

The Solar Prominence of 1919 May 29. By John Evershed
(Plates 2, 3.)

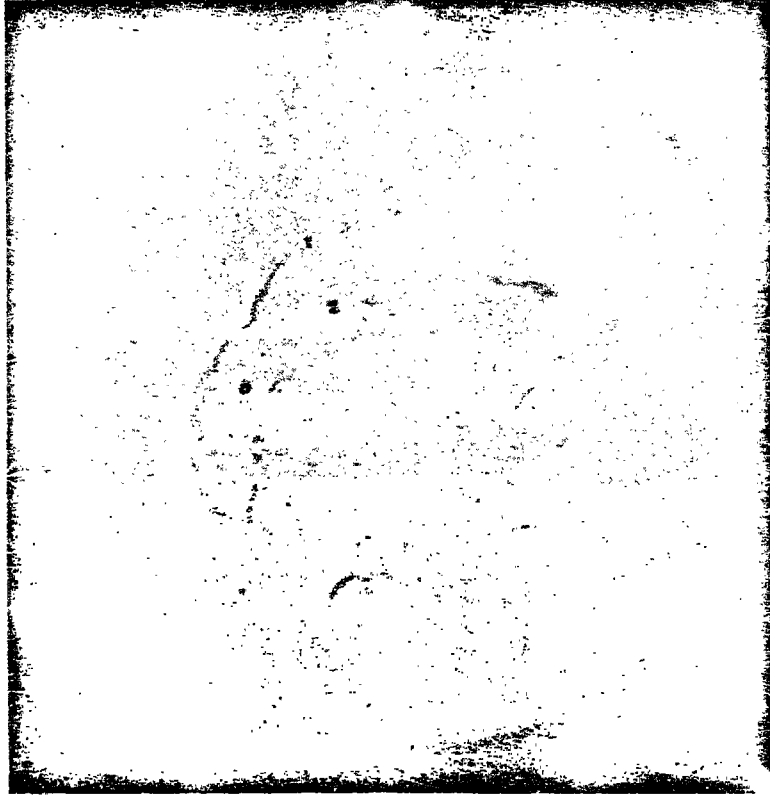
This prominence was photographed at Kodaikanal, and is referred to briefly in my report of prominence observations for the half-year ending 1919 June 30. As it was visible on the Sun's south-east limb during the total eclipse of May 29, a description of our photographs and of the past history of the prominence may be of use, especially for comparison with the interesting series of photographs secured with the Cambridge spectroheliograph and described by Mr. Moss (*M.N.*, 79, 553).

The prominence can scarcely be described as one of the eruptive

* *Astrophysical Journal*, 43, 193.

† *Ibid.*, 43, 190.

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No. 2. 1919 May 10, 8^h 58^m I.S.T.
or " 9, 15^h 28^m G.M.T.

No. 1. 1919 May 8, 8^h 05^m I.S.T.
or " 7, 14^h 35^m G.M.T.

Prominences seen by Absorption on the Sun's Disk in H α Light.

class, although in the final stages it became partly separated from the Sun's limb and showed a tendency to rise, the greater part eventually dissolving away in space. But the early history of the prominence shows it to have been one of a stable character lasting through an entire rotation of the Sun. In the Kodaikanal series of photographs it is first seen on May 1, civil date, on the south-east limb. On the 2nd there is a series of prominences extending from $+25^\circ$ to -35° east, the maximum height attained being $60''$ in the southern portion. On the 5th the prominences appear as absorption markings on the disc in $H\alpha$ light both north and south of the equator. From this date $H\alpha$ photographs show the prominences in patches or in continuous formation crossing the disc and maintaining their identity until May 14, when they are quite close to the west limb. The southern prominence is variable in length, extending from -15° to -30° on the 8th and 10th but inclined to a meridian about 15° , the southern end inclined towards the east (Plate 2, Nos. 1 and 2). It becomes much more extended both north and south on the 11th (Plate 3, No. 3), and appears to broaden out as it approaches near to the west limb; but this is an effect of perspective due to the considerable height of the prominence. The northern part crossed the central meridian on May 9 about $6\frac{1}{2}$ hours Indian standard time (May 8, 13^h G.M.T.). On the plate of May 11 it is seen to form the southern extension of an immense system of prominences reaching far into the northern hemisphere. The whole disposition of these prominences suggests an outer wave of a vast region of disturbance centring in a large sunspot the approximate coordinates of which are, north latitude 7° and longitude 7° . The southern prominence is nearly due south of this spot, and distant from it about 22° of latitude on May 10. In the north the prominences extend about 30° north of the spot, but trail away to the east through 33° of longitude. The southern prominence first appears projecting beyond the limb on May 15. On the 16th it is well developed between -15° and -43° and is $80''$ in height (Plate 3, No. 4).

The next record of the prominence is eleven days later on the south-east limb, when portions of the prominence appear between -7° and -49° , bright but low. On May 28 it has enormously developed, extending almost continuously from -49° to $+22^\circ$ (Plate 3, No. 5); the southern portion is $140''$ in height. On the 29th this part of the prominence is $280''$ in height and is partly separated from the limb by a space $40''$ to $60''$ in height, but at -40° the prominence is attached to the chromosphere by a double stem or root (Plate 3, No. 6). The great mass of interlaced filaments are drawn out towards the north in two long streamers, the lower one connected to the limb near the equator and the higher ending in air, so to speak. It is interesting to compare this photograph with the Cambridge series, which show that this projecting streamer later extended itself towards the north, and finally made connection with the chromosphere 4° north of the



No. 6. May 29, 9^h 05^m I.S.T.
or " 28, 15^h 35^m G.M.T.

On the east limb.



No. 5. May 28, 8^h 45^m I.S.T.
or " 27, 15^h 15^m G.M.T.

On the east limb.



No. 4. May 16, 8^h 26^m I.S.T.
or " 15, 14^h 56^m G.M.T.

On the west limb.



No. 3. May 11, 11^h 03^m I.S.T.
or " 10, 17^h 33^m G.M.T.

On the disk in H_{α} .

The Solar Prominences of 1919 May 29.

equator, the whole prominence on May 29, 2^h 29^m G.M.T., appearing as an immense arch 44° in extent. At Kodaikanal it was not possible to follow up the changes after 9^h 05^m on the 29th (May 28, 15^h 35^m G.M.T.) owing to clouds, but an opportunity occurred in the evening, when two disc plates were taken at 22^h 52^m and 23^h 03^m G.M.T. which show the prominence practically as it appears in the Cambridge series at 22^h 20^m.

On May 30, 7^h 44^m I.S.T. (May 29, 14^h 14^m G.M.T.), the root of the prominence at -40° still remains, but the entire mass of filaments between that position and the equator has vanished.

In the plates the images are shown as seen in northern skies with the north pole at the top and the east on the left side. The Sun's axis is indicated in the disc photographs, and the images of the limb are bisected along the axis.

It is interesting to note that the patches of absorption shown in No. 3 to the south of the spot correspond closely in position with the denser regions in the prominence at the limb as seen in No. 4 five days later.

The disc photographs in H α light afford a good opportunity for measuring the angular rotation speed of the prominence, but an assumption has to be made as to the height of the absorption markings above the photospheric level. If this is taken at 30", the daily angular motion near the limbs and near the centre of the disc give fairly consistent values, whereas if it is assumed to be at the photospheric level the daily motion near the limbs comes out greater than near the centre. Computing the angular motion therefore for a sphere of the Sun's radius + 30", the mean daily motion between May 7 and May 13 is 13°·32. This is for the preceding end of the prominence in latitude -15°. Applying the appropriate correction for the Earth's movement, the sidereal angular speed is 14°·28 per diem, a value almost identical with the rotation movement of the reversing layer as determined by Adams for this latitude. It is to be noted also that the spot in north latitude 7° gives precisely the same angular motion, since it completed an entire synodical rotation in 27·02 days, according to measures of our photographs. The spot and the prominence therefore maintain throughout the same relative positions in longitude, and the prominence does not move with the higher speed which Adams found for the chromosphere.

No H α disc photographs were obtained early in June owing to monsoon conditions, but on July 3, when the same region was near the central meridian, absorption markings are again found having much the same aspect as those recorded in May. There is a great mass in latitude -40°, which crosses the meridian on the 3rd and 4th. This may be identified with the root of the prominence of May 29, if we suppose a rotation at this latitude takes about a day longer than in latitude 15°. In addition to this there is a long filament between latitude -10° and -20° covering almost the same heliographic position as the prominence of May 29; that is, on July 3 it occupies the same position on the disc

after two complete synodic rotations of 27·0 days as the absorption marking photographed on May 10. The only noticeable difference is the greater inclination of the filament to the equator, which now points south-eastwards in the direction of the prominences at -40° , which lag behind owing to the slower rotation.

These results show, as has been found by me previously,* that the prominence-producing forces localised in definite regions remain active for long periods and tend to renew prominences which have suffered complete dissolution. Also the prominence-producing regions rotate with the angular speed of the spots and the reversing layer.

In our study of the prominences at Kodaikānal we have come across several instances of an apparently stable prominence suddenly vanishing into space, either by a rapid and accelerating motion of ascent, or, as in the present case, by a comparatively slow rise with a tendency to form streamers which seemingly try, ineffectually, to hold the ascending mass to the Sun.† Of course in the great majority of cases the dissolution does not happen at the Sun's limb, but may be made evident by the sudden disappearance of an absorption marking on the disc, an occurrence that is frequently observed.‡ It is quite possible that many of the apparently stable prominences end their careers in this way, although the dissolution at the limb is seldom witnessed.

This type of prominence tends to avoid the immediate neighbourhood of sunspots, as is shown by the $H\alpha$ disc images and the K images, where the absorption markings wind between and around the great regions of calcium flocculi in which the spots are immersed. Frequently they appear to form the outer boundaries of the regions of sunspot disturbance, their curved linear forms bending round the preceding side of a sunspot group and trailing eastwards on either side, as though the spot were surging through a liquid sea and causing a diverging wave on either side. It is difficult to avoid the conclusion that sunspots, flocculi, and prominences are all manifestations of the same disturbance emanating probably from the interior of the Sun.

Kodaikānal :
1919 September 16.

* *Astrophysical Journal*, 33, 6.

† *Ibid.*, 23, 81.

‡ In the May series of $H\alpha$ plates the very conspicuous prominence patch north of the spot about 25° vanished utterly between May 11 and May 12.