

## I. PHYSICS

### Astrophysics (Geomagnetism)

# A NOTE ON THE GEOMAGNETIC OBSERVATIONS MADE AT HYDERABAD AND ETAIYAPURAM DURING THE SOLAR ECLIPSE OF 16 FEBRUARY 1980

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THE total solar eclipse of February 16, 1980 offered a unique opportunity for the study of its effect on the geomagnetic field in Peninsular India. The ideal conditions for a clear-cut demonstration of the Chapman-type decrease (1933) of about 28 per cent in the geomagnetic  $sq$  variation at the time of the eclipse (Magnitude of eclipse greater than 70 per cent) are : a magnetically quiet day, occurrence of the eclipse around local noon when the  $sq$  attains its peak value, location of the observation site within the path of totality or closeby, and a duration of several minutes for the totality.

**Keywords :** Geomagnetism; Chapman-type Decrease; Geomagnetic Variation.

### EXPERIMENT

Special magnetic observations and continuous visual recording at a speed of 2cm/min of the total intensity  $F$  were carried out on February 15, 16 and 17, 1980, during the day hours at the Hyderabad Magnetic Observatory of NGRI with a highly sensitive 1 nT/mm) Proton Precession Magnetometer fabricated by the NGRI, besides the continuous photographic registration of the variations of  $H$ ,  $D$  and  $Z$  components using a set of La Cour magnetograms obtained at the Etaiyapuram Magnetic Observatory of NGRI located very close to the magnetic (dip) equator in Tamil Nadu, the Sabhawala Magnetic Observatory operated by the Survey of India near Dehra Dun in north India close to the  $sq$  focus, and the American Observatory at San Juan in the same latitude belt but in the opposite hemisphere which was free from the solar eclipse. Table I gives the coordinates of these observatories (the recording equipment and their sensitivities), the circumstances and the magnitude of the eclipse at each station.

### DATA ANALYSIS AND INTERPRETATION

A moderate magnetic storm began with a sudden commencement of +8 nT in the horizontal component at Hyderabad on February 15, 1980 at 1235 UT. The storm continued through its main phase and recovery phase on February 16, 1980, and ended only at 2300 UT on February 16, and gave a range of 152 nT in  $H$  and one  $K$ -index of 6 on February 15, 1980. Both the horizontal component and the total intensity values at Hyderabad were depressed due to the storm by about 100 nT on February 16, 1980, besides the accompanying short-period (about one hour period) fluctuations throughout. The solar eclipse on February 16, 1980, thus occurred when

TABLE I  
*Co-ordinates of the magnetic observatories, equipments used and circumstances of the solar eclipse of 16 February 1980*

| Observatory              | Geographic Latitude | Longitude | Latitude | Geomagnetic Longitude | Solar Eclipse |          | Time of maximum phase of the eclipse (UT) |          | Magnitude of maximum phase (%)   | Solar eclipse ends (UT) |  | Equipments and their sensitivities |
|--------------------------|---------------------|-----------|----------|-----------------------|---------------|----------|---|----------|--|-------------------------|--|------------------------------------|
|                          |                     |           |          |                       | begins (UT)   | h m s    | h m s                                     | h m s    |  |                         |  |                                    |
| Sabhawala<br>(Dehra Dun) | 30° 22'N            | 77° 48'E  | +20.8°   | 149.8°                | 09 09 04      | 10 18 03 | 61.3                                      | 11 20 12 | Askania variometers,<br>H 3.2 nT/mm, D 0.5/<br>mm, Z 3.4nT/mm<br>20mm/hr.  |                         |  |                                    |
| Hyderabad                | 17° 25'             | 78° 33'   | +7.6     | 148.9                 | 08 58 15      | 10 16 55 | 99.4                                      | 11 25 54 | La Cour variometers,<br>H 4.6 nT/mm, D 0.3/<br>mm, Z 3.8nT/mm<br>15mm/hr and Proton<br>Precession magneto-<br>meter F 1 nT/mm 2cm/<br>min. |                         |  |                                    |
| Etiyapuram               | 09° 10'             | 78° 01'   | -0.6     | 147.5                 | —             | —        | 80<br>(approx)                            | —        | La Cour variometers<br>H 4.8 nT/mm, D 0.37/<br>mm, Z 2.3 nT/mm,<br>15mm/hr.  |                         |  |                                    |
| Trivandrum               | 08° 29'             | 76° 57'   | -1.2     | 146.4                 | 08 49 40      | 10 09 42 | 79.9                                      | 11 19 36 | —  |                         |  |                                    |
| San Juan                 | 18° 07'             | 293° 51'  | +29.9    | 3.2                   | No eclipse    |          |   |          | Askania variometers,<br>H 1.7 nT/mm D 0.5/<br>mm, Z 3.8 nT/mm,<br>20mm/hr.   |                         |  |                                    |

a magnetic storm was already in progress. The 15 minute values of  $F$  and  $H$  variations, respectively, read off from the continuous records obtained at Hyderabad on February 15, 16 and 17, 1980 were plotted, and an attempt was made to look for an eclipse effect, if any. The times of beginning maximum phase (99.4 per cent) and end of the eclipse at Hyderabad were taken from the tables given by Subrahmanyam and Rao (1979).

The oscillations seen in the depressed  $F$  and  $H$  records of Hyderabad on the day of the eclipse are similar as expected due to the magnetic storm. In order to further demonstrate that the geomagnetic field fluctuations observed during the eclipse on February 16, 1980 were due entirely to the magnetic storm and that the eclipse effect, if any, was inextricably lost in the storm, plots of 15 minute scalings from the  $H$ -component of the magnetograms obtained at Sabhawala, Hyderabad, Etaiyapuram and San Juan, were also critically examined (Fig. 1). The fluctuations

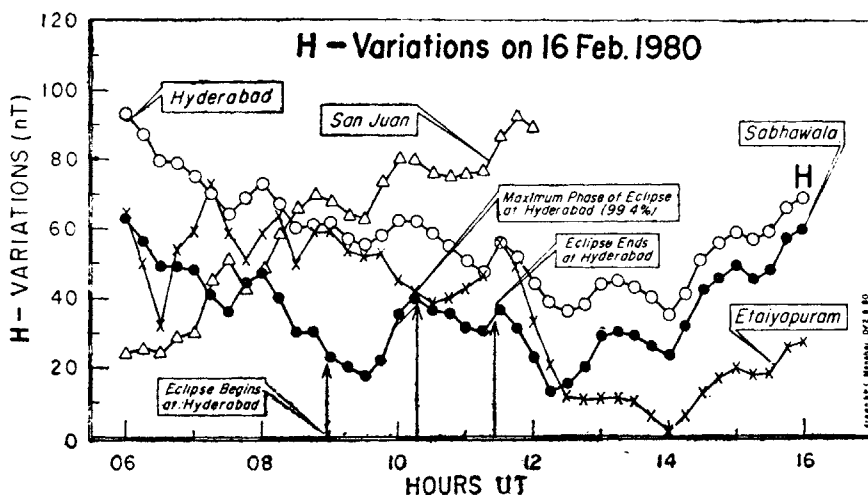


FIG. 1.  $H$ -variations observed at Hyderabad, Etaiyapuram and Sabhawala in India and San Juan in the U.S.A., on the occasion of the solar eclipse of 16 February 1980. Note the global character of the fluctuations caused by the magnetic storm, which apparently masked the eclipse effect. A slight depression observed at Etaiyapuram around the maximum phase is attributable to a counter electrojet event.

observed between 9 and 12 hours UT are identical at Sabhawala, Hyderabad and San Juan, but slightly different at Etaiyapuram from 0945 to 1115 hours UT during which a decrease of about 20 nT at Etaiyapuram relative to Hyderabad has been recorded. This decrease at Etaiyapuram was probably due to a counter electrojet event. The remaining fluctuations were found to be similar at all the four stations including San Juan lying outside the eclipse zone. Of special significance were two sudden impulse events recorded at the commencement and the end of the eclipse at 0901 and 1120 UT with amplitudes of  $-6\text{ nT} + 8\text{ nT}$  at Hyderabad. These events are also seen in the records of the other three stations and are of global character, being part of the magnetic storm. This establishes the global character of these geomagnetic changes forming part of the magnetic storm.

An attempt was also made to examine the ratios of the amplitudes of rapid fluctuations in  $H$  recorded at Hyderabad and Etaiyapuram with respect to the simultaneous events recorded at Sabhawala, respectively, with a view to demonstrate the effect of the solar eclipse on these fluctuations at Hyderabad and Etaiyapuram during a storm, following the method of Stening *et al.* (1971). But the results failed to give any indication of an eclipse effect.

In conclusion, the geomagnetic effects of the solar eclipse of February 16, 1980, in Peninsular India could not be separated from the magnetic records taken on the occasion, due to the interference caused by the magnetic storm.

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