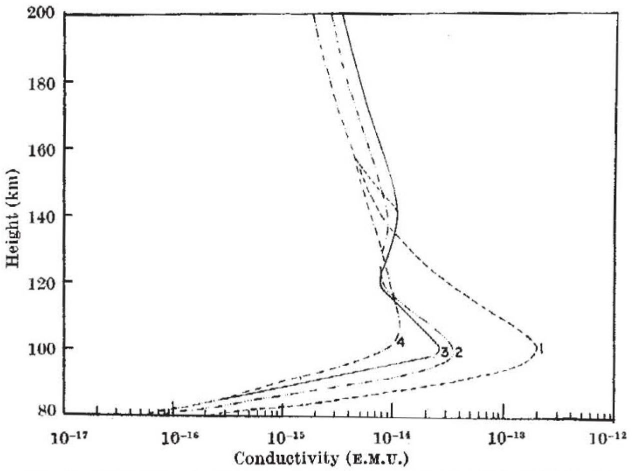

Fig. 2. Variation of effective Cowling conductivity with height; σ_3^c (Curve 1), σ_3^N (Curve 4), and σ_3^P for 50 per cent increases in σ_1 and simultaneous 50 per cent decrease in σ_2 (Curve 2); σ_3^P for 100 per cent increase in σ_1 and 20 per cent decrease in σ_2 (Curve 3).

Curves 2 and 3 in Fig. 2 depict very important characteristics of partial Hall current inhibition and correspond with 50 per cent increase in σ_1 with simultaneous 50 per cent decrease in σ_2 (Curve 2) and 100 per cent increase in σ_1 with simultaneous 20 per cent decrease in σ_2 (Curve 3) respectively. These curves show two peaks, one at a height of about 100 km and another appearing at about 140 km. The magnitude and height of second peak are found to change with degree of Hall current inhibition. The atmospheric model adopted, however, shows no peak around this height. Increase in the effective Cowling conductivity is therefore mainly due to suitable changes in the constituent ionospheric conductivities. Such changes in various conductivities are quite possible during disturbed ionospheric conditions. The presence of sporadic-E at these heights would change the Cowling conductivity considerably and result in a prominent second electrojet current layer[3]. In the absence of a sporadic-E layer, however, the degree of Hall current inhibition is comparatively quite low and gives rise to a comparatively weaker second electrojet current layer. It is well known that the critical frequency, virtual height and time of appearance of the sporadic-E layer are unpredictable. The small number of available rocket flights as shown in Fig. 1, however, have shown considerable variation in the height and the magnitude of the second electrojet current layer. The critical frequency of the sporadic-E layer is known to correlate well with the S_q variation of the geomagnetic field[7].

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Ionospheric No-echo Occurrences

AT stations in high latitudes, the absence of ionospheric echoes at vertical incidence ("blackout") is usually attributed to increased ionization in the D region causing strong absorption of radio waves and is usually associated with a disturbed magnetic field.

In the work reported here, the relation between "no-echo" conditions and absorption of cosmic radio noise as measured with a riometer is studied, using data obtained during 1963 from the Mawson Station of the Australian National Antarctic Research Expeditions (67·6° S., 62·9° E. g.g.; 73·3° S., 104·5° E. g.m.).

Fig. 1 compares the curve of diurnal variation of percentage hourly occurrence of no-echo conditions with that of quarter-hourly maxima of ionospheric absorption of cosmic radio noise for the winter months. The discrepancy between the curves in the 3 h before and after midnight can be explained by the fact that the hourly ionograms show no-echo conditions only when they occur on the hour. Consequently, the frequent night-time auroral absorption events of short duration which are apparent on the continuously recording riometer trace are often not revealed.

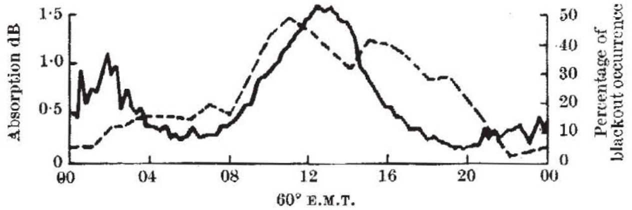

Fig. 1. Mean diurnal variation of percentage hourly occurrence of no-echo conditions and quarter-hourly maxima of cosmic radio noise absorption in dB for the winter months, May–August, 1963, at Mawson. No-echo occurrence: - - - - ; cosmic radio noise absorption: ———.

During the interval 1500–2000 h no-echo occurrences are far more frequent than would be expected from the absorption records. A similar anomaly at about 1900 h L.M.T. was reported by Bellchambers and Piggott[1] from investigations of "blackout" occurrence at Halley Bay (65·8° S. g.m.) during the International Geophysical Year. It was thought to be an effect of low magnetic activity in the winter months.

It is now suggested that this anomalously high frequency of no-echo conditions in winter is due simply to the lack of ionization in the E and F regions. That is, the critical frequencies of both E and F layers are below f_{min}, the minimum frequency not absorbed in the D region.

This explanation is consistent with other observations from Mawson: the occurrence frequency of sporadic E in winter is low at 1500 h and rises to a maximum as the discrepancy between the curves in Fig. 1 diminishes. During magnetically quiet periods, there is usually a negative correlation between sporadic E and no-echo conditions. This is to be expected if the F-layer critical frequencies are less than f_{min} and, in fact, f_0F_2 is sometimes observed as low as 1·5 Mc/s under magnetically quiet conditions in winter. (No pattern of variation of F-layer critical frequencies could be obtained between 1500 and 2000 h because there was not a sufficient number of observations of the F-layer.)

In the summer months, sporadic-E occurrence is less frequent in this 5-h interval but so also is no-echo occurrence, simply because F-region ionization is relatively high. Then, any observations of "blackout" are almost certainly caused by strong radio wave absorption at lower levels.

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