

No. XV.

AN ACCOUNT OF THE METEOR,

*Which burst over Weston in Connecticut, in December
1807, and of the falling of Stones on that occasion.*

BY PROFESSORS SILLIMAN AND KINGSLEY,

WITH A CHEMICAL ANALYSIS OF THE STONES,
BY PROFESSOR SILLIMAN.*

ON the 14th of December, 1807, about half past 6 o'clock, A.M. a meteor was seen moving through the atmosphere, with very great velocity, and was heard to explode over the town of Weston, in Connecticut,

*NOTE.....The following account of the facts which attended the falling of stones from the atmosphere, was first published, *in substance*, in the Connecticut Herald, and, subsequently, in many newspapers, and in several literary and philosophical Journals. A revised account, together with the details of the analysis, was afterwards communicated to the Philosophical Society of Philadelphia, and had been published in their transactions. No communication was made to the Connecticut Academy, because they did not then contemplate publishing anything *immediately*, and the public curiosity was so much alive on a subject which, in this country, was altogether novel, that there was no room for delay.

But, in consequence of the strong local interest which is felt in Connecticut, as the scene of the extraordinary event alluded to, the Academy have thought proper to direct the republication of these papers, that they may be preserved and diffused in Connecticut; disclaiming at the same time any right to them as original communications.

about 25 miles west of New-Haven. Nathan Wheeler, Esq. Of Weston, one of the justices of the court of common pleas for the county of Fairfield, a gentleman of great respectability, and of undoubted veracity, who seems to have been entirely uninfluenced by fear or imagination, was passing at the time through an enclosure adjoining his house, and had an opportunity of witnessing the whole phenomenon. From him the account of the appearance, progress, and explosion of the meteor, is principally derived. The morning was somewhat cloudy. The clouds were dispersed in unequal masses, being in some places thick and opaque, and in others fleecy and partially transparent. Numerous spots of unclouded sky were visible, and along the northern part of the horizon a space of ten or fifteen degrees was perfectly clear. The attention of Judge Wheeler was first

drawn by a sudden flash of light, which illuminated every object. Looking up he discovered in the north a globe of fire, just then passing behind the cloud, which obscured, though it did not entirely hide the meteor. In this situation its appearance was distinct, and well defined, like that of the sun seen through a mist. It rose from the north, and proceeded in a direction nearly perpendicular to the horizon, but inclining, by a very small angle, to the west, and deviating a little from the plane of a great circle, but in pretty large curves, sometimes on one side of the plane, and sometimes on the other, but never making an angle with it of more than 4 or 5 degrees. Its apparent diameter was about one half or two thirds the apparent diameter of the full moon. Its progress was not so rapid as that of common meteors and shooting stars. When it passed behind the thinner clouds, it appeared brighter than before; and, when it passed the spots of clear sky, it flashed with a vivid light, yet not so intense as the lightning in a thunder-storm, but rather like what is commonly called *heat lightning*.

Where it was not too much obscured by thick clouds, a waving conical train of paler light was seen to attend it, in length about 10 or 12 diameters of the body. In the clear sky a brisk scintillation was observed about the body of the meteor, like that of a burning firebrand carried against the wind.

It disappeared about 15 degrees short of the zenith, and about the same number of degrees west of the meridian. It did not vanish instantaneously, but grew, pretty rapidly, fainter and fainter, as a red hot cannon ball would do, if cooling in the dark, only with much more rapidity.

There was no peculiar smell in the atmosphere, nor were any luminous masses seen to separate from the body. The whole period between its first appearance and total extinction, was estimated at about 30 seconds.

About 30 or 40 seconds after this, three loud and distinct reports, like those of a four-pounder, near at hand, were heard. They succeeded each other with as much rapidity as was consistent with distinctness, and, altogether, did not occupy three seconds. Then followed a rapid succession of reports less loud, and running into each other, so as to produce a continued rumbling, like that of a cannon ball rolling over a floor, sometimes louder, and at other times fainter: some compared it to the noise of a waggon, running rapidly down a long and stony hill; or, to a volley of musketry, protracted into what is called, in military language, a *running fire*.--- This noise continued about as long as the body was in rising, and died away apparently in the direction from which the meteor came.

The accounts of others corresponded substantially with this. Time was differently estimated by different people. Some augmented the number of loud reports, and terror and imagination seem, in various instances, to have magnified every circumstance of the phenomenon.

The only thing which seemed of any importance beyond this statement, was derived from Mr. Elihu Staples, who said, that when the meteor disappeared, there were apparently three successive efforts or leaps of the fireball, which grew more dim at every throe, and disappeared with the last.

The meteor was seen as far south as New York: and the explosion was heard, and a tremulous motion of the earth perceived, between forty and fifty miles north of Weston. From the various accounts which we have received of the appearance of this body at different places, we are inclined to believe, that the time between the disappearance and

the report, as estimated by Judge Wheeler, is too little, and that a minute is the least time which could have intervened. Taking this, therefore, for the time, and the apparent diameter of the body as only half that of the full moon, its real diameter could not be much less than 300 feet.*

We now proceed to detail the consequences which followed the explosion and apparent extinction of this luminary.

We allude to the fall of a number of masses of stone in several places, principally within the town of Weston. The places which had been well ascertained at the period of our investigation, were six. The most remote were about 9 or 10 miles distant from each other, in a line differing little from the course of the meteor. It is therefore probable that the successive masses fell in this order, the most northerly first, and the most southerly last. We think we are able to point out three principal places where stones have fallen, corresponding with the three loud cannon-like reports, and with the three leaps of the meteor, observed by Mr. Staples. There were some circumstances common to all the cases. There was in every instance, immediately after the explosions had ceased, a loud whizzing or roaring noise in the air,

*NOTE.....From subsequent information it appears, that this meteor was seen in the eastern part of Connecticut, in New-Jersey, in the interior of the state of New-York, and as high up, at least, as Rutland, in Vermont.

It was stated by Professor Day, in a discourse before the Connecticut Academy, that a gentleman who was riding in Colchester in Connecticut, which is about 50 miles east of Weston, saw this meteor distinctly; it was passing within 15 or 20 degrees of the moon, and appeared to him to be about one half as large as that luminary. It was justly remarked by Mr. Day that, if at this distance, it had this apparent diameter, its real diameter must have 12 or 1300 feet, or, about a quarter of a mile; but, as the apparent diameter was not taken with an instrument, but by estimation, it was not supposed that this conclusion was perfectly exact. It is evident, at least, that the meteor must have been much higher, when it exploded, than was at first supposed.

observed at all the places, and so far as was ascertained, at the moment of the fall. It excited in some the idea of a tornado; in others, of a large cannon shot in rapid motion, and it filled all with astonishment and apprehension of some impending catastrophe. In every instance, immediately after this, was heard a sudden and abrupt noise, like that of a ponderous body striking the ground in its fall. Excepting one, the stones were more or less broken. The most important circumstances of the particular cases were as follows:

I. The most northerly fall was within the limits of Huntington, on the border of Weston, about 40 or 50 rods east of the great road from Bridgeport to Newton, in a cross road, and contiguous to the house of Mr. Merwin Burr. Mr. Burr was standing in the road, in front of his house, when the stone fell. The noise produced by its collision with a rock of granite, was very loud. Mr. Burr was within 50 feet, and immediately searched for the body, but, it being still dark, he did not find it till half an hour after. By the fall, some of it was reduced to powder, and the rest of it was broken into very small fragments, which were thrown around to the distance of 20 or 30 feet. The rock was stained at the place of contact with a deep lead colour. The largest fragment which remained did not exceed the size of a goose egg, and this Mr. Burr found to be still warm

to his hand. There was reason to conclude from all the circumstances, that this stone must have weighed about twenty or twenty-five pounds.

Mr. Burr had a strong impression that another stone fell in an adjoining field, and it was confidently believed that a large mass had fallen into a neighboring swamp, but neither of these had been found. It is probable that the stone, whose fall has now been described, together with any other masses, which may have fallen at the same time, was thrown from the meteor at the first explosion.

II. The masses, projected at the second explosion, seem to have fallen principally at and in the vicinity of Mr. William Prince's in Weston, distant about five miles, in a southerly direction, from Mr. Burr's. Mr. Prince and family were still in bed, when *they heard a noise like the fall of a very heavy body, immediately after the explosions*. They formed various unsatisfactory conjectures concerning the cause – nor did even a fresh hole made through the turf in the door-yard, about 25 feet from the house, lead to any conception of the real cause.

They had indeed formed a vague conjecture that the hole might have been made by lightning, but would probably have paid no further attention to the circumstance, had they not heard, in the course of the day, that stones had fallen that morning in other parts of the town. This induced them, towards evening, to search the hole in the yard, where they found a stone buried in the loose earth which had fallen in upon it. It was two feet from the surface – the hole was about twelve inches in diameter, and as the earth was soft and nearly free from stones, the mass had sustained little injury, only a few small fragments having been detached by the shock. The weight of this stone was about thirty-five pounds. From the descriptions, which we have heard, it must have been a noble specimen, and men of science will not cease to deplore that so rare a treasure should have been immediately broken in pieces. All that remained unbroken of this mass, was a piece of twelve pounds weight, since purchased by Isaac Bronson, Esq., of Greenfield, with the liberal view of presenting it to some public institution.

Six days after, another mass was discovered, half a mile north-west from Mr. Prince's. The search was induced by the confident persuasion of the neighbours that they heard it fall near the spot, where it was actually found buried in the earth, weighing from seven to ten pounds. It was found by Gideon Hall and Isaac Fairchild. It was in small fragments, having fallen on a globular detached mass of gneiss rock, which it split in two, and by which it was itself shivered to pieces.

The same men informed us, that they suspected another stone had fallen in the vicinity, as the report had been distinctively heard, and could be referred to a particular region somewhat to the east. Returning to the place after an excursion of a few hours to another part of the town, we were gratified to find the conjecture verified, by the actual discovery of a mass of thirteen pounds weight, which had fallen half a mile to the north-east of Mr. Prince's. Having fallen in a ploughed field, without coming into contact with a rock, it was broken only into two principal pieces, one of which, possessing all the characters of the stone in a remarkable degree, we purchased; for it had now become an article of sale.

Two miles south-east from Mr. Prince's, at the foot of Tashowa Hill, a fifth mass fell. Its fall was distinctly heard by Mr. Ephraim Porter and his family, who live within forty rods of the place, and in full view. They saw a smoke rise from the spot, as they did also from the hill, where they are positive that another stone struck, as they heard it distinctly.

At the time of the fall, having never heard of any such thing, they supposed that lightning had struck the ground, but, after three or four days, hearing of the stones which had been found in their vicinity, they were induced to search, and the result was the discovery of a mass of stone in the road, at the place where they supposed the lightning had struck. It penetrated the ground to a depth of two feet in the deepest place; and the hole was about twenty inches in diameter, and its margin was coloured blue from the powder of the stone, struck off in its fall.

It was broken into fragments of moderate size, and from the best calculations might have weighed 20 or 25 pounds.

The hole exhibited marks of much violence, the turf being very much torn, and thrown about to some distance.

We searched several hours for the stone, which was heard to fall on the hill, but without success. Since that time, however, it has been discovered. It is unbroken, and exactly corresponds in appearance with the other specimens. It weighs 36 ½ pounds.* it is probable that the five stones last described were all projected at the second explosion.

*It has been purchased by Mr. Gibbs, of Newport, Rhode-Island, who has thus enriched his splendid collection of minerals with the finest meteoric stone which is probably extant. This specimen abounds so much with iron, that it might almost be denominated an iron ore; some of the pieces of iron visible on the surface, are more than an inch long.

III. At the third explosion a mass of stone far exceeding the united weight of all we have hitherto described, fell in a field belonging to Mr. Elijah Seeley, and within thirty rods of his house. Mr. Seeley's is at the distance of about four miles from Mr. Prince's. Mr. Elihu Staples lives on the hill, at the bottom of which this body fell, and carefully observed the whole phenomenon.

After the last explosion, he says, a rending noise like that of a whirlwind passed along to the east of his house and immediately over his orchard, which is on the declivity of the hill. At the same instant a streak of light passed over the orchard in a large curve, and seemed to pierce the ground. A shock was felt, and a report heard like that of a heavy body falling to the earth; but no conception being entertained of the real cause, (for no one in this vicinity, with whom we conversed, appeared to have ever heard of the fall of stones from the skies) it was supposed that lightning had struck the ground. Three or four hours after the event, Mr. Seely [sic] went into his field to look after his cattle. He found that some of them had leaped into the adjoining enclosure, and all exhibited strong indications of terror. Passing on, he was struck with surprise at seeing a spot of ground which he knew to have been recently turfed over, all torn up, and the earth looking fresh, as if from recent violence. Coming to the place, he found a great mass of fragments of a strange looking stone, and immediately called for his wife, who was second on the ground.

Here were exhibited the most striking proofs of violent collision. A ridge of micaceous schistus lying nearly even with the ground, and somewhat inclining like the hill to the south-east, was shivered to pieces, to a certain extent, by the impulse of the stone, which thus received a still more oblique direction, and forced itself into the earth to the depth of three feet, tearing a hole of five feet in length and four and a half feet in

breadth, and throwing large masses of turf and fragments of stone and earth to the distance of 50 and 100 feet. Had there been no meteor, no explosions, and no witnesses of the light and shock, it would have been impossible for any person contemplating the scene to doubt, that a large and heavy body had really fallen from the skies with tremendous momentum.

From the best information which we could obtain of the quantity of fragments of this last stone, compared with its specific gravity, we concluded that its weight could not have fallen much short of 200 pounds. All the stones, when first found, were friable, being easily broken between the fingers; this was especially the case, where they had been buried in the moist earth; but by exposure to the air, they gradually hardened.

This stone was all in fragments, none of which exceeded the size of a man's fist, and was rapidly dispersed by numerous visitors, who carried it away at pleasure. Indeed we found it difficult to obtain a sufficient supply of specimens of the various stones, an object, which was at length accomplished, principally by importunity and purchase.

The specimens obtained from the different places are perfectly similar. The most superficial observer would instantly pronounce them portions of a common mass. Few of the specimens weigh one pound, most of them less than half a pound, and from that to the fraction of an ounce.

The piece lately found on Tashowa Hill is the largest with which we are acquainted. Mr. Bronson's is the next in size. The largest specimen in our possession weighs six pounds, and is very perfect in its characteristic marks. Of smaller pieces we have a good collection. They possess every variety of form, which might be supposed to arise from fracture with violent force. On many of them, and chiefly on the large specimens, may be distinctly perceived portions of the external part of the meteor. It is every where covered with a thin black crust, destitute of splendor, and bounded by portions of the large irregular curve, which seems to have inclosed the meteoric mass. This curve is far from being uniform. It is sometimes depressed with concavities, such as might be produced by pressing a soft and yielding substance. The surface of the crust feels harsh, like the prepared fish skin, or shagreen. It gives sparks with the steel. There are certain portions of the stone covered with the black crust, which appear not to have formed a part of the outside of the meteor, but to have received this coating in the interior parts, in consequence of fissures or cracks, produced probably by the intense heat, to which the body seems to have been subjected. These portions are very uneven, being full of little protuberances. The specific gravity of the stone is 3.6, water being 1. The specific gravity of various pieces varies a little; this is the mean of three.

The colour of the mass of the stone is mainly a dark ash, or, more properly, a leaden colour. It is interspersed with distinct masses, from the size of a pin's head to the diameter of one or two inches, which are almost white, resembling, in many instances, the crystals of feldt-spar in some varieties of granite. The texture of the stone is granular and coarse, resembling some pieces of grit stone. It cannot be broken by the fingers, but gives a rough and irregular fracture with the hammer, to which it readily yields. On inspecting the mass, five distinct kinds of matter may be perceived by the eye.

1. The stone is thickly interspersed with black or grey globular masses, most of them spherical, but some are oblong. Some of them are the size of a pigeon shot, and even of a pea, but generally they are much smaller. They can be detached by any pointed iron instrument, and leave a concavity in the stone. They are not attracted

by the magnet, and can be broken by the hammer. If any of them appear to be affected by the magnet, it will be found to be owing to the adherence of a portion of metallic iron.

2. Masses of yellow pyrites may be observed. Some of them are of a brilliant golden colour, and are readily distinguishable by the eye. Some are reddish and some whitish. The pyrites appear most abundant in the light colored spots, where they exhibit very numerous and brilliant points, which are very conspicuous through a lens.
3. The whole stone is interspersed with malleable iron, alloyed with nickel. These masses of malleable iron are very various in size, from mere points to the diameter of half an inch. They may be made very conspicuous by drawing a file across the stone.
4. The lead-coloured mass has been described already, and constitutes by far the greater part of the stone. After being wet and exposed to the air, the stone becomes covered with numerous reddish spots, which do not appear in a fresh fracture, and arise manifestly from the rusting of the iron.
5. There are a few instances of matter dispersed irregularly through the stone, which are considered as intermediate between pyrites and malleable iron. They are sometimes in masses apparently crystalline, but usually irregular. They are black, and commonly destitute of splendor, but exposed by a recent fracture, they appear like a glossy superficial coating. They are sometime attractable by the magnet, and sometimes not.

CHEMICAL EXAMINATION of the Stones which fell at Weston, (Connecticut,) Dec. 14, 1807. By B. SILLIMAN, Professor of Chemistry in Yale College.

THE public are already in possession of ample details concerning the fall of these bodies, and the phenomena which preceded the event.--- I have made an attempt to ascertain their nature, by a series of experiments, the result of which is now communicated to the public. It will be necessary to make some observations, and to detail some experiments, upon each of the constituent parts of the stone.

- I. Of the stone at large.
- II. Of the pyrites.
- III. Of the malleable iron.
- IV. Of the crust.
- V. Of the globular bodies.

I. Of the stone at large.

1.---100 grains of the stone, taken without any particular reference to the various bodies, and, containing promiscuously, portions of all of them, were pulverized in a porphyry mortar. The malleable iron resisted the pestle, so that the mass could be reduced only to a coarse powder. It was then digested for 11 hours, with a moderate lamp heat, in strong nitric acid, in a capsule of porcelain. Nitrous gas was disengaged with the usual red fumes, and, a light whitish matter appeared, dispersed throughout the solution, resembling gelatinous silex.

2.---The clear fluid was decanted from the insoluble residuum, all of which, except a small portion of the white flocculent matter, had subsided; to separate this, the fluid was filtered, and exhibited a decidedly greenish color.

3.---The solid residuum was heated over an Argand's lamp, till it was quite dry, and then triturated for an hour, in mortars of porphyry and jasper. As the malleable iron had now been removed by the acid, the residuum was easily reduced to a fine powder, which had a brick red color, and was digested again, for an hour, with a mixture of nitric and muriatic acids, somewhat diluted, and then boiled for some time in the same fluid. This was decanted and filtered, and the residuum was washed with water till it came off tasteless; these washings were all filtered and added to the two solutions Nos. 2 and 3. The entire fluid now had a light yellow color, owing to the nitro muriatic acid present in excess.

4.---The solid residuum, together with the solid material arrested by the filters, being ignited in a platinum crucible, became nearly white, and weighed 51,5 grains. It was fused with potash in a silver crucible, and the crucible, with its contents, was immersed in water contained in a silver basin; the resulting fluid was decomposed by muriatic acid and evaporation, and, the precipitate, after ignition in a platinum crucible, was white. There could now be no hesitation in pronouncing it to be silex, and the conclusion seemed sufficiently established, that more than half the stone consisted of this earth.*

5.---The entire solution was next examined, to discover what was the soluble part of the stone.

After the superfluous acid was saturated by ammonia, a very voluminous red precipitate appeared, which was

*Were it not for the infant state of chemistry in this country, it would be unnecessary to remark, that all the most important tests and re-agents employed in these experiments, were *absolutely pure*; for, very few of them can be obtained *pure* from the shops; the silver vessels were also perfectly pure, as were those of platinum.

oxid of iron. The fluid was filtered, and heated on a sand bath, to expel the excess of ammonia, and to precipitate any additional portion of oxid of iron which it might have suspended, but none was obtained.

6.---The precipitate being washed, collected, dried and ignited strongly, in a platinum crucible, had a dark brown color, inclining to red, and weighed 38 grains. Six grains of this weight were allowed for what adhered to the filter, which was accurately weighed before it was used, and after it had been thoroughly dried on a heated slab of Portland stone, and the difference of weight was 6 grains.

The oxid of iron thus obtained was not in the highest state of oxidizement; for, it was *completely*, although not very *powerfully* attractable by the magnet, by which the whole of it was actually transferred from a plate of glass to a wine-glass. It ought to have been oxidized to a maximum, considering the process by which it was obtained;--possibly some adhering ammonia, and a portion of charcoal, which accidentally got into the crucible, might have abstracted a part of its oxygen, with the aid of heat, and indeed heat alone would have expelled a portion of oxygen.

7.---The fluid from which the oxid of iron had been separated, had now a greenish colour, precisely similar to what it had in No. 2. Carbonat of potash produced no

precipitate, but, caustic potash threw down a pretty voluminous fleecy white precipitate. Being separated by the filter, dried, collected, and moderately heated, it became almost black; but, on being reheated strongly in a platinum crucible, covered by an inverted crucible of the same metal, it became white. It weighed 13 grains. It dissolved rapidly in sulphuric acid, and afforded, by evaporation, prismatic crystals, which had an acidulous, bitter taste; the former arising from a redundancy of the sulphuric acid;--- it afforded a white precipitate, with caustic potash --- suffered the aqueous fusion, and became a dry mass, on a live coal. From all these considerations, it was concluded, that the 13 grains were magnesia.

These crystals of sulphat of magnesia had a very slight tinge of green, a circumstance which was, doubtless, connected with the dark appearance of the magnesia, when first heated. It shall be resumed presently.--- It should be observed, that in some of the experiments with sulphuric acid on this supposed magnesia, a white matter, in small quantity, remained undissolved at the bottom of the vessel.--- It could hardly be silex, and preliminary experiments led me to conclude that no lime was present.--- Was it accidental, *or*, was there a small portion of alumine? This white matter, when heated with sulphuric acid and sulphat of potash, did not afford crystals of alum, on evaporation. I have not yet had leisure fully to decide this point, but intend to resume it. The stone has a very slight argillaceous smell, when breathed upon.

8.---The remaining solution still retained its greenish colour. Previous trials had decided, that neither copper nor iron was present in the solution. Nickel was therefore sought for, and the observations of Howard and Vauquelin, in their analyses of the stone of Benares, led me to expect it in triple combination with the ammoniacal nitrat and muriat, which had been formed in the liquor by a previous step of the process. According to the experience of Howard, I found the hidro sulphuret, and the prussiat of ammonia, the only agents among those which I tried, that would precipitate the nickel. The prussiat of ammonia gave a white precipitate, inclining to purple; the hidro sulphuret of ammonia, a voluminous black precipitate. The hidro sulphuret was used, and the precipitate was separated by the filter; the filter was dried, and it was with great difficulty that about three fourths of a grain were collected; the portion adhering to the filter was estimated at a grain; that which had been collected was ignited in a platinum crucible, and became green; it was, without doubt, the oxid of nickel, and with every allowance for loss and other circumstances, the whole cannot be estimated at more than 1,5 grain. In this estimate is included a portion of nickel which adhered to the magnesia, when it was precipitated; which caused it to turn black, when first heated --- which gave the sulphat of magnesia formed from it a slightly greenish tinge; and whose existence is still farther proved, by the black colour which was produced, when a solution of this salt was mixed with the hidro sulphuret of ammonia.

9.---The fluid from which the nickel had been precipitated, was now of a yellow colour, unmixed with green. Its present colour was derived from the hidro sulphuret of ammonia, and nothing could now be detected in the solution, except what had proceeded from the various re-agents employed.

There was, however, one other constituent of the stone, of whose existence the eye furnished decisive evidence, of which no account has hitherto been given, namely, the sulphur. As to the quantity of this, I can give only an estimation. Of the grounds of that estimation, as well as of the fruitless attempts which were made to collect the sulphur, I

will speak presently; but for the sake of concluding this head, I will now add, that the sulphur was estimated at 1,. If this analysis be correct then, the 100 grains which were examined afforded,

Silex,	51,5
Oxid of iron,	38,
Magnesia,	13,
Oxid of nickel,	1,5
Sulphur,	<u>1,</u>
	105,

The excess, instead of the usual loss, proceeds, manifestly, from the oxidizement of the iron, in a considerable, but unknown proportion. I must add, that the proportions of these ingredients vary in different parts of the stone, as is manifest to the eye, and will be immediately more fully evinced. In the analyses of others, should there be found some difference of proportion, it will not therefore necessarily indicate a contradiction. The great point of the similarity of these stones to those which have fallen in other countries, and which have been analysed by Howard, Vauquelin, Klaproth, and Fourcroy, who have been my guides in this investigation, will now, in all probability, be considered as sufficiently established. Had the daily avocations of a course of public lectures allowed the necessary time, I should have attempted something like a complete analysis of each of the constituent parts of the stone. If circumstances permit, this may still be done; but, in the mean time, a few observations of perhaps some utility may be offered.

II. Of the Pyrites.

In the stones in our possession, very few masses of pyrites of any considerable size are to be found; and they are generally so friable, that it was only with great difficulty, and patience, that 20 grains could be collected from 200 or 300 pieces. Their powder is blackish. I digested these 20 grains for 12 hours, in muriatic acid, somewhat diluted, hoping to separate the sulphur, so as to collect it as Mr. Howard had done. But, in this I was disappointed. Only a very few minute portions of sulphur appeared; they did not, as with Mr. Howard, float, but subsided among the earthy sediment; and only enough of them was collected to decide the existence of sulphur, by their burning with the peculiar smell of that substance. During the solution, the smell of sulphuretted hydrogen gas was emitted. As the stone, or, at least, some parts of it, emits the smell of sulphur, when heated, I attempted to procure the sulphur by sublimation. A portion of the powdered stone was placed in a coated glass tube, the upper part of which was kept cold, while the coated part was ignited for an hour, but no sulphur was obtained.

I caused the gas which arose from the solution of the metallic part of the stone in the sulphuric and muriatic acids, to pass into a solution of caustic potash --- only a small portion of it was absorbed; the potash became slightly hidro sulphuretted, since it precipitated the acetat of lead, black, and deposited a little sulphur upon the addition of sulphuric acid.

As I had already robbed the specimens of almost every tangible mass of pyrites, and injured them considerably, by the extraction, I was compelled to relinquish the idea of obtaining the exact proportion of the sulphur.

Mr. Howard, in the analysis of the stone of Benares, states the sulphur at 2 parts in 14 of the pyrites, or, about 15 per cent. If we may suppose these pyrites to be of the same

composition, (and their physical properties correspond with Count Bournon's description,) we might deduce the proportion of sulphur from the proportion of pyrites in the stone, for, there is every reason to believe that the sulphur exists in no other part of the stone, except the pyrites, and those masses which have proceeded from their decomposition. It is impossible, however, to separate the pyrites from the other parts of the stone, so as to estimate their proportion exactly; but, they evidently do not exceed one fifteenth of the whole stone. If therefore the sulphur be estimated at 1, it is probable the estimate will not be very erroneous.

The muriatic solution of the pyrites had a greenish colour; ammonia threw down the iron in a black precipitate, becoming rapidly red, when exposed to the air. The filtered fluid gave no traces of magnesia, when examined with caustic potash; but, hydro sulphuret of ammonia gave an abundant precipitate of nickel. Hence these pyrites are composed of iron nickel, and sulphur. Having saved the precipitates, I still hope to obtain the proportions of the two former.

III. The malleable iron.

When the stone is pulverized, the magnet takes up, usually, more than 40. I have taken up even 50, but once only 23. This is, however, far from being all iron; there is much adhering earthy matter --- some adhering pyrites, and, in short, all the principles of the stone adhere. A separate analysis of the attractable part, gives us nothing different from the results already stated, except an increase in the proportion of metallic matter, and a diminution in that of the earthy principles. The malleable iron contains nickel equally with that in the pyrites. On the other hand, a separate analysis of the unattractable part, presents no other diversity than a diminution of the metallic, and an increase of the earthy principles. I have separated a piece of malleable iron, so large, that by alternately heating and hammering, it was extended into a bar six tenths of an inch long, and one tenth thick; another mass was hammered into a plate more than half an inch in diameter. The attractable part of the stone dissolves rapidly in the strong acids; the muriatic and the sulphuric, diluted, give abundance of hydrogen gas, partially sulphuretted, and, nitric acid gives copious fumes of nitrous gas. In the same masses are found malleable iron --- pyrites --- and matter in an intermediate condition, intimately blended and adhering to each other.*

IV. The irregular black masses.

Some of these appear somewhat regular, like crystals of schorl, but most of them are irregular. While examining them, I found in some, appearances of pyrites in a state of decomposition. This led to a suspicion, that these masses were merely pyrites, which, by the force of heat, had been decomposed more or less completely. Accordingly, on separating a good many portions of these bodies, some were found readily --- others feebly --- and others not at all attractable by the magnet. But, the latter, by being treated for a few minutes, with the blow-pipe, became decidedly attractable. As a standard of comparison, some golden coloured pyrites from Peru, were heated by the blow-pipe, to expel the sulphur, and were made to pass through all the shades of colour, and degrees of magnetic attractability, corresponding with the various conditions of the black irregular masses. Little doubt could now remain, that the conjecture concerning their nature was

well founded. The glossy interior coating, mentioned in the mineralogical description, appeared to be of the same nature, and to approach nearly to the state of malleable iron.

*It is a curious fact, that the two famous masses of native iron, found in Siberia and Peru, (as well as the native iron of Bohemia and Senegal,) contain nickel; no ore of iron contains nickel ---- the popular tradition in some of the countries mentioned, is, that *the iron fell from heaven* ---- the masses are large and heavy, and were found at a distance from any possible source of iron ---- they are cellular and cavernous, as if some earthy cement had been decomposed and washed out by time; and still, a stony matter, resembling crysolite, and extremely like the hardest parts of the meteoric stones, remains adhering to the iron. No such iron is found in iron mines, and there can now be little doubt that *these masses of native irons are really of meteoric origin*; were the large stone from Weston, in the possession of Col. Gibbs, to be exposed to the weather till the earthy cement was worn away, it would resemble the Siberian and Peruvian iron.

V. The Crust.

The black external crust adheres so closely to the earthy matter within, that it is not easy to separate it. Indeed, it appeared scarcely worth while to subject it to a separate analysis, since the blow-pipe sufficiently indicates the difference between it and the rest of the stone. For, on heating any small portion of the stone with the most intense flame that the blow-pipe can give, it becomes covered with a black crust similar to that of the stone. The only point then in which the crust differs from the rest of the stone is, *that it has been changed by strong ignition*, having suffered a sort of vitrification, and its metallic parts a partial oxidizement; I say, partial, for when detached, it is attractable by the magnet, and the file discovers points of malleable iron.

VI. The globular bodies.

These appear to be merely portions of the stone, embracing probably all its principles, which have been melted by intense heat, and, being surrounded by solid matter, have become more or less globular, like to globules of metal which appear dispersed through a flux, in a crucible, upon a very refractory metal.

The globular bodies in this stone, although not attractable by the magnet, readily become so by being heated with the blow-pipe.

Is the iron in them too highly oxidized to admit of attraction, and are they partially reduced by ignition on charcoal? --- Finally, is there not reason to conclude, that there meteoric stones originally presented nothing distinguishable by the eye, except pyrites, and the enveloping earthy matrix --- that, by the operation of heat, the irregular black masses have been produced, by a partial decomposition of the pyrites --- that, by a still more intense heat in certain parts, the pyrites have been altogether decomposed, and malleable iron produced --- that the crust is produced by a mere oxigenizement and vitrification --- that the differences of colour in the earthy part is owing to the unequal operation of heat, the pyrites being left, in some places, especially in the white spots, almost wholly undecomposed, and that the globular bodies have been formed by a complete fusion of certain portions, by intense ignition.

Yale College, January 14, 1808.

POSTSCRIPT ---- *February 22, 1808.*

IN Nicholson's Journal for October, 1806, (No. 61, p. 147,) is an abstract of a memoir by M. Laugier, taken from the 58th volume of the Annals of Chemistry, in which the author asserts the existence of a new principle in meteoric stones, viz. *chrome*. Before advertng to this subject, it will be well to point out another assertion in Mr. Laugier's memoir, which appears to have been incorrectly expressed,--- After remarking, that all chemists who have examined meteoric stones, "have obtained similar results," he enumerates the principles which have been discovered in them, and says they are silex, iron, *manganese*, sulphur, nickel, with a few accidental traces of lime and sublime. It seems plain, that manganese has been careless written instead of magnesia; for, neither Mr. Howard, nor any of the able chemists who succeeded him in the examination of meteoric stones, before Mr. Laugier, ever found manganese, but constantly magnesia; and as magnesia is not mentioned at all by this latter chemist, I think it is plain that magnesia is intended by him, when he writes manganese. Dismissing this for an inadvertency, we will therefore return to *chrome*.

I have carefully repeated, and somewhat varied and extended the experiments of Laugier, on the discovery of chrome in meteoric stones.

1. A strong solution of caustic potash was boiled for an hour on a portion of the stone in powder --- the fluid was filtered --- it had a slightly yellowish colour.
2. Nitric acid was added, somewhat in excess, in order that the potash might all be saturated.
3. Nitrat of mercury, recently formed, without heat, was added, but there was no precipitate whatever;--- at this stage of the process, Laugier "threw down a red orange coloured precipitate, or chromate of mercury."
4. A small portion of the stone was now fused with pure potash, in a silver crucible, and maintained, for some time, in a red heat;--- every thing soluble was then taken up by water --- the fluid was filtered, and had a green colour.
5. Nitric acid was added, a little in excess, and then nitrat of mercury as before, but no precipitate ensued; these experiments were several times repeated, and with the same success.
6. Other portions of the fluid resulting from the boiling of potash upon the stone, and from its fusion upon it, and subsequent solution, were now mixed with the nitrat of mercury, without the previous addition of nitric acid. A copious yellow precipitate was thrown down --- this was heated to ignition in a platinum crucible --- the oxid of mercury was decomposed, and its elements expelled, and a small portion of a green oxid remained in the crucible.

In several repetitions of the process, this invariably occurred.--- I had been led to suppose that this was the oxid of nickel, because the alkaline solution from which it had been obtained, gave a black precipitate with the hidro sulphuret of ammonia. Accordingly, on fusing a portion of this oxid with borax, under the blow-pipe, it produced a glass of a hyacinth red; the same fact took place with a portion of a substance known to be the oxid of nickel, which was fused with borax for the sake of comparison.

On fusing a portion of the chromate of lead, or Siberian lead ore, with borax, and afterwards with vitreous phosphoric acid, glasses, of an emerald green colour, were produced.

Hence it was concluded, that the meteoric stones of Weston do not contain chrome, but that the green oxide obtained was the oxide of nickel.

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