LETTERS TO THE EDITOR

EFFECT OF MAGNETIC ACTIVITY ON NOON BITE-OUT AT KODAIKANAL—INFLUENCE OF SOLAR ACTIVITY

THE occurrence of a prominent trough accompanied by two maxima, one in the forenoon and the other in the afternoon in the diurnal variation of foF2 at equatorial latitudes referred to as noon 'bite-out', is a characteristic feature at stations that fall in the trough of the 'equatorial anomaly'. (Appleton, 1946; Bailey, 1948; Maeda, 1955; Rastogi, 1959). Sarma and Mitra (1956) studied the noon bite-out phenomenon by introducing two parameters: $P_1 = (f_1 - f_2)/f_2$ and $(f_3 - f_2)/f_2$ where f_1, f_2 and f_3 are the frequencies corresponding to the forenoon peak, midday trough and afternoon peak respectively in the diurnal variation of foF2. The ratio P_1/P_2 is thus an index of the asymmetry in the noon bite-out effect. It was shown by Sarma and Mitra (1956) that the ratio P_1/P_2 attains a value of unity at a particular sunspot number known as critical sunspot number which is found to increase with increase in magnetic dip. A later study by Raju and Rao (1959) for a number of equatorial stations indicated the critical sunspot number to increase with decrease in $|L-I|$ where L and I are the geographic latitude and magnetic dip respectively. Bhargava and Subrahmanyan (1962) studied the influence of disturbed geomagnetic conditions on the noon-bite-out in foF2 at Kodaikanal for the period 1955–58 and reported the midday trough and the afternoon peak in foF2 to be reduced during disturbed conditions compared to quiet conditions, while the forenoon peak is more or less unaffected. This means the ratio P_1/P_2 is high during disturbed conditions compared to quiet conditions.

In the present investigation, the effect of disturbed geomagnetic conditions on the asymmetry of the bite-out phenomenon at Kodaikanal (Geo. Mag. Lat. 0·6° N, Dip : 3·5° N) over the ascending phase of the solar cycle (1964–69) has been studied to infer the influence of solar activity. Published monthly ionospheric data of Kodaikanal for the period 1964–69 has been used for this purpose. For each month, the data have been divided into those of quiet conditions ($\Sigma K_p \leqslant 10$) and disturbed conditions ($\Sigma K_p \geqslant 25$) where K_p is the planetary K-index of geomagnetic activity. The median values of foF2 at half-an-hour intervals were calculated for both the periods separately from which the parameters P_1, P_2 and P_1/P_2 have been evaluated. Median values of sunspot number corresponding to the two periods have also been obtained for each month. Running averages were then calculated to smooth out short term and seasonal variations.

In Fig. 1 we show the variation of the ratio P_1/P_2 with sunspot number for the quiet and disturbed periods separately. The following points may be

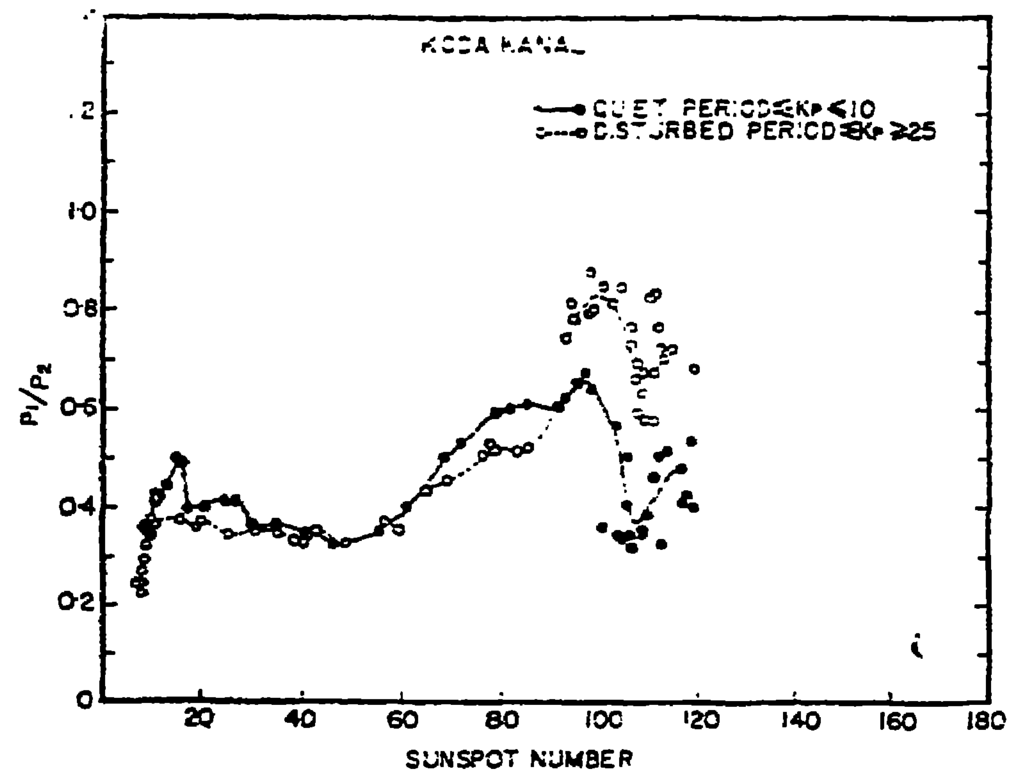

FIG. 1. Variation of P_1/P_2 with sunspot number for quiet and disturbed conditions at Kodaikanal for the period 1964–69.

noticed. Although the ratio P_1/P_2 shows a general tendency to increase with sunspot number, its behaviour during low and moderate solar activity periods is different in that it increases with sunspot number during low solar activity periods ($R_z < 20$) and decreases during moderate solar activity periods ($R_z > 100$). Further, the ratio P_1/P_2 is high during magnetically disturbed conditions compared to quiet conditions during the periods of moderate solar activity ($R_z > 100$), while the behaviour is exactly opposite during the periods of low solar activity ($R_z < 20$) as can be clearly seen from Fig. 1. These observations are considered to be interesting in view of the following considerations.

The bite-out phenomenon is obviously the result of interaction and the relative role played by the production, loss and movements terms in the continuity equation of the electron density at the peak of the layer. The movements term includes the effects of vertical drift, horizontal diffusion of ionization along the field lines and neutral winds. Martyn (1955) and Rao (1967) showed that the forenoon peak in the diurnal variation of foF2 at equatorial latitudes is influenced by horizontal winds besides production and loss processes, while the afternoon peak is determined by vertical drifts and diffusion (Gliddon and Kendall, 1962). Since the results of Bhargava and Subrahmanyan (1962) indicate that the forenoon peak is not much affected by magnetic activity, an attempt will now be made to account for the results of the present study, on a qualitative basis, in terms of vertical drifts, and horizontal diffusion besides production and loss processes. It is known that during disturbed conditions when the horizontal component of the magnetic field is subnormal, there will be a considerable lowering of the height of the layer due to vertical downward drift of plasma (effect of westward electric currents). As such, during periods of low solar activity when the vertical movements play a relatively important role, there should be considerable inhibition of loss of ionization due to lowering of the layer resulting in high values of P_1/P_2 for disturbed conditions compared to quiet conditions, while there is not to be much of a difference between the values of P_1/P_2 for disturbed and quiet conditions during relatively high solar activity periods. The observed result is exactly opposite to that expected on the conceived simplified picture of the origin of the noon bite-out phenomenon.

To sum up, the present investigation revealed a significant influence of solar activity on the relative trend in asymmetry in noon bite-out during quiet and disturbed conditions. This feature does not facilitate even a qualitative understanding in terms of vertical upward drift and subsequent horizontal diffusion of ionization along the field lines.

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