

Experiments and observations on the Horely-Green Spaw, near Halifax. To which is added a short account of two other mineral waters in Yorkshire / [Thomas Garnett].

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EXPERIMENTS
and
OBSERVATIONS
on the
HORLEY-GREEN SPAW,
near
Halifax.

To which is added
A SHORT ACCOUNT
of
TWO OTHER MINERAL WATERS,
in
YORKSHIRE.

BY
THOMAS GARNETT, M. D.
Late President of the Royal Physical and Natural History Societies,
and Member of the Royal Medical Society of Edinburgh, &c.

Justa confessione, omnes terræ quoque vires aquarum sunt beneficii.
Quapropter ante omnia ipsarum potentia exempla ponemus. Cunctas
enim quis mortalium enumerare queat? PLIN.



BRADFORD,
YORKS.
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LONDON.
1790.

EXPERIMENTS

ON OBSERVATIONS

HORLEY GREEN SPAIN

A NEW ACCOUNT

OF THE MINERAL WATERS

IN SPAIN

BY

BY

THOMAS CARLISLE, M.D.

Physician to the Royal Hospital of St. George, London,
and Lecturer of the Royal College of Physicians.

LONDON: Printed by J. G. ALLEN, at the Royal College of Physicians, 17, Pall Mall, 1825.

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1825.

TO

JAMES CROWTHER, M. D.

Physician to the General Infirmary at Leeds, and Member of the Royal
Medical Society of Edinburgh,

AS A SMALL TOKEN OF RESPECT AND GRATITUDE,

THIS TREATISE

is

INSCRIBED

by

The Author.

Bradford,
February 20, 1790.

TO

JAMES CROWTHER, M.D.

Physician to the General Infirmary at Leeds, and President of the Royal
Medical Society of the County of Yorkshire

AS A SMALL TOKEN OF RESPECT AND GRATITUDE

THIS TREATISE

INSCRIBED

The Author

London,
February 20, 1807



EXPERIMENTS & OBSERVATIONS

ON THE

HORLEY-GREEN SPAW.

THE analysis of mineral waters has, with great reason, been looked upon as the most difficult part of chemistry; because it requires a complete knowledge of all the chemical phænomena, together with a peculiar address in making experiments. The tests, likewise, which are used to discover the principles contained in these waters, are liable to much uncertainty; because their action does not indicate, in an exact manner, the nature of the substances dissolved, and we are often ignorant of the causes of changes

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produced

produced in those fluids by their admixture: in fact, the saline substances, which are generally employed in analyzing mineral waters, are capable of producing a great number of phænomena, concerning which it is difficult to give a decided opinion. However exact we may be in our investigations, and whatever degree of purity is possessed by the different substances which we mix with the mineral waters, in order to discover their principles; if it be granted that each test is capable of indicating two or three different matters dissolved in the waters, a doubt will always remain concerning the result of their action. To illustrate this by an example, we know that lime attracts the aëreal acid: it precipitates the salts with a base of clay and magnesia, and also the metallic salts; the volatile alkali has the same effect; and the fixed alkali precipitates besides these salts, those with a base of lime. Lime-water saturated with the colouring part of prussian blue; the prussian alkali, and the spirituous tincture of the gall-nut precipitate vitriolated and aërated iron; the nitrous solutions of silver and mercury

mercury decompose all the vitriolic and marine salts, several of which may be found in the same water, and these solutions are themselves decomposed by the alkalis, chalk and magnesia. Among this great number of complicated effects, the difficulty of accurately distinguishing the different results, and whether they are simple or compounded, can only be conceived by those who have been engaged in making such experiments.

Though evaporation has been looked upon as one of the most certain methods of obtaining the principles of mineral waters, yet it is liable to considerable uncertainty ; since the heat which is employed to evaporate them, however feeble it may be, may produce sensible alterations in their principles, and so alter their nature, that their residuum, examined by the different means which chemistry furnishes, will yield compounds quite different from those which the waters held in a state of solution. The loss of the gaseous substances, or aëriform fluids, which often form one of the active principles in mineral waters, chang-

es their nature in a singular manner; and besides, the precipitation of several substances, which owe their solubility entirely to the presence of these volatile fluids, may produce a reaction between the precipitates which will alter their properties. The phænomena of the double elective attractions which heat is capable of producing between compounds which have no mutual action in the cold, are not to be comprehended without a numerous set of experiments, about which we have, as yet, nothing but conjectures. These observations show that we cannot entirely depend either on tests or evaporation, yet by a judicious and careful use of both, we may, in general, ascertain, with considerable accuracy, the principles contained in mineral waters.

From a view of the abovementioned difficulties, it will not be surprising if some errors are found by the experienced chemist, in the following analysis; though, I hope, they are very few. My apparatus, indeed, was not so convenient as might have been wished for; but the experiments

ments were performed with every possible precaution, and were several times repeated: the tests, likewise, which I used, were the purest that could be procured, and the least liable to exception.

The water which is the subject of this Essay, springs from the side of a hill, at the distance of about a quarter of a mile from Horley-green, the residence of J. Drake, Esquire.* It is about a mile and a quarter distant from Halifax. The spaw has been but lately discovered, and its medicinal powers still more lately ascertained. The great benefit derived from it in many diseases, and the great numbers who have come to drink it, have induced Mr. Drake to build a house for the accomodation of invalids, which is
in

* This family has long been in possession of Horley-green. Watson, in his History of Halifax, gives a pedigree of it; which, he says, is such as, for antiquity and authenticity, will not often, in private families, be exceeded. Shibden-hall seems to have been the old family estate, but was disposed of some time in the reign of Henry VIII, by Thomas Drake, of Horley-green. The famous Sir Francis Drake was a branch of this family.

in great forwardness, and will be finished early in the spring. It stands on the side of a steep hill, about forty yards distant from the spaw, and its situation is the most romantic that can be conceived. Surrounded on all sides with woods, forming almost a circle round it, whose radius does not exceed more than twenty yards, it seems a little paradise. From the spaw to the house, Mr. Drake intends to make a serpentine walk, and the circular space round the house is to be planted with shrubs, which will form a great addition to the beauty of the place.

Though the house is so closely surrounded with trees, many of which are evergreens, which give a beautiful variety to the verdure of the spring, and which make a kind of spring in winter, when other trees are stripped of their foliage; yet the building is not deprived of an extensive prospect. It stands on a rising ground, overlooking the trees that surround it below, and commands a most grand and romantic prospect down the valley towards Wakefield; where, for
near

near twenty miles, the eye is charmed with the alternate view of hills and valleys, the former of which are covered with wood, or highly cultivated to their summits, and the latter are interspersed with numerous villages and country seats; and the number of little rivulets which fall into them from the neighbouring hills, being turned by the farmers into their grounds, and made to overflow almost every part of them at pleasure, produce a verdure, even in winter, scarcely any where else to be found.

The spaw is at a pleasant distance from Halifax, where they who wish to drink the water may meet with every accomodation; and it is probable that those who think the distance too great, may soon be accommodated with lodgings at the houses in the neighbourhood of the spaw.

The baths at Halifax are excellent, and as cold bathing (as will afterwards be more particularly noticed), cooperates with the water in strengthening the constitution, they will be found

found very convenient by the invalids who resort to that neighbourhood for the benefit of the water. Indeed a bath may be very easily made near the spaw, into which common or spaw-water might be admitted at pleasure.

The roads from Halifax to the spaw, are not, it must be confessed, so good as might be wished; but, if the reputation of this water continues to increase for some time as it has hitherto done, it will certainly be an inducement to make the access to it more pleasant and convenient.

The soil in the neighbourhood consists chiefly of clay, and the bowels of the earth abound with various minerals. Various ores of iron are to be found, and particularly pyrites; which substance is so plentiful, that some works for obtaining green vitriol from it have been erected in this neighbourhood. The pyrites having been moistened, and exposed to the air for some time, suffers a decomposition: the empyreal part of the air (to speak in the modern language of chemistry),

try), uniting with the sulphur, forms vitriolic acid, which dissolving the iron, forms the green vitriol, which is dissolved in water and evaporated, to obtain the salt in the form of crystals. The great quantity of vitriolic acid formed in this manner, running over different substances, and uniting with them, forms various chemical compounds. The great quantity of clay which is found among the veins of the minerals, renders it probable that there may exist some considerable stores of alum, in the form of ores; some of which may, perhaps, contain alum already formed, and others its proximate principles, which would unite on roasting. As alum is a very valuable commodity, and particularly in this country, it would be worth while to pay some attention to this subject. Mr. Bergman, in his Physical and Chemical Essays, has given us an excellent dissertation on the preparation of alum, which will be found very useful to those who wish to examine this matter. If my other engagements will permit me, I hope to be able to pay some attention to it next Summer.

Coals

Coals are found in this neighbourhood, in very great plenty; there being mines or pits on almost every side, from which the town and neighbourhood of Halifax are supplied with this necessary article.

The water deposits a kind of brownish ochrey earth, on the bottom and sides of its channel, in considerable quantity. The deposition is least at first, and increases as you go from the spring head, for some distance. About twenty yards below the place where the water first makes its appearance, a large quantity of ochrey matter is deposited, in a spongy form, which makes a kind of bog, and is very elastic. This deposition when analyzed, is found to be composed chiefly of iron; a small quantity of gypsum or selenite is also mixed with it. This matter, which the water deposits, is so considerable as to give colour to the bottom of a rivulet which runs along the valley, and which is known by the name of *Red-beck*. There are several other springs in the neighbourhood, which seem to resemble this, in taste; but
none

none of them seem so proper for medicinal purposes. I have analyzed several of them, and find that they contain a small quantity of iron, but trifling when compared with that which is the subject of this Essay; and most of them contain a very large quantity of selenite, which occasions a disagreeable and heavy sensation in the stomach, and frequently sickness. The bottoms of the channels of those springs which contain little iron and much selenite, are covered with a whitish crust, which proceeds from the deposition of the selenite.

The Horley-green water, when taken up at the spring head, is quite pellucid;----sparkles, when poured out of one glass into another;----and has a sharp, aluminous, styptic taste, not unlike ink. The taste is not unpleasant, when the water is taken from the spring head, and drank immediately; but if it be taken up a few yards only from the source, its taste is more disagreeable, and it is not so clear; the same happens, if the water which is taken up at the spring head is kept

kept in an open vessel for some time. The reason of this will be better understood after we have examined the changes which the water undergoes when exposed to the air.

The water on which I made the following experiments, was taken up from the well only the day before, and sent to me, at Bradford, in bottles, well corked and waxed.

EXPERIMENT I.

A few drops of tincture of galls being mixed with a quantity of the water, a colour as black as ink was instantly produced.

This experiment shows that the water contains iron.

EXPERIMENT II.

When *salited terra ponderosa* is dropped into the water, the mixture immediately becomes turbid, and of a milky hue, and a white sediment soon falls to the bottom.

. This

This experiment shows that the water contains vitriolic acid, since the salited terra ponderosa discovers the smallest portion of that acid, with whatever substance it may be united; because the vitriolic acid has a greater affinity or attraction for the terra ponderosa than for any other substance, and separates it from all the other acids, forming with it a spathum ponderosum, which is scarcely at all soluble in water.

EXPERIMENT III.

Paper tinged by saturated tincture of *turnsole*, when dipped into this water, is immediately changed to a red colour. Syrup of violets being mixed with the water, the colour inclines a little to a faint green, but very nearly the same colour is produced on mixing syrup of violets with common water.

From this experiment with the tincture of *turnsole*, it is evident that the water either contains an acid, or a salt in which the acid is superabundant, and which has the power of changing
paper,

paper, tinged with this tincture, to a red colour, such as *alum* and *sal martis*. Syrup of violets is by no means so delicate a test of the presence of an acid as the tincture of turnsole, even when it can be procured genuine; but, in general, the syrup sold by the druggists and apothecaries, is nothing but simple syrup, coloured by blue-bottle* or some other vegetable. But Mons. de Morveau has taught us how to distinguish the genuine from the spurious syrup, viz. by a solution of corrosive sublimate, which changes the former to a green, while it reddens the latter. This method of detecting the adulterated syrup may be of use to those who wish to employ the syrup of violets as a chemical test, or who cannot conveniently procure the turnsole: and though, as a test, the syrup is inferior to the tincture of turnsole, yet when certainty can only be ascertained by the coincidence of many results, this additional instrument, which in some cases, shows properties different from other analogous reagents, ought not, though
contrary

* The *Centaurea cyanus* of Linnæus.

contrary to the opinion of M. Bergman, to be entirely thrown aside.

EXPERIMENT IV.

In order to see what changes took place, when the Horley-green water was exposed to the air, on the second of October 1789, I poured a wine quart of it into a glass vessel, and covered it with a piece of paper, to keep out the dust.

On the third, the water was not so pellucid as when first put into the glass, having acquired a yellowish tinge, but no precipitation had taken place.

On the fourth, the yellow colour increased, and there were some few brown clouds floating in the liquor: the surface of the water was covered with a very thin film or pellicle.

On the seventh, the styptic or aluminous taste of the water was much stronger, and very similar to that which is taken up at a considerable

ble distance from the spring. The brown clouds were increased, and adhered to the sides of the glass, and a quantity of fine yellow or brownish precipitate was to be seen at the bottom of the vessel.

On the fourteenth, the sharp aluminous taste was still stronger, and the quantity of sediment increased. Paper tinged by the tincture of turnsole, on being dipped into it, was changed to a deeper red than by the fresh water; and tincture of galls produced a black colour as instantaneously as with water just taken up from the spring, but not quite so deep.

October twenty-first, little or no alteration was perceived since the fourteenth.

EXPERIMENT V.

I procured a large Florence flask, which, by cutting a little off the neck, I made to hold exactly a wine quart: into this, by means of a cork, I fixed a very small tin tube, which, when it had
risen

risen about three inches above the neck of the flask, was bent, nearly at right angles, and continued straight for about three feet; it was again bent at right angles so as to point upwards, and continued in that direction about three inches; this extremity went through the bottom of a cylindrical tin vessel which held about a gallon, to which it was soldered. The flask was then filled with spaw-water, and the tin tube fixed into its neck, which was likewise filled with water; the cylindrical tin vessel was then about half filled with common water, and a phial, holding about eight ounces, was filled with the same liquid, heated almost to boiling, to prevent its absorbing any of the air which might pass through it; this phial was inverted, and placed over the end of the tube which came through the bottom of the tin vessel. I then placed the flask in a vessel of water over a fire, and supported the other part of the apparatus by a chair. As the water began to be hot, air-bubbles rose through the tube into the inverted phial, and occupied the upper part of it, displacing an equal quantity of the water. The flask was then taken out of the vessel and placed on the na-

ked fire ; it soon began to boil ; and when it had continued to do so slowly, for three minutes, the whole apparatus was removed from the fire, and the place where the water stood, in the inverted phial, marked with ink. I then closed the neck of the phial, while under water, with my finger ; and taking it out, keeping my finger still close over the mouth of the phial, I shook it, and immersed the neck in lime water ; part of the air being absorbed by the common water, during the agitation, a kind of vacuum was produced, and part of the lime water was forced into the phial by the pressure of the atmosphere. I then took it out in the same manner and shook it again ; the mixture immediately became turbid, and of a white colour. I immersed the phial again in lime water, and a little more was forced into it by the pressure of the atmosphere. I repeated this till all, or very nearly all, the air was absorbed. I then emptied the phial, and filled the part at first occupied by the air, with common water, which being accurately measured, amounted to four cubic inches and a half.

From

From this experiment it is evident, that a quart of the Horley-green water contains four and a half, or a gallon, wine measure, eighteen cubic inches of ærial acid or fixed air; which is far short of the quantity found in the Pyrmont and some other acidulous waters.

The water in the flask, during the experiment, became turbid, and of a yellow or brownish colour; but when it had boiled for a minute or two only, it deposited a quantity of powder, not unlike rhubarb; and the superincumbent liquor became clear.

EXPERIMENT VI.

In order to ascertain the quantity of this powder, I poured a wine gallon of the fresh spaw-water into a clean tin vessel, and placed it over the fire; it soon began to grow turbid; I let it boil for a quarter of an hour, which was a longer time than was necessary, for after it has boiled a minute or two only, it ceases to deposit any sediment.

When the water was cool, I drew off the clear into glass bottles by means of a syphon, till I was
come

come very near the bottom of the vessel ; I then filtered the remainder, and having dried the filter, and carefully scraped off the powder, I found the weight of it to be exactly one pennyweight.

EXPERIMENT VII.

To discover the nature of this powder, after it had been exposed for three weeks, to the rays of the sun, and frequently moistened during that time, I calcined it in a crucible, keeping it in a red heat for two hours ; the powder was changed from a yellow to a beautiful colour resembling rose-pink. I presented a magnet to it, and found that it attracted it very sensibly ; this convinced me that it contained iron. In order to separate the iron from the other matters which might be mixed with it, which most probably would be calcareous earth or magnesia, I put the powder into a phial, poured upon it a quantity of distilled vinegar, and let it stand twenty-four hours, having frequently agitated the mixture in the mean time. The distilled vinegar dissolves the magnesia and lime, but will not act upon iron which has been dephlogisticated by the rays of the sun,
or

or by calcination.* The liquor was then filtered, and having dried the powder on the filter, I found the weight of it to be exactly one pennyweight. The vinegar had consequently dissolved nothing. This powder which was not soluble in the distilled vinegar, was evidently iron; it was attracted by the magnet; and being dissolved in diluted vitriolic acid, it was instantly turned black by tincture of galls.

The water from which this sediment had been procured, had a stronger taste than fresh spaw-water, and was instantly turned black by the tincture of galls; a proof that, besides the earth of iron which it contained, it must also contain a martial salt.

EXPERIMENT VIII.

In order to ascertain the nature and quantity of the saline matter, I evaporated the gallon of water, which had deposited the powder above noticed, in a glass vessel to dryness; and found at
the

* Bergman's Physical and Chemical Essays, vol. I. p. 160, and Fourcroy's Elements of Chemistry.

the bottom of the vessel, a salt of a whitish brown colour, which had a strong, rough, aluminous taste. I found the weight of it to be twelve pennyweights and twenty-two grains.

EXPERIMENT IX.

In order to see whether this salt contained the marine or nitrous acid in its composition, I evaporated a pint more of the water, and obtained a proportional quantity of salt. On this salt I poured some concentrated vitriolic acid, but it produced no change that indicated the presence of either of those acids: if they had been present, it is well known that they would have been expelled by the affusion of the vitriolic acid; the nitrous acid would have been distinguished by its peculiar smell and red smoke, and the marine by its peculiar smell and grey smoke.* And since, in a preceding experiment with the salited terra ponderosa,† we saw that this water contained the vitriolic acid, it was reasonable to conclude that this

* Bergman's Physical and Chemical Essays, vol. I. p. 166.

† Experim. II.

this salt was composed of that acid, united perhaps with different bases; one of which must be iron, from its striking a black colour with tincture of galls.

To be absolutely certain that this salt contained no acid but the vitriolic, and to separate the different salts from each other, I followed the directions laid down by M. Bergman in his *Physical and Chemical Essays*,* and M. Fourcroy in his *Elements of Chemistry*.†

EXPERIMENT X.

(A) The salt collected from a gallon of the water, and which, as was said before, weighed twelve pennyweights and twenty-two grains, was put into a phial, and rectified spirit poured upon it to the height of about two inches; the phial was then close stopped and shaken, and after standing six hours, the liquor was filtered.

(B) To the residuum I then added eight times

* Vol. I. p. 159.

† Vol. II. p. 208.

times its weight of cold distilled water; the mixture was shaken, and after standing twelve hours it was filtered.

(C) I then boiled the residuum for twenty minutes, in about five hundred times its weight of distilled water; it was afterwards filtered, but nothing was found on the filter.

I then proceeded to examine these different solutions, and began with that obtained by rectified spirit, which was of a reddish brown colour, and in general contains lime and magnesia, salited or nitrated, together with salited terra ponderosa, if one or more of these substances be contained in the water.*

EXPERIMENT XI.

In order to discover whether the spirituous solution contained any of these substances, I took part of the salt which was obtained from a pint of the water, (exper. 9.) and treated it with alcohol
in

* Bergman's Essays, vol. I. p. 164.

in the same manner I had done the salt procured from a gallon. (exper. 10. A.) Part of this solution in alcohol was evaporated to dryness; but on pouring upon it some vitriolic acid, and holding a wet paper over it, I could perceive no phenomena that indicated the presence of either the marine or nitrous acids. I therefore took part of the remainder of this last spirituous solution, and dropped into it a few drops of salited terra ponderosa; the mixture became turbid, and let fall a white sediment. This convinced me that the vitriolic acid was contained in the solution: into the remaining part of this solution I poured tincture of galls, and a black colour was immediately produced. This indicated the presence of iron, and shewed that the alcohol had dissolved a martial vitriol; this surprised me a little, but upon looking into Bergman's Physical and Chemical Essays,* I found the following remark;—"Sometimes the alcohol also contains a dephlogisticated martial vitriol. The solution is of a reddish brown."

This

* Vol. I. p. 164.

This *dephlogisticated* martial vitriol, as M. Bergman calls it, is often found in nature, particularly in the ores of alum.* To determine the quantity of this dephlogisticated salt, I evaporated the first spirituous solution (exper. 10. A.) to dryness, and found fourteen grains of a black or dark brown matter, which being dissolved in water, though it turned black when mixed with tincture of galls, yet from the taste, and the bright red colour it produced with tincture of turnsole, it was evident that the vitriolic acid was superabundant.

EXPERIMENT XII.

The solution made by cold water was next examined; it was evaporated to dryness, and found to weigh ten pennyweights and eighteen grains. I dissolved it again in water, and evaporated it with a very gentle heat; I obtained perfect crystals of two different salts; one of which, from its colour, form, and taste, I knew to be *martial vitriol*; and the other, from its transparent

* Bergman on the preparation of alum.

rent octaedral crystals, from its taste, swelling, bubbling, and becoming quite spongy and friable when thrown upon a hot iron, I knew to be *alum*. A very small quantity of white powder was found among the crystals, which appeared to be selenite, of which the solution in boiling water was chiefly composed; but the quantity was so trifling as not to deserve our notice here, especially as the solution in boiling water will be found to contain a very small quantity of martial vitriol, and perhaps of alum, which will be a balance for the small quantity of selenite found in this solution.

We have, then, ten pennyweights and eighteen grains of salt composed of *martial vitriol* and *alum*. The next object was to separate them from each other, and ascertain their quantities.

EXPERIMENT XIII.

In order to do this, I again dissolved the salt in water, and poured into it the *Prussian* or *phlogisticated* alkali,* by little and little, till no farther

* I prepared my Prussian alkali in the manner directed by

farther precipitation was produced. The iron was precipitated in the form of *Prussian blue*. I filtered the liquor, and after having dried the filter, I found the quantity of *Prussian blue* deposited upon it to weigh nine pennyweights and fifteen grains. Now 100 parts of martial vitriol afford 115 of *Prussian blue*.† The quantity of martial vitriol from which this *Prussian blue* was produced, must therefore have been 8 dwts. 8,8 grs. nearly. If this quantity be subtracted from 10 dwts. 18 grs. the whole quantity of salt, we shall have 2 dwts. 9,2 grs. which is the quantity of alum contained in a gallon of the Horley-green water.

EXPERIMENT

by M. Bergman.—Four parts of *Prussian blue* were boiled with one part of vegetable alkali in a sufficient quantity of water. The clear liquor saturated with the vitriolic acid, was then freed by filtration from the small portion of blue which was separated by the acid, and was then fit for use. This preparation is extremely well adapted for discovering the smallest portion of iron, which it precipitates in the form of *Prussian blue*.

† Bergman's Physical and Chymical Essays, vol. I. p. 220.

EXPERIMENT XIV.

I next evaporated the solution made with boiling water, (exper. 10. C) and found a whitish matter in thin flakes or crystals, which had little or no taste, and which weighed one pennyweight and thirteen grains. In order to discover the nature of this substance, I dissolved it in a considerable quantity of boiling water, and then made the following experiments.

EXPERIMENT XV.

I poured a quantity of this solution into a wine glass, and added to it a few drops of salited terra ponderosa; the mixture immediately became turbid, and a copious white precipitate was formed: a proof that one of the component parts of this salt was vitriolic acid.

EXPERIMENT XVI.

In order to discover the base, I poured some more of this solution into another glass, and mixed with it an equal quantity of lime water; but after it had stood three hours, no visible change or decomposition had taken place.

EXPERIMENT

EXPERIMENT XVII.

With some more of this solution I mixed a solution of vegetable alkali in water; in a few minutes white clouds were seen in the glass, and in the space of an hour, a copious white precipitate was formed. This I collected by filtration, and it had every appearance of calcareous earth: but to be more certain, I kept it in a red heat in a crucible for the space of an hour, and then dissolved it in water. I poured some of the clear solution into the bend of a syphon, and making fixed air pass through it from my lungs, it immediately became turbid, and of a milky colour; this confirmed me in my suspicion that it was calcareous earth. From these experiments it appears that the one pennyweight and thirteen grains of salt dissolved by boiling water, is vitriolated lime or selenite, a salt which is soluble, but in a small degree in water; for, according to the chemists of Dijon, about five hundred parts of water are required to dissolve one of selenite. When tincture of galls was added to the solution of selenite, it produced little or no alteration in the colour; but when the Prussian alkali was mixed with

with it, a very small quantity of Prussian blue was precipitated, which indicated the presence of a very small quantity of martial vitriol in the solution; but since a small quantity of selenite was also present in the solution made by cold water, (exper. 12) these two quantities will nearly balance each other, and may perhaps be neglected in the calculation.

From the preceding experiments, it may be concluded that a wine gallon of the Horley-green water contains,

	dwts.	grs.
Of earth of iron, or ochre,	1	0
Vitriolated iron, or sal martis,	8	8,8
Alum,	2	9,2
Vitriolated lime or selenite,	1	13
Dephlogisticated martial vitriol,	0	14
Aërial acid or fixed air, 18 cubic inches.		

When the temperature of a neighbouring spring, equally exposed to the air, was 48° of Farenheit, I found the temperature of the Horley-green spaw 49° .

SPECIFIC GRAVITY.

With a very good hydrometer and assisted by my ingenious and learned friend Mr. Priestley, I compared the specific gravity of the spaw with that of distilled water in the temperature of 60° of Farenheit's scale. The specific gravity of distilled water was to that of the Horley-green water as 1 to 1,0031.

From a knowledge of the specific gravity of the water, we are, in some measure, enabled to detect the degree of accuracy with which our analysis has been performed, provided (which is conformable to the most accurate experiments) no mutual penetration takes place.

A gallon of distilled water weighs 58485 grains. The same measure of Horley-green water, according to a calculation deduced from the specific gravity, must weigh 58666,3035 grains. The difference, therefore, is 181,3035 grains. But we got from the spaw-water no less than 333 grains. $333 - 181,3035 = 151,6965$ grains, which is a considerable difference. But this difference

difference will nearly vanish if we suppose, which, according to the most accurate experiments we are warranted to do, that the specific gravity of the saline matters contained in the water is to distilled water as two to one; for then 333 grains put into a gallon of distilled water, will only displace a quantity of water equal in weight to $3\frac{3}{2}^3 = 166,5$. The weight therefore of a gallon of distilled water in which 333 grains of the salts are dissolved, will be $58485 + 166,5 = 58651,5$ grains: but $58666,3035 - 58651,5 = 14,8$ nearly, so that we are yet 14,8 grains of solid matter short of what ought to have been procured from the water. Now 18 cubic inches of aërial acid, which we procured from a gallon of the water, weigh about 9 grains:* and, as the specific gravity of this air, in a fixed or combined state, has been shown, by Mr. Kirwan, to be very great,† the quantity of water displaced by it will be next to nothing; we may, therefore, add its whole weight to that of the other ingredients, or which is the same thing, subtract it from the differ-

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* Fourcroy's Elements of Chemistry. Bergman, &c.

† Eighteen times the weight of an equal bulk of water.

ence 14,8 grains, and we shall have 5,8 grains, showing nearly how much has been lost on the filters and vessels in performing the preceding experiments.

The data on which these calculations depend, are not perhaps so well established as to warrant an entire dependance on them; yet, their so nearly coinciding with the results of the experiments, would seem to show that the above analysis has been performed with considerable accuracy.

The quantity of iron deposited by the water, when exposed to the air or to heat, is much too great to be held in solution by the aërial acid; for one hundred cubic inches of this acid take up only about four grains of iron.* How then is this quantity of iron kept dissolved, and what is the cause of its being deposited, when the water is exposed to the air? It is a fact well known, that vitriolic acid can unite with iron, even so as to be supersaturated with it; in the same

* Bergman's Essays, vol. I. p. 220.

same manner that the acid of tartar unites with the vegetable alkali, so as to form *soluble tartar*; or the muriatic acid with mercury, so as to form *mercurius dulcis*. By this supersaturation, if it may be so called, the vitriolic acid looses a great part of its taste and quality, and differs almost as much from *sal martis*, where it is united with a less quantity of iron, as *soluble tartar* from the *cream* or *crystals* of tartar, or *mercurius dulcis* from *corrosive sublimate*. But the vitriolic acid cannot long retain this superabundant quantity of iron: when it is exposed to the air, and more particularly with the addition of heat, it immediately begins to deposit part of that metal. As the metallic basis gives out its phlogiston to the air, which attracts it with great eagerness;* or, as the modern chemists say, when the iron unites with the empyreal air of the atmosphere, the acid can no longer hold the same quantity as before in solution; for as the iron is more deprived of the inflammable principle, or takes on the form of a calx, it requires more acid for its dissolution. Even a solution of common martial vitriol, in which

* Bergman's Essays, vol. I. p. 218.

which the acid is not supersaturated with iron, when exposed to the air, will become so far dephlogisticated that part of the iron will be deposited; and in water, containing a very small portion of martial vitriol, the iron may be so far diminished by exposure to the air, that neither tincture of galls nor phlogisticated alkali will produce any sensible effect.

The vitriolic acid in the Horley-green water, loosing part of its iron on being exposed to the air, its taste will be more sensible, and the water will approach nearer to a solution of sal martis. This is the reason why the water seems to be stronger after it has been kept some time, or taken up at some distance from the spring head: but, in reality, it is not so; on the contrary, it is weaker, having lost part of its chalybeate property, and also some of its fixed air. It is likewise more liable to disagree with the stomach in this state than when fresh; and, consequently, those who wish to drink it in perfection must have it from the fountain head.

It

It is evident that this water will bear carriage much better than most mineral waters, provided it be properly conveyed. For though, when exposed to the air, it soon deposits part of its iron, yet if glass bottles be filled with it at the fountain head, and well corked while under water, and afterwards sealed, it will keep for many months, and perhaps years, unimpaired in its qualities. I have, at present, a small phial full of this water, which was corked and sealed as above directed, about four months ago, which has not lost the least of its transparency, or deposited any sensible quantity of its iron.

From a view of this analysis, it will appear that this water is the strongest chalybeate known, at least of which I have seen any account; and its containing a quantity of alum is somewhat singular, as that salt is seldom found in mineral waters. These two active ingredients (the iron and alum) will undoubtedly render it a valuable remedy in many diseases; and its keeping so well, when accurately closed, will render it a still more

more valuable acquisition, as it may be easily conveyed to all parts of the world.

From the preceding experiments, it appears that the Horley-green water contains no pure or atmospherical air, a principle which is found in most waters, even in the purest spring or river water. But when we consider that this water contains martial vitriol, we cannot expect, indeed we should be surprised to find it contain any of this air, since it would unite with the iron and precipitate it in the form of a calx; or, in other terms, would dephlogisticate the iron, and render it incapable of being dissolved by the same quantity of acid. This is, most probably, the reason why the spaw-water, on being mixed with common water, in a few minutes deposits a copious sediment; the air contained in the common water acting upon the iron in the manner just mentioned.

It will not be difficult to offer some probable conjectures concerning the manner in which
nature

nature prepares those waters. The bowels of the earth abound with *pyrites*,* a mineral consisting of sulphur and iron; this mineral is generally found mixed with clay and calcareous earth, which substances are to be met with in great plenty in this country. The pyrites, particularly when exposed to the air, which they will frequently be, by means of the numerous coal-mines in this neighbourhood, will be continually undergoing a decomposition. The sulphur is changed into vitriolic acid, which will, probably, first dissolve the calcareous earth, which is mixed with the pyrites, as it has a greater affinity with that earth than with either iron or clay, and would be separated by it from either of these substances; thus, selenite will be formed; and while part of the acid dissolves all the calcareous earth, the remainder will attack the iron and form martial vitriol, and if there is not enough of that metal to saturate it, it will dissolve part of the clay and form alum. The vitriolic acid by its action on the calcareous earth, will expel from it the fixed air it contains,

part

* See p. 10.

part of which will unite with the water, and probably dissolve a small quantity of iron.

The principles contained in this water, seem to vary considerably, and I think it is stronger after a wet season than after a dry one, which, I believe, is the case with some other mineral waters, and may proceed from the water rising higher in the channels which contain the principles which compose it, when it must dissolve and carry away a greater quantity along with it. Hence it is very probable that experiments made on this water at different times, will not exactly correspond. The preceding experiments were made during a wet season.

EXPERIMENT XVIII.

The Horley-green water will not dissolve soap, but curdles it.

EXPERIMENT XIX.

When boiled with an equal quantity of new milk, it curdles it.

From

From the experiments related in this Essay, it will be evident that this water bears a strong resemblance to the Hartfell-spaw, near Moffat, in Scotland, of which an account is given by Dr. Horseburgh, in the first volume of the Edinburgh Physical and Literary Essays. I procured, at Leeds, a bottle of the Hartfell spaw-water, and by experiments, similar to those made with the Horley-green water, I found that they both contained the same ingredients; but the quantity of the Hartfell spaw-water was so small, that I could not determine exactly the quantity of each ingredient; though I am convinced that the Horley-green water contains, at least, four times the quantity of saline matter that is found in the Hartfell.

With the Horley-green water I repeated all the experiments made by Dr. Horseburgh on the Hartfell spaw, and found them all to correspond except one. The Hartfell water, when boiled with an equal quantity of new or sweet milk, does not curdle the milk.* But from exper. 19, it appears

* Physical and Literary Essays, vol. I. p. 324.

appears that milk is curdled by the Horley-green water, and this can only be owing to the quantity of alum being much greater in the latter, than in the former water.

Since these two waters are so similar, with regard to the nature of their contents, I shall transcribe what has been said of the medical virtues of the Hartfell spaw; as it is evident, that whatever medical powers are possessed by this water, they will be found in an equal or superiour degree in the Horley-green spaw.

I shall first take notice of what has been said by Dr. Horseburgh.

“ This water,” says he, “ seems to belong to the class of *aquæ martiatæ*; for it effervesces not with acids, like the *acidulæ* and *thermæ*; neither is its volatile iron principle so volatile as theirs: hence, in general, it may be said to be aperient and strengthening, both when used internally and externally; whence it must be

of

of use in diseases where the solids are relaxed, and the blood too watery and weak. But, although, when the principles of a mineral water are known, we may, from analogy, deduce its virtues in particular diseases; yet as this method is not so certain, no reasoning being equal to experience, I shall confine myself to the last alone; though it is to be presumed, that there have not been yet sufficient opportunities of discovering all the virtues of a water so lately found out. However, it has been observed to be of great use in curing itchy, hot, tetterous eruptions, old obstinate ulcers and sores, internally used, and externally applied; it has likewise been of great service in disorders of the stomach and bowels; in the bloody flux; bloody urine; immoderate flux of the menses; obstruction of the menses; the fluor albus; gleet; rheumatic pains; in the first stage of consumptions, and even when they have been further advanced; in preventing miscarriages; and in restoring health when the constitution has been impaired by long illness; all which will appear from the following histories, most of which
were

were wrote down from the patient's own mouths, and attested by the physician or surgeon who attended them.*”

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* There were given in to the society (now the Royal Society of Edinburgh), along with Dr. Horseburgh's paper, twenty-two well attested histories of patients cured of the above-mentioned diseases by means of the *Hartfell sparw*, which are too long to insert here; but as the good effects of this water in consumptions are somewhat extraordinary, and may perhaps be doubted by those who have imbibed early prejudices against tonics in these diseases, I shall take the liberty to insert the two following cases.

1. “ Mrs. *Glendinning*, wife to Mr. *Robert Glendinning*, schoolmaster, at *Moffat*, aged fifty-one, was, on the twentieth of *December* 1750, attacked with pains in her right side; a constant sharp pricking pain under the middle of the breast bone; a hard, tickling, dry cough; thirst, difficulty of breathing, and frequent gripes in her guts; all which symptoms increased till the first of *January* 1751, when she began to spit, with difficulty, a little thick, gross, matter. In the beginning of *February* the spitting was so extremely foetid and ill tasted, that it made her often vomit: she frequently washed her mouth with salt and water, but still felt a taste and smell which she thought resembled that of stinking flesh. She now became very weak and emaciated; had hectic fits and night sweats; which symptoms continued increasing till the middle of *April*; about which time (having tried no medicines before), she began to drink the *Hartfell sparw*, to the quantity of half an English

I am happy to have it in my power to call
in

lish pint every morning; she had scarcely used it a week, when her breathing became much easier; after a fortnight, the spitting lost the fœtid smell and ill taste; and in three weeks she was perfectly free of the pain of her breast, cough, spitting, difficulty of breathing, hectic fits, and morning sweats; and has continued ever since in good health.

2. " Mrs. *Halliday*, of Barntympan, aged twenty-eight, of a plethoric habit, complained, in the beginning of *September*, 1750, of a pain under the upper part of her breast bone, which frequently darted to the point of her right shoulder; a pain in her head and neck; her breathing was not quite free, and she could not lie upon her right side. About the middle of *October*, she began to spit florid blood, which continued three weeks, at the rate of a spoonful every day; then stopped a week, and returned again. In this manner, it went on about four months; after which, beginning to fear the consequence might be fatal, as many of her nearest relations had been carried off by consumptions of the lungs; she applied to Mr. *Johnston* surgeon-apothecary in *Moffat*, who, finding the spitting of blood increasing, and her pulse pretty full and frequent, ordered her to be bled, to take the *decoctum tamarindorum* of the *Edinburgh Dispensatory*, and to swallow four of the following pills thrice a day. *R. Extract. cort. Peruvian. drach. ij. balsam. Peruvian. scrup. j. pulv. cort. Peruvian. q. s. ut f. massa, ex cujus singul. drach. formentur pil. xij.* The bleeding and decoction were repeated as often as they seemed necessary; and the pills were continued ten weeks without success; for soon after she left off using them, she began to cough up purulent matter with blood. Whenever the spitting diminished,
her

in to the confirmation of these observations on the success of the Hartfell-spaw, the respectable name of Dr. Percival, of Manchester. In the Memoirs of the Medical Society of London, vol. II. p. 57. that ingenious physician makes the following observations.

“ I have lately prescribed, with considerable success, to various patients, a mineral water, which

her breathing became very difficult ; and the pain of her breast increased, with a particular soreness all along the breast bone when she coughed.

“ She drank goat’s and ewe’s whey, from the beginning of *June* to the end of *August*, without any sensible benefit ; for she continued still to spit blood and matter ; soon after this she was attacked with sudden flushes of heat and morning sweats, which increased till the middle of *January 1752*, when she was become feebler, much emaciated, and often faintish. At this time she was advised to drink the *Hartfell spaw* in small quantity ; but finding it sit easy on her stomach, she drank an English pint of it daily. During the first week after drinking the water, she expectorated dark, blueish, putrid stuff, without blood ; and found her breast much easier than it had been any time from the beginning of her illness. Soon after she began to breathe freely ; and after having drank the water six weeks, was perfectly recovered : since which time, she walked, or rather run, three *Scotch* miles in an hour, without being either hurt or much fatigued by it.”

which I believe is little known in England. It springs from the Hartfell mountain, about three miles north of Moffat; and a very full account of it is given by Dr. Horseburgh, in the first volume of the Physical and Literary Essays. A lady, who had been making a tour in Scotland, brought me a bottle of it some time ago; but I did not examine it till a case of chronic hæmorrhagy, attended by Dr. Eason and myself, suggested a trial of such a styptic remedy. The water appears to be a strong chalybeate, and to contain a portion of alum. It is not unpleasant to the taste; and, in the dose of about a quarter of a pint, is grateful to the stomach. It relieves uneasy irritations and slight pains in that organ; promotes digestion; and abates flatulance, if taken before meals; and though acidulous in taste, corrects acidity, and does not even coagulate milk when mixed with it. I have had experience of its efficacy in profuse discharges of the *catamenia*, in the *fluor albus*, in *dyspepsia*, in *struma*, and other disorders originating from a laxity of the fibres. In such maladies, chalybeates have been long employed; and Boerhaave, you know, speaks
of

of their virtues with enthusiastic admiration, asserting that no medicine, either animal or vegetable; no diet, no regimen can produce the effects which are accomplished by iron. And as I think the Hartfell spaw-water is one of the pleasantest forms under which this active remedy can be administered, with considerable efficacy; as the most fastidious patients may be prevailed on to take it, when drugs are loathed and neglected; as it is much cheaper, as well as stronger, than the Pyrmont or Spa;* and as it bears carriage without injury, it promises to be a valuable acquisition. Its aluminous impregnation, also, adds to the medicinal powers which it possesses as a tonic, a sedative and a styptic. There is often a morbid sensibility and irritability in the stomach, and *primæ viæ*, which render the office of digestion uneasy and painful; and create an habitual disposition to flatulence, and to slight attacks of the cholic. Alum, as I have noticed in a former work, is a valuable remedy under these circumstances.

And

* The *Horley-green* water possesses all the advantages over the *Hartfell*, that this last does over the *Pyrmont* and *Spa*.

And combined with iron, by the chemistry of nature, its energy as a styptic, will doubtless be increased."

From the contents of the Horley-green spaw, it is evident that it must be a powerful tonic, when properly used; since it contains two substances which are amongst the most powerful of the class of tonic remedies, viz. *vitriolated iron* and *alum*. Hence we shall expect to find this water very useful in diseases depending upon debility, where the solids are relaxed, and the system weakened. In the numerous class of nervous disorders, it has been found highly beneficial; particularly when the organs of digestion do not perform their functions properly; such complaints are generally attended with loss of appetite, nausea, vomiting, heart-burn, acid eructations, spasmodic pains in the stomach and bowels, and costiveness. These symptoms generally depend upon a debility of the stomach, and whole body; and may have been brought on by any thing that relaxes the system; such as intemperance, a sedentary life, and too

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close application to study or business, cold, the use of coffee, tea, tobacco, and spirituous liquors. These complaints yield readily to the Horley-green water, when drank in a proper manner. Many scrofulous cases have been very much relieved, and some cured by a judicious use of this water. Some cases of diabetes have been cured by it; it is very useful in hypochondriac and hysteric cases, and in severe head-achs which are of the nervous kind, or proceed from a disordered state of the stomach. In some dropsical and worm cases, it has been productive of surprising effects, and particularly in the latter. A curious circumstance deserves to be noticed here; the moment that a common earth worm is put into the Horley-green water, it is killed. A kind of precarious analogy would lead us to employ it in cases where the *lumbrici* or *teretes** infest the human

* The *lumbrici* or *teretes*, are about a span long, round and smooth, very much resembling the *lumbricus terrestris* or common earth worm; they are seated, for the most part, in the upper small intestines, but sometimes they are lodged also in the stomach, and in any part of the intestines, even to the rectum

man body; for though we cannot, *a priori*, say that its effects upon the worms in the human body, will be the same as upon the earth-worm, yet we are by no means authorised to say the contrary. In several instances, where this water has been used, both the *lumbrici* and *ascarides* have been voided, in great numbers and generally dead. I have heard of no cases where the *tænia* or tape worm infested the body, where this water has been used.

It is very useful in gouty complaints, particularly in that species which is called the *atonic* gout, where the system has been weakened by frequent and severe attacks of that disorder. The symptoms are, severe pain in the stomach, and other

rectum. The *ascarides* are very small white worms, and have usually their seat in the rectum. The *tænia*, or tape-worm, is from two to forty feet or more in length, and generally possesses the whole tract of the intestines, but especially the *ileum*; it very much resembles a piece of tape in its appearance, whence the name of tape worm. As this treatise may probably fall into the hands of persons unacquainted with medicine, it was thought necessary to insert this note.

other affections of that organ ; such as loss of appetite, indigestion, and its various concomitants, viz. sickness, nausea, vomiting, flatulency, and acid eructations. These symptoms are frequently accompanied with pains and cramps in several parts of the trunk, and upper extremities of the body, which are frequently relieved by the discharge of wind from the stomach. In these complaints, tonic medicines, (of which the Horley-green water is one of the best) together with a generous diet, and exercise in the open air produce the best effects.

In Hæmorrhagies, or diseases accompanied by a discharge of blood, particularly when the discharge has continued for some time, and has produced great weakness in the system, we should be led, from a knowledge of the contents of this water, to give it a trial ; and experience shows the efficacy of it in such cases, which frequently arise from a debility or laxity of the whole system, and particularly of the extreme vessels of the part from which the blood flows. It has been used with
success

success in *Epistaxis*, or bleeding of the nose, in *Hæmoptysis*, or spitting of blood, in *Hæmorrhoids*, and profuse discharges of the *catamenia*, and where that discharge has been suppressed or irregular. But since Hæmorrhagies do sometimes depend upon a plethoric state of the system, this water would, in such cases, be very improper, since it would have a tendency to increase that state. It should, therefore, only be used in such cases of hæmorrhagy as are attended with weakness, and have continued for some time.

It has been found very useful in restoring the strength of patients who have been reduced by long and tedious diseases, such as fevers. In consumptive complaints, there are several instances of its having been of service, particularly in relieving the hectic fever and profuse sweats, which seem rather to depend upon a debilitated state of the body than upon irritation.

As the Horley-green water promises to be useful in almost all diseases depending upon debility

bility, so, on the contrary, in all diseases where a plethoric habit, or a too vigorous state of the system exists, it must be hurtful. For instance, in pleurisy and some rheumatic complaints, in persons predisposed to apoplexy, phrenitis, and in all inflammatory affections which depend upon a plethoric state, or where the excitement of the system is too great; for the effect of this water is to increase that state, and, consequently, it must be hurtful in diseases dependant on it.

DIRECTIONS
CONCERNING THE USE OF THE WATER.

As this water is a very powerful remedy, great caution is necessary to prevent its being drank either in too great quantity, or in improper cases. I think I have seen bad effects arising from inattention to these two circumstances, and particularly the former. It would therefore be prudent, never to enter upon a course of it without having first consulted some medical practitioner.

When taken in too great quantity, it lies heavy on the stomach, and produces violent sickness and pain in that viscus, together with diarrhoea. In general, an ounce and half, by measure, or wine-glass full, will be sufficient at first, and the dose may, perhaps, be increased, very gradually, to twice that quantity, provided it does not disagree with the patient. I have known
some

some persons who could not bear a table spoonful of this water, without its producing pain in the stomach and sickness; and I have found several whose stomachs were equally affected by the smallest quantity of chalybeate wine, or sal martis.

If this water disagrees with the stomach, even when taken in very small quantity, it may be proper to dilute it with common water. Half a table spoonful of the spaw mixed with three or four table spoonful of common water will be found, in general, to sit easy on the stomach.

The best times for drinking it, seem to be in the morning betwixt breakfast and dinner, and about the middle of the afternoon. It may, in some cases, be drank three times a day.

If the water, even when taken in small quantity, should be uneasy to the stomach, the patient may mix with it a tea-spoonful or two of brandy, aromatic tincture, or *tinctura amara*.

When

When the bowels are weak, it sometimes occasions gripes, but this effect may be best prevented by warming the water a little; which may be best done in the manner directed by Dr. Horseburgh for warming the Hartfell water, viz. by putting as much as the patient intends to drink, into a small phial; the phial must then be corked, and set before the fire, or put into warm water, till it has acquired a sufficient degree of heat: it will, however, be best to drink it cold, where it does not disagree with the patient, as it deposits part of its iron, and loses its fixed air on being warmed.

The Horley-green water seldom produces costiveness, on the contrary, in habits naturally costive, it contributes very much towards bringing about a regular motion of the intestines, and generally procures a gentle stool extraordinary every day; but if costiveness should attend its use, it will be proper to guard against it, by taking a little *lenitive electuary*,---one or two of *Rufus's pills*, at bedtime,---or, by chewing a little *rhubarb*. It sometimes

sometimes purges those who are subject to a diarrhœa, or whose bowels are very irritable, in which case, it may be proper to restrain the diarrhœa, by adding a few drops of *laudanum* to every dose of the water.

With regard to the external use of this water,----it may be used cold; or warmed a little to wash old, obstinate ulcers, and itchy tetters eruptions, two or three times a day; and in some instances, particularly in scrofulous cases, it may be proper to keep linen cloths, wetted in the water, constantly applied to the parts affected.

DIET.

It will be seldom necessary to make any material alteration in the diet of those who drink this water; indeed, it is impossible to give particular directions which would suit every individual. Almost every person will be able to judge what kind of diet agrees with him, as well as any one can inform him. It may be noticed, however, that temperance is, in general, necessary to be observed

observed by those who are using this water. By temperance, I do not mean abstemiousness; for most, if not all of the diseases in which this water is found useful, require a generous temperance, rather than a severe abstinence. A plain dinner will be found the best, and the patient may indulge himself with a glass of wine; but particular care ought to be taken, neither fully to satiate the appetite with the luxuries of the table,* nor give way too much to the exhilarating effects of wine;† for the spirits will always be depressed and the constitution weakened by an overdose, in proportion as they have been raised

* ----- Beyond the sense
Of light refection, at the genial board
Indulge not often; nor protract the feast
To dull satiety; till soft and slow
A drowzy death creeps on, th' expansive soul
Oppress'd, and smother'd the celestial fire.
The stomach urged beyond its active tone,
Hardly to nutrimental chyle subdues
The softest food.

Armstrong's Art of preserving Health.

† Tria pocula tantum misceo illis qui sapiunt: unum sanitatis; alterum voluptatis; soporis tertium &c. *Eubul.*

raised, while a sober glass will co-operate with the water in giving strength and vigour to the constitution.

The suppers ought always to be light, and vegetable food is preferable to animal. The evening is not the proper time for taking in much nourishment: the powers of the body, and particularly of the stomach, are, as it were, worn out, and the food will be but half digested. Besides, the addition of fresh chyle to the blood, together with the stimulus of food acting on the stomach, will prevent sleep, or render it disturbed,† and the patient rises in the morning, little refreshed, his appetite gone, and instead of being lively and chearful, he is heavy and stupid. If suppers are allowable at all, they ought to be taken early.

EXERCISE.

† ---Would you sweetly waste the blank of night
In deep oblivion; or on Fancy's wings
Visit the paradise of happy dreams,
And waken chearful as the lively morn;
Oppress not nature sinking down to rest
With feasts too late, too solid, or too full.

Armstrong.

EXERCISE.

Nothing contributes so much to preserve the health of the body as exercise, it puts the fluids all in motion, and gives a new spring to the pulse of the heart. Whenever this water is drank, exercise in the open air, should, if possible, be used. When patients are weak, their exercise must, at first, be very gentle, and gradually increased as their strength can bear it.

Begin with gentle toils, and as your nerves

Grow firm, to hardier by just steps aspire.

The prudent, even in every moderate walk,

At first but saunter, and by slow degrees

Increase their pace.

Armstrong.

The most proper time for taking exercise, is before dinner; for the body is then more vigorous and alert, and the mind more chearful, and better disposed to enjoy the pleasure of a ride or walk, or of contemplating the wild beauties which Nature has so liberally bestowed on this romantic country. Besides, the patient generally returns home with a keen appetite, and the stomach is enabled to perform its functions properly. Exercise, after a full meal, disturbs digestion, and

causes

causes painful sensations in the stomach and bowels, with heart-burn, and acid eructations. The kind of exercise must be suited to the particular situation of the patient. When it can be used without inconvenience, exercise on horseback is preferable to any other; though walking in the open air, or riding in a carriage will suit some patients better, who, on account of weakness, or other circumstances, cannot take exercise on horseback.

COLD BATHING.

Where there is nothing to forbid its use, this remedy is one of the most powerful means of strengthening the system; and, consequently, proper to be used in conjunction with the Horley-green water. It ought to be used in the morning, two or three times a week, as is most convenient for the patient. I must here observe, that in all cases where the cold bath is used as a remedy, the patient ought not to remain for any length of time in the bath, but should plunge into it, and come out immediately; his body ought then to be exceedingly well rubbed with woollen or linen cloths, and he should cloathe himself as soon as possible.

CASES

CASES AND COMMUNICATIONS.

I sent some of the Horley-green water to Dr. Percival, of Manchester, communicating to him, at the same time, my design of laying before the public, an account of its properties, and was soon after honored with a letter from him, part of which I shall insert here: the favourable opinion of so respectable a physician was no small inducement to undertake the present task, and will undoubtedly give weight to what I have before observed concerning the virtues of this water.

“It was my intention,” says the Doctor, “to have made some experiments on the mineral water which you have sent, and which has been the subject of your investigation: I have not, however, had leisure to put my design into execution; and must content myself with expressing my conviction, that a spring so strongly impregnated with martial vitriol and alum, as it appears to

to be by your trials, cannot fail to answer many important medicinal purposes, and you will do a very acceptable service to the public by making known the virtues of such a spa.

Manchester, Jan. 12, 1790."

Nearly about the same time I received the following letter from Mr. Cooper, surgeon, at Wetherby, containing some particulars of the case of a lady who had received very great relief from the Horley-green water, after she had continued in a very bad state of health for some years, and tried a variety of medicines, without any permanent relief; she had, likewise, used the Thorp-arch water, for a considerable time, without any benefit.

" SIR,

Miss ———, of ———, desired me to state what I knew of her case to you, which I cannot now do, perfectly to my satisfaction, 'tis so long since she was attacked with her disorder; but I will endeavour to give you as clear an account as I can. Her first symptoms were
acute

acute pain at her stomach; parched tongue and throat, with frequent nausea, and a degree of yellowness upon her skin, which led the physician who attended her to suppose that her liver was much affected; which, I am of opinion, was not the case, as she always found relief from an emetic, the bitter infusion, bark, chalybeates, and gently opening medicines; which, I think would have cured her, had she persevered in the use of them for some time, and dieted herself properly: but getting wet of her feet, or being guilty of the least irregularity in diet, always made her as ill as ever; so that it seems to me clear, that the stomach and intestinal canal were the seats of all her grievances. But what were the first causes of that degree of debility and relaxation of the stomach, I cannot say, as I was very little acquainted with her, till I attended her in the case in question; but, that a relaxed stomach, and, consequently, a degree of debility through the intestinal canal, was the case, I am well assured; and though it may seem a case of no great consequence, yet, from its long continuance, owing to

little irregularities in diet, and the want of proper care, I began to despair of her ever again enjoying a state of perfect health; which I now hope she will, as she has reaped more benefit from the Horley-green water, than from all the medicines she has taken; indeed the effect it has had upon her is astonishing; and convinces me, that the publication of its properties and uses, may prove as great a blessing as this nation can boast of, and which I am happy to hear you have undertaken.

I am, sir,

your most obedient, &c.

Wetherby,
14, Feb. 1790.

WILL. COOPER.

The three following cases were communicated to me by Mr. JOSEPH FRYER, surgeon, at *Rastrick*, and member of the Royal Physical Society of Edinburgh.

A gentlewoman, at *Brighouse*, of a delicate habit, in the early part of pregnancy, complained
of

of much pain in her stomach and bowels, attended with sickness and throwing up her food. The last of these symptoms, after taking medicines, was relieved, but the pain became more constant and severe, for which a variety of medicines were in vain had recourse to, till hearing that the Horley-green water had been effectual in removing similar complaints, she was induced to try it, and took a small teacupful two or three times a day; the first dose of which she found relief from, and in a few days thought herself entirely well. She then omitted the water, but her complaint soon returned with the same severity as before; it was again, however, immediately relieved by taking the water, which she then continued without intermission, for some weeks; and, during that time, found herself free from all complaint, and has continued so to the time of writing this account, which is several weeks after discontinuing the use of the water.

Sarah, the wife of John Marshall, of Ras-trick, shopkeeper, aged upwards of fifty, had been

a long time afflicted with pain at her stomach, want of appetite, flatulency, costiveness, and general weakness, attended with much pain in the loins, for which she had formerly taken medicines, and used the cold bath with temporary advantage. About the latter end of January, 1790, she was recommended to make trial of the Horley-green water, from which she found considerable relief; taking, occasionally, a little *biera picra*, to prevent the bad effects of costiveness. She took a wine-glass of the water, forenoon and afternoon, which was always followed by windy eructations; her pain began to abate, and her appetite to return; but, after continuing its use about a week, having finished the quantity of water she had procured, and being a few days without, her complaints, in some degree, returned.

Feb. 13. Has had a fresh supply of water, and taken thereof two or three days; in which time, she has found herself much relieved, her appetite better, flatulency and pain abated, and her strength increasing.

A middle aged man in the same neighbourhood, had complained a long time of bad digestion, and, for some weeks past, of much pain at his stomach, want of appetite, loathing of food, flatulency, and lowness of spirits. About the middle of January, 1790, he began to take a wine-glassful of the Horley-green water, three times a day; from which he soon found relief: each dose he took was immediately succeeded by windy eructations, and exhilaration of spirits; the pain at his stomach abated, and appetite returned.

Feb. 4, Has continued to take the water near three weeks, and finds himself in a good state of health,----has had regular stools,----and observes, that the water made no alteration in that respect.

The following cases I took down from the patients themselves, and though they are not so much to my satisfaction as if they had been taken down by those of the faculty who had attended them; it being very difficult to gain, from patients,

tients, an exact description of their disease, and almost impossible to ascertain the methods of treatment which have been made use of, yet they will be sufficiently accurate to show the good effects produced by the Horley-green water.

Ann Bible, aged twentyfive, was, about two years ago, while at *Greenwich*, seized with a violent pain of the stomach, giddiness in the head, and *vertigo*; her appetite was bad, she was very weak, and much emaciated; her extremities often became cold, during which the ends of her fingers turned black. She took a number of medicines without relief, and was recommended to Dover for the benefit of the sea air; she was considerably relieved by it, though bathing in the sea did not agree with her; however, when she went back to Greenwich, her complaints returned with equal violence, and soon began to be attended with cold sweats, particularly in the morning, and frequent flushings in the face. Her legs too began to swell very much, every evening: these complaints increased to such a degree that her
life

life was despaired of, and she was advised to visit Yorkshire for the benefit of her native air. Accordingly, she came to Halifax, on the 31st of October, 1789, where she took several medicines, but none of them afforded any permanent relief. She had a slight cough from the beginning of her illness, but it was not attended with much expectoration. About the beginning of December, 1789, she was advised by Dr. Alexander to try the Horley-green water. She drank about a quarter of a pint twice a day, and experienced almost immediate relief from it. When she had used it about three weeks, the sweats had entirely left her; the pain at the stomach was gone; and the giddiness in her head much relieved. She has used it about two months; her appetite is now very good; and her strength increases every day. Her legs have not swelled for some time, and she has every prospect of again enjoying a good state of health.

B. Fenton, near *Halifax*, aged twenty-nine, about six years ago, had a fever, from which she recovered

recovered very slowly and imperfectly. About two years and a half ago, being in a state of pregnancy, she was seized with a cough which she attributes to cold; the cough was accompanied by an expectoration of greenish coloured matter, which was so extremely foetid and offensive, that her mother could scarcely wash the cloths on which she spit. These symptoms were attended with night sweats, which reduced her strength very much. After delivery, she was better for about a fortnight; when her cough, which had nearly left her, returned, and was much more troublesome than before; the sweats were likewise increased, and the expectoration became, if possible, more foetid. Her appetite was exceeding bad, and her strength became so far reduced, that she could not be moved out of her bed without the greatest difficulty. During this time, she took several medicines, and though they relieved her for a little, yet her complaints returned. In October 1788, she was advised to try the Horley-green water, and drank a teacupful twice a day. In about a week after she began to use the water, she found herself

herself better; the cough, sweating, and expectoration went off by degrees; her appetite and strength returned; and in about three months, she was so well as to walk about, and attend the duties of her family. Her complaints are liable to return in some degree, her appetite becomes bad, and she finds herself weak; but these symptoms are always relieved by the water, which she constantly has recourse to whenever she finds any return of her complaint.

Susan Fisher, of High-Sunderland, near Halifax, aged sixteen, was affected, about three or four years ago, with a swelling of the glands on the right side of her neck, which was evidently of a scrofulous nature, and many of the same family had ulcers and swellings in various parts of the body. After the swelling had continued for some months, it was cut; but all attempts to heal it were in vain: she consulted several of the faculty, but to no purpose. Her appetite was bad; she was much emaciated; and her complexion very pale and delicate. About the beginning of December, 1789, she began to use the Horley-green water,

water, drinking a teacupful of it night and morning, and washing the ulcer with it twice a day: her appetite soon began to mend; the ulcer was healed in about a fortnight; she gained strength fast; and I think I have seldom seen a more healthy looking girl than she is at present.

John Wright, aged twentyfour, a labourer, near *Halifax*, was, in the beginning of May, 1789, seized with pain at his stomach, and threw up his meat, constantly, soon after he had taken it. His legs and thighs then began to swell very much; the abdomen was also very much swelled; and he had great difficulty in breathing, particularly when in a horizontal posture. The legs pitted on pressure, his urine was considerably diminished in quantity, and he was extremely weak. About the middle of May he began to drink a teacupful of the Horley-green water, twice a day, but afterwards increased it to half a pint twice a day. Each dose of the water procured, at first, two or three loose stools; after he had taken it only a few days, he began to make more water, and

and the swelling of the abdomen and legs grew less and less every day ; his appetite and strength increased ; and, in about three weeks, he was perfectly well.

I have, in my possession, a great many more instances of the good effects of the Horley-green water, which might be inserted here, if they could serve any other purpose than that of enlarging the size of this treatise. But I hope the cases which I have already given, will be sufficient to show the utility of this water.

Among the cases I have taken down, I find several instances of persons, after drinking the water, having parted with a great number of *lumbrici* and *ascarides*, and though they had been in a bad state of health for a considerable time before, yet, having used the water some time, they got perfectly well.

Two cases of *diabetes* have likewise come to my knowledge in which this water has been of great service. One is the case of *Radcliffe Ingham*,

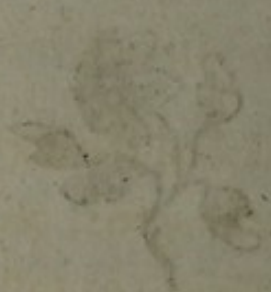
ham, the bar-keeper, at *Blackstoned*, who had been afflicted with this complaint for a number of years; the quantity of water he made, he assured me, was, at least, five times the quantity of liquid which he drank. He was very much emaciated; had great thirst; and his water was very sweet to the taste. He says, he is convinced, that he owes his life chiefly to the use of the Horley-green water, which was recommended to him by Dr. Alexander, of Halifax, and which he drank in very large quantity; I think two quarts in twenty-four hours, and continued it for a long time. He is now in a good state of health, and the quantity of water which he makes is much less than the quantity of liquid taken in by him.

The other is the case of Mr. H. in the same neighbourhood. The disease had only continued a short time, but he made considerably more water than the quantity of liquid which he took; his water had a sweet taste, and he had very great thirst. The Horley-green water was recommended to him by Dr. Alexander, and was I think

think approved of by Dr. Percival. He believes it was of great service to him, though he could not speak very positively, as he took medicines all the time that he drank the water. He is now, however, in very good health, and makes a natural quantity of water.



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A
SHORT ACCOUNT
of
TWO OTHER MINERAL WATERS,
in
Yorkshire.

HAVING finished the account I intended to give of the Horley-green water---and which will, I hope, be sufficient to call the attention of the public to the virtues of a spaw which promises to be of great service to the country---before I conclude this treatise, I shall give a short account of two mineral waters, which I have not had an opportunity of examining, with sufficient accuracy; I however think it, in some measure, my duty

ty to mention them, as it may put others, who may have more convenient opportunities, upon examining their properties.

The first was mentioned to me by Mr. W. Maud, surgeon, in Bradford, who went with me to see it. It is situated on *Romalds-moor*, about two or three miles from Bingley, and goes by the name of *Redmire-spaw*. The access to it is by no means good; the ground about it being very spongy and soft. On the bottom and sides of the channel is deposited an ochrey matter, of a very fine, bright, yellow colour; and which I believe is used, by the country people in the neighbourhood, to paint their houses. It sparkles, when poured into a glass, and has a taste very like the *Tewit-well*, at High-Harrogate; which water it very much resembles in all its properties, and seems to be about the same strength. When tincture of galls was dropped into it at the well, it soon turned to a purple colour, and, in a few minutes, became nearly black. Syrup of violets produced a colour inclining a little to green, but

I think not much more so than when the same syrup was mixed with common water. We brought two bottles of the water to Bradford, which were very closely corked, and kept inverted; notwithstanding which, on examining it, two or three days after, a number of clouds were found floating in it, and neither tincture of galls, nor Prussian alkali, showed that it contained any iron; neither did the tincture of turnsole produce any phænomena which could lead me to suspect an acid. Salited terra ponderosa being dropped into it, some white clouds were perceptible, which shows that the water contains some vitriolic acid, though not more than the best spring water in Bradford: for the same phænomenon, and in an equal degree, is produced on dropping the salited terra ponderosa into the softest spring water I could meet with. The vitriolic acid is probably united, in this water, with calcareous earth, in the form of selinite; but---as I had no acid of sugar, and the quantity of selenite, if it contained any, being so exceeding small---I could not ascertain that point to my satisfaction. This water seems

to

to hold a quantity of iron dissolved by means of fixed air. Its taste is very pleasant; it is said to act very powerfully as a diuretic, when drank in considerable quantity, and may prove an useful remedy, in cases where good effects may be expected from chalybeates in very small doses; the fixed air, and even the pure water itself may be useful in some cases. It is, however, necessary to drink it at the well, for it seems to loose its iron and fixed air very soon.

The other water, which I proposed to notice, springs from the side of a hill at *Batley*, about a mile or somewhat more from *Dewsbury*. The ground in which it springs, is, I believe, the property of Lord Grey. The water, when just taken up from the spring, has a strong sulphureous smell, similar to the sulphureous springs at *Harrogate*, and nearly as strong; it however so soon looses this smell by boiling, that it is sometimes used, by the people in the neighbourhood, for culinary purposes, but for which it is not very proper, on account of its hardness. It deposits

a considerable quantity of matter, resembling selinite, on the bottoms of vessels in which it has been long boiled.

EXPERIMENT I.

A piece of paper, on which characters were written with a pen dipped in a solution of saccharum saturni being placed over a glass, nearly filled with water just taken from the well, the characters soon became visible, and of a dark brown colour, though not quite so much inclining to black as when such a paper is held over the Harrogate water.

EXPERIMENT II.

Salited terra ponderosa being dropped into the water, a white precipitate is formed, though the quantity is not very considerable.

EXPERIMENT III.

Tincture of galls being mixed with the fresh water, a colour slightly inclining to purple is produced; but the same does not take place when the tincture of galls is mixed with water which has been taken from the well a considerable time before.

before, neither has the Prussian alkali any effect upon it in this state. It will not dissolve soap but curdles it.

From the above experiments, it would seem that this water is impregnated with hepatic or sulphureous air, and, perhaps, with a little fixed air. It is also probable that it contains a little iron, held in solution by fixed air; though the quantity of this metal must be very small. It likewise seems to contain a small quantity of vi-triolated lime or selinite, to which it owes its hardness. It is, I am told, some degrees warmer than the water of the neighbouring springs; but, as I had not a thermometer with me when I went to see this water, I could not ascertain that point. The only material principle which it possesses, as a medicinal water, is its sulphureous im-pregnation, and which may sometimes render it an useful remedy, particularly when externally applied, in scorbutic complaints, the itch, and other cutaneous complaints.

FINIS.

ERRATUM.

Page 15. line 7. read *substance, except phlogiston, and separates it—*