

Eclipse of the Moon.

Eclipse of the Moon.—September 2, 1830.

To those who observed this beautiful occurrence, it may be of interest that we attempt, in these spare pages of our Journal, a record and explanation of its appearances. Many of the beautiful and interesting phenomena of the heavens are here more beautiful and interesting, from the pure and gentle transparency of the atmosphere through which we gaze at them. A spectator accustomed to the hazy skies of the North, turns oft with untired gladness to the distinct and vivid objects of our horizon, the hues and changes of the twilight, or the brilliancy of the azure noon. The nearer to us of the heavenly bodies partake of this distinctness; the setting planets blaze like masses of flame on the sea; the moon, after rushing in obscurity through the sun's radiance, early displays its filmy thread of light, and in its increase presents at all times an appearance of substantial rotundity, very dissimilar to its vapoury and languid disk in the English sky. It is

well known that the planets, primary and secondary, in their circuit round the sun, must project a cone of darkness pointing into the void behind them, which becomes visible, as a shadow, when it sweeps across any thing to be obscured by it. The shadow must consist of two parts; one of which includes the space in which the sun is totally hidden by the planet: this ends in a point, and is surrounded by the other part of the shadow, which extends widening, as far as the sun's rays serve to give a boundary to it, including all the space in which the planet can appear to touch upon, or obscure any portion of the sun's disc: this is the penumbra. Hence arise the appearances of the moon when eclipsed in the earth's shadow. A section of this shadow would present a darker disc, included by a rim of ill-defined obscurity, across which the full orb'd satellite passes in entering or leaving the deeper shade which circumscribes it. The moon's appearance in both cases is much modified by the earth's atmosphere. The breadth of the exterior lighter shadow ought to be generally, at the distance of the moon, greater than the breadth of the moon's disc, but in the late eclipse it was only about one-third of this breadth; this arises from the bending of the sun's rays in passing through the earth's atmosphere, in such a manner that the greatest proportion of the sun's light reaches any part of the moon's disc, even after a large part of the earth is interposed between them. From the same cause it is that the moon scarcely ever disappears, even in the darkest part of the earth's shadow. In fact, if the atmosphere exerted no influence on the sun's light, except that of bending it, the darker cone of the earth's shadow would be so much shortened that it would fall within the moon's orbit; and that luminary, in passing behind the earth, would be subjected to only slight variations of brilliancy; when opposite the earth, it would then be intersecting a cone of condensed light, and shining with greater radiance than usual: the earth's atmosphere being to the moon like the rim of a gigantic lens, appearing to augment the objects situate at a due distance beyond it. Such, however, is the absorbing power of the denser portions of the earth's atmosphere, that only a small portion of the light which it would concentrate, if perfectly transparent, can pierce through it to the moon.

La Place, who, in the *Système du Monde*, mentions these appearances, has calculated that so little of this refracted light reaches the moon, that its centre cannot then be brighter than one-fiftieth part of its brilliancy at full moon, and must generally be much less illuminated than this. The appearance of the moon will depend considerably on the nature of the outline of that hemisphere of the earth turned towards it; and if the atmosphere over the bounding meridian be much

obscured, the moon may be entirely darkened. The earth, as seen from it, will in these, and indeed, in all circumstances, present wonderful and interesting phenomena; reserved, however, for but one half of the Lunar orb. To every point of that face of the moon which constantly looks upon us, the earth retains a fixed position, having all other bodies, during the moon's month-long days and nights, rising culminating or setting beyond it, and in every spot enjoying the glorious vision, affords the finest and readiest opportunities of ascertaining relative positions and distances. It marks the same periods as the moon does to us, by its increasing and waning through the Lunar varieties of aspect; and with our oceans and continents, flitting across in rapid succession; or the points and ridges of our snowy mountains, glowing like spots of flame above the dullness or commotion of our atmosphere, it presents a ready and splendid chronometer, sub-dividing into our days the moon's long intervals of light and darkness. When the great orb is hidden in the sun's beams, and advancing to cover his disc in the Lunar eclipse, it will seem, for a little, to push the sun's limb before it; till, shortly, the sun's disc will appear to extend round the earth's orb, and embrace it with a ring of light, which will continue to diminish on one side, and increase on the other, till they be again disjoined.

But, besides the refractive power causing these appearances, the earth's atmosphere possesses also a considerable dispersive power; in virtue of which, the rays passing through it are separated into portions of different colors, which are transmitted in different proportions to the different parts of the earth's shadow. This dispersion produces the blue of the zenith, and the reddened atmosphere round the sun on the horizon. A beautiful example of it is presented to us in this climate at our sun-set; which may, perhaps, afford the means of comparing its influence in this respect with that of other bodies. If we turn from the setting sun and look to the eastern horizon, we shall observe along the tops of the mountains a long arc of dull purplish red; which, as the sun descends, rises toward the zenith, followed by a border of pale bluish green: these, when most distinct, have a breadth of about six degrees; and, as they ascend, fade, and become indistinguishable. They appear to be a sort of spectrum produced by the structure and lenticular shape of the portion of the atmosphere traversed by the sun's rays, which are reflected back to us in their separated state by the particles of the eastern atmosphere; the dispersed light being intermingled with the ordinary blue of the sky. A similar effect was observable in the eclipse. During the greatest obscuration, the moon had a fiery brassy hue, which arose

from a great proportion of the blue rays of the light which passed through the lower regions of the atmosphere, being refracted farther inwards in the cone of the earth's shadow, or bent down on the earth's surface. The penumbra, however, had a purple tint, which seems to be an effect due chiefly to the higher regions of the atmosphere; the blue refracted by a higher and rarer stratum, being intermingled with the red, refracted by a lower and denser one.

Different portions of the moon's surface continued to shine during the eclipse with different degrees of brilliancy, as observed in the obscure part of the new moon. The portions most highly illuminated, were disposed as a ring round the disc, but appeared in greatest breadth towards the poles of the moon, and narrowest towards the western side. The North Pole was the most illuminated, and at the upper or southern limb, the greatest light seemed to come from a point to the eastward of the pole; nothing appeared to determine decisively whether this difference arose partly from light emitted by the moon itself, or altogether from more copious reflection by different parts of its surface. If water existed in a state of fluidity in the moon, we should see its poles more brilliant, from accumulations of snow there. The atmosphere of the moon is so rare and shallow, that astronomers doubt whether a slight indecision some times observed in the sinking of stars behind it, ought to be ascribed to that or to some other cause; the warmest parts of its surface must be in the condition of the tops of our loftiest mountains, and the temperature of its elevations is probably little above that of the planetary space.

If water therefore abound there as on the earth, it cannot be fluid, but must rest almost every where as a covering of changeless snow; and if we conceive it somewhat less abundant, or more in the state of ice in the depressions of the moon's surface, the hypothesis will explain all the appearances of the disc.

During the greatest obscurity in the late eclipse, the moon was still beautifully distinct, and might have been supposed only under a slight discoloring haze. When the edge of the disc attained again its full illumination, there was in some degree the same appearance of projecting, as we see in the brilliant part of the new moon, compared with the obscured part which it grasps. The shaded part at the same time, appeared to assume a deeper tint. The effect of a brilliant object in obscuring a gloomier one beside it, may be readily seen in the new moon, when nearly half-full. The unilluminated part will then be scarcely observable, but if we place ourselves so that an object at some distance from the eye, obscure the enlightened part, then may we observe the other, hitherto obscure, start into view in gratifying brilliancy and distinctness.

J. A.