

comparatively steady and permanent character, being subjected only to variations due to changes in the state of that atmosphere; whereas, on all occasions where a blunted horn has been observed, it has been only a transient phenomenon. Thus, in the eclipse of 1842, M. Arago notices that each cusp was repeatedly blunted and recovered its natural form. Again, there appears to be no evidence of any prolongation of the bright segment, which would certainly be produced by the existence of such an atmosphere. And, what is perhaps the most conclusive evidence of all, eclipses have been repeatedly observed without the cusps being seen to be blunted at all; as was the case in the eclipse of 1854, the cusps having appeared perfectly sharp, and free from all distortion throughout the eclipse to the observers at Prescott, Kingston and Toronto. We may, therefore, safely ascribe the phenomenon observed by Dr. Smallwood to the existence of a considerable mountain on the portion of the moon's disc forming the extremity of the cusp.

II. At 4h. 49m. 15s. a minute bright spot was seen at Kingston on the surface of the moon, near the eastern cusp. Several theories have been suggested to account for the appearance of such spots, which have been frequently observed. The first mention of them is by Ulloa, who, in the total eclipse of 1778, "saw in the N. W. region of the moon a luminous point, shining successively as brightly as a star of the 4th, 3rd and 2nd order." This phenomenon received from him a very strange explanation, viz., that the moon is penetrated by a sort of long tunnel, through which the sun's disc could be seen. And the same hypothesis, slightly modified, was adopted by M. Valz, who observed the eclipse of 1842 at Marseilles. It seems strange that such hypotheses could be gravely set forth. It is obvious that, if such were the real cause of the appearance of these luminous spots, instead of being momentary and variable phenomena, they would retain their brilliancy at least for some considerable period; and, moreover, if such gaps existed, they could scarcely fail to be observed as *shadows* on the full moon, considering the magnitude of the astronomical instruments now employed. It has also been supposed that the appearance of such bright spots might be due to the existence of active volcanoes on the moon's surface, which several astronomers have fancied they have seen. Thus Hævelius asserted that the mountain known as Aristarchus "appeared reddish and seemed to burn"; and several other astronomers—among whom we may mention Sir W. Herschel—have recorded similar appearances. It seems, however, probable that the volcanic character of these mountains cannot be maintained. The flickering appearance of the light—on which the hypothesis materially depends—seems wholly due to atmospheric causes, as it is not observed when the sky is clear, and the air still. The other grounds on which the mountain in question has been conjectured to be a volcano, are, that it has been distinctly seen during a lunar eclipse, and that it is often very conspicuous at the time when the moon is nearly new, and when the portion of her disc not illuminated by the sun is seen by aid of the light reflected from the earth. In the latter case, if we suppose the mountain to have a smooth table land at its summit, and the sides to be rugged and broken, it is easy to understand that the plateau at the top would reflect more light than the surrounding regions, and so appear brighter. But it seems almost impossible to account for the continued brightness during a lunar eclipse, when there is actually no light falling upon the moon, except by supposing the spot in question either self-luminous, or, at any rate, capable of giving out during the darkness the light previously absorbed. On either supposition the appearance of a bright spot on the moon during a solar

eclipse might be accounted for, supposing it to have been observed by several persons, and for some considerable time. But it seems that whenever such appearances have been observed, they have been temporary, and that they have been noticed only by a few observers. Thus, in the eclipse of 1842, neither Mr. Airy, nor Mr. Baily, nor M. Arago perceived any such bright spots; and, though they were observed by others, the observations do not present accordance either in time or position—which evidently suggests the enquiry, whether these appearances may not be optical illusions. That a person might be deceived in this respect is evident from the fact that one of the observers at Prescott repeatedly thought he saw such a spot, but as on moving the telescope the spot moved with it, it was at once evident that it was due to some particles of dust or accidental inequality on the object-glass scattering the sun's rays.

III. None of the observers of the eclipse of 1854 succeeded in seeing the portion of the moon's disc exterior to that of the sun. It was seen by M. Arago during the eclipse of 1842, and is thus described by him:—"About 40 minutes after the commencement of the eclipse of July 8th, at 5h. 35m. by our clock, I saw the outline of the moon delineated upon the heavens. It formed accurately the prolongation of the dark circular arc which another portion of the same limb traced on the surface of the sun, and joined it at two points on the bright limb of the latter body." The same appearance is thus noticed by M. Flaugergues, who observed the eclipse at Toulon. "Towards the middle of the increase of the eclipse, the disc of the moon was visible about 25° beyond each of the points of intersection of the circumferences. When the eclipse amounted to eleven digits, all the disc of the moon became visible."

In the Instructions printed by order of the Institute, it was pointed out that this phenomenon would certainly escape observation, if the lenses of the telescope were not perfectly polished and scrupulously clean, and it was probably chiefly to the fact of the former condition not being fulfilled, that we must ascribe the failure of the observers in this respect. To explain why these precautions are essential to the success of the observation, it will be necessary to point out the mode in which the moon's disc does become visible under these circumstances.

The explanation which would at first offer itself, and which was assumed to be the true one by some observers in 1842, is that the moon's disc might be rendered visible by the twice-reflected light of the sun, which is called by French astronomers, "*la lumière cendrée*," and which has been by some English writers termed "*earth-shine*." That this light is, under certain circumstances, sufficiently strong to render the moon's disc visible, is evident to any one who has remarked the appearance of the moon when very young, when not only the small crescent illuminated by the sun's direct rays is visible, but we can also see the remainder of the disc of a peculiar grey colour. This is owing to the fact that at that time the earth as seen from the moon is nearly full, and that the light reflected from the earth to the moon is strong enough, when reflected again to us, to render visible the part of the moon not illuminated by the direct rays of the sun. Is it possible, then, that when the eclipse has begun, the portion of the moon exterior to the sun should be rendered visible by this light? In order to answer this question, it will be necessary to ascertain under what conditions an object becomes visible, either by the naked eye or through a telescope. It is evident that we have to take into account something besides the actual amount of