agreeable or convenient form. The addition of soap to aloes or extract of jalap is cited by Dr. Paris, (*Pharmacologia.*) as an instance in which soap fulfils all three of these objects.

ADMINISTRATION.—The usual dose of soap, taken in a pilular form, is from grs. v. to ʒss. In cases of poisoning by the mineral acids, half a pint of strong solution of soap should be instantly administered.

1. **LINIMENTUM SAPONIS**, L. E. D. *Soap Liniment; Opodeldoc.* (Soap [Castile,] ℥iij.; Camphor, ℥j.; Spirit of Rosemary, f℥xvj. *L. D.*—Castile Soap, ℥iv.; Camphor, ℥ij.; Volatile Oil of Rosemary, fʒv.; Rectified Spirit, Oj. and f℥xij. *E.*—The London College orders the camphor to be dissolved in the spirit, and the soap to be added afterwards: but the Edinburgh and Dublin College direct the soap to be first dissolved, and the camphor [and oil, *E.*] subsequently. The Edinburgh College orders the mixture to be agitated briskly.)—If made with hard soap, as directed by the Pharmacopœias, this preparation is apt to solidify in cold weather. On this account druggists usually substitute common soft soap. The only objection to this is its unpleasant smell.—Soap liniment is used as a stimulant discutient, as well on account of its lubricating qualities, in local pains, sprains, bruises, rheumatism, &c. It is a constituent of *Linimentum Opii:* [The LINIMENTUM SAPONIS CAMPHORATUM of the U. S. Pharmacopœia is a preparation founded on the same basis as the preceding, it differs slightly from it. Take of Common Soap, three ounces, Camphor an ounce; Oil of Rosemary, Oil of Origanum, each a fluid drachm; alcohol a pint. Digest the soap with the alcohol, by means of a sand bath, till it is dissolved; then add the camphor and oils, and when they are dissolved, pour the liquid into broad mouthed bottles.]

[An analogous preparation is the TINCTURA SAPONIS CAMPHORATA, U. S. It is made as follows:—Soap in shavings, four ounces; Camphor, two ounces; Oil of Rosemary, half a fluid-ounce; Alcohol, two pints. Digest the Soap with the Alcohol by means of a water bath till it is dissolved, then filter and add the Camphor and Oil. This preparation retains its fluidity, not becoming consistent upon cooling, this is owing to its formation from a soap fabricated with vegetable oil and not with an animal soap as in the case of the liniment.]

2. **CERATOM SAPONIS**, L. (U. S.) *Soap Cerate* (Soap, ℥x.; Wax, ℥xijss.; Oxide of Lead, powdered, ℥xv.; Olive Oil, Oj.; Vinegar, *Cong.* j. Boil the Vinegar with the Oxide of Lead, over a slow fire, constantly stirring them until they incorporate; then add the soap, and boil again in like manner, until all the moisture is evaporated; lastly, with these mix the Wax first dissolved in the Oil.)—The sub-acetate of lead formed by boiling the oxide of lead with vinegar, is decom-

posed by the soap, the soda of which combines with the acetic acid, and the fatty acids with the oxide of lead. The wax and oil serve to give consistence to the preparation. It is used as a mild cooling dressing for scrofulous swellings, and other local inflammations, as well as for fractured limbs: in the latter case its principal use is as a mechanical support.

[The *U. S. Pharmacopœia* directs to take of solution of sub-acetate of Lead, two pints; Soap, six ounces; white Wax, ten ounces; Olive Oil, a pint. Boil the solution of sub-acetate of Lead with the Soap, over a slow fire, to the consistence of honey: then transfer to a water bath and evaporate until all the moisture is dissipated; lastly, add the Wax previously melted with the Oil and mix.]

**3. EMPLASTRUM SAPONIS,** L. E. D. (U. S.;) *Soap Plaster.* (Soap, sliced, lbss.; Litharge Plaster, lbiij. *L. D.* (U. S.)—Litharge Plaster, ℥iv.; Gum Plaster, ℥ij.; Castile Soap, in shavings, ℥j. Mix the soap with the liquefied plaster, and boil down to a proper consistence.) The quantity of soap here ordered is said by Mr. Scanlan[1] to be too much by one-half; as when prepared by the formula of the London and Dublin pharmacopœias it is quite pulverizable and falls into crumbs. The Gum Plaster ordered by the Edinburgh College will tend to obviate this defect. Boiling is unnecessary. This plaster, spread on leather, is used as a discutient and mechanical support.

**4. EMPLASTRUM SAPONIS COMPOSITUM VEL ADHÆRENS,** D. *Adhesive Plaster.* (Soap Plaster, ℥ij.; Litharge Plaster with resin, ℥iij. Make a plaster, which should be melted and spread on linen.)—This plaster is less apt to irritate than the litharge plaster with resin, "owing to the much smaller proportion of resin. It is a very useful application to those abrasions of the skin which take place in consequence of long confinement to bed."[2]

## ORDER XIII.—COMPOUNDS OF BARIUM.

### 1. BARY'TÆ SUL'PHAS, *E. D.*—SULPHATE OF BARYTA.

HISTORY.—Native sulphate of baryta, called *Ponderous* or *Heavy Spar* (*Spathum ponderosum,*) was formerly confounded with sulphate of lime. In 1774 Scheele discovered baryta, and in the year following, Gahn analyzed heavy spar, and found that it was composed of sulphuric acid and baryta.

NATURAL HISTORY.—It is peculiar to the mineral kingdom.

It frequently occurs crystallized in forms belonging to the right prismatic system. The crystals are commonly tabular. The *Straight-lamellar Heavy Spar* forms splendid groups of crystals. It occurs in Cumberland, Durham, Westmorland, &c. The *Curved-lamellar Heavy Spar* is generally known as *Cock's Comb Barytes.* It is common in Scotland, Derbyshire, &c. *Compact* or *Earthy Sulphate of Baryta* occurs in Staffordshire and Derbyshire, and is called *Cawk.* The *Bolognese Spar*, from Monte Paterno, near Bologna, is *Radiated Sulphate of Baryta.*

PROPERTIES.—Sulphate of baryta has a density of from 4·41 to 4·67. It is inodorous and tasteless. When pure it is, in the pulverulent form, quite white. The form of its crystals has been above noticed.

"White or flesh-red; heavy; lamellar; brittle." *Ph. Ed.*

*Characteristics.*—Before the blowpipe it decrepitates, but is not easily fused. "This difficult fusibility constitutes a good mark of distinction between this mineral and sulphate of lime or of strontian."[3] Ultimately it melts into a hard white enamel. It is insoluble in nitric acid. Reduced to powder, mixed with charcoal, and ignited, it is converted into sulphuret of barium, which, on the addition of hydrochloric acid, evolves sulphuretted hydrogen (see p. 406,) and yields a solution of chloride of barium (See the tests for this salt at p. 485.)

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[1] Dr. Montgomery, *Observations on the Dublin Pharmacopœia*, p. 596.

[2] *Ibid.* p. 597.

[3] Dr. Thomson, *Outlines of Mineralogy, Geology, and Mineral Analysis*, vol. i. p. 104. Lond. 1836.