PAPERS.

I. *Some remarks on the Total Eclipse of the Sun, on July 8th, 1842. By Francis Baily, Esq. Vice-President of this Society.*

Read November 11, 1842.

It is well known to many members of this Society that I proposed to proceed to the Continent, during the last summer, for the express purpose of observing the total eclipse of the Sun which was to take place on the morning of July 8th, civil reckoning. This object has been accomplished; and I flatter myself that an account of that rare phenomenon, by an eye-witness, may be acceptable to this meeting. A statement of the principal observations that I made, was communicated by me to one of the Vice-Presidents of this Society, in a letter written at Milan within forty-eight hours after the eclipse, whilst the circumstances were still fresh in my memory; and they do not differ from those that I am now about to relate more in detail, and which I am desirous here to place on record.

A total eclipse of the sun, in any particular portion of the globe, is an event of very rare occurrence, since only four or five of these remarkable phenomena are recorded as having been seen in Europe during the last century: to which we may add another that was fortunately seen *at sea*, by Don A. de Ulloa. But, the accounts of these several eclipses are by no means satisfactory, since they are discordant in many particulars; which probably has arisen not only from the sudden and unexpected appearances that oc-

curred, but also from the loose description that has been given of them, either by the observers themselves, or by those who drew up the accounts and perhaps did not fully comprehend the intention and meaning of the authors. The difficulty also is very much increased from the want of drawings to represent the exact appearances seen, which are always more readily understood by this method, than by any verbal description.

During the present century another eclipse of this kind has taken place in the United States of America, which was observed by Mr. Ferrer; and a minute account of the same, together with a drawing of its appearance, has been published in the 6th volume of the *Transactions of the American Philosophical Society*. These are the only cases of interest that are on record since the invention of the telescope, within which period we must necessarily limit our attempt to acquire any useful information relative to this remarkable phenomenon. But, I must proceed with my narrative.

My original intention was to have taken up my station, for observing the eclipse, at Digne, in the south of France; and I had proceeded on my way thither till I arrived near Lyons, when I found that I had a few days to spare; and, as I had proposed to visit Venice before my return home, I altered my route and resolved to proceed in an easterly direction, along the line of the moon's shadow, till the day before the eclipse, when I proposed to halt at the most convenient place that might offer. I therefore turned off towards Chambery, and crossing the Alps at Mount Cenis, passed through Turin, Asti, and Alessandria, and arrived at Pavia about noon on July 7th.

As this place was directly on the central line of the moon's shadow, I resolved at once to make it my head-quarters. I had intended to apply to the Director of the University there for the use of a convenient place where I might observe the eclipse; but I was agreeably anticipated in this respect, by a visit from one of the Professors, who having heard of my arrival and my object, immediately and obligingly came to offer me the use of any one of the apartments in the university that might be considered most adapted for my purpose. On accompanying him to the university, with this object, I selected one of the upper rooms of the building, which was admirably adapted for making the observations that I had in view. He then very kindly expressed his readiness to furnish me with any instruments at the university that I might require for my use. But, I had taken with me from London the same $3\frac{1}{2}$-feet telescope by Dollond, that I had formerly used in the *annular* eclipse

of May 15, 1836, as already described in the 10th volume of the *Memoirs* of this Society: and I therefore informed him that all I wanted was to be left *alone* during the whole time of the eclipse, being fully persuaded that nothing is so injurious to the making of accurate observations, as the intrusion of unnecessary company. Acting upon this hint, he immediately took the key from the outside of the door, and placed it in the inside, and told me that I might lock myself in; but there was no occasion for this precaution, for although I heard numerous footsteps pass the door, in their way to an adjoining apartment which was also used as an observatory on this occasion, no one attempted to enter the room in which I was located.

At 4 o'clock in the morning of the eventful day I went to the University, in order to prepare for the observation; and at that early hour I found many of the students, and official persons, walking about. At sunrise a thin stratum of clouds was seen in the east near the horizon, but the sun soon got above this obstruction, and the remainder of the day was beautifully clear and serene: not a cloud was to be seen in any part of the heavens, visible from my window, during the whole time of the eclipse. It was as fine a day as that which I had fortunately witnessed in Scotland, at the annular eclipse of 1836.

I had a very good observation of the commencement, and the end of the eclipse, but I did not pay any great attention to these secondary objects; and as my chronometer was not adjusted to correct mean time, these observations can be of no use, except as indicating the duration of the eclipse, which, according to my reckoning, was $1^h\ 56^m\ 39^s{\cdot}6$ mean time.

As the moon advanced towards her central conjunction with the sun, I watched very carefully and with much anxiety, the approach of the border of the moon towards the still illuminated portion of the sun, which was now rapidly assuming a fine crescent shape, the precursor of total obscuration. I used a *red*-coloured glass, in order to observe the phenomenon, notwithstanding the remarks and advice to the contrary by an American observer: and the power of the eye glass was about 40. When the total obscuration took place, the coloured glass was removed.

I at first looked out very narrowly for the *black lines* which were seen in the annular eclipse of 1836; as they would probably precede the *string of beads*. These lines, however, did not make their appearance; or, at least, they were not seen by me. But, the *beads* were distinctly visible; and on

their first appearance I had noted down, on paper, the time of my chronometer, and was in the act of counting the seconds in order to ascertain the time of their duration, when I was astounded by a tremendous burst of applause from the streets below, and at the *same moment* was electrified at the sight of one of the most brilliant and splendid phenomena that can well be imagined. For, at that instant the dark body of the moon was *suddenly* surrounded with a *corona*, or kind of bright *glory*, similar in shape and relative magnitude to that which painters draw round the heads of saints, and which by the French is designated an *auréole*.

Pavia contains many thousand inhabitants, the major part of whom were at this early hour, walking about the streets and squares, or looking out of windows, in order to witness this long talked-of phenomenon: and when the total obscuration took place, which was *instantaneous*, there was an universal shout from every observer, which "made the welkin ring;" and, for the moment, withdrew my attention from the object with which I was immediately occupied. I had indeed anticipated the appearance of a luminous circle round the moon during the time of total obscurity: but I did not expect, from any of the accounts of preceding eclipses that I had read, to witness so magnificent an exhibition as that which took place. I had imagined (erroneously as it seems) that the *corona*, as to its brilliant or luminous appearance would not be greater than that faint crepuscular light which sometimes takes place on a summer's evening, and that it would encircle the moon like a *ring*. I was therefore somewhat surprised and astonished at the splendid scene which now so suddenly burst upon my view. It riveted my attention so effectually that I quite lost sight of the string of *beads*, which however were not completely closed when this phenomenon first appeared. I apprehend that only a few seconds of time (perhaps three or four) were wanting to complete the perfect obscuration of the sun; but I cannot speak on this point with much certainty.

I had previously noted down some of the principal objects to which I was desirous of directing my attention during the time of total obscuration, and which seem to have given rise to much discussion on former occasions. These, as far as the *corona* is concerned, had reference principally to its colour, its lustre or paleness, its magnitude and extent, its state of motion or repose, and its encircling the sun or the moon as its centre; then, as to the moon, whether any holes were discernible, or any coruscations of light on

the dark side; next, as to the amount of darkness in the atmosphere, the change of colour in surrounding objects, and some other points not requisite here to enumerate further. The time, however, for making accurate observations of this kind is always so short in total eclipses (in the present case being less than $2\frac{1}{2}$ minutes) that one individual can scarcely attend to all the objects that are requisite to be noticed; more especially if his attention is called away (as in this instance) by any new phenomenon which had not been previously observed, nor even anticipated. It is therefore desirable, in any future occurrences of this nature, that a *division of labour* should be made between two or three observers at the same place; each attending solely to the part which he has selected for his particular object.

The breadth of the *corona,* measured from the circumference of the moon, appeared to me to be nearly equal to half the moon's diameter. It had the appearance of brilliant rays. The light was most dense (indeed, I may say quite dense) close to the border of the moon, and became gradually and uniformly more attenuate as its distance therefrom increased, assuming the form of diverging rays in a rectilinear line, and at the extremity were more divided and of unequal length: so that in no part of the *corona* could I discover the regular and well-defined shape of a *ring* at its *outer* margin. It appeared to me to have the sun for its centre, but I had no means of taking any accurate measures for determining this point. Its colour was quite *white,* not pearl colour, nor yellow, nor red; and the rays had a vivid and flickering appearance, somewhat like that which a gas-light illumination might be supposed to assume, if formed into a similar shape. I should think it not impossible to give a tolerable representation of this phenomenon by some artificial contrivance. I have seen something like it, in miniature, by the reflection of the sun's light from a piece of broken glass; and on a larger scale by viewing the sun through a grove of trees; but in both these cases it is necessary to obscure the central portion of the rays. The brilliancy of the *corona* was however quite as great as that which is produced by either of the methods here alluded to. I have annexed hereto a drawing of the *corona,* representing, as nearly as I can preserve in my recollection, the appearance of its shape and extent, and the ramification of the rays, at the time of the middle of the total obscuration. I had no time or opportunity for ascertaining the deviation of the moon from the central position of the *corona,* at any other point of its progress. (See the copper-plate No. I. accompanying this paper.)

Splendid and astonishing, however, as this remarkable phenomenon really was, and although it could not fail to call forth the admiration and applause of every beholder, yet I must confess that there was at the same time something in its singular and wonderful appearance that was appalling: and I can readily imagine that uncivilised nations may occasionally have become alarmed and terrified at such an object, more especially in times when the true cause of the occurrence may have been but faintly understood, and the phenomenon itself wholly unexpected.

But the most remarkable circumstance attending this phenomenon (at least, that which most engaged my observation during the short interval of total obscuration, and drew my attention from other objects of interest) was the appearance of *three large protuberances* apparently emanating from the circumference of the moon, but evidently forming a portion of the *corona*. They had the appearance of mountains, of a prodigious elevation; their colour was red, tinged with lilac or purple; perhaps the colour of the peach blossom would more nearly represent it. They somewhat resembled the snowy tops of the Alpine mountains, when coloured by the rising or setting sun. They resembled the Alpine mountains also in another respect, inasmuch as their light was perfectly steady, and had none of that flickering or sparkling motion so visible in other parts of the *corona*. All the three projections were of the same roseate cast of colour, and very distinct from the brilliant vivid white light that formed the *corona;* but they differed from each other in magnitude. I have endeavoured to represent the appearance of the shape, size, and position of these several protuberances, in the accompanying Plate; and I have numbered them in the order in which they were first seen by me. My attention was drawn, first of all, to No. 1, which is situate considerably to the right of the vertical point in the circumference; and on looking round the moon, I observed the other two. The largest of them was No. 2, which appeared to be bifurcated, and the separation of the parts was discernible even to the base, so that they might be taken for two distinct projections, one overlaying the other. No. 3 was not quite so large as No. 1. The whole of these three protuberances were visible even to the last moment of total obscuration, at least, I never lost sight of them, when looking in that direction; and, when the first ray of light was admitted from the sun, they vanished with the *corona*, altogether, and day-light was *instantaneously* restored.

I should mention that this drawing represents the appearances as seen in a telescope that *inverts:* and it may be interesting to know that the moon made the first impression on the sun's disc very near the point No. 3, and left it very near the point No. 1. My attention was so constantly taken up by these remarkable and unexpected appearances, that I omitted to watch for the reappearance of the *beads,* and therefore cannot add my testimony to the recurrence of that phenomenon.

The darkness, during the time of total obscuration, was not so great as I had anticipated. I had caused a lighted candle to be prepared, in order to be ready in case of need; but I eventually extinguished it, as I found I could read very small print, and note the time by my chronometer, without its assistance. Prior to the commencement of the eclipse, I had observed a great number of swallows flying about; but towards the middle of the eclipse they had all vanished, and did not make their appearance again till a few minutes after the first ray of light emanated from the sun, when they were as active, and soon became as numerous, as ever.

During the time of total obscuration, I examined carefully with the telescope the body of the moon, but could not discern any bright spot that might be mistaken for a hole; nor could I discover any coruscations issuing from the dark side of the moon. These, however, were only momentary observations. I was told that several stars were seen, but I could not spare the time to look about for them myself; every moment was occupied with more important matter.

Having thus given a detail of all the principal circumstances that occurred, and precisely in the manner in which they presented themselves to my view, as far as my recollection (committed to paper, immediately after the event) will assist me, I had intended to have subjoined to this communication an account of the several phenomena that had been noted on former occasions of this kind, and to have compared the various descriptions with each other, in order to see how far any differences that were observed, might be reconciled with present appearances. Or, in other words, to have presented a sort of historical view of the subject, somewhat similar to the plan which I adopted in my Memoir relative to the annular eclipse in 1836. But, I fear that I may already have encroached too much on the time of the meeting; and I am moreover of opinion that a review of this kind can be taken with greater advantage at a more advanced period of time, when we may be in

possession also of the several observations that have been made on the present eclipse, at different places on the Continent, and which might thus be introduced into the comparison. Should such a measure be thought desirable and useful to future observers, I may probably intrude again upon the time and attention of the Society.