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INTERNATIONAL CONFERENCE ON COSMIC RAYS AND THE EARTH STORM Part I

I-5-P2. Morphology of the Disturbed Ionosphere

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During the Second Polar Year (1932–33) Appleton and Ingram established that equivalent heights and maximum electron densities in the ionosphere were perturbed during magnetic storms, in polar and moderately high latitudes. Later Berkner, Wells and Seaton showed that ionospheric perturbations occurred at such times, in low latitudes extending even to the magnetic equator.

Later Appleton and Piggott analysed *F2* noon data by the "superposed-epoch" method used by geomagneticians for the study of magnetic disturbance. On this procedure the days of biggest ionospheric disturbance was called "zero" days and average disturbance before and after zero days were plotted. This led to certain anomalous conclusions, such as the classification of Washington as an "auroral zone" locality. Following this Martyn, using hourly values, obtained the storm-time variation of *F2* parameters for a number of localities. He made the procedural change of using *geomagnetic* instead of *ionospheric* storm time. Thus the average *ionospheric* variations were obtained for the first 72 hours of sudden commencement geomagnetic storms, zero hour being the hour of commencement of the *geomagnetic* storm. These procedures resulted in a consistent picture of the world morphology of *F2* variations for the first three days of geomagnetic storms. In general *foF2* rises by some 10% at all latitudes during the first few hours of a storm; this rise is maintained in low latitudes throughout the storm, but in high and moderate latitudes is followed by a rapid depression of about 30%, which troughs about 24 hours after the sudden commencement and is followed by a slow recovery.

Martyn also studied the departure (*DS*) from the normal daily variation during disturbed conditions. Here again a clear world picture emerges. There is a fairly well marked 24 hourly variation at moderate latitudes with minimum values of *foF2* soon after dawn and maxima between sunset and midnight. At low latitudes the picture is more complicated; at the magnetic equator there is a large pre-dawn peak in *DS* and a subsidiary peak near noon; in other works magnetic disturbance removes the anomalously low pre-dawn and noon minima characteristic of quiet day behaviour at such latitudes.

The equivalent heights of the *F2* region also show marked storm time and *DS* variations. In fact this index is the one most sensitive to disturbance. It is well-known, however, as has been recently emphasized by Ratcliffe, that this index by no means represents the true height or even the sense of the true height variation of *F* region peak ionisation.

Martyn has proposed that the *F2* variations during magnetic storms are caused mainly by vertical ionisation drift (and divergence) occasioned by electric fields generated in the auroral zone, which spread in the ionosphere over the whole globe. On these lines he has gone some way to explaining the *DSt* and *SD* ionospheric variations. Further progress along these lines has been made by Sato.

Confirmation of the correctness or otherwise of this approach would be afforded by accurate knowledge of the true disturbance height variations over the full range of latitudes. Robbins and Thomas have made a first step in this direction for one locality (Slough). Their results differ both quantitatively and qualitatively from those obtained by Somayajulu for Washington.

References

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Discussion

Nagata, T.: What is Dr. Martyn's latest opinion for interpreting *Dst*-component of *foF2*?

Martyn, D. F.: I have no opinion except that it remains unexplained.

Beynon, W. J. G.: Dr. Martyn. In your diagram showing the disturbance in region *F2* at Watheroo, there appeared to be a marked seasonal change in the magnitude of the storm effect. How do you explain this? Could it be that the seasonal shift in the latitude of the *Sq* current system contributes to the observed storm perturbation of *foF2*?

Martyn: No, I don't understand it.

Knecht, R. W.: Dr. Martyn mentioned that early Cambridge $N(h)$ results tended to show that the height of the night F layer peak was higher during magnetically disturbed conditions whereas a recent Penn State analysis shows the reverse. This could come about through the failure to take proper account of ionization below the F layer in the earlier studies. Sweep low frequency observations of the type made by Watts suggest that electron densities in the night E region increase during magnetic disturbance.

Martyn: I agree.