He then states two extraordinary and unforeseen productions of this acid: one was during an analysis of manachanite from Botany Bay, in which oxygen had passed from oxide of titanium into a combination of potash with muriatic acid, and formed hyperoxygenized muriate of potash; and the other was in distilling nitro-muriatic acid upon platina. He tried the action of manganese in the same manner as the titanium, but could not succeed; nor did nitric acid convert oxygenized into hyperoxygenized muriatic acid.

Mr. Chenevix states that Mr. Berthollet had proposed to consider muriatic acid as the radical of the other two, and says that oxygenized muriatic acid corresponds with nitrous and sulphureous acids, and hyperoxygenized muriatic acid with nitric and sulphuric.

Our author states the arguments in favour of the old and the new mode of denomination; and upon the consideration that many bodies called acids have not been proved to contain oxygen, and that of some the contrary has been demonstrated, he seems inclined to think that an impartial hearing of both sides of the question must, in the present state of chemical knowledge, decide in favour of

Muriatic radical, or some word of the same import,	instead of	Muriatic acid;
Muri*atous* acid,		Oxygenized muriatic acid;
Muri*atic* acid,		Hyperoxygenized muriatic acid.

Experiments and Observations on certain Stony and Metalline Substances, which at different Times are said to have fallen on the Earth; also on various Kinds of native Iron. *By* Edward Howard, *Esq. F.R.S.* Read February 25, 1802. [*Phil. Trans.* 1802, *p.* 168.]

In considering the copious contents of this paper, we shall find it convenient to distribute them under the four following heads: 1. The historical part; 2. The descriptive part; 3. The analytical part; and 4. General observations on the subject, and a comparison of these stones with other substances which seem to bear some affinity to them.

And, First, as to the historical part. Waving all former accounts, both of the ancients and moderns, of stones which, under the names of Ceraunia, Bœtilia, Ombria, Brontia, Belemnitæ, &c. were supposed to have fallen from heaven, of which accounts most are disproved, and others are involved in inexplicable obscurity, we may lay some stress on the instances adduced by Mr. King, in his late tract "concerning stones which are said to have fallen from the clouds;" and also on the evidence of the Abbé Bachelay, who laid before the French Royal Academy a stone, which he asserted had been found on the 13th of September, 1768, still hot, by persons who saw it fall; and that of Professor Barthold, who analysed and described a stone found near Ensisheim in Upper Alsace, under the unqualified name of Pierre de Tonnere. These observations and experiments of the Abbé and

the Professor are here quoted at some length; as our author proposes to draw a comparison between their results, and those he deduces from his own investigation.

The instances next in succession, and which are the principal objects of this paper, are: 1. The several stones, about twelve in number, which in the year 1794 were seen by several persons falling from the clouds near Sienna, in the midst of a violent thunder-storm, and eighteen hours after an enormous eruption of Mount Vesuvius. As an ample account of this extraordinary phænomenon is printed in the Philosophical Transactions for the year 1795, it will be needless to dwell here any longer upon it, than merely to observe that these stones are of a quality not found in any part of the Siennese territory; and that as to their being of volcanic origin, it is scarce credible that they could have been carried in the air to a distance of at least two hundred and fifty miles. 2. The second instance is that of the stone, weighing no less than fifty-six pounds, which, according to the attestation of several persons who profess themselves eye-witnesses, fell on the 13th of December, 1795, near Wold Cottage in Yorkshire, and was, when extracted from the depth of about eighteen inches in the earth, still warm, and smoking. Here too no similar stone is to be met with in any part of that county. The weather was mild and hazy, but there was no thunder or lightning the whole day. 3. The third instance, which comes perhaps better authenticated than the two preceding ones, is that of a number of stones which, after the explosion of a meteor on the 19th of December, 1798, fell about eighteen miles from Benares, in the East Indies. The account of this phænomenon is given in a very circumstantial manner by John Lloyd Williams, Esq. F.R.S. At the time when the meteor appeared, the sky was perfectly serene, nor had the smallest vestige of a cloud been seen for several days before and after the phænomenon. The largest of the stones, of which Mr. Williams had seen eight, weighed 2lb. 12oz. There are no volcanoes on the Continent of India, nor have any stones yet been met with in that part of the world which bear the smallest resemblance to those here described. Lastly, the fourth instance occurs in the collection of Baron Born, now in the possession of the Right Hon. Charles Greville*. In Born's catalogue the specimen here mentioned is described as a mass of iron found near Tabor in Bohemia; and in a note it is observed that credulous people assert it to have fallen from heaven on the 3rd of July, 1753: in fact, on comparing it with the Sienna and Yorkshire stones, there appeared sufficient reason to excite a suspicion of its being of the same nature.

We here anticipate the account given in the latter part of the paper of the two enormous masses of a substance which has been considered as native iron, the one weighing about 15 tons, observed in South America, and described by Don Rubin de Celis, whose account is inserted in the Philosophical Transactions for the year

* Since purchased by Government, and deposited in the British Museum.

1788; and the other discovered in Siberia, and described by Pallas. This latter the Tartars consider as a sacred relic which had descended from heaven.

II. For the descriptive part of the four stones which have been analysed by Mr. Howard, we are indebted to the Count de Bournon, who observes in general, that none of them are, or appear ever to have been, of any regular shape; and that when entire they are all coated with a black crust, the thickness of which however is very inconsiderable. The Benares stone being that which has the most striking mineralogical characters, obtained the preference in these descriptions, and served as an object of comparison in the account to be given of the others. The crust already mentioned, which is common to all, is of a deep black colour, and of an uneven surface. It strikes fire with steel, and frequently contains particles of native iron. The stone itself when broken is of a grayish ash-colour, and of a granulated texture: it appears evidently to be composed of four different substances; one of them, which is in great abundance, shows itself in the form of small spherical bodies of various sizes, of a gray colour, sometimes inclining to brown, perfectly opake, and so hard as to give faint sparks when struck with steel. Another of these substances is a martial pyrites, of a reddish yellow tinge, somewhat inclining to the colour of nickel. When powdered it is of a black colour, and not attractable by the loadstone. The third substance consists of small particles of iron, in a perfect metallic state. These, although they compose only about $\frac{1}{50}$th part of the whole stone, give, however, to the whole mass the property of being attractable by the magnet.

These three substances are united together by means of a fourth as a cement, which is nearly of an earthy consistence, and of a whitish gray. The specific gravity of the aggregate stone is 3352.

The constituent parts of the stone from Yorkshire are exactly the same as those of the above, except that its grain is finer, that the globules are more irregular in their shape, that the martial pyrites is in less, and the iron in greater proportion, and that the earthy cement is more compact. Its specific gravity = 3508.

The Sienna stone was more similar to that from Benares than the last mentioned; the particles of iron were in a somewhat greater proportion. It contained some particles of black oxide of iron; and likewise one single globule of a vitreous substance, of a pale yellow colour inclining to green, and of a hardness rather inferior to that of calcareous spar. The specific weight of the aggregate was = 3418.

Lastly, the stone from Bohemia was most similar to that from Yorkshire, except that it appeared to be totally free from any particles of pyrites, and on the other hand to have a much larger proportion of globules of native iron; many of which, perhaps, on account of the stone having remained longer in the earth, had undergone a degree of oxidation on their surfaces. Its specific gravity was = 4281.

From these descriptions we learn that these stones, though they have not the smallest analogy with any of the mineral substances already known, have a very peculiar and striking resemblance to each other; a circumstance surely which must excite the attention and

stimulate the endeavours of philosophers, and particularly of chemical analysts.

III. The foremost among these was Mr. Howard, who, in the third part of his paper describes the several methods by which he examined each of the constituent parts of these stones separately, avoiding thereby the mistakes of the Abbé Bachelay and Professor Barthold, who by making their experiments only upon the stones in the aggregate, obtained of course none but fallacious results.

The Benares stone being, as Count de Bournon had already mentioned, the most characteristic, was the first he undertook to examine. In analysing the crustaceous matter, in which some nickel was soon found to be contained, the process led to an investigation of the triple salt, described by Mr. Hermstadt as an ammoniacal nitrate of nickel, which was soon found to be a proper menstruum for discovering the presence of the last-mentioned metal. The presence of iron and nickel was manifestly discovered in their substance; but the quantity that could be obtained was so small that it was found impracticable to give the proportions of their constituent parts.

The pyritical part was next examined. The result of the analysis, the particulars of which cannot be abridged, was, that 16 grains contains iron $10\frac{1}{2}$ grains, sulphur 2 grains, nickel nearly 1 grain, and extraneous earthy matter 2 grains: half a grain appears to have been lost in the process, owing probably to the impossibility of reducing the sulphur to the same degree of dryness as it existed in combination with the iron. The weight of the nickel, too, is a mere estimation, our acquaintance with that metal being as yet too imperfect to speak of it with accuracy, except as to its presence.

The third substance Mr. Howard examined was the native iron disseminated in the mass in small globules. Having reason to suspect that some nickel was likewise contained in this substance, he contrived an expedient for estimating its proportion, of which the following is a slight indication:—Finding that 100 grains of pure iron would yield about 145 grains of oxide, it would be a certain proof that the metal contains something which is either volatilized or left in the solution, if, under the same circumstances, it do not acquire the same proportionate weight. Hence when a metallic alloy of nickel and iron in known proportions is digested in nitric acid, it is plain that the deficiency of weight in the precipitated oxide of iron will be proportionate to the quantity of nickel contained in the alloy. By this means 25 grains of these metallic globules, being freed from earthy and other extraneous matter, left 23 grains of alloy, which were found to consist of 14 grains of pure iron, and 9 of nickel.

The small spherical bodies, equally dispersed throughout the mass, were the fourth objects of inquiry. The result of this analysis was, that 100 grains of the substance was decomposed into 50 silica, 15 magnesia, 34 oxide of iron, and $2\frac{1}{2}$ oxide of nickel. By summing up these it will be found, that instead of the loss usual on these occasions, there was an excess of weight of $1\frac{1}{2}$ grain; this is ascribed to the oxidizement of the iron.

Lastly, the earthy matter, forming a cement or matrix for the sub-

stances already examined, became the subject of investigation; and the mean result of two analyses gave, in 100 grains of the earth, 48 silica, 18 magnesia, 34 oxide of iron, and $2\frac{1}{2}$ oxide of nickel.

When we observe that the three other stones were found to contain the same elements as that just now described, only in somewhat different proportions, we may be excused from detaining the Society with the particulars of their several analyses. Nor shall we here dwell upon Mr. Howard's manner of reconciling his results with those of the Abbé Bachelay and Prof. Barthold, any further than to state, that the inferences drawn are favourable to the supposition, that the stones they examined were of the same nature as those here described.

IV. In this section we collect some of Mr. Howard's principal observations on this curious subject. It must be admitted, that notwithstanding the concurring evidence we have of the fall of some of these substances from the atmosphere, yet the fact itself is so repugnant to what we know as yet of the operations of nature, that we are likely to pause a while before we shall venture to form any decided opinion on the subject. Had the fall of all these stones been attended with meteors, we should naturally combine the two phænomena; and in this case Mr. Howard contends, that as these meteors generally move in a direction nearly horizontal, and probably not very high in the atmosphere, the objection of the stones not striking deeper into the earth, owing to their accelerated velocity, would be obviated. The imperfect knowledge we have of the origin and nature of meteors may likewise be considered as an encouragement for inquiring further into this hypothesis.

Should these masses, after all, turn out to be the effects of some regular and simple operation of nature, it is likely that many more will be found on the surface of the earth, which will become the objects of future inquiry. Meanwhile, Mr. Howard has thought proper to take a comparative view, not only of the masses of what has been denominated Native Iron in South America and Siberia, but also of every other specimen that could be met with in our collections of the substances that came under the same denomination. For a description of these substances, together with various observations thereupon, we are likewise indebted to Count de Bournon, who seems to think, that were the particles of iron and nickel in the stones here examined so numerous as to be in contact with each other, and were the earthy particles interposed between them wholly destroyed, as may happen by a variety of causes, the ferruginous cellular texture that would remain would be very similar to the native iron of Siberia and South America; both which have, moreover, by chemical analysis, been found to contain an ample proportion of nickel. The Count, in describing the Siberian iron, mentions the hard transparent nodules found in the cells of that metal, which bear a great resemblance to the peridot (chrysolite of Werner), the decomposition of which leaves the empty cells which we observe in all the specimens that are brought to us. Mr. Howard, on analysing these transparent nodules,

found them consisting of the same elements as the earthy globules of the stone from Benares.

From a collective view of the contents of this paper, we may now reasonably infer, that all the substances here mentioned, not excepting the native irons from Siberia and South America, and some from Bohemia and Senegal, have a manifest relation with each other. Mr. Howard recapitulates these analogies; and, with a view to the further investigation of the subject, closes his paper with the following queries:—1st. Have not all fallen stones, and what are called Native Irons, the same origin?—2nd. Are all or any the produce of meteors?—and 3dly. Adverting to the circumstance of the Yorkshire stone having fallen during a serene sky, might not this stone have formed a meteor in regions too elevated to be within the reach of our observation?

Observations on the two lately discovered celestial Bodies. By William Herschel, *LL.D. F.R.S.* Read May 6, 1802. [*Phil. Trans.* 1802, *p.* 213.]

The observations described in the first part of this paper relate to the magnitude, the colour, the disc, and the atmosphere of the two moving stars lately discovered by Mr. Piazzi and Dr. Olbers, to which they have assigned the names of Ceres and Pallas; and also to the question, whether they be attended by any satellites. Their magnitudes were determined by means of a comparison of their reflected images with a lucid spot of a disc micrometer placed at considerable distances. The results of many observations were, that the diameter of Ceres does not subtend an angle of more than $0''{\cdot}40$, or in actual length only $162\frac{1}{2}$ miles; and that the diameter of Pallas can hardly measure more than between 71 and 72 miles. The colour of these bodies was ruddy, and in one instance Pallas was of a dusky white. Their discs were never of a well defined planetary appearance; and as to their atmospheres or comas, the greatest extent of that attending Ceres was in one instance about two diameters beyond its disc; in another instance the whole had a cometary appearance; or when viewed most accurately, it bore a great resemblance to a small, much compressed, but ill-defined planetary nebula. Pallas never exhibited more than a faint haziness. As to satellites, it was inferred previous to the observations, that bodies of such very small dimensions could hardly contain a quantity of matter sufficient for the retention of secondary bodies; and in fact the several appearances that seemed to denote the existence of such attendants, were on more careful inspection found to be fallacious.

In the second part of the paper Dr. Herschel enters into an inquiry concerning the nature of these new stars, particularly as to the question whether they be planets or comets. And in ordĕr to proceed upon certain grounds, he previously enumerates certain criteria by which the heavenly bodies may be properly distinguished. These, as to the planets, are seven in number. 1. Those till lately discovered are all