third question is as to what we are to do with it. I think that probably the Council will recommend that it be handed over to the Geological Survey for the Museum, where there is already a fine collection of meteorites.

*The President.*—I think the first thing we have to do is to have this analysis pushed through, and we also have to decide as to what we are going to do with it. Dr. Harrison suggests that we make it over to the Museum and have it labelled as a present from us. I think we may leave that for the Council to decide. In the meantime I think we had better have the analysis carried out.

A hearty vote of thanks was accorded to the Rana Bahadur, and a vote of thanks returned to the officers of the Geological Survey for their courtesy in giving information about this meteorite, also to Dr. Harrison, amid much applause. The meeting was then adjourned to the next Annual Meeting which takes place on October 31st.

# The Solar Eclipse of October 1911 as it will be observed in India.

BY A. T. MITRA AND B. M. RAKSHIT.

We shall have an eclipse of the sun in the morning hours of the 22nd of October next. It will be visible from all parts of India, though the magnitude of the maximum phase will vary considerably. Thus for example the obscuration will be a quarter of the sun's diameter at Madras, a third of it at Bombay, two-thirds of it at Calcutta, three-quarters of it at Darjiling, and seven-eighths of it at Dibrugarh. In order to understand the cause of this difference we have to bear in mind that a solar eclipse is caused by the interposition of the moon between the observer and the sun. Just as an isolated patch of cloud sometimes cuts off the sun from view either wholly or in part, so the dark opaque moon sometimes comes between us and the sun, causing a complete or partial obscuration of his disc. Now, we have frequently noticed that a small patch of cloud does not conceal the sun from view equally for all; that while some are in the shadow others stand in sunshine. In the same way while the moon obscures the sun completely for some, for others it causes a partial obscuration, there being for some others no obscuration at all. Behaving, in an eclipse, like a patch of passing cloud the moon comes up to the sun, covers it and then moves away, presenting different views to different observers.

To have a more scientific idea of the subject we must conceive of two sets of common tangents joining the globes of the sun and the moon as in diagram No. 1. These form two cones of which one has its apex above the moon and the other has its apex below the moon The latter or the inverted cone contains the perfect or darker shadow known as the umbra and the former contains the lighter shadow known as the penumbra. These cones exist permanently in space, and when, owing to the relative positions of the sun, moon, and earth, they come in contact with our world we have an eclipse of the sun. This eclipse is partial or total according as the observer happens to be inside the penumbral or the umbral cone. When an observer happens to be at the surface of the external cone he sees only a simple contact of the discs of the sun and moon; when he is at the axis (*i.e.*, the line S.M. in the diagram) the eclipse is central for him; when he is between these two he finds the sun more or less obscured according to his nearness to the axis.

The rapid motion of the moon in the sky combined with the diurnal rotation of the earth makes the shadow cones sweep along the surface of our globe. As a locality is overtaken the eclipse commences at it. The obscuration grows there as the shadow passes on and the axis line comes nearer and nearer. It attains a maximum varying according to the approach of that line. Thus according to the position of a city or town an eclipse is central or partial. If the axis passes through it, it has a central eclipse, otherwise it has only a partial eclipse. A central eclipse again may be total or annular. When the umbral cone is long enough to reach the surface of our globe the central eclipse becomes total, but when the cone terminates up in the air at some distance above the ground, the eclipse becomes an annular one in which a ring of light is left uneclipsed, as shown in the illustrative figure before us.

The coming October eclipse will be an annular one, though in India it will be partial. The axis of the cone will trace out a line which will lie out of India. Starting from the Sea of Aral it will move south-east and pass through Turkestan, Kashgaria, Thibet and China. Then crossing the China Sea and passing between Borneo and the Philippine Islands it will enter New Guinea, passing out of which it will proceed along the sea for some time and then leave the earth. Places situated on this line will see the sun centrically covered by the dark disc of the moon with a ring of light surrounding it. The southern half of the penumbra will pass over India, making the eclipse visible from all parts of this country

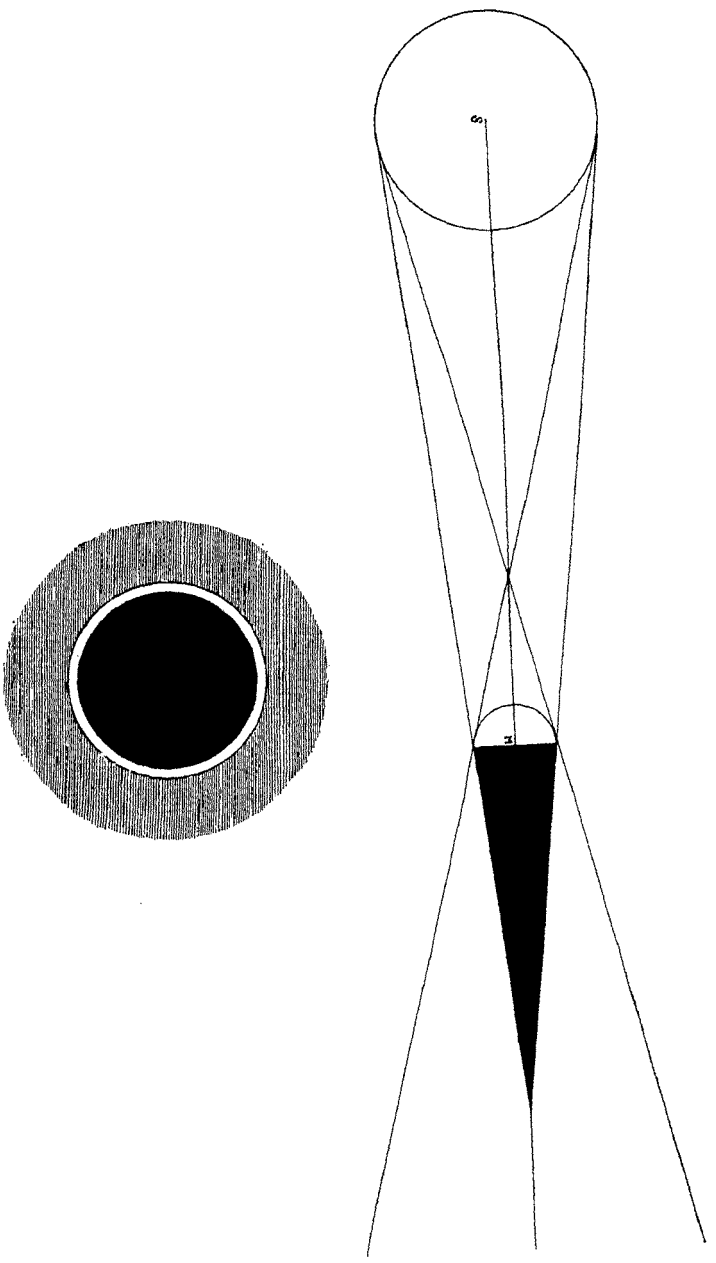

Photo.-Engraved & printed at the Offices of the Survey of India, Calcutta, 1911

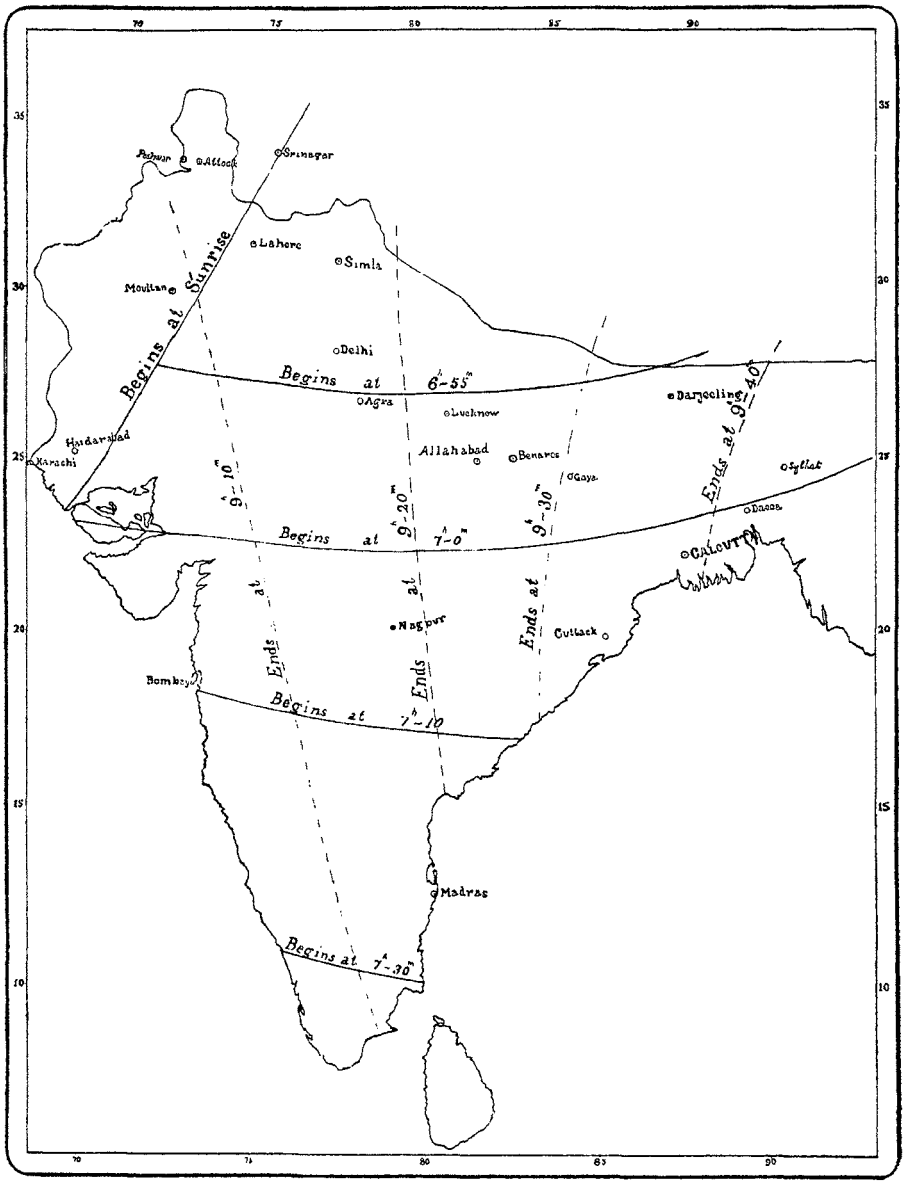


Photo-Engraved & printed at the Offices of the Survey of India, Calcutta, 1911

The phenomenon will be first visible at Srinagar in Kashmir (Fig. 2), where it will commence at sunrise, and the last station in India where it will continue after it has ceased to be visible elsewhere will be Dibrugarh, the easternmost city of Assam. The shadow cone moving south-east will enter India by its north-western extremity and gradually spread itself more and more over our country. As it moves on, its outline will stretch east and west and move southward. Now, all places lying on this outline at a particular instant will have the eclipse commencing simultaneously at that instant. Hence we shall have time lines joining the localities where the phenomenon will commence together. The map before us shows some of these lines, each of which indicates that at the standard hour marked near it, all the places north of it will be inside the penumbral cone and will therefore find the sun more or less eclipsed. Now, an examination of the time lines makes it clear that Kashmir and the Punjab will see the eclipse earlier than any other part of India. Next it will be visible in the North-Western Provinces and Rajputana. At the 7th hour of the morning it will become visible from almost all parts of upper India. Then gradually the time line will move down bringing the Deccan inside the penumbral cone. When the eclipse becomes visible at Cape Comorin, we must know that India is entirely inside the shadow, and that no part of our country is out of it. For over an hour it will remain completely within the penumbra, though the phase of the eclipse will continually change for every station while the simultaneous phases will be different for different stations. At last India will approach the boundary line of the shadow cone and commence emerging out of it. Sind and the Punjab will cease to see the sun eclipsed while the rest of India will still continue within the penumbra. We shall have now the outline of the cone stretching again across our country just as at the commencement of the eclipse. But the time lines at the end of the eclipse will move eastward and stretch north and south. Some of these are on the map before us. They indicate that at the hour for which a line has been drawn, all places west of it will find the sun uneclipsed while all stations east of it will find it still eclipsed. An inspection of the lines shows that following Sind and the Punjab, Rajputana will pass out of the shadow, and then the North-Western Provinces and the Deccan, and last of all Bengal and Assam will emerge out of the penumbra.

There may be a natural curiosity to know how big the size of the moon's penumbra is at the earth, and how fast it travels. Astronomical treatises inform us that the maxi-

mum breadth of the shadow is about 4,800 miles and its average velocity at places where it is perpendicular is about 2,070 miles. In the present case the breadth of the penumbra will be about 4,416 miles, and we can form a rough idea of its speed when we consider that its outline will move from Delhi to Calcutta in about 23 minutes. From Delhi to Calcutta is, as the crow flies, 815 miles. The velocity calculated from these data is a little over 35 miles per minute that is about 50 times the speed of the Punjab mail.

There is one point about the map before us which cannot be passed over. Stretching from the mouth of the Indus to Srinagar in Kashmir we notice a line at all points of which the eclipse will commence at sunrise. Places lying west of this line will have the sun rising more or less eclipsed, whereas all places east of this line will have the eclipse commencing after sunrise. As the line passes between Lahore and Multan the sun will rise eclipsed at Multan, while the eclipse will commence at Lahore ten minutes after sunrise. Karachi, Haidarabad, Quetta, Peshwar, Attock, and Rawal Pindi will see the sun rise more or less eclipsed.

Let us now pass on to the times and phases of the eclipse at some of the important stations of India. The annexed table gives the precise standard times of the beginning, middle and end of the phenomenon and the degree of obscuration at the maximum phase :—

| | H. M. S. | H. M. S. | H. M. S. |
|---|---|---|---|
| Calcutta ... | 7 1 28 | 8 15 17 | 9 38 36 |
| Bombay ... | 7 9 36 | 8 4 12 | 9 3 6 |
| Madras ... | 7 22 18 | 8 17 0 | 9 17 0 |
| Lahore ... | 6 51 34 | 7 57 45 | 9 11 47 |
| Allahabad ... | 6 57 3 | 8 6 8 | 9 23 50 |
| Nagpur ... | 7 3 33 | 8 6 54 | 9 18 0 |
| Rangoon ... | 8 13 1 | 9 33 17 | 11 3 15 |

We next proceed to consider in detail the times and phases of the eclipse at Calcutta. In this city the eclipse will commence at 7 hours 1·5 minutes standard time, or 7 hours 25 minutes local time. The point of the disc of the sun where the obscuration will commence will be 31 degrees to the left of the vertex as given in Figure 3. If we imagine the disc to be marked like a clock dial the point will be very near the mark XI, or more precisely, it will be where the end of the hour-hand is just two minutes before eleven o'clock. As time passes on the obscured portion will increase in size, and shift (to coin a term) anti-clock-wise, presenting the aspect shown in the diagrams before us at the standard times noted just above

each. The arrow represents the up and down line and the vertex of a figure is determined by imagining a line parallel to the arrow drawn through its centre. The fourth figure is the precise view of the maximum phase which will occur at 8 hours 15 minutes 17 seconds standard time. After this hour the obscuration will begin to decrease but continue shifting in the same direction as before. Seven and a half minutes after the view of the last figure (*i.e.*, at 9 hours 38 minutes 36 seconds standard time) the eclipse will end, the point of the last contact being 29 degrees left of the bottom, or where the hour-hand of a watch has its tip two minutes before seven o'clock.

# The August Meteors.

BY THE DIRECTOR OF THE SECTION.

One of the most important meteoric showers is that of the Perseids of 10th to 12th August. It is a rich annual shower and its meteors are remarkable as rapid and leaving trails of luminous vapours behind them. As the meteors of this shower are not collected into a narrow path on each side of the computed orbit, but spread far on both sides of it, they are also visible some days before and after the above-mentioned dates. It is suggested that if the weather permits observations may be taken of the shower, and in order to facilitate the observations a short description of the constellation Perseus which contains the radiant point is now given. This constellation is situated north of the zodiacal constellations Aries and Taurus. Most persons, I suppose, know the star cluster known as the Pleiades in Taurus. North of this star cluster will be found in a curved line from south towards north the three stars $s$, $\varepsilon$, and $v$ Persei. Of these the lowest and the middle one are of the 3rd and the uppermost of the 4th magnitude. North of $v$ Persei will be found, in a line running from south-east to north-west, the four stars $\delta$, $\alpha$, $\gamma$, and $\eta$ Persei; their magnitudes are respectively 3·2, 1·9, 3·1, 3·9. On the south and a little towards west of $\alpha$ is the remarkable variable star named Algol or $\beta$ Persei. On the 10th of August $\alpha$ Persei will rise at Calcutta at 10h. 5m. p.m., and its amplitude or the angular distance from the east point will be 55° 30′ towards north. The R. A. and the declination of the radiant point of the shower are respectively 3 hours and 57° N. On the 10th of August it rises at Calcutta at 9h. 5m. p.m., and its amplitude will be 65° 18′ towards north. It is very near the small star $\eta$ Persei.