I.—OF MINERAL WATERS.

WATERS, which flow at the surface of the earth, are frequently impregnated with foreign matter, so far as to acquire peculiar taste or odour, to be capable of exerting specific chemical actions, or to produce changes in the state of the living system. Such waters are denominated Mineral, it being usually matter belonging to the mineral kingdom which communicates these powers.

Important medicinal effects are frequently obtained from mineral waters, arising primarily from the operation of the substances which they hold dissolved, though this is no doubt aided by the state of dilution in which they are administered, the action of the water itself as a diluent, and by other external circumstances. The chemical analysis, therefore, of these waters is of importance, as determining the principles in which their active powers reside, and thus enabling the physician to employ them with more advantage and discrimination.

Mineral waters, both in a chemical classification, and considered in relation to their medicinal use, may be arranged under four orders: CARBONATED MINERAL WATERS, or those impregnated with carbonic acid gas; SULPHUREOUS MINERAL WATERS, or those impregnated with sulphuretted hydrogen; SALINE MINERAL WATERS, or those which hold certain neutral salts in solution; and CHALYBEATE MINERAL WATERS, or those, the properties of which depend on an impregnation of iron. These indeed are not perfectly insulated, but, in general, those of one division have a certain relation to those of the others, by being likewise impregnated with one or other of the ingredients which these contain. But still each may be classed according to its predominant ingredient, or that which gives it its most characteristic chemical and medicinal powers.

It would be foreign to the object of this outline, to give the minute details connected with the analysis of mineral waters. This properly belongs to a System of Chemistry. It will be sufficient to point out the general modes of analysis, or rather of discovering their principles, and to add to this chemical view, a brief account of their medicinal applications.

I. Carbonated Mineral Waters.—The waters referred to this class are those which contain carbonic acid gas; to bring them under the appellation of mineral waters, however, this must be present in such quantity as to communicate certain sensible qualities. Waters impregnated with free carbonic acid gas, sparkle when drawn from the spring, or when poured into a glass; they have a taste more or less pungent and acidulous, but become vapid from exposure to the air. Along with the carbonic acid there may be present, and, indeed, generally are present, portions of saline earthy or metallic matter, chiefly carbonates of lime, magnesia, and iron. But the carbonic acid in excess still communicates the same sensible qualities, modified, particularly with regard to medicinal powers, by these impregnations.

Carbonic acid in excess, in a mineral water, is discovered, when present in any considerable proportion, by the qualities above enumerated, communicated to the water. It is also easily distinguished, even when in more minute quantity, by chemical tests. Infusion of litmus receives from the addition of the water a red tint, which is evanescent, disappearing from exposure to the air, and more quickly when heat is applied. And lime water produces a milkiness or precipitation; the lime, when the lime water is added in due proportion, forming with the carbonic acid, carbonate of lime, which is insoluble. But the turbid appearance is removed, and the transparency restored, either by adding an additional quantity of the mineral water, the excess of carbonic acid thus communicated rendering the carbonate soluble, or by adding a few drops of nitric or muriatic acid, either of which decomposes the carbonate, and dissolves the lime. By the evanescent redness, carbonic acid is discriminated from any other free acid that a mineral water might hold dissolved; and by the precipitate formed by lime disappearing from the addition of a larger quantity of the mineral water, or of a little muriatic or nitric acid, the fallacy is guarded against that might arise from any precipitation produced by sulphates that the water might contain.

The quantity of carbonic acid contained in mineral waters is very various. Under a common pressure, pure water can absorb its own volume of the gas, but the quantity in any mineral water is generally much inferior to this. The quantity is discovered by expelling the gas from a given quantity of the water, by heating it gradually in a retort nearly filled to the neck, and receiving the elastic fluid in a graduated jar, over quicksilver: the diminution of volume it sustains, by the introduction of a solution of potash, is then observed, and this gives the volume of carbonic acid gas.

Waters highly impregnated with carbonic acid gas are grateful from their pungency, sit light on the stomach, and in a large dose produce a sensible degree of exhilaration; they increase the appetite, and generally have a diuretic effect. They prove useful in dyspeptic affections, from the grateful and moderate stimulus exerted by the carbonic acid on the stomach, aided by the diluent operation of the water, and hence the advantage derived from them in the numerous chronic affections connected with impaired power of the digestive organs, and particularly in simple dyspepsia, in hypochondriasis and gout. They generally also contain some saline substances, which communicate additional powers, and the operation of these is usually promoted, or at least they are rendered more grateful, by the carbonic acid. Those which contain carbonate of soda, as Seltzer water, prove more powerfully diuretic, and are employed with advantage, as palliatives in urinary calculus, and in the painful discharge of urine from other affections of the urinary organs. Those impregnated with iron are more particularly employed in those diseases in which that metal is beneficial. Some of the most celebrated mineral waters of Europe belong to this class, such as the Spa, Pyrmont, and Seltzer water. The Pyrmont contains very nearly its own volume of the gas; the Seltzer, more than half its volume; the Spa, rather less than half the volume: they besides hold dissolved carbonates of soda, lime, and magnesia; and the Spa and Pyrmont have a considerable impregnation of carbonate of iron. Their more minute analysis will be found in the table at the end of this article. None of the mineral springs of this country are much impregnated with carbonic acid; and those which contain any sensible quantity, as the waters of Bristol and Cheltenham, derive more activity from the presence of other substances.

II. Sulphureous Mineral Waters.—These waters owe their distinguishing character to an impregnation of sulphuretted hydrogen, and they are at once recognised by their peculiar fœtid smell. They are transparent when drawn from the spring, but become turbid from exposure to the air, and gradually lose their odour. When strongly impregnated, they redden infusion of litmus, and even in their weakest state they give a dark precipitate with solution of nitrate of silver, or acetate of lead, and tarnish the metals.

To estimate the quantity of sulphuretted hydrogen gas contained in these waters, various methods have been employed. The gas is not easily expelled entirely by heat, nor is it easily collected, so as to measure it accurately, water absorbing it, and quicksilver decomposing it; it may also have an intermixture of carbonic acid gas, and the proportion of this is not easily ascertained, both gases being absorbed by the same liquids. The mode which has been followed is to decompose the sulphuretted hydrogen, by adding to the water, highly fuming nitrous acid, as long as there is any precipitation of sulphur. This precipitation is owing to the oxygen of the acid combining with the hydrogen of the sulphuretted hydrogen. Instead of adding the acid, Kirwan employed the method of filling a jar with the water, and mixing over it inverted, nitric oxide gas with atmospheric air, when nitrous acid is formed, and produces a similar decomposition: he supposed, that in this way the acid acts in a more concentrated state on the water. The manipulation, however, is difficult, and does not appear to have any advantage over the more simple mode of adding the fuming acid. The suphur precipitated in either mode is collected on a filter, and from its quantity, the quantity of sulphuretted hydrogen is inferred, 30 grains of sulphur being supposed to be contained in 100 cubic inches of the gas. This estimate, however, of the proportion of sulphur in sulphuretted hydrogen is somewhat uncertain, and the method is liable to some fallacy, from the action of the acid becoming weak by its dilution, so as not to precipitate the whole of the sulphur, or, if it be used in excess, from its communicating oxygen, and converting it partially into sulphuric acid.

The sulphureous mineral waters almost uniformly contain saline substances, which modify their powers. From the action of the sulphuretted hydrogen, they are employed more particularly in cutaneous affections; and from the combined action of this and the saline matter, which generally has a purgative effect, they are farther used in diseases of the digestive organs, dyspepsia, hypochondriasis, torpor of the intestines, visceral obstructions, and in scrofulous affections. They are also applied externally in cutaneous eruptions, and the warm sulphureous baths have been in particular celebrated for their efficacy under this form of application. The principal sulphureous mineral waters of this country are those of Harrowgate and Moffat: the former have a large proportion of saline matter, muriates and carbonates. Those celebrated on the Continent are chiefly the warm sulphureous springs of Aix lá Chapelle, and Barege.

III. Saline Mineral Waters.—Under this class are comprised those waters in which, without any large proportion of aërial matter, various saline compounds, generally neutral, exist. The salts usually present are sulphates, muriates and carbonates; and the bases with which the acids forming these are combined are soda, magnesia and lime. Their analysis is accomplished, first, by detecting, by the employment of tests, the acids present and the bases by which these are neutralized; and, secondly, obtaining the entire salts by evaporation, or by the action of certain re-agents.

In these waters, there is often an impregnation of elastic fluid, particularly of carbonic acid, which would modify the results from the application of tests. This, after its nature has been determined by experiment, is expelled by heat, in order to facilitate the farther analysis; and in general also, it is of advantage to reduce the volume of the water by evaporation, as the operation of tests becomes then much more sensible than under a state of great dilution.

Sulphuric acid, in any state of combination in a mineral water, is discovered with great delicacy by muriate or nitrate of barytes, the barytes attracting it, and forming a compound not sensibly soluble, the production of which, therefore, gives rise to a turbid appearance, and precipitation. The only fallacy that requires to be guarded against is, that the same apparent results may be produced by carbonic acid present in the mineral water, either in a free or combined state; but this is easily discovered by the precipitation or turbid appearance from the action of carbonic acid being removed, by the addition of a few drops of nitric acid, or not appearing if this has been added to the mineral water previous to the addition of the muriate of barytes. Other tests of sulphuric acid have been employed, such as superacetate of lead, and nitrate of mercury; but these are both less delicate and less accurate.

Muriatic acid is detected by nitrate of silver, the oxide of silver combining with the muriatic acid, and forming an insoluble compound, which gives to the water first a bluish white turbid appearance, and ultimately a precipitate. This test is extremely delicate, and detects the most minute quantity of muriatic acid, in any state of combination whatever. But it is liable to fallacies, against which it is necessary to guard. The principal of these arise from the presence of carbonic acid or sulphuric acid, either of these giving rise likewise to milkiness and precipitation on the addition of the solution of silver. The operation of carbonic acid is prevented by previously adding a little pure nitric acid to decompose any carbonate: that of sulphuric acid can be obviated only by removing it by the previous addition of nitrate of barytes, as long as any precipitation is induced. If, on adding to the transparent fluid, after these preliminary experiments, the nitrate of silver, any milkiness is produced, this indicates the presence of muriatic acid. Sulphuretted hydrogen gives a precipitate with this test; but the nature of this is, from its dark colour, sufficiently evident.

Carbonic acid, in a combined state, is detected by muriate of barytes producing a turbid appearance, and a precipitation, which are removed by the addition of a few drops of nitric acid. Waters containing any considerable impregnation, either of alkaline or earthy carbonates, sensibly affect the vegetable colours, changing, when there is no excess of carbonic acid, or when this is removed by ebullition, the colour of Brazil wood, which is red, to a tint of blue, or restoring the blue tint of litmus which had been reddened by the addition of a little vinegar. When the water is considerably reduced by evaporation, a sensible effervescence is excited on the addition of an acid; and during the evaporation, the earthy carbonates are precipitated, while the alkaline carbonates remain dissolved, and are discovered by their power of changing the yellow colour of turmeric to a brown.

These acids are usually combined with soda, lime or magnesia; and to complete the analysis by the application of tests, these bases must be discriminated.

Lime is detected, with the greatest delicacy of effect, by oxalic acid. The acid indeed with which the lime is combined in the water, when evolved by the action of the oxalic acid, is liable to re-act on the precipitate, and retain it in part dissolved; but this may be guarded against by using oxalate of potash. Magnesia is precipitated by the same acid; but this can scarcely give rise to any fallacy, as this precipitation takes place very slowly, while that with lime is immediate.

Magnesia is precipitated by ammonia partially, and by lime water entirely; the principal fallacy to which both tests are liable is, that argil is also precipitated by them, and though this earth is not of very common occurrence in mineral waters, it is occasionally found. The best method of distinguishing them is to dry the precipitate, and boil gently a solution of potash on it, this dissolving argil, but leaving magnesia undissolved. Succinate of ammonia, it has lately been discovered, precipitates argil, but not magnesia, and forms therefore a delicate test. In using lime water as the precipitant, it is necessary to guard against the fallacy that may arise from the presence of carbonic acid free or combined, with which the lime may unite, and form a precipitate: this may be avoided by removing any carbonic acid by the previous addition of a little nitric acid. Any sulphuric acid also that may be present ought to be removed by nitrate of barytes, as it might unite with the lime, and give rise to a precipitate of sulphate of lime.

Soda, which is the alkaline base almost exclusively found in mineral waters, cannot be discovered by any test, such as that by which we discriminate the preceding ingredients. The presence of it, therefore, is inferred, when the analysis discovers acids in the water, which are not uncombined, and which, at the same time, cannot be inferred from the application of tests to be in combination with earthy bases. It is also discovered in its state of combination with any of the usual acids by evaporation, carried so far, that its salts are obtained crystallized. By the same method the other compound salts, those having lime, magnesia, or argil, for their base, are discovered, and hence evaporation is always employed in combination with the use of tests in conducting the analysis of a mineral water. Different substances separate at different stages of the evaporation, according to their degrees of solubility: the earthy carbonates are usually first precipitated, afterwards the earthy sulphates, at least the sulphate of lime: the clear liquor poured off and allowed to cool, affords the alkaline neutral salts and sulphate of magnesia by crystallization; the muriates of magnesia and lime usually remain dissolved in the residual liquor, and by these separations the analysis is facilitated.

Advantage is also taken of the powers of alkohol, both as a solvent and as a precipitant, to separate these substances. When the water is reduced to a concentrated state by evaporation, the addition of alkohol throws down certain salts, while others remain dissolved; and of those which are precipitated, some are thrown down by a small quantity of alkohol, or when the evaporation has not been carried far; while others are separated only when the alkohol is added in larger proportion, or when the water is farther evaporated. Thus, sulphate of lime is first precipitated, then carbonate of lime and carbonate of magnesia, afterwards sulphate of soda and sulphate of magnesia, while the muriates in general remain dissolved. In applying the solvent power of alkohol to facilitate the analysis, the water is evaporated to dryness, and this dry matter is submitted to the action of alkohol; the muriates which are present are in general dissolved, while the sulphates and carbonates remain undissolved.

By these operations, too, the quantities of the respective salts contained in a water are determined; the substances separated being either brought to a certain state of dryness, or being dissolved separately in water and crystallized. The quantities are sometimes inferred, too, by estimation from the precipitates afforded by re-agents; the quantity of sulphuric acid, for example, being determined from the weight of the precipitate of sulphate of barytes, obtained by the addition of muriate of barytes; that of muriatic acid from the weight of the precipitate of muriate of silver, obtained by the addition of nitrate of silver; and that of lime from the weight of the precipitate of oxalate of lime; these quantities being inferred according to the composition of these compounds, as they have been determined by the most accurate experiments. In general, these methods require to be combined to insure accuracy, especially with regard to the determination of proportions.

At the same time, it may be doubted, whether the view, which has usually been given with regard to the state in which these substances exist in mineral waters, is just. It has been supposed, that they are dissolved in the water in those forms of binary combination in which they are obtained by evaporation or precipitation; that if muriate of soda, for example, sulphate of magnesia, and carbonate of lime are obtained by these methods, the mineral water held these salts dissolved. Of this, however, there is no proof, and the most correct views of chemical affinity rather lead to the conclusion, that the different acids and different bases exist with their affinities balanced, contributing to mutual neutralization, in simultaneous combination, and that these binary compounds are rather formed by the processes by which they are obtained. If this view be just, the only conclusion that can strictly be drawn from the analysis is, that certain acids and certain bases exist in the mineral water, and it may appear to be superfluous to attempt to determine the quantities of the binary compounds. Still, as reducing the estimation to a standard, this is as useful as any other mode: it corresponds more directly with the results of the experiments which have been hitherto made, and we can, if it were of any advantage, infer from the quantities thus determined of the secondary compounds, the proportions of the primary principles.

Saline Mineral Waters are usually aperient, the substances which they hold dissolved being either so far as can be determined inert, such as the sulphate and carbonate of lime, or being cathartic, as the greater number of the other compound salts. It has always been remarked, too, with regard to them, that their cathartic power is greater than could be supposed from the extent of their saline impregnation, as determined by analysis;—a proof of the influence of dilution in the operation of mineral waters. They are usually employed in diseases where it is of advantage to stimulate the digestive system, the intestinal canal, and the secreting organs connected with it, or where advantage is derived from moderate and continued evacuations. Hence their celebrity in the treatment of some forms of dyspepsia and hypochondriasis, chlorosis, chronic hepatitis, jaundice, and in scrofula. The most noted saline water is that of Sedlitz: that of Seltzer, along with a portion of saline matter, has a large impregnation of carbonic acid, and that of Cheltenham, an impregnation both of carbonic acid and iron. Pitcaithly Spring, in this country, affords an example of a pure saline water, its principal ingredients being muriate of lime and muriate of soda, with a slight impregnation of carbonic acid.

When these waters are impregnated with carbonic acid, which they frequently are, they become more grateful, and sit easier on the stomach. When they have an impregnation of iron, they acquire tonic powers, and more efficacy as remedies in amenorrhœa, and the other chronic diseases in which this metal is employed: And the muriate of soda and muriate of lime which some of them contain, probably render them more beneficial in scrofula and affections of the glandular system.

Sea Water, in strict chemical arrangement, must be regarded as belonging to the glass of saline mineral waters, as it holds dissolved merely various neutral salts, chiefly muriate of soda and of magnesia, and sulphate of soda and magnesia, with a little sulphate of lime. It much exceeds, however, in the extent of impregnation, any common mineral water: the proportion of saline matter varies in different latitudes, according to the temperature, producing greater or less evaporation, and it is liable to be varied by the discharge of large rivers into the ocean. But, on an average, the quantity appears to be about $\frac{1}{30}$, of which, from the experiments of Bergman and Lavoisier, it follows, that about 20 are muriate of soda, 5 muriate of magnesia, 3 sulphates of magnesia and soda, and 1 sulphate of lime. Its medicinal powers are similar to those of the saline mineral waters; from the extent of its saline impregnation, it is more active as a cathartic, and this renders it more stimulating than fresh water as a bath.

IV. CHALYBEATE MINERAL WATERS.—These owe their characteristic properties, chemical and medicinal, to an impregnation of *Iron*. The oxide of iron is almost uniformly held dissolved by carbonic acid, the acid being usually in excess; in a few mineral waters, sulphate of iron is present; but these are not of common occurrence, and are in general too active to be well adapted to medicinal use.

Chalybeate waters have a peculiar styptic taste; they are transparent when taken from the spring, but when exposed for some time to the air, a pellicle forms on the surface, and a quantity, generally minute, of ochry sediment subsides, the water at the same time losing its taste; this change is accelerated by heat.

Iron is discovered, with great facility, by chemical tests. Prussiate of potash detects it by the blue colour to which it gives rise; infusion of galls by the purple colour which it strikes. The latter test is more delicate than the former, and it is much more accurate; the prussiate of potash being always liable to fallacy, from the difficulty of obtaining it free from iron; hence the infusion of galls, or rather the tincture of galls, ought always to be preferred. The principal circumstance to be remarked with regard to its operation, is, that the purple colour which it strikes, is liable to be altered in its tint by the presence of other substances: alkaline and earthy carbonates in particular render it violet: neutral alkaline salts appear to deepen the purple colour, and sulphate of lime renders the precipitate at first whitish, and afterwards black. Carbonate of lime has a singular effect: if the iron is in a low state of oxidation, it heightens the colour; but when the oxidation is greater, it has the opposite effect; and if the quantity of iron be small, the colour may even not appear on the addition of the test. This fact, discovered by Mr Phillips, gives the explanation of a singular circumstance with regard to the Bath Mineral Water,—that when newly taken from the spring, and while still warm, it gives a purple colour with galls, indicating the presence of iron; while, after exposure for a little time to the air, no colour appears, though no oxide of iron has been precipitated.

By applying the test of galls before and after boiling the mineral water, we are enabled to discover whether the iron is held dissolved by carbonic or sulphuric acid; the carbonic acid being expelled by the ebullition, and the oxide of iron precipitated, so that after filtration of the liquor when cold, the purple colour does not appear; while the sulphate, though likewise partially decomposed by the ebullition, still so far remains, that a colour not much fainter will be produced. The presence of carbonic or sulphuric acid may also be determined by their usual tests, and sulphate of iron may be obtained by evaporation.

The quantity of oxide of iron may be determined from its precipitation, on exposure to the air; the whole, or very nearly the whole of it, when it is combined with carbonic acid, being precipitated, in consequence partly of the escape of the acid, and partly of the iron passing to a higher state of oxidation, so that its attraction to the acid becomes weaker. It has also been estimated from the weight of the precipitate, formed by the addition of prussiate of potash; or, by a more recent and less exceptionable mode, precipitating it by the addition of succinate of soda, and afterwards decomposing the precipitate of succinate of iron, by exposing it to a red heat with a little carbonaceous matter, 100 parts of the oxide obtained by the calcination containing about 70 of iron. Benzoate of soda, which is a cheaper salt, may be used for the same purpose, 100 parts of the precipitated benzoate of iron dried by exposure to the air containing 25 of red oxide of iron.

Chalybeate mineral waters are remedies of considerable activity and power. They act as tonics, increasing the strength of the system, raising the force of the circulation, giving tone to the digestive organs, augmenting muscular vigour, and promoting the excretions. They are of course employed in those diseases in which iron is principally used, amenorrhœa, chlorosis, some states of menorrhagia, leucorrhœa, dyspepsia, scrofula, and various forms of chronic debility. And as iron always succeeds best when given in small doses, and in a state of considerable dilution, the chalybeate waters afford the best form under which it can be prescribed, that which is at once attended with least irritation, and from which the greatest benefit is obtained. The powers of these waters, too, are often aided by the presence of other ingredients. The impregnation of carbonic acid, when it is present in excess, gives them a grateful stimulant quality, which is exerted on the stomach; and saline substances communicate to them an aperient power.

One of the purest chalybeate waters, as will be perceived from the annexed table, is that of Tunbridge. In the celebrated Spa and Pyrmont waters, the impregnation of carbonic acid is so great, as very materially to modify the action of the iron; and in the Cheltenham water, the quantity of active saline matter is such, that it can scarcely be regarded as a chalybeate.

Besides the substances which have been enumerated as forming the preceding classes of mineral waters, there are some principles common to all of them, so as to be occasionally found in those of each class; and there are some also, which are of very rare occurrence, either of which scarcely require more than a concise enumeration.

Atmospheric air is contained in all water that flows at the surface of the earth, and renders it more grateful and light as drink. It scarcely in its entire state appears to be contained in more than the usual proportion in any mineral water, while in those in which other elastic fluids are present in large quantity, it is probably deficient. Neither does it appear that *Oxygen* gas is ever present in a proportion larger than that in which it exists, as a constituent of the atmospheric air in water. The fact, rather singular, has been established, however, that *Nitrogen* gas is afforded by mineral springs. It had often been observed, that, in the mineral spring at Buxton, a quantity of elastic fluid is discharged with the water, and a portion escapes on exposure from the water itself. This was supposed to be carbonic acid; but Dr Pearson discovered it to be nitrogen gas, mixed with a little atmospheric air, the volume of air amounting to about $\frac{1}{64}$ of the water. The same gas was afterwards discovered by Dr Garnet in the mineral waters of Harrowgate, and has since been found in others. It is probably in general derived from the oxygen of the atmospheric air, with which water is impregnated, being abstracted by other substances present in the mineral water, particularly by sulphuretted hydrogen or oxide of iron, leaving the nitrogen in combination with the water.

Sulphurous acid gas has been found in some hot mineral waters in the neighbourhood of volcanoes, but is scarcely to be looked for in any other situation. The *Mineral acids* have likewise, though rarely, been found uncombined, or at least in excess. *Sulphate of Argil* and *Sulphate of Iron* sometimes occur, arising probably from the oxygenation of aluminous slate impregnated with sulphuret of iron, through which the water has passed. *Muriate of Manganese* has been detected in minute quantity. Lastly, *Silex* exists in solution, especially in hot springs. It is deposited abundantly from the water of the Geyser fountain in Iceland. It is dissolved in the water of the hot springs of Carlsbad, in the Bath waters, and in many others, and is in general discovered by forming, when the water is evaporated to dryness, a residuum insoluble in acids, and having, previous to its perfect exsiccation, more or less of a gelatinous consistence.

The temperature of mineral waters gives rise to a very important distinction among them. The greater number are at the average annual temperature of the place where the spring is situated; others are considerably superior to this, or are positively warm. This modifies their powers. The warmth of the tepid waters renders them rather more stimulating when swallowed, a glow being felt in the stomach, and sometimes the head is slightly affected. When externally applied under the form of the bath, the temperature has a more important influence on their operation, than any impregnation they may have. In some celebrated mineral springs, the salutary powers appear to depend principally or entirely on the temperature, and on the water acting as a diluent, as in the warm mineral waters of Bristol, Matlock, and Buxton, and in the cold spring of Malvern.

In the following table is presented the results of the analysis of the most celebrated mineral waters. They are arranged as nearly as possible according to the preceding classes, though there is considerable difficulty with regard to some of them, which, from the substances they hold dissolved, belong to one class as well as to another. Thus the Spa and Pyrmont waters belong both to the classes of carbonated and chalybeate waters. I have placed them under the former, as the impregnation of carbonic acid is so very considerable, and gives them probably their most important properties. Cheltenham water may be placed either as a saline or as a chalybeate water. I have given it the former rank, as the saline matter appears to give it its principal activity. There are other mineral waters so free from any foreign matter that their operation must be ascribed to the fluid acting partly by its temperature, and partly as a diluent; or if in some of these the analysis indicates a certain portion of foreign matter, the substances are in general not different from those in common spring water, and are in smaller quantity, and hence cannot communicate any great degree of active power. This is the case, for example, with the Bath water, and the waters of Bristol and Buxton, in all which the impregnation of active matter is inconsiderable, and their operation seems principally dependent on dilution and temperature. These I have placed under those classes, with which, judging both from their analysis and their operation, they are most nearly connected. With regard to the temperature, I have thought it sufficient to add the epithet cold, where the temperature is not above that of the external atmosphere; where it exceeds this, the precise degrees are added. The proportions of the ingredients are those contained in a wine gallon of the water.

WATERS.	Nitrogen.	Carbonic acid gas.	Sulphuretted hydrogen gas.	Carbonate of soda.	Carbonate of Magnesia.	Carbonate of Lime.	Sulphate of Soda.	Sulphate of Magnesia.	Sulphate of Lime.	Muriate of Soda.	Muriate of Magnesia.	Muriate of Lime.	Oxide of Iron.	Silex.	Temperature.
Carbonated.		cub. in.	cub. in.	grains.	grains	grains.	grains	grains.	grains.	grains.	grains.	grains	grains.	grs.	
Seltzer,		138		32	40	24				140					Cold
Pyrmont,		208			80	34 8		44.5	68.6	12.4			4 5		Cold
Spa,		104		11.7	35.3	11.7				1.37			4.5		Cold
Carlsbad,		32 to 50		39		12	70			34.6			0.125	2.5	165°
Bristol,		30				13.5	11.2		11.7	4.	7.25				74°
Sulphureous.															
Harrowgate,	7	8	19		5.5	18.5		10.5		615.5	91	13			Cold
Moffat,	4	5	10							36					Cold
Aix la Chap.			Supersulphuretted hydrogen.	90		38				40					143
Saline.															
Sedlitz,		8			21	6.7		1444	41.1		36.5				Cold.
Cheltenham,	12.	30.3	3		12.5		480		40	5	12.5		5		Cold.
Plombieres,				4.4		1	4.7			0.5				2.6	
Pitcaithly,		8				5			5.5	100		180			
Buxton,	2					10.5			2.5	1.7			0.25		82°
Chalybeate.															
Tunbridge,	5	10.6							1.25	0.5	2.2		1		Cold.
Brighton,		18							32.7	12.2	6.		11.2	1.12	Cold.
Bath,		9.6				6.4	12		72	26.4			.016	1.6	116

The practicability of imitating the mineral waters has engaged the attention of Chemists. With regard to the active saline waters, it is easily done, by dissolving the due proportions of the compound salts in water corresponding to the analysis of the water designed to be imitated. We may also impregnate the solution with carbonic acid gas, and even with sulphuretted hydrogen; and by the medium of carbonic acid, it might receive an impregnation of iron. Directions for conducting these processes have been given by Bergman. But in all these cases, there will be wanting the confidence on the part of the patient in the efficacy of the artificial water, which, if not necessary to its success, is at least requisite to its continued and regular use: the external advantages too, attending the visit to a mineral spring, may not always be obtained. Hence these artificial waters, designed as substitutes for the natural ones, have never been established in use. Water, impregnated with carbonic acid, with the addition of an alkaline carbonate, which is now in general use, may be considered as operating on a similar principle; and to this super-carbonated soda, or super-carbonated potash water, a small quantity of any of the purgative salts is often added with advantage, communicating to the water an aperient quality, while the taste of the salt is covered, and it is rendered more grateful to the stomach.