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THE BATH WATERS

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Second Edition

THERE is nothing in the character or appearance of the country around Bath which should induce an expectation of the discovery of hot springs. The hills are for the most part limestone, with an intermixture of shales, containing a soft limestone. Coal mines are found in a distance of about five miles from the city, but no considerable mines containing ore of any metal are nearer than Mendips, distant about eighteen miles. The hills in the immediate neighbourhood are in no determinate order. They are generally rocky and steep from South West and West North West.

Concerning the general effect of the waters, it is known to excite the system, and to be useful in many cases.

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A TREATISE
ON

THE BATH WATERS.

THERE is nothing in the character or appearance of the country around Bath which should induce an expectation of the discovery of hot springs. The hills are for the most part limestone, with an intermixture of silex, constituting a soft freestone. Coal mines are found at a distance of about five miles from the City, but no considerable mines containing ore of any metal are nearer than Mendip, distant about eighteen miles. The hills in the immediate neighbourhood lie in no determinate order. They are generally rocky and steep from South West and by West to North.

Considering the powerful effects which the Bath Waters are known to produce on the human constitution, it is astonishing that so few active

principles should have been discovered by those learned men who have made them the subject of their inquiries. It has been alleged, that all attempts to discover the properties or effects of mineral waters on the human body by chemical experiment or analysis are vain and insignificant, as many effects are produced by them not to be accounted for from any discoverable impregnation. Dr. Falconer very justly combats this opinion : he observes, that " Such reasoning if applied to all branches of learning, would preclude all search whatever ; and had it formerly obtained, would have prevented our acquisition of many useful and important discoveries which we now enjoy."

The Doctor, with that liberality which distinguishes the character of the man of learning, observes, that in discussions on subjects of science, when opinions alone are controverted, it may be alleged, that no apology is necessary, as candour should be the inseparable attendant on learning ; and no man of science should be ashamed to receive information, from whatever channel it may be derived.

As an apology for offering to the public the present Treatise, it ought to be recollected that the science of chemistry has, within these few years, made very rapid advances, and the cultivators of it have now many more fixed principles, on which to found their reasonings than were suspected by those who applied to it but a few years

since. The existence even of many very active principles was then totally unknown. Many agents and principles which were then supposed to regulate the phenomena of nature, are now proved to have been merely hypothetical.

A science which comprehends so large a field of inquiry must doubtless be subject to continual changes, according to the advances made in it; and the detection of new phenomena may, in every science, suggest that our knowledge of first principles, and that our reasoning upon them are very imperfect. This is peculiarly illustrated in the examination of elastic aeriform fluids which now form a very essential part in the analysis of mineral waters.

As facts accumulate, new theories are necessarily adopted for explaining phenomena where the old are inadequate; and although the oxygene of Lavoisier may have the fate of the phlogiston of Stahl, yet is the advancement of the science manifested by such changes as depend on the acquisition of a further insight into the operations of nature.

The difficulty, which has been ever acknowledged, of analyzing mineral waters, arises from the multiplicity of agents which nature employs in their production. As water is so universal a solvent, its impregnations must be numerous and complicated. Even the air of our atmosphere contains substances which water collects and pre-

cipitates in its descent from the clouds. In the bowels of the earth, this wonderful agent gives form and stability to the numerous substances contained therein. On the surface of the earth, the substances composing mountains are dissolved and brought down into the vallies, and by the agency of water are elaborated into the vessels of organised beings. Descending from the surface into the hidden recesses of the earth, it is pent up in reservoirs, from which it gradually flows in springs, correcting thereby the irregular distribution of the atmospheric supplies.

Owing to the solvent power of water, it seldom leaves the bowels of the earth without bringing with it many substances which it meets with in its course. Hence spring-water is never entirely free from foreign admixture. Salts, earths, minerals, even animal and vegetable substances, have been found to flow forth dissolved or suspended in the water of springs. As water, free from such impregnations, is a desirable object in common life, much attention is requisite to ascertain the nature of this fluid in every situation. The more dangerous mixtures of deleterious substances are not sufficiently obvious to the senses to enable us to detect either the purity or the detrimental properties of water, where the substances are held in perfect solution; neither sight nor taste can discriminate between noxious and salubrious ingredients.

If there be this difficulty in forming a gross judgement of the water which is used for the purposes of common life, it becomes a matter of much greater attention to ascertain, with nicety, the proportioned composition of those waters whose medicinal qualities are the object of research.

The impregnations of water are almost as various as the substances which form the globe. It occasionally flows fully saturated with some of the strongest mineral poisons: in the isle of Anglesey, the labour of the metallurgist is rewarded by extracting the copper with which the water is impregnated.

It would open a large field of inquiry to trace the varieties of phenomena attendant on springs; they vary according to the situation of the strata, and according to the nature of the substances of which the strata are composed. Water in finding its level rises in the vacuities of rocks until it obtains an outlet, or proceeds to great distances, until those vacuities terminate on the surface of the earth. Water which has fallen to great depths through inclined strata may arise in seeking a level at a great distance from the spot which received it from the clouds. Though mountains be elevated to such vast heights, their summits are often composed of materials which existed at a distant period below the stratified surface; hence the strata on the sides of such

mountains form a large angle with the horizon. The tops of inferior hills correspond with strata which imbibe rains on the sides of mountains; hence springs flowing from greater heights, thro' subterraneous channels, rise and break out on many very high stratified hills. The regularity of many springs, and the quantity of water which they continually pour forth, evince that these operations are of great extent, and that an average effect is produced by the operation of a number of causes. These circumstances result from the known laws of Hydrostatics.

Mechanical mixture, chemical solution, decomposition, and deposition give a never-failing variety to the phenomena of water in this active state. Thus, charged with calcareous earth, by various filtrations, it forms the roughest limestone, and the finest dense and chrystalline spar.

The above description may serve to explain the ordinary operations in which water is concerned, near the surface of the earth; but phenomena of a greater magnitude occasionally present themselves, where springs break forth with awful vehemence, and where fire combines to give them irresistible impulse. Volcanic springs of boiling water, charged with ingredients, which water can only dissolve under peculiar circumstances, appear in various parts of the globe; and the presence of these ingredients becomes the criterion

by which we may determine the nature of the springs.

Mr. Kirwan has given us a very complete account of the uses which may be made of an attentive examination of the phenomena presented by mineral waters. He remarks that there is a point of view in which an acquaintance with the contents of mineral waters must be deemed of some importance; arising from unknown depths, they alone announce to us several of the substances therein existing, and frequently the awful operations therein transacted. Thus several valuable ores have been discovered, witness the copper ores of the county of Wicklow in Ireland; and the various mines of salt, alum, &c. The Waters of Bath, Aix-la-Chapelle, Carlsbad and many more, manifest the secret operations of heat at depths hitherto inaccessible, and by the nature of their contents suggest the causes that most probably maintain it. In mineral waters we find many substances dissolved, whose existence, in a state of solution, hath, until of late, been thought impossible. Thus the Sprudel springs at Carlsbad in Bohemia, annually afford seventeen thousand, three hundred and sixty-nine pounds of siliceous earth held in solution, and although this water also contains fossil alkali, yet that earth does not owe its solubility to this salt, as the alkali is fully saturated. To say nothing of the waters of Geyzer, in which this earth also

abounds, in quantities, utterly disproportionate to the quantity of alkali also contained in them.

That liberal and enlightened patron of science, Sir Joseph Banks, led the way to the knowledge of the mixtures in mineral waters which were not suspected to exist in them in any large quantity, until he returned from Iceland. The chief of these productions was found to be siliceous earth. In consequence of this discovery in 1772, the world was presented with a master-piece of chemical analysis in the investigation made by Dr. Black of the waters of Geyzer and Rykum.—The wonderful phenomena attendant on these springs have been fully described by Mr. Stanley, in the third volume of the Transactions of the Royal Society of Edinburgh.

I shall now attempt an explanation of the phenomena which the Bath Waters continue regularly to present; and I shall, as far as I am able, deduce my reasonings from an experimental inquiry into their component parts. The two new facts which I shall here mention of their containing siliceous earth, and of the peculiar state of combination in which the iron is held in them, will, I apprehend, contribute to the illustration of the volcanic nature of these springs.

The uniformity as to temperature, quality, and quantity, observable in the Bath springs, shews that their heat is caused by continued and regular action of extensively operating agents in the

bowels the of earth. Various have been the opinions respecting the cause of the heat of these waters. Subterranean fires, fermentation, the decomposition of pyrites, &c. have each had their advocates. Dr. Cheyne accounts for the heat of these waters by the following experiment. If filings of iron and the powder of sulphur made into a paste with water, are put into a cellar under a cock which drops water gradually and slowly, it will ferment, and the water running from it will be of the same heat and virtue with those of Bath, though not equally pleasant. Tournefort observes, that the filings of iron will grow warm by steeping in common water, but much more so in sea-water; and if powdered sulphur be added, the mixture will burn.

As our researches into the operations which are going on in the interior of the globe, are limited, actual experiment must, in many instances, be assisted by analogy, and our reasonings be often taken from remote data. It is hardly possible to conceive the variety of circumstances to which nature may extend the application of her laws. Principles, which on the surface of the earth act without interruption, in the bowels of the earth become formidable, and produce some of her boldest features. The matter of heat, for example, which meets with but little interruption in its course through the substances forming the superficies, in the interior causes convulsions which

shake large continents, or bursts forth in tremendous volcanoes.

Water also, when unconfined, produces but little apparent effect ; but when subjected to heat and pressure, its energies are incalculably powerful. Where every agent is so varied in all its relations, and where every thing assumes such irregular modes of action, the cause of a uniform series of effects becomes a very difficult question.

The three principal springs of the Bath Water are within a short distance of each other, near the river Avon ; the triangle which they form measures on one side 415 feet, on another 380 feet, and on its shorter side 110 feet.

The King's and Queen's Bath are supplied from the same spring. The Hot Bath, and the Cross Bath differ from each other in the quantity as well as in the temperature of the water which they contain.

When filled to the height of 4 feet 6 inches, the King's Bath contains 314 tuns 36 gallons ; the Queen's Bath, at the same level, 81 tuns 3 hogsheads 11 gallons ; the Cross Bath, at an equal depth, 53 tuns 47 gallons ; and the Hot Bath, 54 tuns 27 gallons.

The temperature of the King's Bath Water, as drawn at the pump, is 114 degrees of Fahrenheit ; that of the Hot Bath in Hetling Court, is 116 degrees ; that of the water at the Cross Bath pump, is 107 degrees. These temperatures were ascer-

tained by applying a thermometer to the water as it issued from the several pumps, and keeping it in the stream of the water until the mercury of the thermometer had remained stationary for several minutes. As the mercury had ceased to rise, and as the above degrees were ascertained by several trials, they may be regarded as accurate.

The heat of the water in the several Baths is not so easily ascertained, as many causes operate in lowering the temperature, and these causes are continually varying. The water at the edge of the King's Bath is about 98 degrees; over the spring it is above 100 degrees; and as the King's and Queen's Baths are a continuation of the same water, part of the Queen's Bath is about 98 degrees, lessening in its temperature as it recedes from the spring. The temperature of the Hot Bath is above 100 degrees; and of the Cross Bath from 92 to 96 degrees.

It has been said that the specific gravity of all the waters is the same, namely, 1,002; but as there is a manifest difference of temperature in the waters, this assertion is improbable. Dr. Falconer's statement appears to be correct, namely, the specific gravity of the King's and Hot Bath, 1,0020; the Cross Bath, 1,0018; the ordinary pump water, 1,0016; Avon water, 1,0008.

The quantity of solid matter in the waters has been given by different authors, as follows:—Dr.

Lucas obtained $33\frac{1}{2}$ grains of dry residuum from a quart of the waters; Dr. Charlton, 34 grains; Dr. Falconer, $17\frac{1}{4}$ grains; Mr. Phillips, at the heat of boiling water, 32 grains; and when the heat of a sand bath was employed, he obtained 30 grains. I carefully evaporated 26 gallons of the water, and the residuum, dried before the fire, weighed 2252 grains; this quantity, even after making every allowance for waste, shews that the water contains about 22 or 23 grains in every quart.

Upon examining with a microscope the dry residuum, it is found every where interspersed with black particles; and it is a singular fact, unnoticed by those who have heretofore analysed these waters, that if a magnet be presented to this dry residuum it attracts these black particles, and removes them from the general mass. So strongly does the magnetic influence act on the iron, that lumps of the residuum which had, on drying, coalesced and enveloped the iron, have been found to adhere to the magnet, in the middle of each of which was discovered a particle of iron. The residuum from which the magnet attracted this iron was procured by evaporating the water in a large brass boiler, in which there was no iron, and merely drying it before the fire in an earthen dish. The boiler was previously cleaned with care, so that there was not the least foreign matter to mix with either the water or with the

residuum. This experiment was repeated upon twenty-six gallons of the water, and there was not a vessel, or any thing containing iron, used during the process: the residuum was treated in the same manner, and the magnet attracted innumerable particles of iron from it. This fact, which is as curious in a mineralogical point of view as it is important in illustrating the nature of these springs, clearly confirms the opinion that the waters contain more iron than the tests, previously applied, have discovered. The waters bring up much gritty sand into the reservoir, and a great deal is gradually deposited by the waters in the Bath. The magnet attracts from this sand numberless particles of iron, which particles, when examined by a microscope, are found precisely similar to those obtained from the residuum after evaporating the waters.

It has been said that no ochrey matter is deposited by the waters, and that the yellow colour of the bottom and sides of the bath is owing to the alternate action of air and water on the calcareous stone of which the bath is built. But as the city of Bath is entirely built of this stone, Oolithe, and as no such colour is produced on it by the alternate action of the rain and the air, we must look for some other cause why the ochrey appearance takes place in the bath. That it arises from the iron deposited by the water is evinced by the same occurrence taking place in the glasses made

use of for drinking the waters. This circumstance, so well known to all the attendants at the several pumps, who are obliged to scrape their glasses to remove the yellow golden-coloured crust that adheres to them, proves that iron is deposited from the waters in an ochrey state. The cause of the colour therefore on the sides and bottom of the baths is the iron deposited from the waters. Pyritical incrustations also take place about the baths. Thus among the substances deposited by the waters, we find iron in three different states, namely, pyrites, particles of iron attracted by the magnet, and the ochrey rust. It is of the greatest importance to ascertain the nature of the mineral impregnation of the Bath Waters. That they are charged with an active principle, and that of the mineral kingdom, is evinced by their rapid effects on the human constitution. They differ essentially from ordinary water at the same temperature. It is to the quality as well as quantity of the mineral that we must look for an explanation of their powers. It is well known that iron, in a state of solution, is an active medicine, producing decided effects on the human body, and we have many medicinal formulæ for its preparation. Upon a careful examination of these preparations, we find, that the nearer the iron is to the metallic state, consistently with a high degree of solubility and divisibility, the greater and more decidedly active are its effects on the

human constitution. Thus that preparation, which is known by the name of Griffith's mixture, is one wherein iron is held in solution nearly in its metallic state, as is evinced by its green colour, where *according to the French theory* the iron is but little oxydated.

If we examine the several phenomena of the Bath Waters, at their source, in the Bath and out of it, we shall find that they owe their powers and activity to the peculiar state of combination in which the iron is held in them, as well as to the quantity of iron; and a very interesting part of mineralogical inquiry will receive illustration from a consideration of the processes which are apparently carried on in these waters. Pyrites, where iron in a metallic state is united to sulphur, is found formed in the Bath, and in such situations as prove that it must have been deposited by the waters themselves. It appears that these waters contain the principles from which the pyrites is composed, and we seem here to obtain a glimpse of nature's laboratory, and to detect an operation hitherto unexplained. Whatever may be the arrangement that takes place in forming the pyrites, it is evident that the whole quantity of iron contained in, and brought up by the waters, is not employed for that purpose alone; many particles of iron are found in the sand of the bath, and many of the same kind are obtained by evaporating the waters, which particles are attracted by

the magnet, shewing thereby, that the iron is nearly in a metallic state, or if we adopt the language of the *French chymists*, that it is in a state of low oxydation.

Another portion of the iron unites with carbonic acid, and it is this portion which appears on the sides of the bath in an ochrey form, and which, when the waters are fresh from the spring, yields a rose-colour with the tincture of galls. The waters contain no uncombined sulphur, and it may be presumed that the quantity, which at some early period has been mingled in them, has been wholly expended in forming with the iron the pyritical incrustations.

Mr. Kirwan in the second volume of his *Mineralogy*, page 82, when speaking of the iron in pyrites, says, that "the state in which it (iron) exists in that mineral spontaneously vitriolizable, is its metallic state before any efflorescence, appears; 1st, because in all the artificial mixtures of iron and sulphur, which blackened, swoll, heated and vitriolized like pyrites, as in those of Rinman, Lemery, Scheele and my own, the iron employed was constantly metallic iron; 2d, because Rinman found mixtures of sulphur and iron in the state of *Æthiops*, and Scheele those of sulphur and iron in the state of *crocus*, to be incapable of heating, and acting on each other; 3d, because the solution of pyrites in marine acid assumes a green colour, which is the colour it

receives from iron in a metallic state, and never from calces of iron; 4th, because the decomposition of water is always the first symptom of efflorescence, and this can only be produced by iron in its metallic state."

The pyritical state of the sand in the bath is most clearly evinced by its forming vitriol when exposed to the air, as mentioned by Mayow, "*Advertendum est autem, quod sabulum istud thermarum aliquandiu servatum, aerique expositum sponte sua in vitriolum commigrabit.*" From Mr. Phillips' experiments it appears, that the air bubbles which arise with the waters contain no vital or oxygene air; thus nothing is discovered which should disturb the process of bringing the iron, contained in the waters, to the surface of the earth in its metallic state.

The fact which I have mentioned respecting the state of part of the iron contained in the Bath Waters, shews that the opinion heretofore advanced, that the carbonic acid holds the iron in solution, is erroneous; at least that all the iron is not thus combined. A small portion is, without doubt, in union with carbonic acid, and this portion, as before observed, is that which gives the colour when tincture of galls is added to the waters fresh from the spring. If therefore we estimate the quantity of iron by the precipitate formed by the tincture of galls, a quantity far too

inconsiderable to account for the effects of the waters on the body, or even for their taste, we shall very much underrate their mineral impregnation.

As the dried residuum, after evaporating the waters, is interspersed with numberless black particles, every one of which is attracted by the magnet, it is impossible to suppose that this iron should have been united to carbonic acid, or that the iron should have been contained therein in the state of an oxyde.

As in the sand of the bath there are similar black particles alike obedient to the magnetic influence, we must conclude that a common cause produces these and those found in the residuum, and that the ochrey substance in the glasses used at the pumps, and which is also deposited about the baths, is that portion of iron which had arisen in combination with carbonic acid, which acid escapes or enters into new combinations on the water becoming cool. On the immediate cooling of these waters they do not cease to give some appearance of iron when treated with the tincture of galls; but even when closely stopped, and when no uncombined vital air can be supposed present, the waters in a cold state are affected by tincture of galls in a degree considerably less than when the waters are hot from the spring. I have ascertained this fact repeatedly upon many different quantities of the water.

It appears that the carbonic acid is but weakly combined with iron, for the mere cooling of the water lessens the capability so manifest when they are hot of being tinged by galls. If the waters are for a long time exposed with a large surface to the air, and suffered to cool, they lose entirely the property of being affected by galls. The cessation of liability in the waters to be tinged by galls, seems to prove that it could not have been that portion of iron which was attracted by the magnet from the dry residuum, which was at any time acted on by the galls; and, therefore, the only quantity of iron which has been examined and estimated by former writers on this subject, is that which is dissolved in the water by means of carbonic acid.

I have filled twelve eight ounce bottles with the water hot at the spring, one of which was not closed, the others were closely stopped, so that no air could be in contact with the water; on adding tincture of galls, at the end of a month no effect whatever appeared which at all indicated the presence of iron in any of them. A dozen clean eight ounce bottles were filled with the water of the King's bath, in some of which there was not any air above the water, in others there was some small portion. After standing a month, the water of each was tried with galls, and not one of them shewed the least sign of iron. There was a pre-

cipitation in each bottle of a yellow ochrey substance, similar to that which collects on every glass used at the pumps. A bottle was filled with the King's bath water, and carefully closed under the water in the bath, and a piece of bladder tied over the cork. After remaining some weeks, and being again heated to the temperature of the spring, it shewed no signs whatever of the presence of iron. These experiments shew how little advantage is to be expected from the Bath waters when they have been conveyed to a distance from Bath, and how great must be the alteration of their medicinal qualities from those which they possess when drunk fresh from the spring.

From the above experiments, and from others of a similar tendency, no fact can be more clearly ascertained than that the waters whether cooled in contact with atmospheric air, or where the external air is completely excluded, lose in time the power of being tinged by tincture of galls, and that iron in a state of yellow carbonate or oxide is separated from them by cooling. I have insisted the more on the forgoing facts as illustrative of the chalybeate nature of these waters, from the circumstance of Mr. Phillips having, after a most able analysis of them, declared that the iron is not deposited in the state above described, and that the yellow appearance of the walls of the bath is merely owing to the effect of the alternate

action of air and water, on the iron contained in the oolithe of which those walls are built.

Mr. Phillips says, "It has been asserted that the water deposits, a pale yellow ochrey precipitate; but this," he continues, "is certainly an error, the precipitate being perfectly white." Had Mr. Phillips examined the glasses which are used at all the pumps, he would have found that they became tinged with an orange-coloured ochrey substance.

The sand which arises with the Bath waters is, in a great degree, siliceous; when united with nitrous acid, it readily produces nitrous gas; the nitrous acid attacking the particles of iron which are mixed with the sand. The solution from heating the sand with nitrous acid acquires an inky blackness on the addition of tincture of galls, and when prussiate of potash is used, a blue precipitate is instantly formed. This production of nitrous gas is an additional convincing evidence that the iron found in the sand is nearly in a metallic state.

It scarcely admits of a doubt, that thermal waters, which preserve an uniform temperature at the surface, must have been of a much higher temperature in the bowels of the earth. We know that water, however high its temperature, will, on being exposed to the weight of the atmosphere, sink to the boiling point; now as the

earth at a certain depth maintains nearly a medium temperature between the heat of summer and winter, it is probable that it is the cooling process which preserves uniformity in the temperature of such waters.

If the heat of the Bath waters arose from the decomposition of martial pyrites, they would be impregnated with substances, the known result of that decomposition ; but pyrites is formed by the waters, and so far is the iron from being dissolved in them, in consequence of the decomposition of pyrites, that it is brought up by them in a state fit for the instant formation of that substance. The heat of the waters, therefore, does not arise from the above alleged cause.

From whatever depth the Bath waters may be supposed to arise, it is probable that they owe their heat to actual fire, for the air which arises with them has lost its vital part, or that part which serves in combustion, and the iron is reduced to nearly its metallic state. That the waters have been of a temperature far greater than that which they exhibit at the surface of the earth is proved by their holding siliceous earth in solution, and by their depositing such large quantities of silex in their passage. The waters on cooling deposit such substances as are held in them in solution with the least attraction ; consequently we find the sand of the bath to be siliceous, and the residuum, from evaporating the waters, to be for

the most part calcareous. But as both silex and iron must have been held in solution in the waters prior to the deposition that takes place on their cooling, so do they still retain a portion of their original contents. These waters, therefore, contain, even when they are drunk at the pump, both silex and iron in a state of solution, part of which iron is in combination with carbonic acid, and a part more nearly in a metallic state. The following experiments shew the existence of silex in the Bath waters, a discovery which I made public in a former treatise on these waters.

The residuum obtained by evaporating the Bath Waters assumed somewhat the appearance of a jelly, but not similar to the artificial solution of silex in water. During evaporation the mass divided into separate portions, the fissures between which did not distinctly enlarge according to the progress of exsiccation. The substance adhered to the sides of the vessel during evaporation, forming circles not easily to be detached. The vessel in which I evaporated some of the water was of block tin, and I found that by detaching the substance from its sides, the ivory knife which I used was considerably abraded. This circumstance induced me to examine the nature of the products with much attention, and I found that some portion remained undissolved, after I had subjected them to the action of the three strong mineral acids. To this in-

soluble substance I added above a thousand times its quantity of distilled water ; still I observed that it remained unchanged. This precipitate fell rapidly to the bottom of the vessel : I separated it by a filter from the water, and I found it to possess no saline or earthy taste. The oxalic acid did not decompose it, neither was its quantity diminished by boiling it a considerable time in distilled water.

Professor Bergman observes, in his analysis of mineral waters, that the portion, when the other ingredients are separated, which resists the action of a sufficient quantity of marine acid, is siliceous earth, which may be further determined by the blow-pipe ; for this earth when added to the mineral alkali in fusion, unites with it with a violent effervescence, and is thereby totally dissolved.

Mr. Kirwan says, that the general method of discovering the siliceous earth, is to evaporate a large quantity of water nearly to dryness, then to supersaturate and re-dissolve all that may have been precipitated, by adding a sufficiency of nitrous or vitriolic acids, and then evaporate to dryness. If then the dry mass be once more re-dissolved in water, and filtered, the siliceous earth will remain on the filter. It is distinguished by its insolubility in most acids, and its vitrescibility with two parts of soda.

I exposed this substance mixed with double its weight of soda, in a small platina crucible to a

very strong heat, which I urged with a pair of double bellows ; and I found that it acquired a vitreous appearance, after having suffered a very considerable effervescence, similar to that observed in making glass. I have already mentioned that this substance resisted the action of the marine, nitric, and sulphuric acids. Thus it appears, that this insoluble substance is siliceous earth, and that this earth forms one of the solid ingredients which are held in solution in the Bath Waters.

There is no disengaged acid in the Bath Waters, except a small quantity of carbonic acid, for the tincture of Litmus suffers no change of colour when added to them. Sulphuric acid is shewn to exist in them by the precipitation which ensues on the addition of the nitrate and muriate of Barytes ; and the marine acid by the precipitation with the nitrate of silver. Oxalic acid and the oxalate of ammonia separate the lime from its connection with the carbonic and sulphuric acids ; and the salts which are extracted from the residuum obtained by evaporation, by distilled water, are sulphate and muriate of soda. Thus it appears that the earthy and alkaline salts contained in these waters are carbonate of lime, sulphate of lime, sulphate of soda, and muriate of soda. I was mistaken in my experiments respecting the presence of sulphate of alumine, as the excess of oxalic acid re-dissolved the oxalate of lime, which

is shewn by Mr. Phillips to be precipitated by pure ammonia.

None of the tests of sulphur shew the least trace of that substance uncombined in the Bath Waters.

There is often much difference in the results of experiments which are made to determine the precise quantity of each of the ingredients contained in mineral waters. Operations on a small scale may produce conclusions different from those which arise from experiments made on large quantities. I have carefully evaporated many gallons of the Bath Waters, and have frequently attempted to determine the precise weight of each of the ingredients of the residuum, but I have found that in these different experiments a precisely similar result was never obtained.

I shall annex the results of the experiments of others who seem to have been more fortunate, and shall only observe that it may not be of any very great consequence in a medical view, where the exact point scrupulously lies. The iron, however, contained in the Bath Waters is confessedly in very small quantities, yet it is admitted to be not only very discernible by the taste and even by chemical tests at the spring, but when taken internally that it possesses very active powers.

I have given my reasons for believing that the quantity of iron in the water has been underrated, and for conceiving that the chalybeate properties

of the waters depend no less on the mode of combination, than on the quantity of iron really contained in them.

The following results are given in medical works on this subject.

According to the experiments of Dr. Bryan Higgins, a Winchester gallon of Bath Water contains :

	dwt.	gr.
Of calcareous earth, combined with vitriolic acid, in the form of selenite - - - - -	0	319 $\frac{1}{2}$
Of calcareous earth, combined with acidulous gas - - - - -	0	22 $\frac{3}{4}$
Of marine salt of magnesia - - - - -	0	22 $\frac{1}{2}$
Of sea salt - - - - -	1	14 $\frac{1}{2}$
Of iron, combined with acidulous gas - -	0	0 $\frac{1}{2}$

Of acidulous gas, besides what is contained in the above earth and iron, twelve ounces measure ; and of atmospheric air two ounces.

Dr. Monro, in speaking of these waters, says, the highest degree of heat attributed to them by Dr. Howard, Dr. Charlton, and Dr. Lucas, are from the pump of the

King's Bath	113	116	119	} Of Faren- heit's Ther- mometer.
Hot Bath	115	116	119	
Cross Bath	106	110	114	

And that, on evaporation, a gallon has been found to contain of iron $\frac{1}{17}$ or $\frac{1}{18}$ parts of a grain ; of calcareous earth, 22 $\frac{1}{2}$ grains ; selenites, 31 $\frac{1}{2}$ grs. Glauber's salt, 25 $\frac{1}{2}$ grains ; sea salt, 51 $\frac{1}{2}$ grains ;

which were mixed with an oily matter, but not more so than is common to all waters,

The Bath Waters are thus represented to be acidulous chalybeates, in which iron and earth are kept suspended by means of aërial acid; and that they are impregnated with a small portion of selenites, sea salt, and muriated magnesia. Less accurate inquirers for a long time esteemed the waters to be sulphureous; but certainly they have not a title to that name in the least, as they do not affect the colour of silver or metallic solutions, or produce any other effect of water impregnated with sulphur.

Dr. Saunders, in his treatise on mineral waters, says "From the various chemical investigations that have been mentioned, we may form this general conclusion concerning the composition of Bath Water; that it contains a good deal of calcareous salts, which render it hard and unfit for domestic purposes; that it holds in solution but little, if any, neutral alkaline salts, and therefore is scarcely saline; that it is in a very slight degree impregnated with carbonic acid; in a still slighter, with iron, and as it should appear, only when hot from the spring; and that it holds suspended a small portion of siliceous earth, which will deserve notice from the chemist, as a curious, though not singular occurrence. The precise quantities of all these ingredients it is not easy to determine, on account of the difference in the

result of experiments made by different persons, none of which are at all improbable, as there are many waters that contain less foreign matter than the lowest estimation, and more than the highest. Perhaps we shall make a pretty near approximation to the truth, if we reckon a gallon of the King's Bath Water to contain, for its gaseous contents, about eight cubic inches of carbonic acid, and the same quantity of air nearly azotic; for the solid, about 80 grains, in the whole of which, perhaps one half may be sulphat and muriat of soda, $15\frac{1}{2}$ grains of siliceous earth, and the remainder selenite, carbonat of lime, and a very minute portion, scarcely appreciable, of oxyd of iron. The waters in the three baths differ in some degree in chemical composition. According to Dr. Falconer, the solid residuum from a gallon of each water, is in the proportion of 71 grains in that of the King's Bath, 78 grains in the Hot Bath, and 86 grains in the Cross Bath. Of 80 grains of each residuum, the saline part soluble in water, was 31 grains in the first, 29 in the second, and only 11 in the third. This latter, therefore, contains much more insoluble matter, and as this residuum does not effervesce very strongly with nitrous acid, it is probable chiefly sulphat of lime. The depth of colour produced with tincture of galls, was the greatest in the first mentioned water, less in the second, and least of all in the third. The degree of pre-

cipitation with lime-water followed the same order. Hence we may conclude, that the King's Bath Water is the strongest chalybeate, that it contains the most carbonic acid, and active neutral salts, and the least of the selenite and other earthy residuum. The Hot Bath water is a very little weaker as a chalybeate, as well as in gaseous and saline contents, but yields more earthy residuum. The Cross Bath water is still less gaseous, chalybeate, and saline, but much more earthy."

It is to be presumed from the very scientific character of Mr. Phillips's analysis, that he comes the nearest to the real quantity of each of the substances contained in the Bath waters. Speaking of the gaseous fluid that arises with the waters and appears in bubbles over the spring, he says, that it consists of

Carbonic acid gas.....	5
Nitrogen gas.....	95
	<hr/>
	100

I have often examined this gas, and it has always appeared to me, as well as to others who have witnessed the experiments, that there is an evident discolouration when nitrous gas is added to it, and likewise some diminution of bulk in the fluids. If this be a fact, we must conclude that oxygene gas forms some small portion of the composition.

One quart of the water, Mr. Phillips observes, contains

Carbonic acid	2,4 inches.
Sulphate of lime	18 grains
Muriate of soda.....	6,6
Sulphate of soda	3,0
Carbonate of lime.....	1,6
Silica.....	,4
Oxyde of iron.....	.00394

29.60394

Loss

.39606

30.

Estimating the muriate and sulphate of soda in the crystallized state, one pint of the water contains nearly as follows :

Carbonic acid	1½ inch
Sulphate of lime	9 grains
Muriate of soda.....	3½
Sulphate of soda	3½
Carbonate of lime.....	10
Silica.....	1
Oxide of iron.....	1

Dr. Wilkinson has lately given the result of some experiments on the Bath waters, particularly on the water of the Kingston Bath. It appears from his account that the Kingston Bath is supplied by another spring, within a short distance of the King's Bath; and he is of opinion that the spring which supplies the Kingston Bath, and the springs which supply the other baths, are ramifications from some great general source.

The water of the Kingston Bath, according to his experiments, contains, of solid matter

9,97 grains in each pint.

That of the King's Bath 9,03 ditto

of the Hot Bath 9,40 ditto

of the Cross Bath 6,6 ditto

The same results he observes would have appeared had equal quantities of the water been subjected to experiment, except of that of the Cross-Bath.

He states, also, that in 400 grains of the gross residuum from the water of the Kingston Bath, there exist

Sulphate of lime.....231

Muriate of soda.....84

Sulphate of soda 45

Carbonate of lime.....22

Oxy-carbonate of iron..... 5,6

Silex..... 5

Variable quantity, vegetable extract 2,5

395,1

Loss..... 4,9

400

Dr. Wilkinson subjected to the same analysis 400 grains of the gross contents from each of the other springs, viz. : the Hot Bath, the King's Bath, and the Cross Bath. The two former evinced the same proportionate parts with the Kingston waters, the shade of difference not being more than what frequently attends two analyses of the same compound. The investigations of the four salts were made at the same time, under the same con-

ditions, and exposed in their various stages to the same temperature, to guard, as much as possible, against any error.

The Cross Bath water, gave out a much larger proportion of a calcareous salt than of the alkaline salts.

400 GRAINS DECOMPOSED.

Sulphate of lime	- - - - -	276
Carbonate of lime	- - - - -	23
Sulphate of soda	- - - - -	52
Muriate of soda	- - - - -	29
Carbonate of iron	- - - - -	4
Silex	- - - - -	4
		<hr/>
		393

I have devoted a considerable portion of the foregoing pages to the consideration of the chalybeate impregnation of these waters; and I have attempted to shew, that the quantity of iron has been underrated; it certainly appears that so small a quantity of iron as the 1-136th part of a grain would not be sufficient under any mode of combination to give a sensible taste to a quart of water, or that any test of iron should detect it when so extremely diffused.

Besides the foregoing substances, there arises, principally during the summer, with the waters a vegetable substance, like a conferva, which floats on the surface of the bath. I have collected large quantities of this substance, and have no doubt of its being a vegetable. This is noticed by way of

completing the survey of the waters, not with any view of attributing to the conferva any property contributory to their medicinal effects.

THE great reputation which the Bath Waters have obtained for their efficacy in removing many of the most deplorable diseases to which the human body is subject, is evinced by the writings of many of the most respectable physicians, and by the number of invalids who are continually sent to Bath by the most distinguished medical practitioners of the present day.

Dr. Saunders says, that the diseases which have rendered these celebrated waters objects of general resort, are very numerous, and are some of the most important and difficult of cure of all that demand medical treatment. The medicinal properties of these waters have uniformly claimed the attention of physicians through a long succession of ages; and the remains of antiquity which have been discovered at Bath, shew that the Romans were acquainted with their virtues. It is impossible to discover whether the Romans knew their medicinal qualities when taken internally, although their known partiality for warm bathing must have rendered these springs an object of the first importance to the earliest of those settlers in Britain. Whether luxury or health induced the Romans to use these waters, it is certain that they were the first founders of this city, that they adorn-

ed it with all the beauties of architecture, and drew the attention of the world to the virtues of the springs.

Dr. Jones who wrote concerning these waters in 1572, among other things gives these directions: "About an hour after sun rising, drink the water out of the spring, the body afore purged, the digestion fulfilled, and the bath first cleansed remaining clear six hours before. So much of the water as shall not be grievous to the stomach may be drank. The water being drank, the patient must walk gently a few paces in a temperate air."

It appears from these directions that the Bath waters were taken internally as a medicine in the 16th century, and that Dr. Jones was acquainted with their peculiar action on the stomach, by the very judicious precautions which he recommends.

It has happened with the Bath Waters, as it frequently does with most medicinal agents, that their virtues and excellencies have been extolled beyond all reasonable bounds. Such unreserved praise always creates suspicion, and we find, even among modern writers on medicine, many doubts expressed as to their efficacy. Some of the earlier writers on this subject have attributed contradictory qualities to them, and have given them so general a character of curing disease, that we are induced to disregard such opinions altogether; still, however, many useful and practical observa-

tions occasionally occur which lead us to a knowledge of the real and efficient operation of these waters on the human body. The manner of applying them has at various times been variously recommended; by some physicians their internal use has been entirely proscribed.

Dr. Venner whose work on this subject is dated in 1650, answers negatively the question, whether the drinking these waters be in any cases convenient. He says, that by reason of their bituminous and sulphurous quality they relax and weaken the stomach. It is difficult to conceive what the older writers on this subject meant by the bituminous and sulphurous quality of the waters, since not a particle of sulphur or bitumen is to be discovered in them by the nicest analysis.

Dr. Charlton says, that the sulphurous principle of the Bath Waters is an exceeding fine aromatic balsam, entirely dissimilar from common brimstone.

Dr. Venner further observes, that "these famous hot waters are of singular force, not only against diseases gotten by cold or proceeding from a cold and moist cause, but also bring in time of health exceeding comfort and profit to all cold, moist and corpulent bodies; for they open the pores, resolve, attenuate, digest, consume and draw forth superfluities, and withal strongly heal and dry the whole habit of the body."

Although the explanation given of the effects of

the same medicine by writers of different ages of the world is tinctured with the prevailing theories of the day, yet we find the facts, on which these theories rest, remain the same at all times; it is on this account that I have quoted the authors on the Bath Waters, to shew that the opinion has been uniformly the same in respect to the decided action they produce on the human frame. Imaginary agents have been given as the cause of their producing their medicinal effects, although we find that their chalybeate imgregration has been generally looked upon as the efficient cause of their operation.

Dr. Sutherland remarks, that in the third volume of the Edinburgh Medical Essays, we find an experiment recorded by Professor Monro which enables us, with some sort of certainty, to determine the quantity of iron contained in waters. He observes, that the quantity of iron contained in its salt or vitriol is little more than one third. If one ounce of this salt of steel be dissolved in 20 ounces of water troy-weight, 142 drops of which weigh two drachms, every such drop will contain 1-75th of a grain of iron. By this standard, Dr. Charlton and Dr. Lucas have investigated the iron contained in the Bath Waters. According to the former, (Essay on the Bath Waters, page 9), the chalybeate principle in a pint of King's Bath pump water comes out to be 1-70th of a grain nearly; in the Hot and Cross Bath

pump water 1-140th. According to the latter (Essay on Mineral Waters, page 293), every pint of the King's Bath water may be supposed to contain 1-37th of a grain of iron.

In an inconclusive experiment of this sort it signifies little on which side the quantity scrupulously lies. The experiments of both tend to corroborate the existence of iron. This extreme divisibility and tenuity of metal is the workmanship of wise Nature, who deals out her sanative compositions in quantities which heal more safely and surely than waters deeply saturated.

I shall not attempt to give an exact account of the quantity of iron contained in a given bulk of the Bath Waters, because of the numberless causes which operate in varying the results of experiments made on such delicate combinations; but I wish to prove, that the ordinary tests do not detect the whole quantity of iron contained in them, and that to the hitherto supposed quantity of metal must be added a further portion, probably of protoxyde, which may be supposed to have its share in the production of their medicinal powers.

Neither do I pretend to determine how this additional quantity of iron is held dissolved in the waters. It may be loosely combined in the state of protoxyde with carbonic acid; a state of activity may be given to it by sulphur, though not a particle exists uncombined in the waters in a

quantity under that which is necessary to the production of pyrites; or from having been exposed to a violent heat, as in a Papin's digester, it may be dissolved in water as is the case with the silex.

After attempting to shew the nature of the substances, which by means of chemical analysis I have been able to discover in the Bath Waters, I shall proceed to the examination of their medicinal powers, and to a description of the practical advantages which experience teaches us are to be expected, and which a knowledge of their contents gives us a rational hope of deriving from the use of them. We are taught by daily experience that these waters possess very active powers when introduced into the body, and we are, I apprehend, authorised in attributing their effects to those substances in them, with which chemistry has made us acquainted.

Because other chalybeate waters contain larger quantities of the metal, it is not to be supposed that a different mode of impregnation may not augment or vary the effects which these produce on the animal economy. Who could suppose that an apparently trifling addition of one of the principles which compose our atmosphere, should change calomel into corrosive sublimate, or the imperceptible operations going on in the glands of vegetables, should produce from water, air, and earth, the deadliest poisons. It is not, I contend,

from the fewness of the principles or from the smallness of their quantity, that we should suspect *a priori*, these waters to possess no activity, which when we have proved them to possess it, should lead us to determine that it does not arise from the substances as yet discovered in them.

It is to be observed that the natural substances which produce on the human body the most violent effects, are resolvable by chemistry only into a few simple and apparently inert principles; witness the medicines and poisons which are derived from the vegetable and animal kingdoms; nay the constitution of the atmosphere, wherein the most malignant fevers prevail, shews, when examined chemically, but little variation. In short, the slightest perceptible variation in the affinities of innocuous principles produces in the chemistry of nature her most active agents.

As far as my experience goes, their chalybeate impregnation set into activity by their temperature is fully capable of producing those peculiar effects which are found to arise from the use of the Bath Waters. An increase of activity results from the mere division of substances received into the stomach. It is well known that the surfaces of bodies increase according as they are divided, and that thereby, more and more parts, by greater division, must be brought into contact with the surface of the stomach; in short, substances thus comminuted become more and more diffusible.

It may not be amiss to observe, that after all our experiments we must remain totally ignorant of the exact quantity of any medicinal preparation that is concerned in the effect produced. The real efficient part may bear but a very small proportion of many medicines; when presented, therefore, as iron is in the Bath Waters, to the human stomach, it may all be actively concerned in the production of a medicinal effect. Indeed upon the divisibility of it depends its greater efficacy, for if by the common tests of chemical experiments, we can certainly discover a single grain of vitriolated iron minutely diffused through every drop of several gallons of water; there is no good reason to reject the supposition that the same, or any other medicine, may be equally divided and diffused through the whole animal machine. Even the mineral waters, which are reputed to be strongly impregnated with iron, contain but a small proportion of that metal; for instance, a wine-gallon of Tunbridge water, according to Dr. Babington, contains only one grain of oxyde of iron, and the celebrated waters of Spa and Pyrmont contain, according to Bergman only 56-100th of a grain of oxyde of iron in a pint.

I knew a lady who was peculiarly susceptible of the action of steel medicines, being always affected with head-ache, giddiness, and a prodigious increase of activity in the vessels of the head whenever she took even a slight dose. The chalybeate

nature of the Bath Waters, was strongly shewn in this lady's case, for she was affected in a similar manner on taking only two ounces of the water of the Hot Bath. Repeated trials were made, and every plausible plan adopted to prevent the above effect from taking place, without success; and the idea of using the waters was relinquished, when it was found that the waters, even in the smallest doses, excited such marked symptoms. Ordinary water, at the same temperature as that of the bath, produced no visible effect.

The Bath Waters are well adapted to alleviate the diseases incident to a rich and luxurious nation. Amongst the numbers who come for relief, we find a large portion who have incurred the penalties attendant on high living, indolence, and excess. But whilst I notice the sufferings resulting from indiscretion, I by no means exclude that melancholy list of disorders which attach to human nature, and which are derived from the natural constitution of the human body, or from the inevitable exposure of it to the vicissitudes of weather or change of climate; neither must I pass over hereditary complaints.

In order to form a proper estimate of the Bath Waters, we should ascertain their effects on the human constitution in a state of health, for by knowing what powers a medicine possesses when applied to a healthy subject, we may hope duly to appreciate its action in disease.

So great a dependance have the actions of medicines on the state of the constitution, that contradictory properties might be assigned to almost every agent, and the suitableness of any medicinal application is as much referable to the habit of the body, as to the inherent qualities of its own composition. Dr. Saunders says, that "We should always keep in mind, that the Bath Waters, whether from the warmth, or from other causes, though capable of increasing a febrile state of body, where such already exists, will seldom, if ever, produce it in a healthy subject." Although these waters may not produce a permanent febrile affection in a healthy subject, yet I know from personal experience that they cause very painful and distressing symptoms. They produce much head-ache and heat over the system, and they give to the blood a strong determination to the head. As every one has a peculiarity of constitution, it is not from a trial with one person, that these powers are to be deduced. The sanguineous and the melancholic are not similarly affected by the same agent; thus we find that the Bath Waters, whilst they raise the circulation of the former beyond its healthy bounds, will scarcely, if at all, rouse the latter.

In the sanguineous person, the circulation of the blood is quickened, the face flushes, a violent head-ache is produced, and even apoplexy in some habits may be brought on. Some tendency

to these effects may be observed in every one of a full habit who incautiously drinks the Bath Waters ; and as in constitutions where from disease the body is much weakened, there is a great disposition to febrile action, the Bath Waters will often excite fever in even the weakest habits. A giddiness in the head is frequently occasioned by them, which effect generally arises within a few minutes after they have been drunken. As a violent head-ache with throbbing, giddiness, dryness of the tongue and febrile heat over the system, are to be apprehended by those of a full habit who incautiously drink the Bath Waters ; so do we find, as we might expect, that they warm and strengthen the stomach, and usually produce a good appetite for food, with a great flow of spirits, in those of a weak fibre and whose bowels are habitually somewhat relaxed.

The Bath Waters sometimes, as before noticed, excite a feverish heat when taken in but small quantities ; but to some people's stomachs they are particularly grateful and refreshing ; they even take off the desire for vinous and ardent spirits, which is so urgent in those who have been habituated to their use ; and the melancholy establishment of the habit of drinking, whereby the imperious cravings for these baneful resources can scarcely be withstood, may here be unsettled, and a stimulus friendly to the constitution substituted in its stead.

That the increase of the urinary discharge is a criterion that the waters agree, is in many cases warranted by experience, although it is not an infallible guide. The quantity of additional fluid taken into the body must occasion an increase in the urinary discharge, without its being strictly looked upon as a diuretic effect. I have seen many instances, of patients being deceived as to the waters agreeing, from this circumstance. I believe a better proof of their agreeing, is their occasioning a flow of saliva and allaying thirst; at least no great danger is to be apprehended from their use when they do not occasion a dryness in the mouth and thirst. These observations are only applicable to such cases as are but little affected by the use of tonics. It is often from an accumulated effect in long courses of medicines of a particular character that we hope to induce a healthy state of constitution, and in such cases the progress cannot easily be detected. An attention to such remarks becomes necessary where the Bath Waters are thus used as an alterative.

I have known cases where the urine has flowed copiously in consequence of drinking the waters, but as costiveness was produced, much fever ensued. An increase of urine, and the body at the same time gently relaxed, are states of the constitution in which we may expect the greatest advantage from the use of the waters.

But the circumstance of the waters producing

a diuretic effect being a criterion of their agreeing with the constitution, must be taken with great limitation. In many complaints, and particularly some of those for which these waters are recommended, patients would be much deceived in this respect. Nervous complaints, as will be more fully described hereafter, occasion much irregularity in the discharge of urine, and in these complaints there is often so great a determination of blood to the head, as by no means to allow the use of the waters. The waters may even in these instances occasion a greater flow of urine by confirming that irregularity in the circulation of the blood which is so apparent in nervous disorders. If local congestion be removed, and the circulation of blood be equalized over the system, the waters may be taken with advantage, but the marks of fulness, and particularly of determination of blood to the head, must be much more adverted to than any alteration which may take place in the quantity of the urinary discharge.

It is usual and highly beneficial to excite both the urinary and alvine excretions during the exhibition of the Bath Waters, and I have often found that some of the mild neutral salts, as those obtained by evaporation from the waters of Cheltenham, fulfill both these indications. A couple of drachms of Cheltenham or Epsom salt, taken every morning before the water, have effectually answered this purpose.

Diuretic salt dissolved in the bitter infusion, has been serviceable where the diuretic effect was required. In some instances, however, these waters prove somewhat purgative; the continuance of this effect should be checked, for which purpose absorbent earths are found to agree, and particularly when joined with aromatics, as in the aromatic confection of the London Pharmacopœia. The sweet spirit of nitre is also a very useful remedy when the waters do not pass off readily by urine, especially should the bowels be in somewhat of a relaxed state. Although a greater quantity of liquid is taken by those who drink the Bath Waters than is customary to them, yet the increase of the quantity of urinary discharge which attends their use when they agree, proves them to possess a diuretic quality. As the irritating effect of small quantities of urine is relieved by the dilution of the salts usually contained in it, so, when the Bath Waters pass off that way, and as they do not possess any quality to irritate the kidneys or bladder, the urinary organs are not stimulated sensibly by them. This quality of the waters is highly advantageous, for no medicines are so little under the controul of the practitioner as diuretics. Some preparations of iron, as the tincture of muriated iron, seem to act as diuretics; this is one, and perhaps the mildest effect produced by iron on the system. Both the quality and quantity of the iron in the Bath Waters

are suited to this purpose, at the same time that it is amply diluted with water; but of the three Baths, the Cross-Bath appears to contain less iron, and to produce a greater diuretic effect.

The reason why tonics produce a diuretic effect, may I think be explained by supposing, that to constitute a healthy and sufficient quantity of urine, a given activity and force of the heart and arteries is necessary. When the circulation is languid, stimulants may act as diuretics, by rousing the action of the heart, and by those means calling forth the proper exertion of the several secreting organs.

It is thus that wine produces a diuretic effect; for it cannot well be supposed that the wine has any direct influence on the kidneys.

The nerves of the stomach communicate to the brain the action which has been induced by wine and other stimulants, the brain acts on the arterial system, and thus a glow and activity of organs is excited through the system; and in this, as in other instances, the influence of the brain by means of appropriate nerves, is exerted in removing morbid causes, by actions remote from the seat of those causes, and exactly correspondent to the necessity arising from them. I shall have repeated occasions to refer to the influence of nerves in producing those symptoms of disorders which take place remote from the apparent exciting cause. If, however, there exist fever, or if

a particular organ has been unduly acted upon by an increased force of the sanguiferous system, then as in the case of fever the kidneys would cease to secrete so large a quantity of urine; for after the first early impressions of stimulants on the stomach have subsided, a reduced quantity of urine is discharged in consequence of the exhaustion that has been induced. It may be here observed, that the several parts of the human body may undergo alterations, both of action and structure; and that new habits may be established by the constant operation of given agents, and that by a gradual and continued action, parts may acquire new or increased powers. Instances of this sort occur in those chronic disorders for which the Bath Waters are so justly celebrated, and which I shall attempt to explain under their proper heads.

A comparatively small dose of medicine will frequently exhaust, where after its continued use it will barely have any effect; and the gentle and constantly repeated use of stimulants, even though in larger quantities they may be violent, will often produce a tonic effect. Large doses of steel quicken the circulation, and increase the general heat of the system, but in small doses often repeated it only causes a steady and tonic effect. Such a quantity seems to be afforded by the Bath Waters, and the action of the urinary organs seems

by their use to acquire a firm and continued increase.

Although medicines acquire general names from their effects on the human body, yet we must allow a very great limitation in the application of those names, on account of the diversity observable in the constitutions to which they are applied. Their general character is often completely reversed in particular instances. Medicines which are generally reputed tonic will often debilitate; and those of a lowering character will, in particular instances, raise a languid circulation. Their effects may be sometimes of a positive character, and sometimes wholly negative. Thus, if it be owing to fever that a person is oppressed and feels low and languid, tonics, by increasing the fever, will augment its pernicious effects, and will still further increase the languor; and those medicines, which under other circumstances would lower the force of the circulation, will, by removing this cause of oppression and languor indirectly produce a strengthening and reviving effect.

The pulse will sometimes be raised by blood letting; and I shall have occasion hereafter to refer to a case, where a strong and full pulse was diminished both in fulness and frequency by strong and powerful stimulants.

In speaking therefore of the Bath Waters, it must be understood that given effects are pro-

duced under given states of the constitution; which states, in the several diseases for which the Bath Waters are recommended, I now proceed to examine.

In treating of the disorders for the cure of which the Bath Waters have been so justly celebrated, many reasons offer themselves for beginning with Dyspepsia. It may be said to be the first disorder that announces in an otherwise well-conditioned person the approaches of disease; as it precedes, generally speaking, the gout and many of the worst constitutional disorders. The young are subject to it, and it affects not only those who live luxuriously and are dissipated, but the man of letters, and those who pursue the duties of life which require attention and study. Men of exemplary moral conduct are not exempt from this disease. It prevents the student from prosecuting with effect his well-directed attention, and it unsettles the mind frequently at a time when the object of his application is nearly attained. To constitute perfect health, it seems necessary that the several powers of the human body should be in some measure proportionably exerted. Excess implies that some faculty of the body is over-acted on, and thus many innocent, as well as laudable pursuits, tend to the production of disease.

No disorder to which man is subject appears to have so many forerunners, if I may be allowed the expression, as the gout; and no disorder

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and comfort are restored by a quantity of wine and spirit. Fuel is thus continually added, and the seeds of the disease are nourished and supported. Perhaps it is in thus purchasing ease that this dreadful disease is suffered to attain its full maturity, and perhaps it is only in this early stage that its progress can be arrested, and its consequences effectually prevented. We see by continuing a healthy action by means of medicine, that such regular action will in time be habitually established; now the continued production of surfeits, & the debilitated state induced repeatedly by strong liquors, establish in the constitution a continued and similar state of debility, a state of constant crapula. But the stomach is not the only part that suffers; a variety of symptoms arises and the whole constitution is affected. The indigestion, anxiety, flatulence, acid eructations, are generally relieved by food and wine; but their return is constant as soon as their stimulating effects cease. The body is in a state of languor, and the mind is agitated and inconstant. A great depression of spirits comes on, and life itself is frequently burdensome. Strong liquors, however, give temporary relief, and the ease of the evening is, I believe, generally acknowledged to infringe on the comforts of the morning; the balance, in short, of the constitution is destroyed. With some or all of these symptoms it is not surprising that patients should most willingly suffer the pain

of a severe inflammation on the foot, rather than continue in so tormenting a state of mind as well as body. It ought to be mentioned that this habitual derangement of the body is attended with an impaired action of most of the secreting organs. The kidneys do not perform their office, the urine is high coloured and in small quantities, except during the action of wine or spirits. The bile does not flow regularly, consequently at times the body is costive or much relaxed. Unsatisfactory and frequently painful evacuations, tenesmus with irritating and distressing efforts, announce the disordered condition of the stomach and the intestinal canal. Violent retchings come on, whereby nothing but clear water is discharged, owing to the diseased action of the mucous glands of the stomach, or the gastric juice being improperly secreted. There is frequently a great discharge of water from the mouth, although more commonly the mouth is hot and dry. There is, also, great palpitation of the heart, and much anxiety about the præcordia. The patient is observed to sigh deeply to relieve his anxiety, and imaginary evils assume in his mind all the importance of truth. The tongue is constantly white and furred in the morning, and the saliva flows sparingly. The pulse is quick and irregular. There are but few people who live well and use but little exercise who do not labour under some of these symptoms.

As many of the foregoing symptoms disappear, on the abstraction of the causes producing them, they are not regarded as leaving any real disorder in the constitution; but it must be observed, that there must be a period to the powers of reparation, and that a permanent diseased state must be induced by frequent repetition, and that the stomach must be brought into a confirmed derangement, which in many particulars is similar to that condition which was before only casual: when in this state it is considered as a disease under the name of Dyspepsia. A serious circumstance even here sometimes happens, namely, that the brain from being so continually acted upon by the sympathy which it bears with the stomach, becomes itself, in time, the seat of disease; and the reaction of this important organ, gives rise to a train of symptoms of the worst kind; for apoplexies, epilepsies, and various other mental affections, frequently close the scene of this miserable disease.

Dyspepsia, however, the symptoms of which I now enumerate, does not always lead to gout, neither is the gout always preceded by Dyspepsia. A constitution may be so far hereditarily disposed, and so far disturbed by other morbid causes, as not necessarily to require the accomplishment of every stage in its progress; but generally speaking, the gout is formed and produced in the individual affected by it, and that by a de-

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of vessels take place; the cuticular vessels over the body are constricted; greater internal secretions are produced, and vomiting and diarrhæa occur to expel the offending matter from the stomach and bowels. It appears that these sympathetic actions are destined for the removal of the causes producing disease, and that the brain dispenses its powers through the nerves for this salutary purpose. But in speaking of the fulness of the vessels which takes place in the head when the stomach is deranged, it is necessary to observe that the venous vessels of the brain are more liable to accumulation, stagnation and regurgitation than any others in the system. Dr. Cullen has observed that it has been computed that one-third of the blood sent from the left ventricle is distributed to the head and the chief of that to the brain. But if we take of the blood sent off by the subclavian and other vessels, we may allow between one-fourth and one-fifth to be sent to the brain, which is a large quantity in proportion to the size of the viscus. These vessels then being extremely turgid, the effects of any irregularity in the sanguiferous system, will be peculiarly felt there. Another circumstance is the peculiarity of the venous system. The venous blood here is not carried from smaller to larger vessels, as in other parts of the system, but immediately conveyed into sinuses. Again, the entrance of the veins into these sinuses is very unfavourable being

contrary to the course of the blood in the sinuses. Nature seems to have provided against a too great distention here, by surrounding these sinuses with transverse filaments, and enveloping them in the dura mater; so that in case of an accumulation it must fall on the vessels. The jugular veins are also unfavourable for carrying off the blood, as we may judge from the large cavities provided there. Again, the venous blood must move slowly in the brain for want of muscular compression. Even the structure of the jugular veins, shews the slow motion of the venous blood; for though favoured by the common erect position of the body, they are provided with valves, which yet are not sufficient to prevent regurgitation. A proof of this we have in that remarkable pulsation of the brain, which may be seen if the cranium is at any time laid open, and which is synchronous with respiration. This shews how apt the venous blood is to regurgitate, and so to be accumulated in the vessels. The size of the jugular veins also is greater in proportion to their corresponding arteries, than in any other part of the system, which proves that the blood moves more slowly in them. Dr. Cullen says, that another argument may be taken from the final cause, which, though but a *bado ne*, is generally mentioned in all hypotheses. It seems to have been the intention of nature, that the vessels should have been full and turgid, in order to serve for the flow of nervous power.

Before we proceed farther, it is necessary to say, that the par vagum, or eighth pair of nerves, terminates on the interior surface of the stomach in a manner similar to the expansion of the optic nerve, and forms its villous coat. The stomach by means of this nerve is in close connection with the brain, and the reciprocal action of these organs is produced by it.

It would be foreign to the object of this Treatise, to trace the several branches of the par vagum; but by its distribution we might explain a large variety of those sympathies, which the stomach calls forth from its connection with the brain, and which are observable between the stomach and the various other organs of the body. That the several actions which arise in the different parts of the human frame, are occasioned by the agency of the brain through the nerves, is evinced by some of the most common effects produced by any offending matter received into the system. All noxious substances, as ardent spirits, opium, poisons of different kinds, when introduced into the stomach, impair the powers of the nerves by acting on the brain; thus palsies of different kinds arise from their use. The same effects likewise arise whether the brain be primarily or secondarily affected. The secretion of urine, and, in short, many of the most important functions of the body are changed, both by the passions of the mind, and by the influence of certain substances on the

body. If it can be proved, that a certain degree of determination of blood to the head be necessary towards the exertion of the nervous power in the brain, for the purpose of communicating through the nerves to such parts of the system, an effect destined for the removal of the morbid cause, it will be necessary, in a practical point of view, to consider such a determination as an healthy effort, and one by no means to be counteracted or destroyed. It should be regulated in a manner similar to those inflammations and suppurations, which prove critical in fevers and many other diseases. But these natural exertions may be often prevented by a due attention to the original cause, and should at all times be moderated if possible by remedies thus applied, as the excess of even healthy and natural actions may soon become disease. Thus may the efforts of nature become the indices from which we may learn the seat of a disease, and symptoms seated in one part of the body, may announce the existence of a remote and otherwise hidden cause. In common complaints of the stomach, the head is generally more or less affected, and the expulsion of the offending matter from the stomach, by vomiting, relieves such sympathetic pains of the head; but in this apparently simple process, many other great and essential organs are concerned. The force of the pulsations of the heart is greatly diminished, and the blood is constrained in it

flow through all the cuticular vessels of the body. Now, I contend, that the brain by means of the nerves from the stomach, is so affected as to cause the distribution of its influence through other appropriate nerves to the heart itself, and that a complete new arrangement takes place throughout the system; the result of which is the expulsion from the stomach and bowels of the offending cause. To cure, therefore, or to relieve a headache of this kind, our indication is not the head itself, whilst a morbid cause exists remote from it; we must not here interrupt the efforts of nature. Sickness is such an effort, [and by promoting it we remove the disease. In speaking therefore of Dyspepsia, it is of the utmost importance accurately to distinguish between the several symptoms; for many, even of the most distressing kind, may be merely such as would eventually remove the complaint. Were it not for the continued application of the exciting causes, this, as well as many other diseases, would spontaneously disappear. If excess in eating, in drinking, or any other kind, be the cause of disease, the symptoms will arise whilst the causes act, and in fact the very means nature employs for the removal of disease, will in time, by continued exertion, lose their powers and the system have no rallying point. The action of the heart itself will be weakened, and all the organs dependant on it will become diseased. Thus from the constant application of

noxious substances to the stomach, and by the repeated action of strong liquors on it, the liver gets torpid and diseased, and this in exact proportion to the diminished force of the heart and arteries. I shall have occasion to dwell more on this subject and of the obedience of the function of the secretion of bile to the force of the heart, when speaking of bilious and liver complaints.

Certain healthy and necessary actions take place on the admission of wholesome food into the stomach, which during the digestive process, prepare it for the nourishment and support of the body.

A late writer points out this, in a work on the disorders of the stomach; he says, when a person feels oppressed after eating, one of these two causes may be assigned—either his stomach is weaker than it ought naturally to be, or he has taken food too strong for his powers of digestion. A person under such circumstances complains frequently that the food lies heavy at his stomach; that this sensation does not arise from mechanical weight is certain, because the same person would be capable of containing a much greater weight, of another substance more congenial to his appetite. It must proceed, then, from a change produced by the quantity of the food itself on the nervous energy of the stomach, and will be best explained by what has been already said on the nature of digestion. Children in health never complain of

this oppression, and it is curious as well as pleasing to observe their vivacity immediately after eating a meal, which seems instantly to communicate fresh energy to the system.

The celebrated Venetian, who is well-known by the title of old Cornaro, and who wrote his life on purpose to inculcate the virtues of temperance, declares the same thing respecting himself. He says, he always felt very lively, and supplied with fresh energies after a meal; was at all times cheerful and in good spirits, and lived for the last few years of his life, on one or two eggs a day. The life of this veteran may be read with much real advantage, by those who have occasion either to recommend or adopt the regimen best adapted to old age. Whatever irregularities in diet occur between twenty and fifty, may, in a good constitution, be easily overcome; but in a more advanced period, especially after sixty, the observance of temperance is an imperious duty, which cannot be infringed with impunity. A practitioner should be very inquisitive in regard to the diet of patients of this description, as it will be found on examination, that the diseases of elderly people, depend more frequently on derangement of the stomach and the digestive organs, than on any other cause whatsoever. Many functions are destined to select what is proper to be admitted as food, and there is a dislike and a disgust at what ought to be rejected. Certain organs

are appropriated for this purpose, and a balance in these several functions constitutes health. Besides this due regulation among the digestive organs when in health, there is a provision made against a derangement of them, so that the balance is naturally restored, even after they have suffered much violence. But as the human body may bear great vicissitudes of heat and cold, and yet be destroyed by their extremes, so do the stomach, and the powers connected with it, resist destructive agents only to a certain extent. In a practical point of view, therefore, it is to the early symptoms of disease that we must attend, to prevent those complicated evils which I am now considering. A long series of distressing symptoms may come on, before any great organic injury takes place. There may be repeated head-aches, and many fulnesses of blood in the head, before the brain may receive a real and lasting injury. The powers of the brain and nerves may be greatly impaired by a constant exertion, called forth to repair the injuries from the application of mischievous agents; thus drunkards lose the faculties of their minds, and are deprived of the due exercise of their memory, imagination, attention and judgment. The force of the heart and the circulation is also weakened. There are many phenomena in the economy of the human body, which cannot be explained by any theory yet devised. Many dreadful diseases are known to disappear upon a

critical discharge taking place remote from the seat of complaint, and many fevers, which affect the whole constitution, have been removed as soon as a local inflammation has arisen. There is a power in the human body of sacrificing a part, in order that the remainder may be preserved, and parts less essential to the existence of the human body are those that are thus generally affected. Extraneous substances are propelled towards the surface, when by accident, they are placed within the body, and parts which have become useless, are thrown off from the general mass. Diseased actions on the surface of the body relieve internal disorders, and actions of quite a different nature remove diseases existing in remote parts. Abscesses spontaneously arising on the surface of the body, frequently stop the progress of extensive internal suppurations; and eruptions on the skin, are known sometimes to allay the most furious maniacal paroxysms. In short, the provisions made in the human body against disease, are numerous and extensively effectual.

It may at first view appear strange, to suppose the gout an effort of the above nature; that so painful and distressing a malady, should be merely destined to overcome a disease elsewhere situated, which would otherwise quickly destroy life, and that the violent inflammation on the extremi-

ties should be absolutely necessary to supercede or suspend a mortal symptom.

We have seen that the balance between the several powers of the human body is frequently destroyed, and we know that on the removal of the cause of irregularity, the balance is frequently restored. An intoxicating liquor will excite new actions which in time subside, and passions of various kinds will effect similar changes. The powers of the whole body are not affected by some diseases to any great extent, but there are many complaints wherein the whole constitution is deeply concerned. Some noxious matters will occasion pain and inflammation around the part where they are introduced, and their offending qualities are overcome by the local reaction which takes place, but other morbid causes acting more generally, call forth a more general reaction in the system. Thus fever is excited to remove contagious matter, and to overcome the threatening injury. That the gout is not a local disease merely of the part inflamed, is evinced by the sudden manner in which it shifts from place to place. The inflammation proves critical to some disease elsewhere situated; the slightest apparent causes will often occasion its removal from one place to another, and we have many lamentable instances to prove the ill effects which arise from stopping the inflammation of the gout when it has fairly taken place in the extremities. As all disorders,

which arise from eating and drinking must primarily affect the stomach, and as it appears that the gout is aggravated, if not produced by excess in those particulars, it becomes a matter of necessary investigation to inquire what the causes are which ought to conspire towards the proper digestion of food. Not only must the food be presented to the stomach in quantities suitable to the appetite, but universal experience teaches that it is of the utmost importance to attend to the qualities which it possesses. But as the indulgence in vicious habits creates vicious propensities, there must be some surer criterion than the mere cravings of such an appetite. Substances even, which are not nutritious, may become necessary if the appetite alone be regarded. It is painful to withstand the cravings of a disordered appetite. The immediate effects produced on the stomach by unwholesome food, and the painful consequence of too much indulgence, are, generally speaking, the surest guides in directing mankind in the selection of diet; and universal experience establishes the fact, that under different climates and in different constitutions, a great variety obtains in these things. Excess, therefore, is often referable to the particular instance. An inordinate desire for food is as often a sign of disordered digestion as a want of relish, and the cravings of the stomach impel a dyspeptic patient to a frequent

recourse to food. The food thus taken becomes a source of uneasiness, for as the craving arose from morbid irritation, the stomach is not in a state to digest what is taken. A sense of fulness, flatulence, and acid eructations, announcing improper digestion, take place. A certain quantity of food must be necessary to the maintenance of the human fabric, and its quality must bear a given proportion to it; for, however unable we may be to fix the limits, we still must acknowledge that they exist. As pleasurable sensations are excited by intoxicating liquors, so is there an indulgence in gratifying the appetite for food; but, although, agreeable sensations may arise by exciting the several powers of the body and calling into action new combinations of the faculties of the mind, it is nevertheless true, that to this overaction of parts and powers, particularly if repeated, that we must look for the cause of many of the diseases to which we are subject.

After the paroxysm of intoxication has ceased, much febrile affection remains, a chilliness, shivering, and a sensibility of external objects succeed; there is a great inactivity of the body, and the mind is agitated and confused; the stomach is affected with nausea and sickness, the pulsations of the heart are irregular, and a general state of debility pervades the system. Thus after excess in eating, there remain a fulness and torpor, indigestion, nausea, sickness; and the stomach be-

comes incapable of its healthy and ordinary functions. I cannot better explain these points than by quoting "*An Essay on Deformity*," by W. Hay, Esq. who says, "I hold as articles of faith, (but which may be condemned as heresies in many a general council assembled about a large table) that the smallest liquors are best, that there never was a good bowl of punch, nor a good bottle of Champagne, Burgundy, nor Claret; that the best dinner is one dish, that an entertainment grows worse in proportion as the numbers of dishes increase; that a fast is better than a Lord Mayor's feast; that no connoisseur ever understood good eating; that no minister of state ever gave a good entertainment, no King ever sat down to a good dinner, and that the peasant fares better than the prince &c. &c."

To obviate and effectually to remove the early symptoms of dyspepsia and gout, there can arise no question as to the necessity of temperance; and although there may be cases where these maladies may be hereditarily transmitted from father to son, and where, under the strictest rules of regimen, they may occur, yet in a general view, we may affirm, that the safest plan involves the most undeviating moderation and temperance. Excess in both eating and drinking is habitual in most wealthy families, and an almost perpetual state of surfeit exists amongst the greater part of the finest families in this kingdom. Nothing can

prove more forcibly that this is the case, than the numbers of such people that flock to the several watering places in this country to be cured of their indigestions, and to remove the ill consequences resulting from them. Under this point of view, and for these purposes, the Bath Waters hold a distinguished rank, for they admirably fulfil the purpose of alleviating or obviating those indications of disease which I have been enumerating. The Bath Waters take off the desire for wine, and a pleasant glow is felt over the system from their effects on the stomach. They exhilerate and leave no debilitating effects after they have ceased to affect the system. In dyspepsia simply, and in that state of it, where the gout usually comes on before its symptoms can be relieved, much advantage is found to arise from the use of the Bath Waters. Words are metaphorically applied, when speaking of the powers of the stomach, which words convey no accurate idea of its mode of action. Thus we often say, that the stomach is weak or strong, according as food is more or less easily digested. It, however, frequently happens, that the powers of the stomach are remarkably increased in that respect, in disorders which arise from their prior overaction; and that what might be thus called a strong state of the stomach, might be brought on by the diminished state of power resulting from indigestion. A more detrimental error does not exist in the

compass of medical science, than in the improper application of the ideas of strength and weakness to the description of disease.

An idea suggested by muscular force in raising a weight, or the strength of continuity in inanimate bodies, in resisting external violence, cannot with propriety be applied to the living action of secreting organs, or to those wonderful powers of assimilation which take place throughout the living frame. The whole science of medicine consists in developing facts; and the laws of mechanical as well as chemical philosophy fade away, when we attempt to apply them to the explanation of even the simplest combination of a living process.

In a person labouring under indigestion, there is frequently a great craving for food, and the pains and uneasinesses of the stomach, which arise from the separation of acid and other agents in the stomach, are quickly quieted by food or any strong liquor. But this ease is purchased at the expense of future comfort; for when the irritating effects of these go off, a greater necessity for stimulants will exist to produce a similar effect. Cordials of all kinds are, on such occasions, usually resorted to, and the consequences have uniformly been deplored. The Bath Waters supply a cordial without the subsequent exhaustion and they give a warmth without exciting a fever. Powerful means are often necessary to rouse even healthy actions, and powers partially applied, must often be in-

dispensable when an irregularity of action obtains through the system. Torpor and inflammation are alike discernible in cases where the medium effect is interrupted; and thus we see that the great action of the vessels of the extremities, and spasms in the stomach, heart and head, will often alternate with each other. Inflammation and cramp are both symptoms of the same disease, and are only different means, employed by nature, for the removal of the same complaint. The effect is but little different, whether the force of the heart be increased by fever, or whether a proportional action take place by the constriction of other vessels. In relaxing cramps we may produce the gouty diathesis, but in restraining the inflammation of the gout, we may produce spasms which threaten life. Until the real disorganization of various parts of the frame takes place, almost all the symptoms of gout may be traced to these two causes.

In an instant, and frequently during sleep, the joint of the great toe is afflicted with excruciating pain, heat, and throbbing; the whole body becomes feverish, and all the secretions are altered. The urine becomes thick, high-coloured, and deposits a lateritious sediment. The bowels are inactive, and the whole system partakes in the commotion. Indifferent to its seat, the gout shifts from place to place, and in a few hours, a part though grievously affected by it will resume its healthy charac-

ter. One foot will succeed another, and hardly a joint is free from the occasional visit of this painful tormentor. But whilst it thus exerts its rage, on these remote parts of the system, the vital, or those organs more essentially connected with life, assume a serene and tranquil character. The faculties of the mind resume their wonted calmness, and the stomach and heart, are relieved of their oppressive burdens. A little patience and a due degree of warmth enable the system to bear up against this formidable foe, and this one great effort seems to deprive him of all his power. During a fit of the gout, the patient's good spirits seem to keep pace with the existence of pain, and his feelings declare its efficacy in removing the tormenting cause. If it be true, that a fit of the gout is necessary under any circumstances, of which I have not the least doubt, though such an idea has been many times ably disputed,—I say, if a fit of the gout be necessary to avert other more dangerous symptoms, we have unquestionable proofs that the Bath Waters will fix the gout in the extremities, after every other attempt for the same purpose, has failed. It may not be necessary for me to adduce instances, to prove a truth so generally admitted by all our greatest medical characters; but there can be no harm in confirming any fact of great general importance. A gentleman was two years afflicted with all those symptoms which are supposed to arise from un-

settled gout, and all means, under the best professional directions, were used to fix it. After being in Bath one week, and making use of the waters only a few days, a regular and fixed gouty inflammation seized his foot; his former symptoms disappeared, and he was, as is usual in such cases, in due time relieved from the disorder. I have seen in four or five cases, the gout produced by twice drinking the Waters; and although the exact period of time, when it has usually appeared, might have been the one for its coming forward even had the Bath Waters not been taken, yet the number of cases that occur, and the chances against such a coincidence, being extremely great, we must admit this property in the use of the Waters. Besides in the cases to which I allude, there was no alteration in the ordinary plans of life; and no other cause whatever that could then be adverted to, which would produce the effect. The Bath Waters have been drunk by a person confined to his house under a strict regimen, and I have seen the gout come on as regularly, as when we expect the known effects to arise upon the exhibition of ordinary medicines. But here we must observe, that we cannot precisely promise such decided effects in all cases which occur, and many are the symptoms which take place in gout where the Bath Waters would be inadmissible. Were it only from this property of the Bath Waters that they

derived their celebrity, or were they only recommended in such cases under any empirical idea of such a property merely existing in them for the cure of a particular disease, their credit might be very reasonably disputed. But the same power which they exert in this instance, is by attention to be discerned wherever they are applied, and it is not perhaps too much to hope that by a knowledge of the general properties of this medicine, we may be led to a knowledge of those causes, which operate in producing gout in the human body. I have already mentioned that as extremes frequently meet, the two apparently contradictory effects of gout are equally concerned in what may be called the crisis of gout. Cramp and inflammation alternate with each other. The slightest causes will frequently occasion the most formidable symptoms of cramp and spasm in a gouty patient. As the gout is a disorder in which the Bath Waters are particularly recommended, it will be proper to enlarge on its symptoms, and to endeavour if possible to discover some fixed principles on which we may reasonably ground our practise with them. The foregoing account relates to those disorders which precede gout, and those symptoms which I have been enumerating, may be considered as the forerunners and the more obvious character of this formidable complaint. To draw a perfect picture of this disease, it will be necessary to collect the symptoms from

various cases of it, for it rarely happens that it evolves all its mischief in one person. Few are the constitutions which can cope with it, and the natural age of man sets limits to the fulfilment of all its stages.

Before a person is regularly attacked with a decided fit of the gout, he generally has for some time laboured under some of the foregoing symptoms of dyspepsia. A general state of uneasiness is felt, the disposition alters, and a cloudiness is observed to hang over the countenance. The appetite for food is irregular, and immediately before the fit, is sometimes much increased.

Erratic pains affect different parts of the frame, and cramps and numbnesses are felt about the lower extremities. These sufferings are but preludes to greater affliction, for on a sudden a lacerating pain is felt in the joints of the feet, which threatens a dislocation of one joint from another. The vessels and tendinous parts seem to oppose that inflammatory action which in a short time occupies the part on which it seizes. The whole mind of the patient is rivetted to the part affected, and the most trifling apparent cause of danger, becomes a serious source of dread, lest it may receive external injury. Every mental as well as bodily pain seems absorbed in this new and agonizing complaint. It is true that this state of pain and inflammation passes on regularly, and gradually subsiding relieves the body generally from

the cause of affliction; but that regularity is not always to be observed. Consolation may be drawn from the worst extremes, and here perhaps the gout may avert some other more dreadful shock, but pain can no where be more exquisite, or human suffering reach a higher pitch. It frequently goes beyond the powers of self-possession, and unsettles the ordinary powers of the mind, whose faculties it disturbs, causing delirium. It is difficult to appreciate the degrees of pain, but when we hear men of the strongest corporeal powers of forbearance complaining that their torments overcome them; and see them actually giving way to the excess of their sufferings, we must acknowledge that pain has there arrived at its acmé, for in this disease it extinguishes even all other feeling.

In this state of things, it is not surprising that all other comparatively trifling pains and uneasinesses should vanish. Most of the usual attendants of great inflammatory action accompany this attack; fever, chills, and a great increase in the action of the arteries. The urine becomes high-coloured, and deposits a copious sediment; the bowels are generally costive, and during the continuance of the fit, a regular succession of febrile symptoms shews the universal effect that has been produced on the system. At uncertain periods there comes on a breathing perspiration, and the patient falls asleep. The part affected swells and

the pain subsides. But this remission of pain is of short duration, other parts become affected, and the joints in all the extremities partake in the general commotion. All power of moving is denied, and the patient is rivetted to his bed from a fear of aggravating the pains which now afflict him. The muscles of the arms and legs communicate with every affected part, and although the patient's posture is irksome in the extreme, every restless removal of the affected parts, from one place to another, only increases the agitation and pain of those parts. Although it frequently happens, that the pain subsides in the part originally affected, when the disorder takes a new situation, yet we find numberless cases, where the disorder exists in all the affected parts at the same time. After that these symptoms have attained their height, they gradually subside, and the constitution is restored as the effects of the commotion gradually go off. The appetite returns by degrees, and the parts which have been affected gradually resume their healthy state. The cuticle of the parts not bearing distension gradually peels off, an itching is thereby excited, and a new skin is formed over the parts.

Various theories have been framed to connect the several symptoms, although all are agreed as to the phenomena and facts which occur in constituting the disease. In adverting to the several opinions which have been entertained of this dis-

order, it may fairly become a question whether the differences may not arise more from the words than from any essential difference in the ideas themselves. Sydenham admitted a morbid cause, and supposed that the gouty matter was expended and overcome by the inflammation that took place. Dr. Cullen says, that the supposition of a morbid matter is superfluous, that the gout is a disease of the whole system, or depends upon a general conformation and state of the body, which state of the system depends chiefly upon the state of its primary moving powers, and therefore the gout may be supposed to be chiefly an affection of these.

With all due deference to such great authority, it may be asked, whether the great moving powers of the body do not always require some cause to call them forth? or, whether that conformation of body does not exist in all mankind, wherein under certain circumstances the gout may be produced? Whether the existence of morbid matter preceeds the morbid action, or the contrary, is of little importance; or whether the terms morbid action be substituted for morbid matter; for this matter could have no effect but by altering the actions, which alteration of actions constitutes the disease. We can have no hesitation in saying, that morbid action takes place in gout, and that there must be some cause which produces the morbid debility of the great moving powers.

Dr. Cullen observes also, that the gout is ma-

nifestly an affection of the nervous system, in which the primary moving powers of the whole system are lodged. That we must seek for an explanation of the whole of the disease in the laws of the nervous system, and particularly in the changes which may happen in the balance of its several parts. Sydenham observes, that pain in this disease is the disagreeable remedy of nature, and the more violent it proves the sooner the fit terminates, and the longer and more perfect is the intermission, and so on the contrary.

I have mentioned that the Bath Waters are peculiarly serviceable in fixing a fit of the gout. It may therefore on this occasion appear unnecessary to dwell at all on the attempts that may be made to cure this painful malady. The gout has ever been accounted an intractable disorder; no plan or medicine having as yet been discovered, that safely and permanently cures it.

Lucian's ideas respecting gout are so truly to the point that I here insert a part of Dr. West's translation which is called *The Triumphs of the Gout*.

Ocypus having been accustomed to insult and deride whomsoever he saw grievously afflicted with this malady, brought upon himself the indignation of the Goddess, who presides over gout, and was at last driven by the violence of the disease to a recantation.

Ocypus solus.

O horrid name ! detested by the Gods !
 Gout, rueful Gout ! of sad Cocytas born,
 Whom in the murky caves of Tartarus,
 The fiend Megæra in her womb conceived,
 And nourished at her breast : Alecto too
 With her fell milk the wayward infant fed.
 But, oh ! what God brought thy disastrous power
 To taint this light, and harass human kind ?
 If punishment condign pursue the dead,
 For crimes committed in their days of nature,
 What need was there in Pluto's dreary realms
 With streams forbidden, Tantalus to vex ?
 To whirl Ixion on the giddy wheel ?
 And weary Sisyphus with fruitless toil ?
 It sure had been sufficient punishment,
 Had each offender the sharp pains endured,
 That tear this meagre miserable carcase ;
 While through th' obstructed pores the struggling vapour
 And bitter distillation force their way.
 Ev'n through the bowels runs the scalding plague
 And wastes the flesh with floods of eddying fire.
 So rage the flames in Ætna's sulphurous womb :
 So 'twixt Charybdis and vex'd Sylla rave
 Th' imprisoned tides, and in wild whirlwinds toss'd
 Dash 'gainst the mouldering rocks the foaming surge.
 O, evil unexplored ! how oft in vain
 We fondly try to mitigate thy woes,
 And find no comfort, by false hopes abused !

The Goddess who presides over Gout.

Lives there on earth, to whom I am unknown,
 Unconquerable queen of mighty woes ?
 Whom nor the fuming censer can appease,
 Nor victim's blood on blazing altars pour'd.

Me, not Apollo's self with all his drugs,
 High Heaven's divine physician can subdue ;
 Nor his learn'd son, wise Æsculapius.
 Yet ever since the race of men began,
 All have essay'd my fury to repel,
 Racking the invention of still baffled physic.
 Some this receipt 'gainst me, some that explore,
 Plantane they bruise, the parsley, odorous herb,
 The lenient lettuce, and the purslain wild.
 These bitter horehound, and the watery plant,
 That on the verdant banks of rivers grows ;
 Those nettles crush, and comfrey's viscid root,
 And pluck the lentils in the standing pools ;
 Some parsnips, some the glossy leaf apply
 That shades the downy peach, benumbing henbane,
 The poppy's soothing gum, th' emollient bulb,
 Rind of the punic apple, fleawort hot,
 The costly frankincense, and *searching root*
Of potent Hellebore, soft fenugreek,
 Tempered with rosy wine, collamphacum,
 Nitre and spawn of frogs, the cypress cone,
 And meal of bearded barley, and the leaf
 Of Coleworts unprepared, and ointments made
 Of pickled Garus, and (O vain conceit)
 The dung of mountain goats, and human ordure,
 The flower of beans, and hot sarcophagus.
 The poisonous ruddock some, and shrewmouse boil,
 The weasel some, the frog, the lizard green,
 The fell hyæna, and the wily fox,
 And branching stein-bock bearded like a goat.
 What kind of metals have ye left untried ?
 What juice ? what weeping trees medic'nal tear ?
 What beasts ? what animals have not bestowed
 Their bones, or nerves, or hides, or blood, or marrow,
 Or milk, or fat, or excrement, or urine.
 The draught of four ingredients some compose,
 Some eight, but more from seven expect relief ;

Some from the purging hiera seek their cure ;
 On mystic verses vainly some depend ;
 The tricking Jew gulls other fools with charms ;
 While to the cooling fountains others fly,
 And in the crystal current seek for health.
 But to all these fell anguish I denounce,
 To all who tempt me evermore severe.
 But they who patiently my visit take,
 Nor seek to combat me with anodynes,
 Still find me gentle and benevolent.
 For in my rites whoe'er participates,
 His tongue with eloquence I straight endow,
 And teach him with facetious wit to please,
 A merry, gay, jocose companion boon,
 Round whom the noisy crowd incessant laugh,
 As to the baths the crippled wretch is borne.
 For that dire Ate of whom Homer sings,
 That dreaded powerful deity am I ;
 Who on the heads of men insulting tread,
 And silent, soft, and unobserved approach.
 But as from me the acid drop descends,
 The drop of anguish, I the Gout am called.
 Now then, my votaries all, my orgies sing,
 And praise with hymns the unconquerable goddess.

Every opposite system has been fully put in practise, yet still are we without a safe and efficient remedy in this complaint. *Tollere nodosam nescit medicina podagram* is still applicable, for although successive generations have passed away, we yet find that mankind have remained doubtful in respect to the advantage of either one or other extreme of medical practise. The antiphlogistic has its advocates as well as the stimulant plan,

and each carried into full action is found detrimental. Bleeding, purging, and repellents were and are recommended ; for we now find, that the gout is represented as an inflammatory disease, and like other inflammatory diseases, can only be cured by the cooling or antiphlogistic plan. As far as I can judge from the experience I have had in this complaint, I am convinced that the gout is not cured by the repellent and cooling plan, on the contrary, the utmost danger is to be apprehended from it. That the disorder is to be prevented by early and unqualified moderation and temperance, with suitable exercise and employment must be admitted; its violence also, even after it has been once established in the system, may, I doubt not, be checked, and in a great measure subdued by the same means; but I am not prepared to say, that in every stage of gout, stimulants, whether of diet or of medicine, can be with safety totally abandoned. We have at Bath strong presumptive evidence, that in many stages of this disorder, these waters have been found useful by the most eminent professional characters, and that plans of the stimulant and sustaining kinds, are still found necessary.

I have often been earnestly solicited to give medicines of this class, and I have found that such were necessary in cases where repellents had been largely applied. The Bath Waters afford an innocent and efficacious tonic and stimulant, they

produce that state of constitution which enables the natural powers to throw off at the extremities a regular fit the gout, and they produce that invigorating effect on the system, which is ever required to repair the injuries sustained by the constitution, from a long confinement, under the progress of this natural solution of the disorder.



Nearly allied to Gout, and remarkably similar in many of its symptoms, is the disease which I now intend to describe, the Rheumatism. The causes producing it are, however, supposed to be very different, and it affects a larger proportion of the human race. Unlike the gout it visits the peasant's cottage, and its ravages are peculiarly felt among the lower orders of society. It is the disease of an inclement climate, and the people who are most exposed to the vicissitudes of weather are its subjects.

It is clear that the antients confounded the two diseases, Gout and Rheumatism, and comprehended them both under the general name of Arthritis; and even later writers have shewn the same confusion respecting them. It has been said that the rheumatism is induced by cold and moisture: the gout scarce ever is. Hereditary communication may often be considered as the cause of gout; never of rheumatism. Sauvages calls gout *dolor articulorum*, and the rheumatism *car-*

nearum partium ; Boerhaave places the rheumatism entirely in the ligaments "*Juncturas quorumque artuum obsidit.*"

The rheumatism appears to be an accidental disease, not owing to any particular predisposition, or propagation from parents to children. It is topical and never affects the nervous system. The gout is, on the other hand, a constitutional disease, is general, and affects the viscera and nervous system. Dr. Cullen says, "A rheumatism is a pain in the joints, commonly inflammatory, and, so far as it is so, affecting the other parts at the same time, free of any peculiar acrimony, or with any tendency to Hæmorrhagy. By being inflammatory, I mean it is attended with fever ; but I have added commonly, because authors have divided it into acute and chronical ; and frequently, in the latter, there is no fever present."

"I have in this definition added, that it is only in consequence of the inflammation attending it, that it affects the system in any other part but the joints, to distinguish it from the gout, which has a particular connection with the viscera."

The seat of the rheumatism has been placed, by some writers, in the slender radicles of the lymphatic vessels. Arteries have a two-fold termination wherein the blood in one instance is conveyed into continuous veins ; another termination is in secerning extremities, which pour forth

for the purposes of moistening and lubricating internal surfaces a suitable secretion, from the accumulation of which, in undue proportion, there are provided a series of vessels, the absorbents or inhalents, and from the regularity of functions subsisting between these exhalents and absorbents, depends the healthy state of our frame. Among these vessels some place the seat of rheumatism. By reasoning on these vessels, it is contended, that as the lymphatics about the joints usually run more superficially than in other parts, and as we there generally find fewer collateral branches, obstruction may perhaps really happen more frequently from cold in those parts than in others; but should it be otherwise, yet from the paucity of vessels, and the consequent difficulty in the transmission of their fluid, when those vessels have been constricted, obstruction must from any common cause be oftener there produced, accumulation must take place, and tumour, heat, redness, and pain must follow. This places before us an exceedingly plausible reason, for supposing the rheumatism to reside among these vessels, as it accounts for the joints being so frequently affected in this complaint.

It occasionally happens that cases occur, wherein we may mark a developement of the several causes acting on different parts of the body, and wherein we may trace the intervening series of phenomena producing remote local effects, which

effects either alternate with each other, or are subdued by the production of succeeding symptoms. Rheumatism has in this way appeared to be an effect produced by a cause operating at a distance from the seat of its peculiar systems. I saw this plainly marked in the case of a young man, who, when in perfect health and strength, caught cold from exposure to cold and damp. Violent rheumatic pains invaded the joints of his lower extremities, attended with tumour, redness and heat. One joint after another became affected, and the usual alternation between the parts disordered, took place, regularly announcing the disease in question. Two days after the attack, these arthritic pains left him almost suddenly, and a profuse bleeding of the nose came on. Here there was a marked determination of blood to the head. He was bled largely from the arm, and the bleeding from his nose ceased. During this part of the complaint there arose, as we might expect, further proofs of the fulness of vessels about the head, some stupor, coma, and delirium. Purgatives of calomel and cooling medicines were ordered, and a decided jaundice appeared, with some tenderness and pain about the region of the liver. Blisters were now applied to that region, and more blood was locally taken away. By continuing a laxative plan the jaundice disappeared, which took place when the head was relieved, and the affection of the head succeeded

the removal of the rheumatic pains. He perfectly recovered, and has not had, for several years, the slightest return of any of the above symptoms. Here we have a series of symptoms which may be all, I think, with propriety referred to the liver. Obstruction in that viscus, by which the due circulation of the blood may have been impeded, will account for a superabundance in distant parts, and the first determination shewed itself in the joints. The balance being again destroyed, this morbid symptom ceased and gave way to the fulness in the vessels of the head. The vessel breaking in the nose, relieved the head, and, perhaps, by the effects of the medicine, the hepatic action took place, and the blood passed more freely through the vena portarum. A great secretion of bile occurred, and the jaundiced effusion followed.

Had no fresh determination taken place in this case, or had the rheumatic affection of the joints been sufficient to remove the cause, without the necessity of a more extended effort of the natural powers, for I contend that these natural efforts are salutary, the liver might never have shewn its disease, nor the head have been at all affected, but rheumatic injury might have taken place in the joints, and he might have been a martyr to this disease. Had the completion of the cure been left to the joints, they might have been permanently and radically injured.

Dr. Heberden mentions, that one of the worst rheumatisms which he remembered, immediately succeeded a most profuse bleeding of the nose, which continued so long, as almost to exhaust the patient, and to bring his life into imminent danger. He says, he observed something like this to have happened in a second instance.

A young lady went to church in very cold and damp weather, and on her return home was seized with rigors, succeeded by heat, announcing that she had caught a violent cold. Her knees, ancles, and joints generally were affected with pain, tumour, heat, and inflammation. Antiphlogistic medicines were given and she became free of her rheumatic symptoms. On the disappearance however of the local disorder of the joints, she began to shew symptoms of disease about the head; and twitchings and motions about the head, neck and arms, announced a true case of chorea sancta viti. Although her bowels had been duly attended to, and the evacuations were apparently healthy, yet even in opposition almost to the intreaties of her friends, who feared the production of debility, purgatives, of rather an active nature, were ordered and frequently repeated. Prodigious large and foul evacuations were the result of this plan, and in the end a perfect cure was effected. The amendment was discernible as soon as the bowels discharged their office in a regular and healthy manner, and the evacuations

changed from a clay colour to a properly tinged state. Here again I contend, that the rheumatism arose from a remote cause, and that the determination of blood to the joints and to the head formed two symptoms of one and the same disease. A multitude of cases, where from the blood's loitering in the vena portarum, or from obstructions in the liver, symptoms arise very remote from each other, could be adduced; but it is my intention in this place, only to insist on this being sometimes the cause of a regular rheumatism.

Epileptic convulsions are frequently produced by biliary or alvine obstructions, and it is satisfactory to see, that the violent concussions of that disorder, will often dislodge the cause existing in the bowels, or remove the obstructions elsewhere situated.

The Stahlians imagine all diseases arise from Plethora, and are attended with a tendency of hæmorrhage; and hence a kind of disease is established by them, which they call a congestion, when this tendency is not sufficient to bring about the hæmorrhagy; and of this kind, say they, is the rheumatism, where the molimen hæmorrhagicum is not sufficient to produce an actual discharge of blood.

The immediate cause of rheumatic pains may arise from the affection of the lymphatics of the joints, but the real and efficient cause, which gives a permanency to the symptoms, exists at a distance.

I shall have occasion, when treating of bilious disorders, to shew, that an inactivity of action may arise as much from a diminished power in the heart as from obstruction, or torpor in the liver itself. It is therefore probable, that whatever diminishes the force of the general circulation, may occasion rheumatic pains after exposure to cold and damp, as well as diseases of the liver. This is particularly observable in those cases where low living and poverty conspire to produce this disorder.

I have brought forward my reasons for believing that the brain, the liver, and the joints, may successively be acted on and affected by the same cause, and I have drawn such conclusions from a very general view of the construction of the human frame. Deeper anatomical research will, I conceive, further illustrate the position, that the primary organs of the body have a great and mutual dependance on each other; for instance, in those functions dependant on the action of the heart and those almost inscrutable powers proceeding from the brain. The *modus operandi* must for ever be hidden from human investigation, we can only remark, where there is an uniformity of action, and there we can only fix according to our conceptions, a law of nature. The circulation of the blood is demonstrated, and the organization of the parts, to which and through which the blood flows, is clearly developed. The

brain also, with the nerves proceeding from it, clearly points out to what parts it extends its influence; and the provisions which are made in the system of the nerves, explain the importance that many organs have in the general constitution of the body. It often happens that debilitating causes will produce local congestions, and that an inflammatory character will often be presented to our observation, in disorders where the great moving powers are weakened. Both gout and rheumatism afford examples of the above facts, and a mode of practise has been particularly established, by very eminent practitioners, on this principle in the latter disorder. Although unconnected apparently with rheumatism, it may be considered a pardonable digression to introduce a case where the heart itself was the remote cause of a great variety of symptoms, and wherein we may trace how often it may happen, that consequences may arise at great distances from the primarily affected organ. I had the painful task of witnessing all the symptoms of the case, and friendship added the strongest motives for every exertion in behalf of the patient. A gentleman, whose ordinary health kept apparently beyond the reach of any sudden indisposition, was one morning, whilst under the hands of his hair-dresser, suddenly attacked with an epileptic fit. By the time I reached him, he was so far recovered from it as to have an indistinct perception of external objects. In the course of the

day he had a second and a third attack, for which he was blooded and blistered, and effectually acted upon by purgative medicines. He was variously affected during this and the succeeding day, at one time shewing signs of fulness about the head, with flushings of the face and other indications of congestion, at other times he was pale and sunken in his countenance; and the pulsations of his heart, which at first were strong and bounding, became at other times, languid and slow. The indication for profuse blood letting was not certainly strongly marked during the continuance of the epileptic paroxysms. Being himself of the medical profession, and being on terms of friendship with all his brethren, he was quickly supplied with every assistance that could be afforded. Proportionate relief was therefore expected to follow the means which were so soon at hand, and so soon put in practise, for there was no emergency that occurred, that was not met by a corresponding zeal for his welfare. Of the epileptic attack he appeared to be completely recovered, and for weeks, excepting the being, under such precautions as were necessary for averting a recurrence of the disorder, he acquired a convalescence, wherein his usual vivacity again broke forth, and wherein his mind, by being persuaded that the blow had passed off, resumed nearly its usual character. During this apparent convalescence, however, there were occasional misgivings of his mind respecting his safety; which were

met with such corresponding observations of hope as for a time to operate on him. The most eminent of the faculty joined in endeavouring to rally him from under such morbid anticipations and apprehensions. It must here be remarked, that none of the circumstances denoting organic injury were to be detected, and for a month or more, he had not the slightest symptom of the epileptic kind. He ate well, but with moderation, and his sleep was natural and apparently refreshing, for I usually saw him daily on my first going out in the morning. He had all the appearance of a confirmed and regular convalescence, for the result of every consultation on his case was, that no symptom of disorder could be discovered on which to affix the character of a real disease. When in this state and whilst walking about his room, he fell down and instantly expired.

On dissection no morbid cause could any where be discovered but in the heart, which was much enlarged and flaccid.

In reasoning on this case it may be proper to advert to his ordinary habits, and it must be mentioned that at one time he had some gouty affection. Apparently healthy and well-looking he was not considered as an invalid, though he complained occasionally of fulnesses about the præcordia, and was in the habit of striking his breast as if to remove some uneasiness. He was much in the habit of taking aperient medicines, and he held

a doctrine that the fear of even large doses of drugs was unfounded, and he would often make trial of the effects of them, before he administered them to others. He was also frequently attempting the removal, in his own person, of some imaginary or real obstruction. I mention these circumstances to shew that his habits were enervating and lowering. During his last illness, we were several times cheered with the hope that a regular fit of the gout would come on, for his joints swelled and were painful, and he had a considerable degree of inflammatory redness on the joints of his foot.

Morgagni mentions cases of asphyxia and sudden deaths arising from an enlarged and relaxed heart; "For," says he, when speaking of an instance where sudden death was produced by this cause, "what can a heart so much enlarged do, when the fibres of it are weakened, but admit a greater quantity of blood than it is able to expel? It must, therefore, necessarily be filled, and consequently become still more relaxed. And when it is more relaxed, it will throw out a less quantity of blood into the arteries, and with less force, from whence the smallness and weakness of the pulse will arise. But the laxity of the fibres of the heart, even when not macerated in the water of the pericardium may sometimes be so great, that only the heart may, by degrees, acquire an

enlarged state, but that no pulse at all can, at length, be perceived."

I have insisted the more on the above case, as it tends to establish a fact which has been suggested to me by a great number of other cases, that fulnesses locally taking place may arise from a diminished force in the great moving powers of the body, and that arthritic pains and affections may be produced by the same cause.

The limits, Dr. Cullen observes, between the acute and chronic rheumatism, are not always exactly marked. "When the pains are still ready to shift their place; when they are especially severe in the night time; when, at the same time they are attended with some degree of fever, and with some swelling, and especially with some redness of the joints; the disease is to be considered as still partaking of the nature of the acute rheumatism. But, when there is no degree of fever remaining; when the pained joints are without redness; when they are cold and stiff; when they cannot easily be made to perspire, or when, while a free and warm perspiration is brought out on the rest of the body, it is only clammy and cold on the pained joints; and when, especially, the pains of these joints are increased by cold, and relieved by heat applied to them; the case is to be considered as that of a purely chronic rheumatism."

Dr. Cullen says, "He cannot find either evidence or reason for supposing that the rheuma-

tism depends upon any change in the state of the fluids; and he concludes, that the proximate cause of acute rheumatism is commonly the same with that of other inflammations not depending upon a direct stimulus." In opposition to this opinion of Dr. Cullen, and to prove that there is a peculiar character in the inflammation of rheumatism, Dr. Heberden observes, that "The degree of fever denoted by the quickness of the pulse, does less injury to all the powers of the body and mind in the rheumatism, than in any other distemper; for what might be considerable enough to make others lose their senses, will scarcely make these patients lose their appetites, or shew much sign of distress or of sinking under their illness."

Dr. Falconer also says, that "At its first attack, and often at several of those succeeding, the rheumatism is accompanied with considerable signs of fever and inflammation. The heat of the body is much above the natural degree, and the pulse strong and quick, often to 120 strokes or more, in a minute, with the tongue commonly white, and sometimes, though not generally, rather dry; but the head-ache, deprivation, or weakness of the mental faculties, prostration of strength, want of sleep, unless from pain, and failure of appetite, do not, as Dr. Heberden observes very justly, take place in nearly the same proportion as they do in most idiopathic fevers."

In the case of rheumatism, Dr. Cullen sup-

poses, that the most common remote cause of it, that is, cold applied, operates especially on the vessels of the joints, from these being less covered by a cellular texture than those of the intermediate parts of the limbs. He supposes, further, that the application of cold produces a constriction of the extreme vessels on the surface, and at the same time an increase of tone or phlogistic diathesis in the course of them, from which arises an increased impetus of the blood; and, at the same time, a resistance to the free passage of it, and consequently inflammation and pain. Further, he supposes, that the resistance formed, excites the vis medicatrix to a further increase of the impetus of the blood; and, to support this, a cold stage arises, a spasm is formed, and a pyrexia and phlogistic diathesis are produced in the whole system.

According to this mode of reasoning, we should be led to imagine that the rheumatism would be a disorder of very frequent occurrence, for by these principles we might expect an attack of rheumatism, whenever we were exposed to a severely cold atmosphere.

The causes producing this disorder, and the seat of the malady would lead us to conclude that the injury was directly perceived in the parts affected. Exposure to cold and dampness when the body is heated; being affected by a current of air after exercise; sleeping in a damp bed;

clothes kept on after being thoroughly wetted, are usually the causes of this disease. Most authors agree, that fever, with its accompanying symptoms of heat, shivering and restlessness, precedes usually the pains of the joints, which then become swelled, look red, and are shining and glossy. From which it would appear, that the *vis medica* trix was not called forth by the local affection of the joints.

Rheumatism has different appellations, according to the part it occupies, as lumbago, sciatica, &c. but I by no means agree with those who in directing the cure, assert that the only difference consists in the simple distinction of the disease into acute and chronic rheumatism. There are no indications to be fulfilled by the Bath waters in the highly feverish state of acute rheumatism; and it is here only noticed as leading on to the chronic rheumatism, which is a disease of great extent, involving a vast variety of symptoms. As it affects the great moving parts of the body, its appearance is very various, and in consequence of the morbid enlargement of parts which it occasions, it not only produces an altered sphere of action to the limbs, but great changes arise from the pressure of these enlarged parts in the functions of many important organs. Every kind of tortuous action is brought on by this disease, and the powers even of locomotion are withheld by it. The limbs are thrown into the strangest attitudes, and the

healthful and erect posture of the body gives way to deviations the most unfavourable to their action. The causes which originally produce the acute form of this disease, are often found to occasion chronic rheumatism. I have mentioned many points wherein the diseases of the liver and the joints agree, and I have attempted to explain, in some measure, the reason of this agreement. The rheumatic pains which result from the use of mercury, and the power which that mineral possesses over some cases of rheumatism, furnish still further arguments in favour of that opinion. It has very fairly been questioned, whether the seat of this complaint be not in the muscles, and whether the joints be not disordered only in consequence of the muscular affection, as the muscles are in general inserted there, and the pain is always observed to be most acute where they rise or terminate. The experience which I have had of this disorder, would lead me to conclude, that no two diseases, however dissimilar, can be more opposite than some reputed instances of chronic rheumatism. Those forms of the disease, known by the names of lumbago and sciatica, where the one seems clearly seated in the muscles of the back, and the other to be a disease of the sciatic nerve, are extremely different from those rheumatic affections where the joints of the wrists are so much enlarged and diseased. The rheumatic pains also, which arise after long courses of mer-

cury, are very different from those diseases of the articulations which threaten and so often produce anchylosis. Some authors reprobate the idea of there being any necessity for altering the practice according to the situation of the rheumatic affection; if there is general fever throughout the system, and great pain, with tumour of a part, it is certainly not material with respect to the curative intention, whether it may be seated in the loins or the shoulders, in an arm or a leg, an upper or a lower extremity; but in the chronic form, without fever, it is of the utmost importance to attend minutely to the seat of the disorder, not only on account of the reference the disease bears to the general constitution, but from the mischief that may be likely to ensue from the local derangement. Another argument for supposing that a great difference obtains in the causes producing rheumatism, according to the parts wherein it resides, is the great contrariety observable in the recommendations given by different authors of medicinal applications, and here we could hardly dare to speak of the Bath waters as a remedy in this complaint, were not the assertions of some great authorities opposed successfully by other writers, or by our own experience. Dr. Heberden says, that he has remarked some instances, in which warm bathing seemed prejudicial, but not one, in which it did any good in either species of this distemper.

Dr. Falconer gives the number of patients received into the Bath Hospital, from May 1, 1785 to Nov. 19, 1793, who were admitted for this complaint, viz : 444.

Of these were cured	154
Much better - - -	167
Better - - - - -	65—386
No Better - - - -	53
Dead - - - - -	5—58

Total 444

It would be endless to enumerate the plans of cure that have been recommended in this disorder. A specific cannot be expected for a disease which appears of so various a character.

It has often occurred to me to observe, the treatment judiciously and successfully carried on, with medicines of a diametrically opposite nature, in different habits, affected with apparently the same complaint. If the rheumatism should arise constitutionally from weakened power in the circulating system, and if no fever be present, tonics, such as bark and steel, may fairly be given; here the internal use of the Bath Waters may be recommended, and, as in gout, the weakened powers may be renovated by this mild chalybeate. If the disease arise from exposure to cold and damp, and great febrile reaction take place, the antiphlogistic plan with antimonials afford relief.

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render us less susceptible of those diseases, which, under such circumstances, are to be apprehended. I find that Dr. Falconer has a remark to that effect; he says, "Observation leads us to think, that a liberal and even free diet of those who are most exposed to the causes which produce rheumatism, provided such indulgence does not degenerate into intemperance, tends rather to prevent than invite attacks of rheumatism. Warm food and fermented liquors, if not taken in over proportion, form the best defence against cold and moisture, by supporting the strength and keeping up a regular perspiration; and it is owing in no small degree to such accommodations, that hospitals are enabled to remedy the bad effects such hardships are apt to occasion." However powerful the reaction of the system may be to overcome the evils resulting from exposure to the severe changes of weather and temperature, and besides the possibility of its going beyond a point where the system may rally, yet that very reaction constitutes disease; and local congestions, with inflammation in the joints, as well as latent diseases of the lungs are called forth and occasioned. A liberal and free diet would, I am persuaded, meet the evil, and enable the constitution by this acquired force to resist, in an eminent degree, such causes of disease. This object would be defeated by intemperance, but it is a

difficult matter, on such occasions, to draw the precise limits of the cardinal virtue.

I shall, hereafter, make it a subject of inquiry, how far certain enlargements of the joints, which are supposed to arise from this disease, and which are so frequently observed among people at an advanced period of their lives, tend to renovate the powers of the heart and to prolong human existence; for I contend that life is preserved by many diseases, and that the human frame is necessarily subject, by an established order of phenomena, to such changes in its constitutional arrangements, for the prolongation of its existence.

As the chronic is the state of rheumatism, in which the Bath Waters are peculiarly recommended, it is necessary accurately to determine the exact state of the disorder under which the patient labours. Acute rheumatism has a variety of gradations, and runs so imperceptibly into the chronic, that there is often a difficulty in distinguishing them. The chronic rheumatism is not attended with fever, and blood drawn in this disorder shews no sign of inflammation. The affected part does not retain its redness which marked its acute form, and the swelling often subsides. Though heat may aggravate some cases of chronic rheumatism, yet when such aggravation does not arise from heat, we may pronounce the disease not the acute. There is a rigidity and torpor in

the parts affected by this state of rheumatism, and a degree of paralytic affection sometimes attends it. Indeed it would appear as if palsy and rheumatism depended on a similar cause, for the former is often preceded or attended by the latter, and here we have another argument, for supposing the disorder of the joints to have a remote cause, to which I shall particularly advert when treating of paralytic affections. It is not easy to determine how the acute rheumatism produces any paralytic tendency, or torpor in the chronic, but we may presume, as nature is uniform in her operations, we may be able to trace the intervening links, when we have investigated the phenomena of the two diseases.

Dr. Cullen observes, that "We commonly consider the sensorium as always active with respect to the organs of motion, and passive as to those of sense. Instances, however, could be produced where the contrary of both happens, namely, the organs of motion communicate effects to the sensorium, and the senses are acted on by it. Now this being the case, resistance at the nerves of motion may be propagated to the sensorium, and palsy by those means may be produced." This particularly occurs in cases of arthritic affection where great local disease has been produced, but I should imagine in general, that the brain was the medium by which the morbid cause acted on particular parts, and that in this office it became

itself affected, as will be shewn when we attempt to explain the nature of palsy.

To remove the local obstruction in chronic rheumatism seems to be the first indication of cure, and this is to be effected both by giving a general activity to the vessels of the body, and by exciting those of the part. Whatever therefore is debilitating must protract the cure, and bleeding, which in the acute form of the disorder may under certain limitations be admitted, in this seems improper. Bleeding, however, is of dubious efficacy, even in states of rheumatism, where inflammation may be suspected, for though there may be much inflammatory crust observable in blood drawn from patients labouring under acute rheumatism, the disorder by no means relents on pushing that remedy to any extent similar to what is required in other inflammatory complaints. Irreparable injury arises from too much bleeding in this disease, for not only are states of chronic rheumatism, which are incurable, brought on, but it is very probable, that there would be a greater quantity of gelatinous exudation where patients have followed a very lowering plan.

Morgagni mentions, that on the dissection of a rheumatic patient, Drelincourt found a jelly concreted on the surface of the muscles, equal to two or three ducats in thickness. This gelatinous substance is far different from those depositions which take place in consequence of great inflam-

matory action. Topical bleedings with leeches, &c. are, however, often required in diseases of the joints, though they may not be attended with general fever, particularly in recent cases of chronic rheumatism. Stimulants of various kinds are recommended for this disease, and nearly the same internal remedies are required for rheumatism as for palsy. Sudorifics, as Dover's powder, guaiacum, volatile alkali and antimonials are used with advantage, when suited to other constitutional circumstances of the case. Great stress has always been laid on external remedies. Dry cupping, blisters, and even cauteries have been found of use, and every kind of acrid and stimulant substance has at one time or another been tried. Fomentations, poultices and the warm bath may be all ranked together as their principal operation is by their heat. Baths of warm water are of excellent use, as are those of the mineral thermæ, as Bath and Buxton in England, Aix in Germany, &c. which are remarkable for curing the disorder in question.

There are various modes of applying the Bath Waters in this disorder, and the first and most advantageous method is by regulating the temperature of the waters. In no other disease is there the necessity of attending to the degree of heat to the same nicety as in rheumatism, for a bath of a high temperature usually increases the complaint or protracts the cure. Buxton has been

supposed to have an advantage over Bath in this respect, as its waters preserve a lower temperature; but it may be observed, that at Bath every mode is adopted for regulating the temperature of the waters, as Baths can be obtained at every necessary degree of heat. Besides, at Bath, the douche, or dry pump, as it is called, can be easily applied locally, by which the relaxing, or otherwise hurtful effects of warm bathing, can be completely obviated.

In the second part of this Treatise I intend to describe the phenomena attendant on palsy, bilious disorders, cutaneous affections, and such other complaints, for the cure of which the Bath Waters are celebrated. In the course of which I shall attempt to explain, from the real anatomical connection between distinct parts, the causes of many of the symptoms which constitute those diseases, and to prove that great local injury is often caused by efforts destined to remove distant affections.

It will be more necessary in treating of the diseases, included in the second part of this work, to point out the anatomical structure, as the only groundwork of pathology, than in the disorders which are included in the foregoing pages; and as illustrative of that view of medical practice which is there described.

No disorders could be more adapted for such an inquiry, than those which form the subject of this

Treatise. The constitutional character of palsy, and the importance of the liver to the animal frame, involve subjects the most illustrative of the laws which regulate the body. I shall shew reasons for believing that many affections which are generally referred to the liver, are not caused by biliary obstructions, or by an affection of the digestive organs, but that the liver, the stomach, and the chylopoetic viscera are secondarily disordered, and that the medicines now so commonly recommended for such obstructions, fail of their object. Since the present practise of medicine has authorized the use of minerals of the greatest power, it may not be amiss to consider how far they are admissible in the treatment of the above diseases; for should it be proved that their present repute stands on an untenable foundation, we may be, in some measure, relieved from a practise that under even the best circumstances, must be attended with hazard from exhausting animal power; or we may learn to appreciate the precise point where such a necessity exists. We have daily instances to prove the failure of remedies which, from their powerful operation on the human body, ought not to be of dubious efficacy; and we may be led to dispute the universality of a remedy as inconsistent with philosophical or medical accuracy. There can be no doubt of the power which mercury possesses over the secretion of the bile; but it may be a question, when there

is a deficiency of that essential fluid, whether medicines acting on the liver be appropriate or safe; particularly when we consider that the deficiency in the secretion from the liver, may be only an effect from diminished power in some other important organ, as the heart or brain. The reaction of the system in expelling and resisting medicines of such force, as some of the preparations of mercury, may be a source of exhaustion, which may leave a more prejudicial effect than what the disease may occasion, and may so far diminish the powers of life as to render restoration difficult.

In the second part I also intend to treat particularly of warm bathing, and of its applicability to the several symptoms of the disorders which I have described. I mean likewise to explain the different methods that are adopted for applying the waters, as in the public and private baths, by the douche, by steam, and by injection; and, as far as is in my power, to complete the History of these celebrated thermal Waters.

END OF PART FIRST.





