

readily distinguished from the bitartrate by its deliquescent property, its greater solubility, and its want of acidity.

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

	Eq.	Eq.Wt.	Per Cent.	Berzelius.
Potash	1	48	42.1	41.31
Tartaric Acid.	1	66	57.9	58.69
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Tartrate of Potash 1	114	100.0	100.0	100.00

IMPURITY.—It may contain excess of acid or base, either of which is easily recognised; the one by litmus, the other by turmeric. The sulphates may be detected by chloride of barium throwing down a white precipitate insoluble in nitric acid.

PHYSIOLOGICAL EFFECTS.—This salt is a gentle purgative, analogous in its action to the sulphate of potash, from which it differs in being milder in its operation, and partially digestible; for, like the other vegetable salts of the alkalies, it is decomposed in the system, and converted into the carbonate, in which state it is found in the urine.

It is said to have the power of preventing the griping of other more active cathartics; as senna and scammony; but, from my own personal observations, I doubt the correctness of this statement.

USES.—It is employed as a mild purgative in dyspepsia, at the commencement of diarrhoea, in some liver complaints, &c. Sometimes it is used as an adjunct to other more active purgatives: as the infusion of senna.

ADMINISTRATION.—It may be given in doses of from two to three drachms to half an ounce, or even an ounce.

ORDER 11.—COMPOUNDS OF SODIUM.

So'dii Chlo'ridum.—*Chlo'ride of So'dium.*

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.

(a) *In the inorganic 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* various analyses of this fluid in Thomson's *System of Chemistry*, 6th ed. vol. iii. p. 196). It is found also in great abundance in mineral waters (Gardner, *On Mineral Springs*, p. 12). It has not hitherto been found in the oldest stratified rocks (De la Beche, *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, 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 Beche, *op. cit.* p. 293). The salt deposit of Wieliczka, near Cracow, belongs to the *supracretaceous group* (De la Beche, p. 270). Lastly, in the Crimea, salt is said to be daily accumulating in the inland lakes.

(b.) *In the organized kingdom.*—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 deposits 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*, or *pan-scratch*. As all parts of the pan are not equally heated, the crystallization of the salt takes place in different parts at different times, and consequently in the same pan the grains or crystals vary considerably in size. 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 deposited in the coolest part of the pan. (For further information on the manufacture of common salt, consult Aikin's *Dictionary of Chemistry*, vol. ii. p. 118; Holland's *Agricultural Survey of Cheshire*; Mr. Furnival's *Wharton and Marston Patent Salt Refineries*, 1836; Dr. Brownrigg's *Art of making Common Salt*, 1748.)

In some parts of the world chloride of sodium is obtained from sea-water: but the mode of extracting it varies according to circumstances. In warm countries it is procured by solar evaporation, and is then called *bay salt*. 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 further concentration is effected by heat.

PROPERTIES.—It crystallizes in colourless cubes, or more rarely in regular octahedrons. 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 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. 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:—It 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 chloride 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, 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:

	Eq.	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 its 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.)

PHYSIOLOGICAL EFFECTS. (a.) *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 Decandolle, *Phys. Vég.* pp. 1262 and 1343.)

(b.) *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 power-

fully," observes Moiroud (*Pharmac. Vétérin.* p. 410), "to prevent, in these animals, the influence of rainy seasons and wet pasturage, as well as of 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.

(c.) *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, inasmuch as some have a much greater relish for it than others. It is, I think, not improbable, that this unequal appetite for salt, in different individuals, is indicative of different wants of the system for this necessary substance;—for salt must serve some more important function than that of merely gratifying the palate. It is an invariable constituent of the healthy blood. Dr. Stevens (*On the Blood*) has shown that the red colour of the blood depends on the saline matters contained in it, for without these this fluid is black. 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 free hydrochloric acid found in the stomach, and which is so necessary to digestion, is probably derived from the salt taken in with the food, as is also perhaps the soda of the blood. The chloride of sodium found in some of the secretions, as the bile and tears, probably serves some important purposes.

It is said that persons who take little or no salt with their food are very subject to intestinal worms. Dr. Paris (*Pharmacologia*) tells us that 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. Jour.* 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 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 an alterative or resolvent.

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 (*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 (Searle, *Med. Gaz.* vol. viii. p. 538; Sir D. Barry, *Med. Gaz.* vol. ix. pp. 321 and 407; Brailoff and Isenbeck, *ibid.*, p. 490*). 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-spoonfuls 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-spoonfuls 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*. Dr. Stevens (*op. cit.*) has shewn that the red colour of the blood depends on the presence of its saline constituents, and that when deprived of these, this fluid is black. Now, 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 (Dr. O'Shaughnessy, *Report on the Chemical Pathology of the Malignant Cholera*, 1832). 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.	Take of Phosphate Soda 10 grains.
Chloride of Sodium . . . a scruple.	Chloride of Sodium 10 grains.
Chlorate of Potash . . . 7 grains.	Carbonate of Soda 5 grains.
Dissolve in half a tumblerful of water. This	Sulphate of Soda 10 grains.
to be repeated at intervals of from 15 minutes	Dissolve in six ounces of water. The mix-
to an hour, according to circumstances (Dr.	ture to be repeated every second hour (Dr.
Stevens, <i>op. cit.</i> p. 459).	O'Shaughnessy, <i>op. cit.</i> 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 (*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 12 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 53 hours, upwards of 31 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° F. or 110° F." (*Med. Gaz.* vol. x. p. 257.) In another series of cases 40 lbs were injected in 20 hours; 132 ounces in the first 2 hours; 8 lbs. in half an hour! (*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 (*Med. Gaz.* vol. x. p. 453), drowsiness, (*ibid.* p. 447), &c. 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. (*Med. Gaz.* vol. x. p. 717.) Dr. Griffin (*Recollections of Cholera*, in *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 district 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 hæmorrhages, dysentery, and diarrhœa, it has been administered in combination with lime juice or lemon juice (*Memoir of the late Dr. Wright*, p. 322).

As an *external application* salt has been used for various purposes. Thus, a saturated solution of salt, 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 to the chest in fainting and asphyxia. A solution of salt is employed for baths (cold and warm), affusion, the douche, &c. Its action is more stimulant and tonic than simple water, and the reaction or glow more rapidly and certainly takes place. Consequently, the salt-water bath may be used for a longer period, without causing exhaustion, than the pure water bath. It is a popular opinion, which is probably well founded, that patients are less likely to take cold after the salt-water bath than after the common water bath.

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-spoonfuls 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-spoonfuls. A solution of one part of salt in forty parts of water will form a bath of about the same strength as sea water.

Sodæ Hypochlo'ris.—*Hypochlo'rite of So'da.*

HISTORY.—The disinfecting power of a solution of this substance was discovered by Labarraque about 1820 (Alcock, *Essay on the Use of the Chlorurets*, p. vi). In the London Pharmacopœia this solution is called *liquor sodæ chlorinatae*; in the French Codex, *hypochloris sodicus aqua 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 synonyms 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.

(a.) *Process of the Pharmacopœia.*—Dissolve a pound of carbonate of soda in two pints of water; then put four ounces of chloride of sodium and three ounces of binoxide of manganese, rubbed to powder, into a retort; and add to them four ounces of sulphuric acid previously mixed with three fluidounces of water, and cooled. Heat the mixture, and pass the chlorine, first through five fluidounces of water, and afterwards through the above prescribed solution of carbonate of soda.

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.

REAGENTS.		PRODUCTS.	
2 eq. Carbonate Soda	108	2 eq. Bicarb ^{te} . Soda	152
2 eq. Carb ^{te} . Soda	108	1 eq. Hypochlo ^{rite} . Soda	76
{ 2 eq. Carb ^{te} . A ^d	44		
{ 1 eq. Soda	32	1 eq. Chlor ^{ide} . Sodium	60
{ 1 eq. Oxygen	8		
{ 1 eq. Sodium	24		
2 eq. Chlorine	72		
{ 1 eq. Chlorine	36		
{ 1 eq. Chlorine	36		

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. 105).

(b.) *Process of the French Codex.*—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. 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 much weaker than that prepared by the process of the London Pharmacopœia.

PROPERTIES.—The solution of hypochlorite of soda (*liquor sodæ chlorinatae* of the London Pharmacopœia) has a yellowish colour, an astringent taste, and an odour of chlorine. 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 re-solution 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 the *liquor sodæ chlorinate*, Ph. L.:—It decolorizes 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, shewing the absence of lime. Chloride of platinum produces no yellow precipitate, proving the absence of potash and ammonia. That the base of the solution is soda may be shewn 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 recognized by the characters before mentioned (p. 310).

COMPOSITION.—Some chemists regard the *liquor sodæ chlorinate*, Ph. L. as a mixture of chloride of soda and bicarbonate of soda. But the view usually taken of it is that it consists of hypochlorite of soda, chloride of sodium, and bicarbonate of soda.

PHYSIOLOGICAL EFFECTS. (a.) *On animals.*—A solution of chloride of soda acts as a local irritant, more or less powerfully 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 ed. 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.

(b.) *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 symptoms 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 alkalies 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 this remedial agent, 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, Labarraque 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 the solution of chloride of soda 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 the employment of this substance 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. 1826, 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 fœtor, 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 further 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 ozæna 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 justly 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 wash, 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.

ANTIDOTE.—(See CALCIS HYPOCHLORIS.)

Sodæ Sulphas.—*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. 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. 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.—It is a product of several chemical processes. In the Pharmacopœia it is directed to be prepared from the salt which remains after the distillation of hydrochloric acid. This salt consists of sulphate with some bisulphate of soda. It is to be dissolved in water, and to the solution carbonate of soda is to be added, to saturate the excess of acid in the bisulphate. The liquid is then to be boiled down, strained, and crystallized.

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.—[For the theory of this process, see p. 149.]

PROPERTIES.—The primitive form of the ordinary crystallized sulphate of soda is the oblique rhombic prism. 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 for these substances before mentioned (pp. 265 and 310). 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.

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

	Eq.	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.

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 may be 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.

So'dæ Bibo'ras.—Bibo'rate of So'da.

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. 559): 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.

(a.) *By refining native or crude borax.*—About fifteen days' journey north from Teeshoo Lomboo, 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.

It is imported, usually from Calcutta, under the name of *tincal* (a word derived from *tincana*, the Sanscrit name for borax; Royle's *Essay on Hindoo Medicine*, p. 97) 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 grey 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*).

(b.) *By saturating native boracic acid.*—In the year 1776, Messrs. Hoefer and Mascagni discovered boracic acid in the Lagoni of Tuscany, in a state of efflorescence, and also in solution in the waters with which the soil is impregnated. From the soil is constantly evolved aqueous vapour, impregnated with boracic and hydrosulphuric acids; formed, as it is supposed, by the action of water on sulphuret of boron contained in the interior of the earth,—by which part of the water is decomposed, the oxygen of which acidifies the boron, while the hydrogen forms hydrosulphuric acid with the sulphur, and the heat evolved causes the formation of some aqueous vapour. By washing the mud surrounding the *fumaroles*, or craters, decanting the liquor, and evaporating, *rough* or *Tuscany boracic acid* is obtained. To form borax from this, a solution of the carbonate of soda is saturated with the rough acid: effervescence takes place, and borax is formed.

PROPERTIES.—It occurs in large, colourless, transparent crystals, whose primary form is the oblique rhombic prism. 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 recognized by the following characters: it reddens turmeric paper; it fuses before the blowpipe into a

glass, which may be readily tinged by various metallic solutions,—thus, rose red by chloride 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. 310).

COMPOSITION.—Chemists are not agreed as to the precise atomic constitution of borax, in consequence of a difference of opinion as to the equivalent of boron. In the following table the first column shows the number of equivalents according to Berzelius, Dumas, and Turner,—in the second, according to L. Gmelin, Brande, and Phillips.

	Eq.	Eq.	Eq. Wt.	Per Cent.	Berzelius.	L. Gmelin.
Soda	1	1	32	16·666	16·31	17·8
Boracic Acid	2	1	70	36·458	36·59	35·6
Water	10	10	90	46·875	47·10	46·6
Crystallized Borax	1	1	192	99·999	100·00	100·0

By a particular management of the crystallizing process, Payen has obtained borax in permanent octahedral crystals, containing only five equivalents of water. It is termed *octahedral borax*, in contra-distinction to the ordinary kind, which is called *prismatic borax*. Octahedral borax offers several advantages to 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, excites 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 *Pharmakodynamik*). Further 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 (Dr. Copland, *Dict. of Pract. Med. art. Abortion*, and *Brit. and For. Med. Rev.* for July 1838, page 86).

Borax has also been regarded as producing the effects of alkalies on the system; principally, I believe, from an erroneous notion that it was a subsalt (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 aphtha and ulceration of the mouth. In some skin diseases it has been used

with benefit: as 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 it has been applied to inflamed and painful hæmorrhoidal tumors.

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

ADMINISTRATION.—The dose of it is from half a drachm to a drachm. As a detergent in aphtha it may be used in powder, mixed with sugar or with honey. The *MELLITE OF BORAX* (*mel boracis*, Ph. L.) consists of a drachm of powdered borax mixed with an ounce of clarified honey; it is the most eligible form for the employment of borax in the aphtha of children.

So'dæ Phos'phas.—Phos'phate of So'da.

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 *alkali 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*.

NATURAL HISTORY.—It has been found, in small quantities, in some mineral waters (Gairdner, *On Mineral Springs*, p. 19). It exists in many animal fluids, especially the urine of man.

PREPARATION.—It is procured as follows:—carbonate of soda is added to the impure solution of phosphoric acid, obtained by digesting bone-ash in sulphuric acid (*vide* p. 250) to saturation: the liquid is then filtered, evaporated, and put aside to crystallize. A slight excess of soda promotes the formation of fine crystals.

PROPERTIES.—The primary form of the crystals of this salt is the oblique rhombic prism. The crystals are transparent, but by exposure to the air effloresce and become opaque. Their taste is cooling saline. They react feebly on vegetable colours like alkalies. When heated, they undergo the watery fusion, give out water, and form a white mass which has been 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. 310). The phosphoric acid in it is recognised as follows: a solution of the phosphate throws down a white precipitate with acetate 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 soluble both in nitric acid and ammonia: pyrophosphate of soda, obtained by heating the phosphate, produces a white precipitate with nitrate of silver: hydrosulphuric acid, as well as the hydrosulphates, occasion no change in a solution of phosphate of soda. Phosphate of lead fused upon charcoal, in the outer flame of the blowpipe, becomes distinctly crystalline upon cooling.

Y

COMPOSITION.—Some difference of opinion exists as to the atomic constitution of this salt, as is obvious from the following table:—

	Brande and Phillips.			Graham and Turner.			Berzelius. (Experiment.)
	Eq.	Eq.Wt.	PerCt.	Eq.	Eq.Wt.	PerCent.	
Soda	1.....	32.....	18·2	2.....	62·6.....	17·20 17·67
Phosphoric Acid	1.....	36.....	20·5	1.....	71·4.....	19·94 20·33
Water	14.....	108.....	61·3	25.....	225·0.....	62·84 62·00
Crystallized Phosphate Soda	1.....	176.....	100·0	1.....	359·0.....	99·98 100·00

According to Mr. Graham, one of the twenty-five equivalents of water performs the function of a base to the acid.

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 deposit 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.

Sodæ Carbonas.—*Carbonate of Soda.*

HISTORY.—This salt, as well as the sesquicarbonate of soda, was probably known to the ancients under the term of *νίτρον*, or *nitrum* (vide *Potassæ Nitras*, p. 292; 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 *natrum carbonicum*.

NATURAL HISTORY.—It is found in crystals, or in the form of an efflorescent powder, in several parts of the world. According to Klaproth (quoted by Dr. Thomson, in his *Outlines of Mineralogy*, vol. i. p. 96), it occurs at Debrezin, in Hungary, and Montenuovo, near Naples. Beudant (quoted by Necker in his *Règne Minéral*, t. 2^m. p. 667) has analyzed three native carbonates of soda: one from Lac Blanc, in Hungary; a second from Egypt; and a third from Vesuvius. Carbonate 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 p. 148).

PREPARATION.—It may be procured from *barilla*, from *kelp*, or from *sulphate of soda*.

1. *From barilla*.—The substance called *barilla* 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 greyish 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, Carthage, and the East Indies. *Canary barilla* is procured from *Salsola Kali* (Loudon, *Encyclop. of Agricult.*); *Alicant barilla* (*soda hispanica*, *s. alicantina*) is obtained from *Salsola sativa*, *Chenopodium setigerum*, and other species (Lagasca, quoted in Decandolle'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.

Carbonate of soda is procured from *barilla* by dissolving it in water, filtering the solution, evaporating, and crystallizing. 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. (*A General Statement of the Imports and Exports*, printed by order of the House of Commons, 24th Feb. 1829); whereas, in 1837, it was only 16,760 cwts. (*Trade List*, Jan. 9, 1838).

2. *From 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* 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 grey or bluish masses, having an acrid caustic taste, and 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 digestion in a small quantity of water, 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. *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 which is evolved is allowed to escape into the atmosphere, and is most injurious to animal and vegetable life, as I have before stated (*vide* p. 150). In the report of a trial at Lancaster, March 21, 1838, the *Queen v. Airey*, in the *Times* newspaper, is contained a very humorous account of the unpleasant effects of this gas. For the sake of economy, manufacturers of carbonate of soda usually make their own sulphuric acid.

The sulphate of soda is usually decomposed by mixing it with chalk and some carbonaceous matter (small coal, charcoal, or sawdust), and heating the mixture in a reverberatory furnace. The proportions used by Leblanc (Dumas, *Traité de Chimie*, t. 2^{me}. p. 475) are 1000 parts of dry sulphate of soda, 1000 of chalk, and 550 of charcoal. In a large manufactory in the neighbourhood of London the proportions of the ingredients employed are nearly 2 parts sulphate, 1 part chalk, and 1 part small coal. The product of this operation has a dark grey or blackish appearance, and is called *English barilla* or *ball alkali*. By lixiviating with water and evaporating the resulting solution, a blackish crystalline mass is obtained, which, when roasted, is called *soda-ash*. This is digested in water, the solution evaporated, and the carbonate of soda afterwards crystallized in iron pans. For other modes of proceeding I must refer to the *Traité de Chimie* of Dumas, or Brande's *Manual of Chemistry*, and Duncan's *Edinburgh Dispensatory*.

The *theory* of the process is the following: the sulphuric acid of the sulphate is deprived of oxygen by the carbonaceous matter (coal or sawdust), while its sulphur is partly burnt and escapes as sulphurous acid, and partly combines with the calcium of the chalk to form sulphuret of calcium. The soda unites with carbonic acid produced by the decomposition of the chalk, as well as by the combustion of carbon. To purify the impure carbonate of soda of the shops, it is ordered, in the *Pharmacopœia*, to be dissolved, strained, and re-crystallized.

PROPERTIES.—Carbonate of soda usually forms large crystals, the primitive form of which is, according to Mr. Brooke, the oblique rhombic prism. 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, and when the resulting anhydrous carbonate has been rubbed to powder it constitutes the *sodæ carbonas exsiccata*, Ph. L.: 54 grains of which are equivalent to 144 grains of the crystallized salt. 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.

CHARACTERISTICS.—As a carbonate it is known by the tests for this class of salts already stated (*vide* p. 301.) From the bicarbonates it is distinguished by the brick-red precipitate (percarbonate of mercury)

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 basic substance already stated (p. 310.)

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

	Eq.	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 solution, chloride of barium and nitrate of silver: if the first occasion a white precipitate, it indicates the presence of a sulphate—if the second also produce a white precipitate, soluble in ammonia, it shews the presence of a chloride.

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 (*Trans. of a Society for the improvement of Med. and Chirurg. Knowledge*, iii. 347) and Mr. Brande (*Quart. Journ. of Science*, vol. vi. p. 205) 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, or five grains to a scruple of the dried carbonate, which may be given either in the form of powder or pills.

It is sometimes employed in the manufacture of the effervescing draught. A scruple of the crystallized salt saturates about $9\frac{1}{4}$ grains of the ordinary crystals of citric acid, $10\frac{1}{2}$ grains of crystallized tartaric acid, or $2\frac{1}{2}$ fluidrachms of lemon juice.

ANTIDOTES.—(*Vide art. POTASSA*, p. 279).

Sodæ Sesquicar'bonas.—Sesquicar'bonate 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 *νίτρον*, *nitrum*, and *natron* (*vide POTASSÆ NITRAS* and *SODÆ CARBONAS*). But the analyses of Klaproth (*Beitrag*, iii. 83), Phillips (*Quart. Journ. of Science*, vol. vii. 297), and Beudant (quoted by Necker, *Règne Minéral*,

ii. 668) show that the quantity of carbonic acid which it contains is larger than the carbonate, and less than the bicarbonate: hence Mr. Phillips denominated the salt a sesquicarbonate. From the analysis of MM. Mariano de Rivero and Bossingault (*Ann. de Chim.* xxix. 110) it appears that the substance termed *Urao*, and which occurs at the bottom of a lake at Lagunillas, near Merida, in South America, has a similar composition.—[For an account of this lake, see *Quart. Journ. of Science*, vol. i. p. 188.]

The white powder sold in the shops of this country for making *sodaic powders*, and which is denominated *carbonate*, *bicarbonate*, or *sesquicarbonate of soda*, is a compound of soda and carbonic acid; the quantity of the latter constituent being greater than that of the carbonate, but less than that of the bicarbonate. Hence in the Pharmacopœia this salt is denominated *sodæ sesquicarbonas*, and its composition has been supposed to be identical with the *trona* of Africa and the *urao* of South America. It is distinguished from the ordinary carbonate of soda by its not causing a white precipitate with a cold solution of sulphate of magnesia.

The so-called sesquicarbonate of soda of the shops, usually, if not invariably, contains carbonate and bicarbonate of soda; these may be detected as follows:—Wash with a small quantity of distilled water, and filter: the solution contains carbonate of soda (known by its throwing down a brick-dust red precipitate on the addition of bichloride of mercury)—while there remains on the filter bicarbonate of soda (recognized by its causing a white precipitate, or a slight milkiness or opalescence with bichloride of mercury.)* The relative proportions of carbonate and bicarbonate of soda are not constant—a fact which will explain the following remark made by Mr. Phillips (*Transl. of the Pharm.* 3rd. ed. 1838):—"I am informed by Mr. Everitt that bicarbonate of soda is now not unfrequently to be met with; and very commonly, instead of mere sesquicarbonate, a mixture of this salt and a large proportion of bicarbonate may be obtained from those who manufacture on a large scale." (For further information respecting the *sodæ sesquicarbonas*, Ph. L., see *SODÆ BICARBONAS*.)

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

	Eq.	Eq. Wt.	Per Cent.	Klaproth. <i>Trona.</i>	Boussingault. <i>Urao.</i>
Soda	1	32	38.55	37.0	38.62
Carbonic Acid	1½	33	39.76	38.0	40.13
Water	2	18	21.69	22.5	21.24
Sulphate Soda	—	—	—	2.5	—
Native Sesquicarbonate Soda 1	83	100.00	100.00	100.0	99.99

* I have been recently informed by Mr. Scanlan that the salt called *Ammonia Sesquicarbonas* (vide p. 173) is resolved, by washing with water, into two salts, the carbonate of ammonia, which dissolves, and a mass of crystals of bicarbonate of ammonia having the form of the lump of sesquicarbonate employed. Mr. Scanlan has also obligingly furnished me with illustrative specimens of the above results. The crystals of what he has sent me as bicarbonate of ammonia have, however, a slight odour of ammonia; but he tells me, that when first prepared they were odourless. Dr. Dalton (*Mem. of the Lit. & Phil. Soc. of Manchester*, 2nd Ser. vol. iii. p. 18) seems to have been aware that the salt now called sesquicarbonate of ammonia was a mixture of two salts.

Sodæ Bicarbonas.—Bicarbonate of Soda.

HISTORY.—This salt was discovered by Valentine Rose. In some works it is termed *natron carbonicum perfecte saturatum seu acidulum*. Mixed or combined with carbonate of soda it constitutes the *sodæ sesquicarbonas* of the 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.

PREPARATION.—There are several methods of procuring it. Of these I shall briefly notice three.

1. *Process of the Pharmacopœia.*—The substance called in the London Pharmacopœia *sodæ sesquicarbonas* is ordered to be prepared as follows:—Dissolve seven pounds of carbonate of soda in a gallon of distilled water, and strain: then pass carbonic acid into the solution to saturation, that the salt may subside. Dry this with a gentle heat, wrapped and pressed in cloth. According to Mr. Brande (*Manual of Chem.*) 160 lbs. of carbonate should be dissolved in 13 gallons of water, and carbonic acid thrown into the solution in a proper apparatus. About 50 lbs. of bicarbonate fall: and when separated should be dried in an hydraulic press, and afterwards by exposure to heat not exceeding 100° F. A fresh portion of carbonate is dissolved in the mother liquor, and the operation repeated as before.

The carbonic acid used in this process is usually procured artificially by the action of dilute 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. (For a description and sketch of the apparatus used in the collection of the gas by D'Arcet, see *Dict. de l'Indust.* 3^{me}. t. p. 61.)

2. *Smith's process.*—This 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. (*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. 2^{me}. p. 341.)

3. *Process by sesquicarbonate of ammonia.*—This is the process directed to be followed in the London Pharmacopœia for 1809. Sesquicarbonate of ammonia is to be added to a solution of carbonate of soda, and a heat of about 100° F. applied to drive off the ammonia: the solution is then to be set aside to crystallize. The proportions employed in the Pharmacopœia of 1809 were a pound of carbonate of soda, three ounces of sesquicarbonate of ammonia, and a pint of distilled water. Winckler (*Lehrb. d. Pharm. Chemie.* 1^{er}. 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. 2^{me}.) are 6 parts of the crystallized carbonate of soda, 2 parts of sesquicarbonate of ammonia, and 4 parts of water.

PROPERTIES.—Bicarbonate of soda usually occurs in the form of a white crystalline mass. The perfect crystals are, according to Dr. Thomson (*Chem. of Inorg. Bodies*, vol. ii. p. 54), oblique rectangular prisms. 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 recognize the carbonic acid and soda of this salt, the tests are the same as before described (vide p. 324) for the carbonate of soda. From the latter salt the bicarbonate of soda is distinguished by its causing neither a brick-red precipitate with the bichloride of mercury, nor a white precipitate with the sulphate of magnesia. The sodaic powder of the shops (*sodæ sesquicarbonas*, Ph. L.) being a mixture of carbonate and bicarbonate produces a red precipitate with bichloride of mercury, but no precipitate with sulphate of magnesia; and when washed with a small quantity of cold distilled water, leaves a white powder (bicarbonate of soda), which, when dissolved in water, gives a white precipitate or slight opalescence to a solution of bichloride of mercury.

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

	Eq.	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 ^d . Bicarb. Soda	1	94	99.98	100	100.00	100.00

According to Dr. Thomson's analysis (*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 chloride 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 shewn. Lastly, it occasions a white precipitate with bichloride of mercury, by which the freedom from a simple or mono-carbonate is shewn.

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 of course less caustic and irritant than the sesquicarbonate, and still more so than the carbonate of soda. Its remote or constitutional effects are analogous to those of the caustic alkalies. (Vide POTASSA, p. 275.)

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. (For further particulars regarding these uses of bicarbonate of soda, vide POTASSA, p. 277, *et seq.*)

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 (p. 193.) The resulting soda-salt (tartrate or citrate) undergoes partial digestion in its passage through the system, and is found in the urine in the state of carbonate. 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 deposits in the urine. Alluding to these cases Dr. Prout (*Inquiry into the Nature and Treatment of Affections of the Urinary Organs*, 2d ed. p. 145) 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 grains of crystallised tartaric acid, or about 17 grains of the ordinary crystals of citric acid, or four drachms of lemon juice, to saturate it.

1. **SODAIC POWDERS.**—These consist of half a drachm 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. The *pulvis ærophorus e natro carbonico acidulo* of the Prussian Pharmacopœia consists of a drachm of the bicarbonate, two scruples of tartaric acid, and the like quantity of white sugar. *Ginger-beer powders* are made in the same way as sodaic 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 30 grains 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. **SODA WATER**, properly so called: *Liquor sodæ effervescens*, Ph. L.—The greater part of the liquid sold in the shops as *bottle-soda water*, and *soda water from the fountain* or *pump*, is merely a solution of carbonic acid in common water, effected by pressure, and, therefore, has no

claim to the denomination of *soda water* (*vide p. 191*). Some few makers, however, prepare it by condensing carbonic acid in a solution of carbonate or bicarbonate of soda: this is *soda water properly so called*, formulæ for which are given in all the British Pharmacopœias, as well as in the French Codex; but which I conceive are quite unnecessary, as this liquid can be prepared extemporaneously by adding bicarbonate of soda to the ordinary bottle-soda water. Thus, half a drachm of bicarbonate of soda and half a pint of bottle-soda water, will form a solution of the same strength as the *liquor sodæ effervescens* of the London Pharmacopœia, which is directed to be prepared by dissolving a drachm of sesquicarbonate of soda in a pint of distilled water, and forcing into it an excess of compressed carbonic acid gas. The *aqua carbonatis sodæ acidula* (Ph. Dublin) is of the same strength: the *aqua super-carbonatis sodæ* (Ph. Edinb.) contains 96 grains of carbonate of soda to a pound of water.

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.

Soda water properly so called (*liquor sodæ effervescens*, Ph. L.) 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 deposits,—in the latter case, however, carbonic acid water (ordinary bottle-soda water) may be used (*vide p. 198*).

Potas'sæ So'dio-Tar'tras.—*So'dio-Tar'trate of Pot'ash.*

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*. Its other names are, *tartarized soda* (*soda tartarizata seu natron tartarizatum*), or the *tartrate of potash and soda*. In the Pharmacopœia it is termed *sodæ potassio-tartras*.

PREPARATION.—The following are the directions for preparing this salt in the London Pharmacopœia:—Dissolve 12 ounces of carbonate of soda in four pints of boiling water, and add, gradually, 16 ounces of powdered bitartrate of potash. Strain the liquor; then apply a gentle heat until a pellicle floats, and set aside, that crystals may be formed. The liquor being poured off, dry these. Again evaporate the liquor, that it may yield crystals.

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 regu-

larly-shaped crystals, whose primary form is the right rhombic prism: but curiously enough, the crystals are frequently produced in halves. 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.

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: chloride of platinum produces a yellow precipitate of the platinum-chloride of potassium. Nitrate of silver occasions a white precipitate (tartrate of silver), soluble in excess of water. When heated, potash-tartrate of soda is decomposed, evolves various volatile substances, and gives out the odour of caramel. 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 chloride of platinum, leaving chloride of sodium in solution, which may be detected by the tests already mentioned for this salt (p. 310).

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

	Eq.	Eq. Wt.	Per Cent.	Schulze.		Eq.	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					
Crystl ^d . Sodio-Tartrate of Potash	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 (*Heilmittell.*) 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 deposits 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 half an ounce to an ounce. 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. 329).

So'dæ Ac'etas.—Ac'etate of So'da.

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.—It may be readily procured by saturating carbonate of soda by distilled vinegar (as directed in the Dublin Pharmacopœia), evaporating the solution and crystallizing. In this process the acetic acid expels the carbonic acid with effervescence.

On the large scale acetate of soda is obtained by manufacturers of pyroligneous acid by the following process:—Rough or impure pyroligneous acid is saturated with either slacked lime or chalk. In this way there is formed an impure acetate of lime (commonly termed pyrolignite of lime). To the clear solution is added sulphate of soda. Double decomposition takes place: sulphate of lime precipitates, and acetate of soda remains in solution. The clear liquid is then evaporated and crystallized. The impure acetate of soda thus procured is purified by drying, solution in water, re-crystallization, fusion in an iron pot, expulsion of the water of crystallization by heat, incipient carbonization to decompose the impurities of the salt, re-solution, and re-crystallization.

PROPERTIES.—The primary form of the crystals of this salt is the oblique rhombic prism. 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 give, as a residue, a mixture of charcoal and carbonate of soda. They are soluble in about 3 parts of cold water; and are slightly soluble in alcohol.

CHARACTERISTICS.—As an acetate it is recognized by the tests before mentioned (p. 222) for this class of salts. That the base is soda is shewn by the characters already described (p. 310) for the soda salts.

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

	Eq.	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 recognized 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. 274), 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. 221), 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.

Sa'po.—Soap.

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, who (*Hist. Nat.* xxviii.) mentions soap, says it is made of tallow and ashes, ascribes its invention to the Galls, 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.)

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 manufacture of soap varies according to the quality of this substance intended to be produced.

The soaps employed in medicine are those which contain, as their base, potash, soda, ammonia, lime, or oxide of lead: the three first are called *soluble*—the two latter *insoluble soaps*. Of these five, two only require notice at present, viz. those which contain either soda or potash: and for an account of the three other soaps I must refer to the articles LINIMENTUM AMMONIÆ (p. 176), LINIMENTUM CALCIS, and EMPLASTRUM PLUMBI.

1. OF SODA SOAP (*sapo sodaicus: s. natrinus: s. durus: s. spissus* of Pliny?) The quality of this kind of soap varies according to the kind of fatty or resinous matter used in its manufacture.

(a.) *Olive oil soda soap* (*sapo ex olivæ oleo et sodâ confectus*, Ph. L. *sapo durus*, Ph. Dub. *Sapo Hispanicus*).—This is made by boiling olive oil with a solution of caustic soda (prepared by the action of lime on barilla or some other impure carbonate of soda) till the soap separates, to promote which common salt is sometimes added. It is then suffered to congeal, and afterwards remelted in water to remove any adhering alkali. When sufficiently cold it is run into *frames* (wooden troughs with moveable bottoms), and after it has acquired sufficient firmness, is cut into long cakes or bars by means of a wire. (For further details, consult Aikin's *Dict. of Chemistry*, art. *Soap*.)

There are two varieties of olive oil soda soap—one *white* (*sapo albus*)

—another, *marbled* or *mottled*. The soap sold in the shops as *Castile soap* (*sapo castiliensis*) is of the latter kind: “the marbled appearance which it presents is produced by the addition of sulphate of iron to a part of the alkaline ley, after the soap is fully boiled, which gives the blue colour; and the stirring in red oxide of iron, when the soap is almost made, gives the red colour.” (Thomson’s *London Dispensatory*.) The marbling, or mottling, therefore, is an impurity.

(b.) *Almond oil soda soap* (*sapo amygdalinus*. Fr. Codex.)—This is the medicinal soap (*savon médicinal*) of the French; directions for preparing which are contained in the French Codex.

(c.) *Animal oil soda soap* (*sapo sebaceus*, Geiger: *sapo vulgaris*, United States Ph.)—Of this two kinds are in common use in this country. The best is that called *white curd soap*, and which is prepared from pure or white tallow and soda: when scented it constitutes *Windsor soap*. The *common* or *domestic soap*, usually termed *mottled soap*, is made with refuse kitchen grease (commonly called *kitchen stuff*.)

(d.) *Resin soda soap*.—This is the *common yellow soap* of the shops, and is the commonest of the hard soaps of this country. It owes its peculiar properties to the admixture of resin and palm oil with animal fat.

Besides the above, there are many other varieties of hard soap, termed *fancy soaps*, sold by perfumers. The patent *silica soap* consists of the usual kinds of soaps to which precipitated silica is added.

2. OF POTASH SOAP. (*sapo potassicus*: *s. kalinus*: *s. mollis*: *s. liquidus*, Pliny?)—This kind of soap is made with caustic potash instead of caustic soda.

(a.) *Olive oil potash soap* (*sapo mollis*,—*sapo, ex olivæ oleo et potassâ confectus*, Ph. L.)—No soap of this kind is made or known in London. I am informed by Messrs. Rowe, of Brentford (the most extensive manufacturers of soap in the neighbourhood of the metropolis), that they are unacquainted with it. On inquiry I find that a *white soft soap*, made by Mr. Taylor, 13, Newington Causeway, is used at Apothecaries’ Hall, in the preparation of *Ung. Sulph. Co.* Ph. L.; but I have been unable to procure a sample of it. Mr. Taylor tells me it is only made to order, as 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 alkalies (potash and soda)—that it is white, and has the consistence of butter, but by keeping becomes harder.

(b.) *Animal oil potash soap*.—This is the *common soft soap* of the shops, and which is made with fish oil (whale or cod), tallow and potash. (For particulars respecting its manufacture consult *Ure’s Dict. of Chem.*, art. *soap*.)

THEORY OF SAPONIFICATION.—Soaps are to be regarded as alkaline salts, formed by the action of alkaline bases on fatty or resinous bodies. At one time it was supposed that they were mere compounds of fat or resin and of alkali; but it is now known that in the process of saponification, the organic constituents (*stearine*, *margarine*, and *olein*) of vegetable and animal fats undergo certain chemical changes by which acids (*stearic*, *margaric*, and *oleic*) are produced, which, combining with the bases, form the salts (*stearates*, *margarates*, and *oleates*) commonly termed *soaps*; and at the same time a sweet substance (*glycerine*) is generated. Thus it appears that, by the influence of an alkali, one equiva-

lent or 564 parts of stearine are converted into one equivalent or 527 parts of anhydrous stearic acid, and one equivalent or 37 parts of anhydrous glycerine; the stearic acid unites with the alkali to form soap. The following diagram illustrates these changes:—

REAGENTS.		RESULTS.	
1 eq. Stearine 564	73 eq. Carbon 438 70 eq. Hydrog. 70 7 eq. Oxygen 56	70 eq. Carb. 420	1 eq. Anhyd. Stearic Acid = 527
		3 eq. Carb. 18	
		67 eq. Hydr. 67	
		3 eq. Hydr. 3	
		5 eq. Oxyg. 40	
		2 eq. Oxyg. 16	1 eq. Anhyd. Glycerine = 37

In the conversion of resin into soap the phenomena are different. Resins consist of one or more acids, which combine with alkalies 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 kinds. 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: hence tincture of soap may be used as a test of the hardness or softness of common waters. The metallic salts also decompose soap, and give rise to metalline soaps.

Olive oil soda soap may be either white or marbled, as before stated. 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. The marbling, as I have before stated, is an impurity.

Animal oil potash soap (common soft soap) is of a brownish or yellowish colour; transparent, but interspersed with white specks, owing to the admixture of tallow.

CHARACTERISTICS.—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. 274 and 310). Lastly, the action of acids and earthy and metallic salts on a solution of soap, as already noticed, serves to recognise soap.

COMPOSITION.—The following is the composition of several varieties of soap:—

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

For analyses of other kinds of soap I must refer the student to Ure's *Dict. of Chemistry*, and Gmelin's *Handb. d. Chemie*. The atomic constitution of soap cannot be determined with accuracy, on account of the great variation in the quantity of water. The relative proportion of acid and base appear to be nearly one equivalent of the fatty acid to two of the alkali. Thus, olive oil soda soap may be regarded as a compound of one equivalent or 518 parts of oleic acid, and two equivalents or 64 parts of soda, exclusive of the water and the small quantity of stearate (or margarate) of soda present.

PURITY.—The adulterations of soap are excess of water, lime, gypsum, or pipe-clay. 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. (a.) *On vegetables*.—Soap, used as a manure, appears to promote vegetation (Decandolle, *Physiol. Végét.* p. 1343).

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

(c.) *On man*.—Soap acts very much like the alkalies (*vide* POTASSÆ, p. 275). Its local operation, however, is much less energetic than either the caustic or even the carbonated alkalies. 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 alkalies. 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 alkalies; it promotes the secretion of urine, and communicates alkaline properties to this fluid. In large doses, soap 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*, xlvi. 43 & 472) gained great relief from it. By the action of lime-water on soap, 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 employed with considerable benefit in habitual constipation and disordered conditions of the biliary functions. In the form of enema, a strong solution of soap is sometimes used with great relief to dissolve hardened fæces, and relieve obstinate constipation. As a *resolvent* or *alterative*, soap was once much esteemed in enlargements and various chronic disorders of the viscera and glands; and as the alkalies have been found useful in the same diseases, any good effects which may have been obtained by soap 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, soap 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. *pil. rhei comp.*, *pil. sap. comp.*, and *pil. scillæ comp.*) 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 *constituans*, 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 five grains to half a drachm. In cases of poisoning by the mineral acids, half a pint of a strong solution of soap should be instantly administered.

1. *LINIMENTUM SAPONIS*, Ph. L. & D. (soap, ʒiii.; camphor, ʒi.; spirit of rosemary, f. ʒxvi.): *Tinctura Saponis Camphorata*, Ph. Ed. & U.S. (soap, ʒiv.; camphor, ʒii.; oil rosemary, f. ʒss.; alcohol, f. ʒxxxii.) Druggists frequently substitute soft soap (animal oil potash soap) for the olive oil soda soap of the Pharmacopœia. *Soap liniment* or *opodeldoc* is used as a stimulant and discutient, as well as, on account of its lubricating qualities, in local pains, sprains, bruises, rheumatism, &c. When mixed with three-fourths of its volume of tincture of opium, it constitutes the *anodyne liniment* (*linimentum saponis cum opio*, vel *linimentum anodynum*) of the Dublin Pharmacopœia.

2. *CERATUM SAPONIS*, Ph. L. (soap, ʒx.; wax, ʒxiiss.; oxide of lead, powdered, ʒxv.; olive oil, Oj.; vinegar, Cj.)—The subacetate of lead, formed by boiling oxide of lead with vinegar, is decomposed by the soap, the soda of which combines with the acetic acid of the subacetate, while the fatty acids (oleic and margaric) unite with the lead. The wax and oil serve to give consistence to the preparation. *Soap cerate* 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.

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3. *EMPLASTRUM SAPONIS*, Ph. L. & Dub. (soap, lb. ss.; lead plaster, lb. iii.) This quantity of soap is said to be too much by one half. This plaster, spread on leather, is employed as a discutient and mechanical support. When two parts of it are mixed with three parts of resinous plaster (*emplastrum resinæ*, Ph. L.), it constitutes the *emplastrum saponis compositum*, vel *emplastrum adherens*, Ph. D., and which, when spread by a machine on linen, is sold in the shops by the name of *adhesive plaster* (Dr. Duncan, *Edinb. Dispensatory*).

ORDER 12. COMPOUNDS OF BARIUM.

Baryta Carbonas.—*Carbonate of Baryta.*

HISTORY.—The earthy base called *baryta* was discovered in 1774 by Scheele. It was at first termed *terra ponderosa*. In 1783 Dr. Withering recognised the native carbonate of baryta, which has been called, after its discoverer, *Witherite*.

NATURAL HISTORY.—*Witherite* occurs in the lead mines of the north of England (as those of Anglesark, in Lancashire), and in various other localities. The mineral called *baryto-calcite* (a compound of carbonate of baryta and carbonate of lime) is found at Alston Moor, Cumberland. —[For some curious anecdotes respecting its discovery at the latter place, consult Parkes's *Chem. Essays*, vol. i. p. 324].

PREPARATION.—The native carbonate of baryta is sufficiently pure for the preparation of the other barytic salts, and is the kind meant in the Pharmacopœia. Absolutely pure carbonate may be prepared by the addition of a pure alkaline carbonate to a solution of some barytic salt; as the sulphuret (obtained from the decomposition of the sulphate by some carbonaceous matter), or the chloride; or it may be obtained by igniting (or boiling in water) finely powdered sulphate of baryta with three parts of carbonate of potash, and washing away the resulting sulphate of potash; or by decomposing sulphate of baryta by carbonate of ammonia.

PROPERTIES.—Native carbonate of baryta occurs massive, stalactitic and crystallized: the primary form of the crystals is the right rectangular prism. The sp. gr. of this mineral is 4.3. Heated before the blowpipe it melts into a white enamel, with the evolution of much light and the loss of carbonic acid. Artificially prepared, carbonate is a fine, tasteless, odourless powder. It is almost insoluble in both hot and cold water: 4,304 parts of cold, or 2,304 parts of hot water, being required to dissolve one part of carbonate. It is more soluble in carbonic acid water.

CHARACTERISTICS.—It dissolves with effervescence in hydrochloric acid, forming a solution of chloride of barium: the evolved gas, when collected, is found to be carbonic acid (*vide* p. 190). The hydrochloric solution is not precipitated by ammonia, the hydrosulphurets, or the ferrocyanides; but the soluble sulphates, phosphates, and carbonates, throw down white precipitates, which are, respectively, sulphate, phosphate, oxalate, and carbonate of baryta: sulphate of barium is insoluble in both water and nitric acid. The salt (chloride of barium) obtained by the evaporation of the hydrochloric solution, tinges the flame of alcohol greenish yellow.