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THE ENHANCED RADIATION FROM SUNSPOT-REGIONS

M. WALDMEIER

Swiss Federal Observatory, Zurich, Switzerland

The so-called enhanced radiation appears at all frequencies in connexion with sunspot-regions. For $\lambda < 25$ cm. it may be interpreted satisfactorily as thermal radiation of the coronal condensations (Waldmeier, 1955) [1]. For $\lambda > 50$ cm. the mechanism responsible for the production of this emission is still unknown. The enhanced radiation from 62 to 200 Mc./s. shows a strong concentration in the radial direction and, therefore, becomes observable only when the source of radiation is close to the centre of the sun's disk. For $\sin\theta = 0{\cdot}3$, i.e. at an angular distance of $\theta = 17°$ from the centre of the solar disk, the intensity has dropped to 50 % of that for $\theta = 0°$ and for $\sin\theta = 0{\cdot}5$ to about 25 %. For $\sin\theta = 0{\cdot}8$ the radiation intensity is certainly < 10 %. This property has recently been investigated again by Machin and O'Brien (1954) [2] as well as by H. Müller [3], using the entire material of the years 1947–53 published in the *Quarterly Bulletin on Solar Activity*. According to Müller the limb darkening is very similar for the frequencies 62 to 200 Mc./s., the radiation intensity having decreased at $\sin\theta = 0{\cdot}29$ to half of its value for $\sin\theta = 0$. A diminution to 10 % may be found for 62 Mc./s. at $\sin\theta = 0{\cdot}54$, for 80 Mc./s. at $\sin\theta = 0{\cdot}59$, for 98 Mc./s. at $\sin\theta = 0{\cdot}62$, for 175 Mc./s. at $\sin\theta = 0{\cdot}72$ and for 200 Mc./s. at $\sin\theta = 0{\cdot}77$. For 600 and 1200 Mc./s. the limb darkening is much weaker, the intensity decreasing to 50 % at $\sin\theta = 0{\cdot}57$ and $0{\cdot}75$ respectively.

As the chief sources of the enhanced radiation the coronal condensations have to be considered again. If a point source and spherical distribution of the electron density in the corona are assumed, the calculated limb darkening comes out much weaker than the observed one, no matter how high above the photosphere the coronal condensations are assumed to be. Several authors have expressed the opinion that the enhanced radiation is strongly concentrated to the radial direction already in the emission process itself. In my opinion the strong concentration is produced by a

special structure of the corona over the spot-region, which has a marked deviation from the spherical symmetry hitherto assumed.

This interpretation may be illustrated by an example (Fig. 1). On the occasion of the solar eclipse of 25 February 1952 an active spot-region of type E was on the western limb, over which was a well-developed coronal condensation, i.e. a region of increased electron density. This condensation

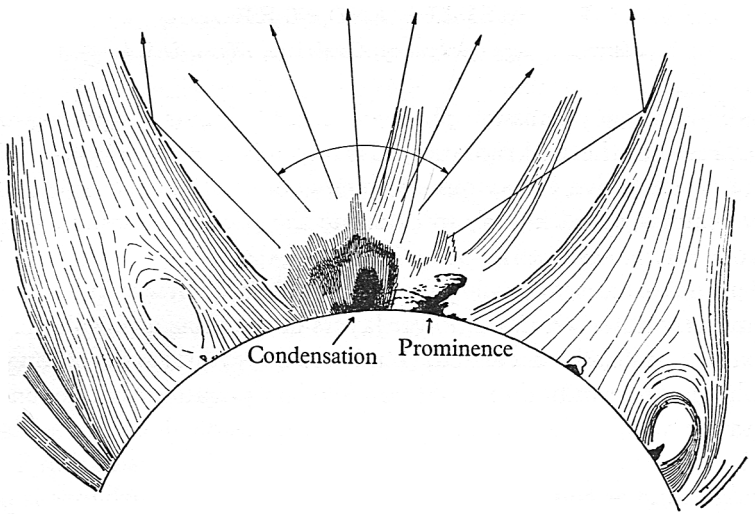

Fig. 1. The structure of the solar corona above a coronal condensation observed at the solar eclipse of 25 February 1952. The arrows indicate the directions in which the enhanced radiation may escape from the corona.

lay at the base of a relatively dark cone, i.e. a region of reduced electron density. The enhanced radiation produced in the condensation can leave the corona through this region of low density. Rays emitted at large angles to the radial direction have to penetrate the dense regions of the corona, whereby they are absorbed. The sharp boundary of the dark region in the shape of a giant parabola corresponding to high gradients of the density is likely to have an additional directional effect.

REFERENCES

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