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, (*Médecine Légale*, t. ii. p. 634. Paris, 1836.) 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.

COMPOUNDS OF CHLORIDE AND OXYGEN.

None of these are used in medicine. The concentrated aqueous solutions of all of them are oxidizing agents, and act on the organic tissues as caustics. Their remote effects are probably similar to the acids generally and chlorine. *Hypochlorous* (Cl. + O) and *Chlorous* (Cl. + 4O) *Acids* are bleaching agents: to the first, the substances called Chloride of Lime and Chloride of Soda owe their disinfecting properties. *Chloric Acid* (Cl. + 5O) has great analogy with nitric acid; combined with potash it constitutes Chlorate of Potash. *Perchloric Acid* (Cl. + 7O) is an excellent test for potash.

Order III.—IODINE, AND ITS COMBINATIONS WITH OXYGEN AND CHLORINE.

IODIN'IUM, *L. D.*—IODINE.

(Iodineum, *E.*) (Iodinum, U. S.)

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.

Natural History.—It exists in both kingdoms of nature.[1]

α. In the inorganized kingdom.—Vauquelin met with iodide of silver in a mineral brought from Mexico, and Mentzel found Iodine in an ore of zinc which contained cadmium. It has also been met with in an ore of lead. (*Journ. de Pharmacie*, tom. xxiii. for 1837, p. 29.) It is said to have been found in coals. (*Lond. and Edinb. Philosoph. Mag.* for Nov. 1839.) In sea-water it has likewise been discovered, where it probably exists as an iodide of sodium or of magnesium. Many mineral waters contain it. It was detected by Mr. Copeland (*Edinburgh New Philosophical Journal*, vol. i. p. 159.) in the carbonated chalybeate of Bonnington. About one grain of iodine was found by Dr. Daubeny (*Phil. Trans.* 1830, Part 2, p. 223.) in ten gallons of the water of Robin's Well at Leamington, in Warwickshire. In the old well at Cheltenham the quantity was not more than one grain in sixty gallons. In a brine-spring at Nantwich, in Cheshire, there was about a grain of iodine in twelve gallons. In the sulphurous water of Castel Nuovo d'Asti, iodine was discovered by Cantu. In some of the mineral waters of Germany, Bavaria, and South America, it has also been detected.[2] Fuchs found it in the rock-salt of the Tyrol. (Gmelin, *Handbuch der Chemie*, Bd. i. S. 350.)

β. In the organized kingdom.—Of Animals containing iodine I may mention the genera *Spongia*, *Gorgonia*, *Doris*, *Venus*, &c.: likewise *Sepia*, the envelopes of the eggs of which contain it. An insect has been found near Ascoli, in Italy, which Savi has described under the name of *Julus fœtidissimus*, containing iodine. The animal emits, when disturbed, a

[1] Since the publication of the first edition of this work, I have met with S. E. Sarphati's *Commentatio de Iodio*, Lugduni, 1835, which contains the most extensive list of natural bodies containing iodine, of any work with which I am acquainted.

[2] Gairdner, *Essay on the Natural History, Origin, Composition, and Medicinal Effects of Mineral and Thermal Springs*, p. 27, Edinb. 1832.

yellow fluid strongly smelling of iodine, and which immediately strikes the characteristic violet colour with starch.[1] Recently iodine has been detected in the oil of the cod's liver. (*Journ. de Pharmacie*, tom. xxiii. p. 501.) A very considerable number of Vegetables, particularly those belonging to the family Algæ, yield it. The following are some instances: *Fucus vesiculosus*, F. *serratus*, and F. *nodosus*; (fig. 47, *a*, *b*, *c*.) *Laminaria saccharina*, and *L. digitata* (fig. 47, *d*;) *Halidrys siliquosa*; *Chorda Filum*; *Gelidium cartilageneum*; *Halyseris polypodioides*; *Phyllophora rubens*; *Rhodomenia palmata*; *Ulva Linza*; *Porphyra umbilicalis*; *Padina Pavonia*; *Gigartina Helminthocorton*, and some of the marine *Confervæ*.

FIG. 47.

a. Fucus vesiculosus.
b. F. nodosus.
c. F. serratus.
d. Laminaria digitata.

"The following table drawn up by Mr. Whitelaw, a manufacturer in Glasgow, from his own experiments, shows the proportion of iodine contained in some of the most common Algæ on our sea coasts:—

	Ratios of Iodine.		*Ratios of Iodine.*
Laminaria digitata.....	100	Fucus serratus.....	20
Laminaria bulbosa.....	65	Fucus bulbosus.....	15
Laminaria saccharina.....	35		

"The quantities of chloride of potassium in those Algæ follow nearly the same ratio." (Thomson, *Organic Chemistry*, p. 946.) Professor Graham states that, according to Mr. Whitelaw, the long elastic stems of the *Rhodomenia palmata* afford most of the iodine contained in kelp.

It has been found in several species of phænogamous plants, as *Zostera marina*, and, more recently, in two growing in Mexico; namely, a species of *Agave*, and one of *Salzola*. (*Journal de Pharmacie*, t. xxiii. p. 31.)

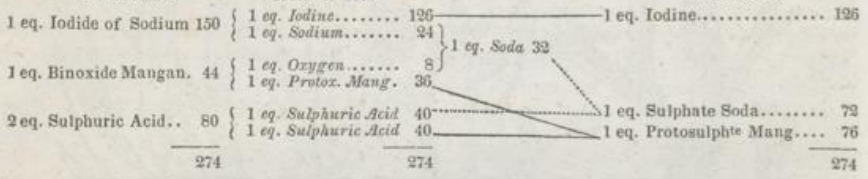
PREPARATION.—British Iodine is exclusively manufactured at Glasgow, from the Kelp of the west coast of Ireland and the western islands of Scotland.

The kelp is broken into pieces and lixiviated in water, to which it yields about half its weight of salts. The solution is concentrated by evaporation, and thereby deposites soda salts (common salt, carbonate and sulphate of soda,) and on cooling also lets fall crystals of chloride of potassium. The mother liquor (called *iodine ley*) is dense, dark-coloured, and contains the iodine, in the form, it is believed, of iodide of sodium. Sulphuric acid is added, to render the liquor sour, by which carbonic acid, sulphuretted hydrogen, and sulphurous acid gases are evolved, and sulphur is deposited. The workmen set fire to the sulphuretted hydrogen as it escapes, to obviate its bad effects. The acid ley is then introduced into a leaden still, and heated to 140° F., when binoxide of manganese is added. A leaden head, having two stoppers, is then adapted and luted with pipeclay, and to the neck of the head is fitted a series of spherical glass condensers, each having two mouths opposite to each other, and inserted the one into the other. Iodine is evolved, and is collected in the condensers. The pro-

[1] Dulk, *Die Preussische Pharmakopöe*, Bd. i. S. 583. Leipzig, 1829; and *British and Foreign Medical Review* for January, 1838, p. 163.

cess is watched by occasionally removing the stopper, and additions of sulphuric acid or manganese are made, if deemed necessary.[1]

THEORY OF THE PROCESS.—The following is the mutual reaction of sulphuric acid, binoxide of manganese, and iodide of sodium:—two equivalents or 80 parts of sulphuric acid, react on one equivalent or 44 parts of binoxide of manganese, and on one equivalent or 150 parts of iodide of sodium; and yield one equivalent or 126 parts of iodine, one equivalent or 72 parts of sulphate of soda, and one equivalent or 76 parts of the sulphate of the protoxide of manganese.



The evolution of iodine in the preceding process may be also accounted for in another way. By the mutual reaction of sulphuric acid, binoxide of manganese and a chloride (as of sodium or potassium,) there is set free chlorine. This reacting on iodide of sodium, would liberate iodine, and form chloride of sodium. Or, the hydriodic acid set free from a solution of iodide of sodium by sulphuric acid, may be decomposed by the nascent chlorine.

PROPERTIES.—Iodine is a crystallizable solid, its primary form being a rhombic octohedron. (Buchner's *Repertorium für die Pharmacie*, 2te Reiter, Band. xx. S. 43. Nürnberg, 1815.) It is usually met with in micaceous, soft, friable scales, having a grayish black colour, a metallic lustre, an acrid hot taste, and a disagreeable odour somewhat similar to that of chlorine. It fuses at about 225° F., and at 347° is volatilized, though the vapour rises along with that of water at 212°. Iodine vapour is of a beautiful violet colour, and a great specific gravity; namely, 8·716, according to Dumas. Iodine requires 7000 times its weight of water to dissolve it, but alcohol and ether are much better solvents for it. Its atomic weight is about 126 [126·57, Berzelius; 126·3, Turner;] its atomic volume is 1.

1 eq. Iodine Vapour = 126

Characteristics.—In a free state iodine is distinguished from most other bodies by the violet colour of its vapour, and by its forming a blue compound (iodide of starch) with starch. So delicate is this test, that, according to Stromeyer, water which does not contain more than one four-hundred-and-fifty thousandth of its weight of iodine, acquires a perceptibly blue tinge on the addition of starch. This blue colour is destroyed by heat, and, therefore, in testing for iodine the liquids employed should be cold: an excess of alkali also destroys it by forming two salts, an iodate and an iodide, but by supersaturating with acid the colour is restored.

Iodine as well as the mineral acids (sulphuric, nitric, and hydrochloric) produce a blue colour with narceine (See *Opium.*)

When iodine is in combination with oxygen, starch will not recognise it. For example, if a little starch be added to a solution of *iodic acid*, no change of colour is observed; but if some deoxidating substance be now employed (such as sulphurous acid or morphia) the blue colour is immediately produced. The *iodates* give out oxygen when heated, and are converted into iodides. They deflagrate when thrown on red-hot coals. The soluble iodates produce, with a solution of the nitrate of silver, a white precipitate (*iodate of silver*) soluble in ammonia. If the iodine be combined with a base (as with potassium, or sodium) forming an *iodide*, chlorine or sulphuric or nitric acid must be employed to unite with the base; and the iodine being then set free, will react on the starch. This is the mode of proceeding to detect iodine in the urine of a patient; for the mere addition of starch will not suffice. Nitric or sulphuric acid or chlorine must be employed to remove the base with which the iodine is combined. Excess of chlorine will unite with the disengaged iodine.

[1] For farther details, consult Graham's *Elements of Chemistry*, vol. i. p. 384.—See also Dr. Thomson, in the *Athenæum*, for 1840, p. 772.

The soluble iodides produce, with a solution of nitrate of silver, a yellowish precipitate (*iodide of silver*) very slightly soluble only in ammonia. They precipitate the salts of lead yellow, (*iodide of lead*,) and bichloride of mercury scarlet (*biniodide of mercury*.)

Adulteration.—The iodine of commerce is always adulterated with variable proportions of *water*. An ounce, if very moist, may contain a drachm, or perhaps even a drachm and a half, of water. This fraud is detected by compressing the iodine between folds of blotting-paper. In this moist state it is "unfit for making pharmaceutic preparations of fixed and uniform strength," and the Edinburgh College gives the following directions for purifying it:—

"It must be dried by being placed in a shallow basin of earthenware in a small confined space of air, with ten or twelve times its weight of fresh-burnt lime, till it scarcely adheres to the inside of a dry bottle."

Various other substances, such as *coal*, *plumbago*, *binoxide of manganese*, *sand*, and *charcoal*, are also said to have been employed for the purpose of adulterating iodine; but in no samples of iodine which I have examined, have I ever found any of these substances. Pure iodine is completely soluble in alcohol, and evaporates, when heated, without leaving any residuum. Any matter insoluble in alcohol, or even vaporizable by heat, is an adulteration. The Edinburgh College gives the following criteria of its goodness:—

"Entirely vaporizable: thirty-nine grains, with nine grains of quicklime and three ounces of water, when heated short of ebullition, slowly form a perfect solution, which is yellowish or brownish, if the iodine be pure, but colourless if there be above two per cent. of water or other impurity."

Physiological Effects. *α. On Vegetables.*—Cantu states that seeds placed in pure sand and moistened with a solution of iodine, germinate more readily than seeds sown in the usual way. Vogel, however, asserts that iodine, so far from promoting, actually checks or stops germination. (De Candolle, *Physiologie Végétale*, tom. 3me, p. 1337.

β. On Animals generally.—On horses, dogs, and rabbits, it operates as an irritant and caustic poison, though not of a very energetic kind. Magendie threw a drachm of the tincture of iodine into the veins of a dog without causing any obvious effects. (*Formulaire.*) Dr. Cogswell has repeated this experiment: the animal was slightly affected only. (*Experimental Essay on Iodine*, p. 31, 1837.) The last mentioned writer found that two drachms of the tincture caused death. But something must be ascribed to the alcohol employed. Orfila (*Toxicologie générale.*) applied 72 grains of solid iodine to a wound on the back of a dog: local inflammation, but no other inconvenience, resulted. One or two drachms administered by the stomach caused vomiting, and when this was prevented by tying the œsophagus, ulceration of the alimentary canal and death took place. Mr. Dick (Cogswell's *Essay*, p. 24.) gave iodine, in very large doses, to a horse for three weeks, but the only symptom which could be referred to its influence was an unusual disregard for water. The average daily allowance was two drachms, administered in quantities ascending from a drachm up to two ounces. Dr. Cogswell (*op. cit.* p. 60.) gave 73 grains of iodine to a dog in nine days. Five days after the cessation of the iodine the dog was killed: the urine contained a highly appreciable quantity of iodine—and a trace, and but a trace, of iodine was found in the blood, brain, and stomach.

γ. On Man.—The *local* action of iodine is that of an irritant. Applied to the skin it stains the cuticle orange-yellow, causes itching, redness, and desquamation. If the vapour of it, mixed with air, be inhaled, it excites cough and heat in the air-passages. On a secreting surface its alcoholic solution acts as a desiccant. Swallowed in large doses it irritates the stomach, as will be presently mentioned.

The effects produced by the internal administration of iodine are those of a liquefacient and resolvent. (See p. 194.) They may be considered under the

two heads, of those arising from the use of small,—and those produced by large doses.

αα. *In small, medicinal doses*, we sometimes obtain the palliation, or even the removal of disease, without any perceptible alteration in the functions of the body. Thus, in a case of chronic mammary tumour which fell under my observation, iodine was taken daily for twelve months, without giving rise to any perceptible functional change, except that the patient was unusually thin during this period. Sometimes it increases the appetite, an effect noticed both by Coindet (*Biblioth. Univers.* tom. xiv. Sciences et Arts.) and by Lugol, (*Essays*, translated by Dr. O'Shaughnessy.) from which circumstance it has been denominated a *tonic*. But the long-continued use of it, in large doses, has, occasionally, brought on a slow or chronic kind of gastro-enteritis; an effect which I believe to be rare, and only met when the remedy has been incautiously administered.

In irritable subjects, and those disposed to dyspepsia, it occasions nausea, sickness, heat of stomach, and loss of appetite, especially after its use has been continued for some days: the bowels are oftentimes slightly relaxed, or at least they are not usually constipated. More than one-third of the patients treated by Lugol experienced a purgative effect; and when the dejections were numerous, colics were pretty frequent. (*Op. cit.* p. 20.) Gendrin (*Dict. de Mat. Méd.* t. 3me, p. 628.) and Manson, (*Medical Researches on Iodine.*) however, observed a constipating effect from the use of iodine.

The action of iodine on the *organs of secretion* is, for the most part, that of a stimulant; that is, the quantity of fluid secreted is usually increased, though this effect is not constantly observed, Jörg (*Material zu einer Arzneimittell.* Leipsic, 1824.) and his friends, found, in their experiments on themselves, that small doses of iodine increased the secretion of nasal mucus, of saliva, and of urine, and they inferred that the similar effect was produced on the gastric, pancreatic, and biliary secretions. "Iodine," says Lugol, (*Essays*, p. 19.) "is a powerful *diuretic*. All the patients using it have informed me that they pass urine copiously." Coindet, however, expressly says that it does not increase the quantity of urine. In some cases, in which I carefully watched its results, I did not find any diuretic effect. Iodine frequently acts as an *emmenagogue*. Coindet, Sablairoles, (*Journ. générale de Méd.* tom. 97.) Brera, (Quoted by Bayle in his *Bibliothèque de Thérapeutique*, tom. i. p. 129.) Magendie, (*Formulaire.*) and many others, agree on this point; but Dr. Manson (*Medical Researches on the Effects of Iodine.* London, 1825.) does not believe that it possesses any emmenagogue powers, farther than as a stimulant and tonic to the whole body. In one patient it occasioned so much sickness and disorder of stomach, that the menstrual discharge was suppressed altogether. On several occasions iodine has caused *salivation* and soreness of mouth. In the cases noticed by Lugol, the patients were males. In the *Medical Gazette*, vol. xvii. for 1836, two instances are mentioned, one by Mr. Winslow, (p. 401.) the other by Dr. Ely (p. 480.) Other cases are referred to in Dr. Cogswell's work. This effect, however, I believe to be rare. De Carro (quoted by Bayle) (*Op. cit.* p. 50.) denies that iodine causes salivation, but says it augments *expectoration*. Lastly, *diaphoresis* is sometimes promoted by iodine.

Two most remarkable effects which have been produced by iodine are, *absorption of the mammæ* and *wasting of the testicles*. Of the first of these, (absorption of the mammæ,) three cases are reported in *Hufeland's Journal*, (Bayle, *op. cit.* p. 162.) one of which may be here mentioned. A healthy girl, twenty years of age, took the tincture of iodine during a period of six months, for a bronchocele, of which she became cured; but the breasts were observed to diminish in size, and notwithstanding she ceased to take the remedy, the wasting continued, so that at the end of two years not a vestige of the mammæ remained. Sometimes the breasts waste, though the bronchocele is undiminished: Reichenau (Christison, p. 180.) relates the case of a female, aged twenty-six, whose breasts began

to sink after she had employed iodine for four months, and within four weeks they almost wholly disappeared; yet her goitre remained unaffected. With regard to the other effect (wasting of the testicle) I suspect it to be very rare. I have seen iodine administered in some hundreds of cases, and never met with one in which atrophy either of the breast or testicle occurred. Magendie also never saw these effects, though they are frequent in Switzerland.

A disordered condition of the cerebro-spinal system has in several instances been caused by iodine. Thus, slight headach and giddiness are not unfrequently brought on. Lugol tells us that, by the use of iodurettted baths, headach, drowsiness, intoxication, and even stupor, are produced. Analogous symptoms were observed in some of Dr. Manson's cases; and in one there were convulsive movements.

A specific effect on the skin is sometimes produced by iodine, besides the diaphoresis before alluded to. Thus Dr. C. Vogel (Rust, *Magazin*, Bd. 14, p. 156.) gives an account of a lady, twenty-eight years of age, of a yellow complexion, who, from the internal employment of the tincture of iodine, became suddenly brown, besides suffering with other morbid symptoms. After some days the skin had the appearance of having been smoked! Mr. Stedman (*London Medical Gazette*, vol. xv. p. 447.) says that in some scrofulous patients it improves the condition of the hair and scalp. Red hair is said to have assumed a chesnut-brown colour under the long-continued internal use of iodine. (Clauzel, *Revue Médicale*, Nov. 1834, p. 30.)

The rapid emaciation said to have been occasionally produced by iodine, as well as the beneficial influence of this substance in scrofulous diseases, and the disappearance of visceral and glandular enlargements under its use, have given rise to an opinion that iodine *stimulates the lymphatic vessels and glands*. (See p. 194.) Manson, however, thinks that it exerts no peculiar or specific influence over the absorbent system, which only participates in the general effects produced on the whole body. And Lugol asserts, that instead of producing emaciation, it encourages growth and increase of size.

There can be no doubt that the continued use of iodine must have some effect over the general nutrition of the body, and by modifying the actions previously performed by the various organs and systems, it may at one time cause the *embonpoint* described by Lugol, and at another may have the reverse effect: in one case it may promote the activity of the absorbents, and occasion the removal of tumours of considerable size, in another check ulceration (a process which Mr. Key, in the 19th vol. of the *Medico-Chirurgical Transactions*, denies to be one of absorption, but considers to be one of degeneration or disorganization) and cause the healing of ulcers.

Some have ascribed to iodine an *aphrodisiac* operation. Kolley, (*Journ. Complém.* tom. xvii. p. 307.) a physician at Breslau, who took it for a bronchocele, says it had the reverse effect on him.

In some instances, the continued use of iodine has given rise to a disordered state of system, which has been designated *iodism*. The symptoms (termed by Dr. Coindet, *iodic*) are violent vomiting and purging, with fever; great thirst; palpitation; rapid and extreme emaciation; cramps, and small and frequent pulse, occasionally with dry cough; and terminating in death. This condition, however, must be a very rare occurrence; for it is now hardly ever met with, notwithstanding the frequency and the freedom with which iodine is employed. But it has been noticed by Coindet, (*Op. cit.*) Gardner, (*Essay on the Use of Iodine.*) Zink, (*Journ. Complém.* tom. xviii. p. 126.) Jahn, (Quoted by Christison, p. 181.) and others. The daily experience of almost every practitioner proves, that the dangers resulting from the use of iodine have been much exaggerated, and we can hardly help suspecting that many symptoms, which have been ascribed to the injurious operation of this remedy, ought to have been referred to other causes; occasionally, perhaps, they depended on gastro-enteritis.

In some cases, the remarkable activity of iodine may have arisen from some idiosyncrasy on the part of the patient. Dr. Coindet attributes the iodic symptoms to the *saturation* of the system with iodine—an explanation, to a certain extent, borne out by the results of an experiment made by Dr. Cogswell, and which I have before mentioned: I allude, now, to the detection of iodine in the tissues of an animal five days after he had ceased taking this substance.

ββ. In very large doses iodine has acted as an irritant poison. In a fatal instance, recorded by Zink, (*Journ. Complém.* tom. xviii.) the symptoms were restlessness, burning heat, palpitations, very frequent pulse, violent priapism, copious diarrhœa, excessive thirst, trembling, emaciation, and occasional syncope. The patient died after six weeks' illness. On another occasion, this physician had the opportunity of examining the body after death. In some parts the bowels were highly inflamed; in others they exhibited an approach to sphacelation. The liver was very large, and of a pale rose colour.

Such cases, however, are very rare. In many instances, which might be referred to, enormous quantities of iodine have been taken with very slight effects only, or perhaps with no marks of gastric irritation. Thus, Dr. Kennedy, (Dr. Cogswell's *Essay.*) of Glasgow, exhibited within eighty days, 953 grains of iodine in the form of tincture: the daily dose was at first two grains, but ultimately amounted to eighteen grains. The health of the girl appeared to be unaffected by it. It should here be mentioned, that the presence of bread, potatoes, sago, arrow-root, tapioca, or other amylaceous matters, in the stomach, will much diminish the local action of iodine, by forming an iodide of starch, which, as will hereafter be mentioned, is a very mild preparation. (See the experiments of Dr. Buchanan, presently to be noticed.)

Modus Operandi.—That iodine becomes absorbed, when employed either externally or internally, we have indisputable evidence, by its detection, not only in the blood, but in the secretions. Cantu (*Journ. de Chimie Méd.*) has discovered it in the urine, sweat, saliva, milk, and blood. In all cases it is found in the state of iodide, or hydriodate; from which circumstance he concludes that its influence on the body is chemical, and consists in the abstraction of hydrogen. Bennerscheidt (*Ibid.* tom. iv. p. 383.) examined the serum of the blood of a patient who had employed for some time iodine ointment; but he could not detect any trace of iodine in it. In the crassamentum, however, he obtained evidence of its existence, by the blue tint communicated to starch. It may be readily detected in the urine of patients who have been using iodine, by adding a cold solution of starch and a few drops of nitric acid, when the blue iodide of starch is produced.

Uses.—As a remedial agent iodine is principally valuable for its resolvent influence in chronic visceral and glandular enlargements, indurations, thickening of membranes (as of the periosteum,) and in tumours. In comparing its therapeutical power with that of mercury, we observe in the first place that it is not adapted for febrile and acute inflammatory complaints, in several of which mercury proves a most valuable agent. Indeed the existence of inflammatory fever is a contra-indication for the employment of iodine. Secondly, iodine is especially adapted for scrofulous,—mercury for syphilitic, maladies; and it is well known that in the former class of diseases mercurials are for the most part injurious. Thirdly, the influence of iodine over the secreting organs is much less constant and powerful than that of mercury;—so that in retention or suppression of the secretions, mercury is for the most part greatly superior to iodine. Fourthly, iodine evinces a specific influence over the diseases of certain organs (*e. g.* the thyroid body,) which mercury does not.—These are some only of the peculiarities which distinguish the therapeutical action of iodine from that of mercury.

α. In *bronchocele.*—Of all the remedies yet proposed for bronchocele, this has been by far the most successful. Indeed, judging only from the numerous cases

cured by it, and which have been published, we should almost infer that it was a sovereign remedy. However, of those who have written on the use of iodine in this complaint, some only have published a numerical list of their successful and unsuccessful cases. Bayle (*Bibliothèque de Thérapeutique*, tom. 1er, p. 394.) has given a summary of those published by Coster, Irmenger, Baup, and Manson, from which it appears, that of 364 cases treated by iodine, 274 were cured. Dr. Copland (*Dict. of Pract. Med.*) observes that, of several cases of the disease which have come before him since the introduction of this remedy into practice, "there has not been one which has not either been cured or remarkably relieved by it." I much regret, however, that my own experience does not accord with this statement. I have several times seen iodine, given in conjunction with iodide of potassium, fail in curing bronchocele; and I know others whose experience has been similar. Dr. Bardsley (*Hospital Facts and Observations*, p. 121.) cured only nine, and relieved six, out of thirty cases, with iodide of potassium. To what circumstance, then, ought we to attribute this variable result? Dr. Copland thinks that, where it fails, it has been given "in too large and irritating doses, or in an improper form; and without due attention having been paid to certain morbid and constitutional relations of the disease during the treatment."

But, in two or three of the instances before mentioned, I believe the failure did not arise from any of the circumstances alluded to by Dr. Copland, and I am disposed to refer it to some peculiar condition of the tumour, or of the constitution. When we consider that the terms *bronchocele*, *goître*, and *Derbyshire neck*, are applied to very different conditions of the thyroid gland, and that the causes which produce them are involved in great obscurity, and may, therefore, be, and indeed probably are, as diversified as the conditions they give rise to, we can easily imagine, that while iodine is serviceable in some, it may be useless, or even injurious, in others. Sometimes the bronchocele consists in hypertrophy of the substance of the thyroid gland,—that is, this organ is enlarged, but has a healthy structure. In others, the tumefaction of the gland has taken place suddenly, and may even disappear as suddenly; from which it has been inferred, that the enlargement depends on an accumulation of blood in the vessels, and an effusion of serum into its tissue. Coindet mentions a goître which was developed excessively during the first pregnancy of a young female: twelve hours after her accouchement it had entirely disappeared. The same author also relates the circumstance of a regiment composed of young recruits, who were almost every man attacked with considerable enlargement of the thyroid gland, shortly after their arrival at Geneva, where they all drank water out of the same pump. On their quarters being changed the gland soon regained its natural size in every instance. A third class of bronchoceles consists in an enlargement of the thyroid gland from the development of certain fluid or solid substances in its interior, and which may be contained in cells, or be infiltrated through its substance. These accidental productions may be serous, honey-like, gelatinous, fibrous, cartilaginous, or osseous. Lastly, at times the enlarged gland has acquired a scirrhous condition. Now it is impossible that all these different conditions can be cured with equal facility by iodine; those having solid deposites are, of course, most difficult to get rid of.

Kolley, who was himself cured of a large goitre of ten years' standing, says, that for the iodine to be useful, the bronchocele should not be of too long standing, nor painful to the touch; the swelling confined to the thyroid gland, and not of a scirrhous or carcinomatous nature, nor containing any stony or other analogous concretions; and that the general health be not disordered by any febrile or inflammatory symptoms, or any gastric, hepatic, or intestinal irritation. If the swelling be tender to the touch, and have other marks of inflammation, let the usual local antiphlogistic measures precede the employment of iodine. When this agent is employed we may administer it both externally and internally.

The most effectual method of employing iodine externally is that called *endermic*, already described; namely, to apply an ioduretted ointment (usually containing iodide of potassium) to the cutis vera, the epidermis being previously removed by a blister. But the *epidermic*, or *iatroleptic* method, is more usually followed —that is, the ioduretted ointment is rubbed into the affected part, without the epidermis being previously removed, or the undiluted tincture is repeatedly applied to the part by a camel's-hair pencil, while iodine is at the same time administered internally.

With respect to the internal use of this substance, some think that the success depends on the use of small doses largely diluted; while others consider that as large a quantity of the remedy should be administered as the stomach and general system can bear.

β. *Scrofula* is another disease for which iodine has been extensively used. Dr. Coindet was, I believe, the first to direct public attention to this remedy in the disease in question. Subsequently, Baup, Gimelle, Kolley, Sablairoles, Benaben, Callaway, and others, published cases illustrative of its beneficial effects. (See Bayle's *Bibliothèque de Thérap.* tom. i.) Dr. Manson (*Op. cit.*) deserves the credit of having first tried it on an extensive scale. He treated upwards of eighty cases of scrofula and scrofulous ophthalmia by the internal exhibition of iodine, sometimes combined with its external employment; and in a large proportion of cases, where the use of the medicine was persevered in, the disease was either cured or ameliorated, the general health being also improved. Three memoirs on the effects of iodine in scrofula have been subsequently published by Lugol, physician to the Hospital St. Louis, serving to confirm the opinions already entertained of its efficacy. From the first memoir it appears, that in seventeen months—namely, from August 1827, to December 1828—109 scrofulous patients were treated by iodine only; and that of these 36 were completely cured, and 30 relieved; in 4 cases the treatment was ineffectual, and 39 cases were under treatment at the time of the report made by Serres, Magendie, and Dumeril, to the Académie Royale des Sciences. In his illustrative cases we find glandular swellings, scrofulous ophthalmia, abscesses, ulcers, and diseases of the bones, were beneficially treated by it. Lugol employs iodine internally and externally: for internal administration, he prefers iodine dissolved in water by means of iodide of potassium, given either in the form of *drops*, or largely diluted, under the form of what he calls *ioduretted mineral water*, hereafter to be described. His external treatment is of two kinds; one for the purpose of obtaining local effects only, the other for procuring constitutional or general effects. His local external treatment consists in employing ointments or solutions of iodine: the *ointments* are made either with iodine and iodide of potassium, or with the protiodide of mercury; the *solutions* are of iodine and iodide of potassium in water; and according to their strength are denominated caustic, rubefacient, or stimulant: the rubefacient solution is employed in making cataplasms and local baths. His external general treatment consists in the employment of *ioduretted baths*. In the treatment of cutaneous scrofula I have seen the most beneficial results from the application of the tincture of iodine by means of a camel's-hair pencil. It dries up the discharge and promotes cicatrization.

The successful results obtained by Lugol in the treatment of this disease cannot, I think, in many instances, be referred to iodine solely. Many of the patients were kept several months (some as much as a year) under treatment in the hospital, where every attention was paid to the improvement of their general health by warm clothing, good diet, the use of vapour and sulphureous baths &c.; means which of themselves are sufficient to ameliorate, if not cure, many of the scrofulous conditions before alluded to. Whether it be to the absence of these supplementary means of diet and regimen, or to some other cause, I know not, but most practitioners will, I think, admit, that they cannot obtain, by the use of iodine, the same successful results which Lugol is said to have met with,

though in a large number of cases this agent has been found a most useful remedy.

γ. Iodine has been eminently successful when employed as a resolvent *in chronic diseases of various organs, especially those accompanied with induration and enlargement*. By some inexplicable influence, it sometimes not only puts a stop to the farther progress of disease, but apparently restores the part to its normal state. It is usually given with the view of exciting the action of the absorbents, but its influence is not limited to this set of vessels: it exercises a controlling and modifying influence over the blood-vessels of the affected part, and is in the true sense of the word an *alterative*. (See some remarks on the operation of resolvents at p. 194.)

In chronic inflammation, induration, and enlargement of the *liver*, after antiphlogistic measures have been adopted, the two most important and probable means of relief are iodine and mercury, which may be used either separately or conjointly. If the disease admit of a cure, these are the agents most likely to effect it. Iodine, indeed, has been supposed to possess some specific power of influencing the liver, not only from its efficacy in alleviating or curing certain diseases of this organ, but also from the effects of an over-dose. In one case, pain and induration of the liver were brought on;—and in another, which terminated fatally, this organ was found to be enlarged, and of a pale rose colour. (Christison, *Treatise on Poisons*, pp. 180–1.)

Several cases of enlarged *spleens* relieved, or cured, by iodine have been published.

In chronic diseases of the *uterus*, accompanied with induration and enlargement, iodine has been most successfully employed. In 1828, a remarkable instance was published by Dr. Thetford. (*Trans. of the King and Queen's College of Phys.* Ireland, vol. v.) The uterus was of osseous hardness, and of so considerable a size as nearly to fill the whole of the pelvis: yet in six weeks the disease had given way to the use of iodine, and the catamenia were restored. In the *Guy's Hospital Reports*, N° I. 1836, is an account, by Dr. Ashwell, of seven cases of "hard tumours" of the uterus successfully treated by the use of iodine, in conjunction with occasional depletion, and regulated and mild diet. Besides the internal use of iodine, this substance was employed in the form of ointment (composed of iodine gr. xv. iodide potassium ℈ij. spermaceti oint. ℥iss.,) of which a portion (about the size of a nutmeg) was introduced into the vagina, and rubbed into the affected cervix for ten or twelve minutes every night. It may be applied by the finger, or by a camel's-hair pencil, or sponge mounted on a slender piece of cane. The average time in which resolution of the induration is accomplished varies, according to Dr. Ashwell, from eight to sixteen weeks. "In hard tumours of the walls or cavity of the uterus, resolution, or disappearance, is scarcely to be expected;" but "hard tumours of the cervix, and indurated puckerings of the edges of the os (conditions which most frequently terminate in ulceration) may be melted down and cured by the iodine." (*Op. cit.* pp. 152–3.)

In *ovarian* tumours iodine has been found serviceable.[1] In the *chronic mammary tumour*, described by Sir A. Cooper, I have seen it give great relief—alleviating pain, and keeping the disease in check. In *indurated enlargements of the parotid, prostate, and lymphatic glands*, several successful cases of its use have been published.

δ. As an *emmenagogue* iodine has been recommended by Coindet, Brera, Sablairoles, Magendie, and others. The last-mentioned writer tells us that on one occasion he gave it to a young lady, whose propriety of conduct he had no reason to doubt, and that she miscarried after using it for three weeks. I have

[1] For some remarks, by Sir B. Brodie, on the use of iodine in morbid growths, see Dr. Seymour's *Illustrations of some of the Principal Diseases of the Ovaria*. Lond. 1830.—Also, *London Medical Gazette*, vol. v. p. 750.

known it given for a bronchocele during pregnancy without having the least obvious influence over the uterus.

ε. In *gonorrhœa* and *leucorrhœa* it has been employed with success after the inflammatory symptoms have subsided.

ζ. *Inhalation* of *iodine vapour* has been used in phthisis and chronic bronchitis. In the first of these diseases it has been recommended by Berton, Sir James Murray, and Sir Charles Scudamore. I have repeatedly tried it in this as well as in other chronic pulmonary complaints, but never with the least benefit. The apparatus for inhaling it has been already described (see p. 159.) The liquid employed is a solution of iodureted iodide of potassium, to which Sir C. Scudamore adds the tincture of conium. (*London Medical Gazette*, vol. viii. p. 157.)

η. *Chronic diseases of the nervous system*, such as paralysis and chorea, have been successfully treated by iodine, by Dr. Manson.

θ. In some forms of *the venereal disease*, iodine has been found a most serviceable remedy. Thus Richond (quoted by Bayle *Op. cit.*) employed it, after the usual antiphlogistic measures, to remove buboes. De Salle cured chronic venereal affections of the testicles with it. Mr. Mayo (*London Medical Gazette*, vol. xi. p. 249.) has pointed out its efficacy in certain disorders which are the consequences of syphilis, such as emaciation of the frame, with ulcers of the skin; ulcerated throat; and inflammation of the bones or periosteum,—occurring in patients to whom mercury has been given.

ι. *In checking or controlling the ulcerative process*, iodine is, according to Mr. Key, (*Medico-Chirurg. Trans.* vol. xix.) one of the most powerful remedies we possess. "The most active phagedenic ulcers, that threaten the destruction of parts, are often found to yield in a surprising manner to the influence of this medicine, and to put on a healthy granulating appearance."

κ. Besides the diseases already mentioned, there are many others in which iodine has been used with considerable advantage: for example—*chronic skin diseases*, as lepra, psoriasis, &c.; (Cogswell, *Essay*, p. 81.)—*dropsies*; (*Ibid.*) *in old non-united fractures*, to promote the deposition of ossific matter; (*London Medical Gazette*, vol. vi. p. 512, 1830.) and *in chronic rheumatism*; but, in the latter disease, iodide of potassium is more frequently employed. *As an antidote in poisoning by strychnia*, *brucia*, and *veratria*, iodine has been recommended by M. Donné, (*Journ. de Chim. Méd.* tom. v. p. 494.) because the compound formed by the union of these alkalis with iodine is less active than the alkalis themselves; *as an injection for the cure of hydrocele*, Velpeau (*London Medical Gazette*, vol. xx. p. 90.) has employed a mixture of the tincture of iodine with water, in the proportion of from one to two drachms of the tincture to an ounce of water: of this mixture from one to four ounces are to be injected and immediately withdrawn; lastly, to *check mercurial salivation* iodine has been successfully used. (*London Medical Gazette*, vol. xiii. p. 32; and vol. xx. p. 144.)

λ. As *a topical remedy* iodine is exceedingly valuable in several classes of diseases. Mr. Davies, (*Selections in Pathology and Surgery*. Lond. 1839.) of Hertford, has drawn the attention of the profession to its employment in this way, and pointed out the great benefit attending it. In most cases the tincture is the preparation employed. The part affected is painted with this liquid by means of a camel's-hair pencil. In some few cases only, where the skin is very delicate, will it be necessary to dilute the preparation. When it is required to remove the stain which its use gives rise to, a poultice or gruel should be applied. In *lupus* it proves highly beneficial. My attention was first drawn to its efficacy in this disease by my colleague, Mr. Luke. Under its employment the process of ulceration is generally stopped, and cicatrization takes place. The tincture should be applied not only to the ulcerated portion, but to the parts around. In *eczema* it also is an excellent application. In *cutaneous scrofula* likewise, as I have already remarked. In several other cutaneous diseases, such as *lichen*,

prurigo, *pityriasis*, *psoriasis*, *impetigo*, *porrigo*, *ecthyma*, and *scabies*, Dr. Kennedy (*London Medical Gazette*, vol. xxvi. [May 8, 1840] p. 260.) has found its use beneficial. According to the testimony of Mr. Davies and an anonymous writer, (*London Medical Gazette*, vol. xxv. [March 20, 1840] p. 943.) it is a valuable application to *chilblains*. In the treatment of *diseases of the joints* it is used with great advantage. In *erysipelas*, I have seen it highly beneficial. In *phlegmonous inflammation*, *sloughing of the cellular membrane*, *inflammation of the absorbents*, *gout*, *carbuncle*, *whitlow*, *lacerated*, *contused*, *and punctured wounds*, *and burns and scalds*, it is most highly spoken of by Mr. Davies. Its topical uses are, therefore, nearly as extensive as those of nitrate of silver. Moreover, it is used very much in the same classes of cases, and with the same views.

Administration.—Iodine is rarely administered alone, but generally in conjunction with *iodide of potassium*, to the account of which substance I must refer for formulæ for the combined exhibition of these substances.

In the administration of iodine, care should be taken to avoid gastric irritation. On this account we should avoid giving it on an empty stomach. Exhibited immediately after a meal, its topical action is considerably diminished. This is especially the case when amylaceous substances (as potatoes, bread-pudding, sago, tapioca, and arrow-root) have been taken, as the iodine forms with them an iodide of starch. Iodine has been given in the form of pills, in substance, in doses of about half a grain. But this mode of exhibition is objectionable, and is now never resorted to.

1. TINCTURA IODINII, D. *Tinctura Iodinei*, E.—*Tincture of Iodine.* (Iodine ℈ij. Rect. Spirit ℥j. [by weight.] D.—The Edinburgh College orders Iodine ℥j. Rect. Spirit f℥xvj.) [This formula has been adopted by the U. S. P.] Principally valuable as a topical remedy. For this purpose it is applied as a paint by a camel's hair pencil. It is also used, mixed with four or six parts of soap liniment, as an embrocation. For internal exhibition it is inferior to the *Tinctura Iodinii composita*, L. hereafter to be mentioned. In the first place, by keeping, part of the iodine is deposited in a crystalline form, so that the strength is apt to vary; secondly, it undergoes decomposition, especially when exposed to solar light; the iodine abstracts hydrogen from the spirit, and forms hydriodic acid, which, acting on some spirit, forms a little hydriodic ether. These are not the only objections: when added to water, the iodine is deposited in a solid state, and may thus irritate the stomach. The dose of it is ♏ v. to f℥ss. Each drachm of the Dublin tincture contains five grains of iodine. The best mode of exhibiting it, to cover its flavour, is sherry wine. Where this is inadmissible, sugared water may be employed.

2. [LIQUOR IODINI COMPOSITUS, U. S.—Take of Iodine six drachms, Iodide of Potassium an ounce and a half, Distilled Water a pint; dissolve the iodine and iodide of potassium in the water. The dose is 20 drops. This preparation, adopted by the U. S. Pharmacopœia, closely approaches that of Lugol, given as the "*Concentrated Solution of Iodine in Iodide of Potassium*, (See article Iodide of Potassium,) and varies only from the "*Liquor Potassii Iodidi Compositus L.*" in strength.]

3. IODIDUM AMYLI; *Iodide of Starch.*—The following is Dr. Buchanan's (*Lond. Med. Gaz.* vol. xviii. p. 515.) formula for preparing this substance:—"Rub 24 grs. of iodine with a little water, and gradually add one ounce of finely-powdered starch: dry by a gentle heat, and preserve the powder in a well-stoppered vessel." In persons not labouring under any dyspeptic ailment or constitutional delicacy of habit, Dr. Buchanan commences with half an ounce for a dose, and increases this to an ounce three times a day,—equivalent to about 72 grains of iodine daily. It frequently caused costiveness, attended with griping pains of the bowels and pale-coloured evacuations. Sometimes, though rarely,

it produced purging. The dose is 3ss. gradually and cautiously increased. I have found the colour of this preparation objected to by patients.

4. UNGUENTUM IODINII, D.; *Iodine Ointment*. (Iodine, ℈j.; Prepared Hog's Lard, ℥j.) – [Iodine twenty grains, Alcohol twenty minims, Lard an ounce. Rub the Iodine first with the Alcohol and then with the Lard, until they are thoroughly mixed.—U. S.] This ointment has a rich orange-brown colour; but by keeping it becomes pale on the surface, and hence should always be made when wanted. It is employed as a local application to scrofulous tumous, bronchocele, &c. If it prove too irritating, the quantity of lard should be augmented.

ANTIDOTES.—In the event of poisoning by iodine, or its tincture, the first object is to evacuate the poison from the stomach. For this purpose, the vomitings are to be assisted by the copious use of tepid demulcent liquids—especially by those containing amylaceous matter; as starch, wheaten flour, sago, or arrow-root, which should be boiled in water, and exhibited freely. The efficacy of these agents depends on their combining with the iodine, to form iodide of starch, which has very little local action. In their absence, other demulcents, such as milk, eggs beat up with water, or even tepid water merely, may be given to promote vomiting. Magnesia is also recommended. Opiates have been found useful. Of course the gastro-enteritis must be combated by the usual means.

COMPOUNDS OF IODINE WITH OXYGEN AND CHLORINE.

None of these are employed in medicine. *Iodic Acid* ($I + O^5$) is used as a test for Morphia and Sulphurous Acid, both of which substances deoxidize iodic acid, and set iodine free.

1. ORDER IV.—BROMINE, AND ITS COMBINATIONS WITH OXYGEN, CHLORINE, AND IODINE.

BROMIN'IUM, *L.*—BROMINE.

(Brominum U. S. Secondary List.)

HISTORY AND ETYMOLOGY.—This substance was discovered by M. Balard, of Montpellier, in 1826. He at first termed it *muride*, (from *muria*, brine,) in allusion to the substance from whence he procured it; but, at the suggestion of Gay-Lussac, he altered this name to that of *brome*, or *bromine*, (from βρωμος, *a stench*, or *fetor*,) on account of its unpleasant odour.

NATURAL HISTORY.—It is found in both kingdoms of nature, but never in the free state.

α. IN THE INORGANIZED KINGDOM.—Hollander detected it in an ore of zinc, and Cochler recognised it in Silesian cadmium. (Gmelin, *Handbuch der Chemie*.) It exists in sea water and many mineral waters, in combination with either magnesium or sodium, or sometimes with both. Thus it has been found in the waters of the Mediterranean, the Baltic, the North Sea, the Frith of Forth, the Dead Sea, many of the brine springs of Europe and America, (as those of Middlewich, Nantwich, Ashby-dela-Zouch, and Shirleywich, in England,) and in many other mineral springs of Europe and America (as the Pittville spring at Cheltenham, the water of Llandridod and of Bonnington.) The saline springs near Kreuznach in Germany are especially rich in it. It has been justly observed by Dr. Daubeny, (*Phil. Trans.* 1830.) that the detection of bromine in brine-springs is a fact interesting in a geological point of view, as tending to identify the product of the ancient seas, in their most minute particulars, with those of the present ocean.

β. IN THE ORGANIZED KINGDOM.—Bromine has been found in the sea-plants of the Mediterranean, and in the mother-waters of Kelp. It has likewise been detected in various marine animals. Thus in the Sea-Sponge (*Spongia officinalis*,) in the stony concretion found in this animal, in the ashes of the *Janthina violacea*, one of the gasteropodous mollusca, and in cod's-liver oil.

PREPARATION.—Bromine was formerly prepared by a complicated process, from *bittern* (the mother liquor of sea-water, from which chloride of sodium has been separated by crystallization.) It is now procured by a simpler method, from the mother-ley of the salt springs near Kreuznach, in Germany. From thirty pounds of the concentrated ley, Liebig obtained twenty ounces of bromine. Of these springs, that of Karshall contains, according to Dr. G. Osann,[1] 6·6025

[1] G. W. Schwartze's *Allgemeine und specielle Heilquellenlehre*, Abt. 1, S. 224. Leipzig, 1839.