

I. PHYSICS

Astrophysics (Solar Corona)

SHAPE AND STRUCTURE OF MAXIMUM CORONA

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THE solar eclipse of October 23, 1976, has been successfully observed in Australia by the author. It has occurred at sunspot minimum while the eclipse of February 16, 1980, coincided almost exactly with the sunspot maximum. Therefore, the author's intention was to repeat the programme from the 1976 eclipse, using the same instrumentation. The scope was to study the differences of the absolute and relative brightness, of the shape and the structure between a typical minimum-corona and a typical maximum-corona. This was the 21st solar eclipse expedition of the author. During the totality the sky was cloudless and very clear. The temperature decreased from 32.3° at first contact to 26.7° 13 minutes after the totality.

Keywords : Minimum and Maximum Corona; Sunspot Minimum and Maximum; Isophotes; Ludendorff Coefficients.

EXPERIMENT

Equipment

Two cameras were in operation : 20 pictures were obtained by the camera of 50 cm focal distance and 24 by that of 120 cm focal distance. The films are provided with photometric marks. The exposure times were not longer than 1s, therefore, no guiding of the instruments was necessary.

RESULTS

(i) Shape of the Corona

Corresponding to the very high activity of the Sun, the corona was of the "globular" type, showing streamers in all directions. The isophotes are, apart from irregularities produced by the individual streamers, more or less roundish (Fig. 1). This is especially true for the northern hemisphere. On the contrary, the isophotes of the southern hemisphere are slightly elliptical. The region of the lowest brightness is found around the S-pole. In opposition to the northern corona, the southern one has not yet reached the maximum-shape. The Ludendorff coefficients have the values : $a = 0.065$, $b = -0.059$. Therefore, the index of the corona's shape amounts to 0.006, a value for a typical maximum-corona. The asymmetry between the two hemispheres arises from a phase shift. The phase is best indicated by the latitude of the polar zone of the prominences. From minimum to maximum of the sunspot activity, this zone is moving from intermediate latitudes to the pole. A corona of the typical maximum-shape is observed when the prominence zone has a latitude of 69° . Between 1977 and 1979, the latitude shift of this zone amounted to 8.5° per year. The migration of the northern zone was ahead of that of the southern

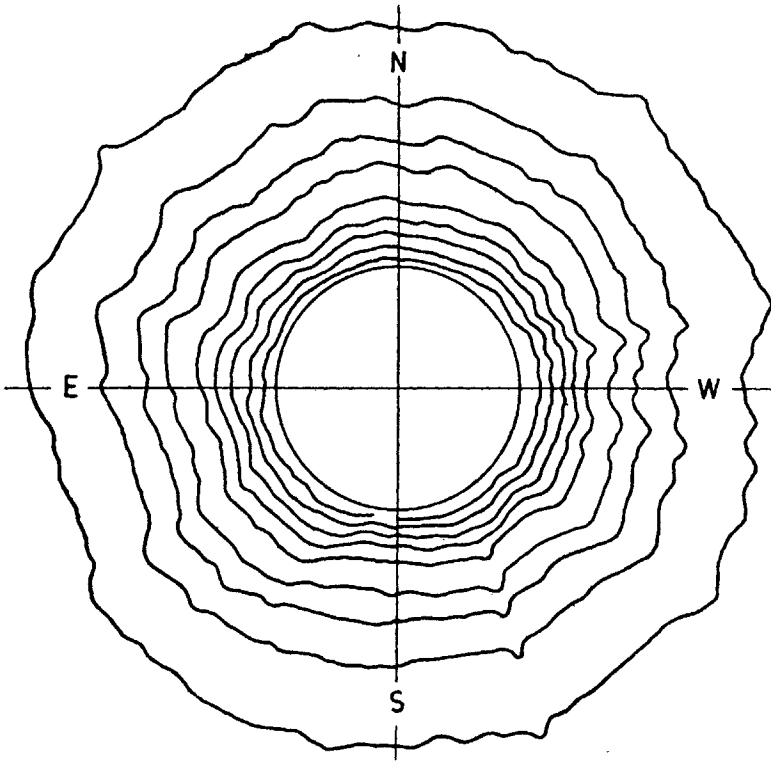


FIG. 1

one by 3° . Extrapolating to the date of the eclipse one gets a latitude of 67.5° for the northern hemisphere and one of 64.5° for the southern one. This explains why the northern corona shows an almost perfect maximum-shape whereas the southern corona will reach this shape not till about 4 months.

Photometric Results

The intensities of the isophotes of Fig. 1 have been measured by the use of standard neutral filters. On the western side of the equator the radial decrease of the brightness follows very closely that deduced by Baumbach from a large number of individual measurements. As the radial variation of the brightness is almost independent on the latitude, the corona over the polar regions must be much brighter than in 1976. The total radiation of the corona amounts to one millionth of that of the sun, roughly, twice the amount of the minimum-corona 1976.

Structure of the Corona

As a result of the high solar activity the corona was especially rich in streamers (Fig. 2). Most of them are straight and radial. Curved rays appear as the boundaries of the broad streamers that narrow with increasing distance. The long streamers dominate the face of the corona and are in close relation to the prominences. In

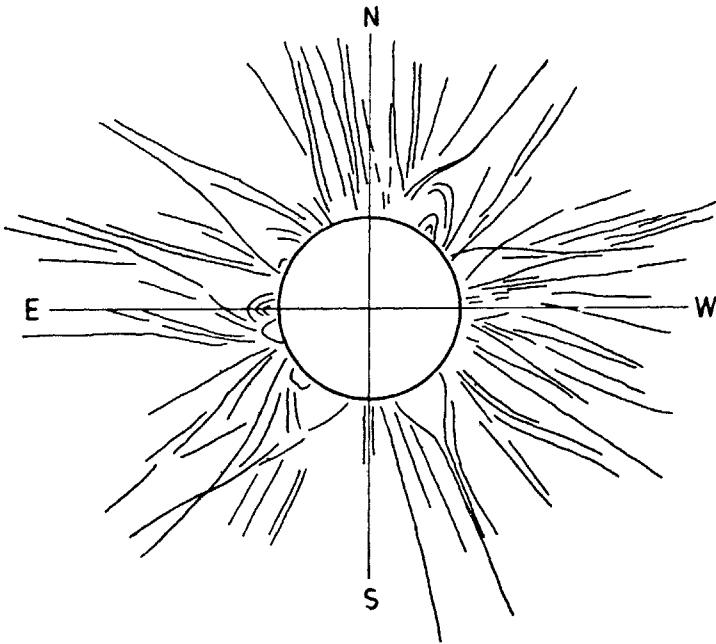


FIG. 2

the actual phase of the solar activity, prominences may occur at all position angles; the same holds for the coronal streamers. Basis points of some of the most pronounced rays are at $+43^\circ$, $+4^\circ$, -40° on the east side and at -61° , -30° , $+50^\circ$ on the west side. Out of the helmet shaped formation at -61° , a long thread-like straight streamer runs up to a height of 2.4 million km. Coronal condensations are found over the centres of activity at $+10^\circ$ and -10° on the east-limb and at $+10^\circ$ on the west-limb.

LOCATION

Yellapur, Karnataka. Lat. $74^\circ 43'E$, Long. $14^\circ 58'N$.

ACKNOWLEDGEMENT

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