which they were supposed to communicate to the system. These notions are now exploded.

In asphyxia arising from a deficiency of atmospheric air, or from breathing noxious vapours, the inhalation of oxygen gas has been said to be, and probably is, useful. On the same principle, it may be employed during an attack of spasmodic asthma, when there is danger of suffocation, but it is at best only a palliative, and has no power of preventing the occurrence of other attacks. Chaussier has recommended its use in children apparently still-born. To combat the asphyxia of malignant cholera, inhalations of oxygen were tried in Russia, Poland, Prussia, and France, but without success (Merat and De Lens, *Dict. Mat. Méd.* tom. 5me. p. 143).

A'qua Oxyge'nii.—Ox'ygen Water.

At the mean pressure and temperature of the atmosphere, 100 vols. of water dissolve, according to Dalton and Henry (*Elem. Experim. Chem.*) 3·7 vols. of oxygen gas, according to Saussure (*ibid.*) 6·5 vols. By pressure in a proper machine, water may be charged with a much larger quantity (Jourdan, in the *Pharmacopée Universelle*, says with half its volume) of gas. This solution has been termed *oxygenated water*, but is a very different substance to the peroxide of hydrogen, which also has been known by this appellation. It has been used to the extent of one or two bottlefuls daily, as a slight excitant. It is said to increase the appetite and promote the secretions; and to be serviceable in spasm of the stomach, amenorrhœa, hysteria, atonic dropsy, &c.

Order II.—Chlorine and its Aqueous Solution.

Chlorin'ium.—Chlo'rine.

History, synonymes, and etymology.—This gas was discovered by Scheele in 1774, who termed it *dephlogisticated muriatic acid.* Berthollet, in 1785, named it *oxygenated muriatic acid.* Sir H. Davy called it *chlorine* (from χλωρὸς, *green*), on account of its colour.

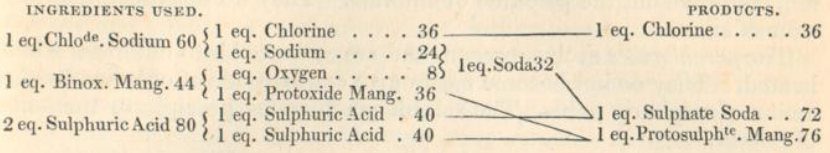
Natural History.—It is found in both kingdoms of nature. (*a.*) *In the inorganized kingdom* it exists principally in combination with sodium, either dissolved in the water of the ocean or forming deposits of rock salt. Chlorine also occurs native, in combination with magnesium, calcium, lead, silver, &c. Free hydrochloric acid is met with in the neighbourhood of volcanoes, and is probably produced by the decomposition of some chloride. (*b.*) *In the organized kingdom*, it is found in combination, in both animals and vegetables. Sprengel (*Decand. Physiol. Vég.* tom. i. p. 220), says maritime plants exhale chlorine, principally during the night. Hydrochloric acid, in the free state, exists, according to Dr. Prout, in the stomach of animals during the process of digestion.

Preparation.—There are several methods of procuring chlorine gas:—

1. *By adding sulphuric acid to a mixture of common salt and binoxide of manganese.*—This is the cheapest and most usual method of preparing it. Mix intimately three parts of dried common salt with one part of the binoxide of manganese, and introduce the mixture into a retort. Then add as much sulphuric acid, previously mixed with its own weight of water, as will form a mixture of the consistence of cream. On the

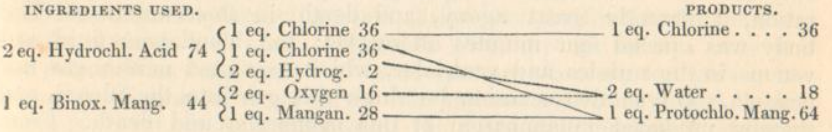
application of a gentle heat, the gas is copiously evolved, and may be collected over either warm or cold water.

In this process two equivalents, or 80 parts of sulphuric acid, react on one equivalent or 44 parts of the binoxide, and on one equivalent or 60 parts of chloride of sodium, and yield one equivalent or 36 parts of chlorine, one equivalent or 76 parts of the sulphate of the protoxide of manganese, and one equivalent or 72 parts of the sulphate of soda.



2. *By heating a mixture of equal weights of common hydrochloric acid and binoxide of manganese in a glass retort over a lamp.*

In this process two equivalents or 74 parts of hydrochloric acid react on one equivalent or 44 parts of the binoxide, and yield one equivalent or 36 parts of chlorine, one equivalent or 9 parts of water, and one equivalent or 64 parts of protochloride of manganese.



3. *By the action of hydrochloric acid on chloride of lime.*—This method may be resorted to when binoxide of manganese cannot be procured. The products of the reaction of the ingredients are, chlorine, water, and chloride of calcium.

PROPERTIES.—Chlorine, at ordinary temperatures and pressures, is a gaseous substance, having a yellowish green colour, a pungent, suffocating odour, and an astringent taste. 100 cubic inches weigh between 76 and 77 grains. Its sp. gr. is, according to Dr. Thomson, 2·5. Its equivalent by weight is 36, by volume 1;—hydrogen being unity.

1 eq. Hydrog. =1	1 eq. Chlor. =36

It is not combustible, but is a supporter of combustion. Phosphorus and powdered antimony take fire spontaneously when introduced into it,—a taper burns in it with the evolution of a red light and much smoke. When water is present it destroys vegetable colours, organic odours, and infectious matters.

By a pressure of 4 atmospheres at the temperature of 60° F., chlorine is a yellow liquid, having a sp. gr. of 1·33 (water being 1·).

CHARACTERISTICS.—The colour, odour, and bleaching property of chlorine readily distinguish it from other gases. It forms a white curdy precipitate (chloride of silver) with the nitrate of silver: this precipitate blackens by exposure to light, from the escape of a little chlorine and the formation of a sub-chloride of silver (Wetzlar, in Landgrebe's *Versuch über das Licht*. p. 53, 1834); is insoluble in nitric acid, readily dissolves in liquid ammonia, and when heated in a glass tube fuses, and on cooling concretes into a gray, semi-transparent mass (*horn silver* or *luna cornea*). An aqueous solution of chlorine dissolves leaf gold. The *chlorides* react on the solution of nitrate of silver as free chlorine. They evolve hydro-

chloric acid when heated with liquid sulphuric acid. If a watery solution of a chloride, coloured blue by sulphate of indigo, be submitted to the action of a galvanic battery, the chlorine is evolved at the positive pole (*anode*) and destroys the colour of the sulphate of indigo in the neighbourhood of that pole.

The *chlorates* when heated evolve oxygen, and are converted into chlorides. When mixed with strong sulphuric acid they become orange red, and give out the peroxide of chlorine. They do not precipitate the salts of silver.

The *perchlorates* evolve oxygen, and are converted into chlorides when heated. They do not become red or give out peroxide of chlorine by the action of sulphuric acid. The soluble perchlorates precipitate the salts of potash.

Physiological Effects. (*a.*) *On vegetables.*—The germination of seeds has been said to be promoted by watering them with a weak solution of chlorine, but the statement is probably erroneous. (*Decand. Phys. Végét.* t. ii. p. 632.)

b. On animals generally.—Nysten (*Recherches*, p. 140,) injected a small quantity of chlorine gas into the jugular vein of a dog, and the only effect was howling. A larger quantity occasioned difficult respiration, apparently great agony, and death in three minutes. The body was opened four minutes afterwards: the blood was fluid and venous in the auricles and ventricles, which contained neither gas nor coagula. On another occasion he threw this gas into the pleura, and thereby produced inflammation of this membrane and death. From these experiments, Nysten (*op. cit.* p. 143) concludes that it is a local irritant, but has no specific effect on any part of the system.

c. On man.—Chlorine gas acts as a *local* irritant. Mr. Wallace (*Researches respecting the Medical Powers of Chlorine, particularly in Diseases of the Liver*, 1822), tells us, that diluted with air, or aqueous vapour, of 116° F., and applied to the skin, it produces peculiar sensations, similar to those caused by the bite or sting of insects: this effect is accompanied with copious perspiration, and a determination of blood to the skin, sometimes attended with an eruption of minute papulæ, or even vesicles. Applied to the skin in a pure form, its action is similar, but more energetic.

If an attempt he made to inspire undiluted chlorine gas, it produces spasm of the glottis. If the gas be mixed with air, it enters into the bronchial ramifications, causes a sensation of tightness and suffocation, and violent cough. Twice I have suffered most severely from the accidental inhalation of it; and each time it gave me the sensation of constriction of the air-tubes, such as might be produced by a spasmodic condition of the muscular fibres of the bronchial tubes. The attack usually goes off in increased secretion from the mucous membrane. When diluted with a large quantity of air, chlorine may be inhaled without exciting cough: it occasions a sensation of warmth in the respiratory passages, and promotes expectoration.

The irritating effects of chlorine are less powerful on those accustomed to inhale it; as I have repeatedly seen in patients who were using the gas, and which is also shewn by the following statement made by Dr. Christison, (*Treatise on Poisons*, p. 736):—"I have been told (says he) by a chemical manufacturer at Belfast, that his workmen can work with

impunity in an atmosphere of chlorine, where he himself could not remain above a few minutes."

The constitutional or *remote* effect caused by inhalations of chlorine, is increased frequency of the pulse and of respiration. But this effect may be in part owing to the increased muscular efforts of the patient. Mr. Wallace states that the application of chlorine to the skin also occasions soreness of the mouth, fauces, and œsophagus, increased vascularity, and even minute ulcerations of these parts, and an alteration in the quantity and quality of the salivary and biliary secretions. He thinks that it has a tranquillizing, and at the same time exciting power, with respect to the nervous system. Dr. Christison tells us that at the Belfast manufactory above alluded to, the chief consequences of exposure to an atmosphere of chlorine are acidity and other stomach complaints, which the men generally correct by taking chalk. Absorption of fat is said to be an effect observed in the manufactories at Glasgow, Manchester, and Belfast. (Cogswell's *Essay on Iodine*, p. 82.)

When applied to the skin or bronchial membrane, does chlorine gas become absorbed? If Mr. Wallace's observation be correct, we must infer that it does, and that it is thrown out of the system by the kidneys; for he says the urine acquires bleaching properties.

Uses.—(*a.*) *As a fumigating agent, disinfectant, and antiseptic*, chlorine, I believe, stands unrivalled. Hallé, in 1785, appears to have been the first person who employed it as a disinfectant; but we are greatly indebted to Guyton-Morveau for the zeal and energy he manifested in his attempts to introduce it into use. For destroying miasmata, noxious effluvia, and putrid odours, it is the most powerful agent known; and is, therefore, well adapted for disinfecting prisons, ships, hospitals, dissecting-rooms, and all other places, the air of which requires purification. The best method of fumigating a large building is that adopted by Dr. Faraday, at the General Penitentiary at Milbank. One part of common salt was intimately mixed with one part of the black or binoxide of manganese; then placed in a shallow earthen pan, and two parts of oil of vitriol, previously diluted with two parts by measure of water, poured over it, and the whole stirred with a stick. Chlorine continued to be liberated from this mixture for four days. The quantities of the ingredients consumed were 700 lbs. of common salt, 700 lbs. of binoxide of manganese, and 1400 lbs. of sulphuric acid. The disinfecting power of chlorine is supposed to depend on its affinity for hydrogen, by which it effects the decomposition of water or aqueous vapour, with the hydrogen of which it unites, while the nascent oxygen oxidizes the organic matter: or it may act merely by abstracting hydrogen from the putrid miasmata.

(*b.*) *As an antidote in poisoning by hydrocyanic acid, sulphuretted hydrogen, or hydrosulphate of ammonia*, chlorine gas is a very valuable agent. I believe, however, that the chloride of lime will be found a more convenient, safe, and opportune substance; of course its activity depends on the chlorine which it contains or gives out. The beneficial influence of chlorine in the treatment of animals asphyxiated by sulphuretted hydrogen, doubtless arises in part at least from its chemical properties; for when mixed with sulphuretted hydrogen, it forms chloride of sulphur and hydrochloric acid. The best method of applying the remedy is to diffuse a little chlorine in the air, and then to effect artificial respiration.

(*c.*) *Inhaled in chronic pulmonary diseases* it is sometimes a useful

remedy. I have carefully watched its effects in phthisis and other chronic diseases of the lungs; and the result of my observation is, that chlorine is rarely serviceable. Frequently, after the first and second inhalations, the patients fancy their breathing much relieved, while the expectoration is promoted, but the amendment is seldom permanent. I need hardly say it has no pretensions to the cure of phthisis, but it may be useful as a palliative (sometimes diminishing the sweating); and I can readily believe that occasionally in chronic bronchitis it may be of essential service, though, I confess, I have never found it so.

I have before described the mode of administering the gas (p. 51). Either the aqueous solution of chlorine, or a small portion of the chloride of lime, may be placed into the inhaling bottle: if the latter be not sufficiently strong, a few drops of muriatic acid are to be added, to develop free chlorine.

(*d.*) *In diseases of the liver*, not attended with active inflammation, Mr. Wallace has successfully employed baths of gaseous chlorine, either in the pure state or diluted with air or aqueous vapour. The benefit of chlorine in these cases has been confirmed by others. The temperature of the bath, and the time the patient ought to remain in it, will vary in different instances; but Mr. Wallace thinks, that, in the greater number, 115° Fah. will be found to answer best, and the proper time about half an hour. The benefit obtained is in part referrible to the heat employed, in part to the irritant effect of the chlorine on the skin, and (according to Mr. Wallace) in part to the specific influence of chlorine on the liver. Ziese, an apothecary at Altona, has also employed chlorine baths in these cases with advantage.

Antidotes.—The inhalation of ammoniacal gas, of the vapour of warm water, of spirit of wine, or of ether, has been recommended, to relieve the effects of chlorine. I tried them all when suffering myself, but without the least apparent benefit. In a case related by Kastner, and which is reported in Wibmer's work (*Die Wirkung der Arzneim. u. Gifte*. 2er. Bd. 109), sulphuretted hydrogen gave great relief. If this agent be employed, it must be done cautiously, as it is itself a powerful poison.

A'qua Chlorin'ii.—Chlo'rine Water.—Ph. Dub.

History.—This compound has been known by the various names of *liquid oxymuriatic acid*, *aqua oxymuriatica*, and *liquor chlori*. In the Dublin Pharmacopœia it is termed *aqua chlorinii*, or *chlorine water*.

Preparation.—In the Dublin Pharmacopœia this compound is prepared as follows:—add 87 parts of sulphuric acid to 124 of water, and when the mixture has become cold, pour it on a mixture of 100 parts of dried common salt, intimately mixed with 30 parts of binoxide of manganese, and placed in a retort. Transmit the gas which is evolved on the application of a moderate heat, through 200 parts of water, placed in a Woolfe's bottle: but in the absence of this a wide-mouthed bottle closed by a cork with two perforations, through which pass two glass tubes, both dipping into the water, but one of which communicates with the retort. A Florence flask, to which a curved tube is adapted by means of a cork, is a more convenient vessel for generating the gas in, than a retort.

Properties.—At the temperature of 60° F. and common pressure of the atmosphere, water takes up about twice its bulk of the gas (*Gay-Lussac*).

The solution has a greenish yellow colour, the strong and peculiar odour of the gas, and an astringent taste. Its sp. gr. is 1·003. It bleaches vegetable colours—as tincture of litmus, turmeric, &c. By exposure to light, the water is decomposed, the oxygen is evolved, while the hydrogen unites with the chlorine to form muriatic acid. Hence the solution should be kept in bottles excluded from the light.

CHARACTERISTICS.—Its odour, its action on a solution of nitrate of silver (as before described for chlorine gas), its power of dissolving leaf gold, and its bleaching properties, readily distinguish this solution. It destroys the blue colour of iodide of starch and of sulphate of indigo. A piece of silver plunged into it is immediately blackened.

PHYSIOLOGICAL EFFECTS.—In a concentrated form, the aqueous solution of chlorine acts as a corrosive poison. Somewhat diluted it ceases to be a caustic, but is a powerful local irritant. Administered in proper doses, and sufficiently diluted, it acts as a tonic and stimulant. The continued use of it is said to have caused salivation. Applied to dead organic matter it operates as an antiseptic and disinfectant.

USES.—Chlorine water has been employed in medicine both as an external and internal remedy.

(*a.*) *Externally.*—It has been used in the concentrated form as a caustic, applied to wounds caused by rabid animals; diluted, it has been employed as a wash in skin diseases, namely, in the itch and porrigo; as a gargle in putrid sore-throat; as a local bath in liver diseases; and as an application to cancerous and other ulcers attended with a fœtid discharge. In the latter cases I have repeatedly employed it with advantage, though I give the preference to a solution of the chloride of soda.

(*b.*) *Internally.*—It has been administered in those diseases denominated putrid; for example, in the worst forms of typhus, in scarlet fever, and in malignant sore throat. It has also been employed in venereal maladies, and in diseases of the liver.

DOSE.—The dose of this solution varies with the degree of concentration. I have frequently allowed patients to drink, *ad libitum*, water, to which some of this solution has been added. If made according to the directions of the Dublin Pharmacopœia, the dose is from one to two drachms properly diluted.

ANTIDOTES.—According to Devergie, the antidote for poisoning by a solution of chlorine is albumen. The white of egg, mixed with water or milk (the caseum of which is as effective as the albumen of the egg) is to be given in large quantities. The compound which albumen forms with chlorine has little or no action on the animal economy, and may be readily expelled from the stomach. In the absence of eggs or milk, flour might be exhibited: or if this cannot be procured, magnesia or chalk. The gastro-enteritic symptoms are, of course, to be combated in the usual way.

ORDER III.—IODINE.

Iodin'ium.—I'odine.

GENERAL HISTORY.—Iodine was discovered in 1811 by M. Courtois, a saltpetre manufacturer at Paris. It was first described by Clement in 1813, but was afterwards more fully investigated by Davy and Gay-Lussac. It was named *Iodine*, from ἰώδης, *violet-coloured*, on account of the colour of its vapour.