LETTERS TO THE EDITORS

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Two Anomalies in the Ionosphere

DURING the War, many new ionospheric stations were instituted in different parts of the world to serve the operational requirements of the Allied Forces. As a result, there have become available, for the first time, sufficient data to provide a rough general morphological picture of the F_2 layer of the ionosphere. A study of these data has disclosed the remarkable result that, although ionospheric events in the E and F_1 layers are similarly reproduced at the same local time on the same day at all locations on a line of constant geographic latitude, the same is by no means the case for the F_2 layer. It has also been confirmed, as was suspected earlier, that under conditions of symmetrical solar illumination, an asymmetry of ionization exists for certain

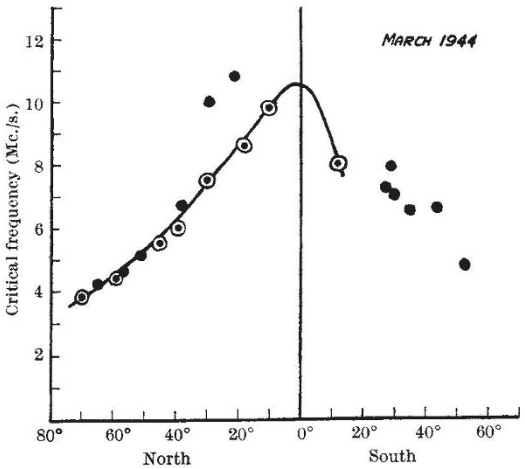

Fig. 1. VARIATION OF CRITICAL FREQUENCY WITH GEOGRAPHICAL LATITUDE

station on the same longitude and situated at equal latitudes north and south of the equator.

These phenomena are best illustrated by considering maximum noon ionization densities in the F_2 layer at the equinoxes, when the sun's zenith distance, χ, is the same for equal latitudes north and south of the equator. From a study of this kind for March 1937, it was found that the values of critical frequency f_{F_2} for Wuchang (lat. 30·5° N.) and Tokyo (lat. 35·6° N.) were definitely higher than those for Watheroo (lat. 30·3° S.) and Sydney (lat. 35·3° S.). An asymmetry of ionization for sites of equal latitudes north and south of the equator, and of roughly the same longitude, was suspected. Many other examples of the same phenomenon have been noted in more recent results.

In 1943, a further anomaly was identified when equinox noon values for two sites of approximately the same northern latitude, but widely different longitudes, were compared. It was found that the f_{F_2} values for Delhi (lat. 28·5° N., long. 77·1° E.) were substantially higher than those for Baton Rouge (lat. 30·0° N., long. 90·0° W.), indicating a variation of noon ionization with longitude along a line of constant latitude.

These two anomalies are illustrated in Fig. 1, where all the available March 1944 values of f_{F_2} at noon are plotted as a function of geographical latitude. The values corresponding to a narrow range of longitude (60°–90° W.) are ringed, and the curve drawn through them shows clearly the asymmetry about the geographical equator. The 'longitude effect' is illustrated by the fact that the values for Delhi (lat. 28·5° N.) and for Kihei (lat. 20·8° N.) lie completely off the curve. The longitudes of these two stations are, respectively, 77·1° E. and 156·5° W.

In Fig. 2 the same values are plotted as a function of magnetic dip, and it will be seen that the above-mentioned anomalies in respect of the low-latitude stations have substantially disappeared. A geomagnetic control of f_{F_2}, for low values of sun's zenith distance, is therefore indicated. It should, however, be noted that, for higher latitudes and thus for higher values of χ, the longitude effect is practically absent, since f_{F_2} is more closely related to geographical latitude than to magnetic dip.

Later results, with a greater wealth of data, have confirmed the general shape of the continuous line drawn in Fig. 2, though it is not yet certain whether or not the two maxima reach equal values. It appears that, for noon equinox conditions, there is a belt of low values of f_{F_2} circling the earth and centred roughly on the magnetic equator. For stations situated within this belt it is found that these low values are associated with marked bifurcation of the F layer into the F_1 and F_2 strata. Such bifurcation is accompanied by the usual phenomena (for example, low noon value, evening concentration of ionization, slow electron disappearance after sunset, etc.) with which we are familiar under English summer conditions[1]. In other words, the longitude effect and the geomagnetic control are exhibited not only in the noon values of f_{F_2} but also in the whole diurnal behaviour.

I am indebted to the collaborating ionospheric authorities in America, Australia, India and New Zealand for permission to use the results of their measurements in the above figures. This work was carried out as part of the programme of the Radio Research Board of the Department of Scientific and Industrial Research.

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[1] Appleton and Naismith, *Proc. Roy. Soc.*, A., **150**, 685 (1935).

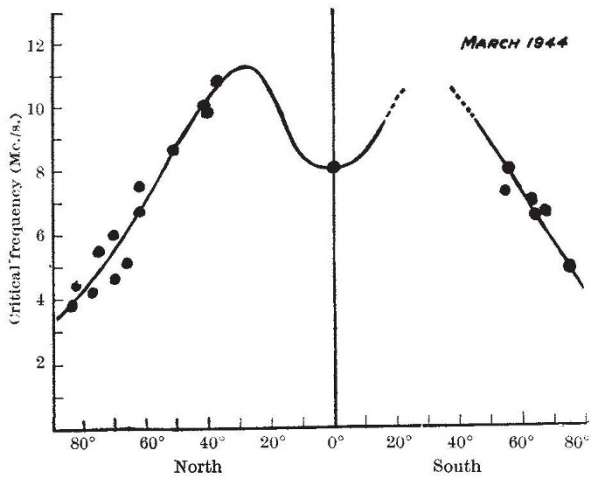
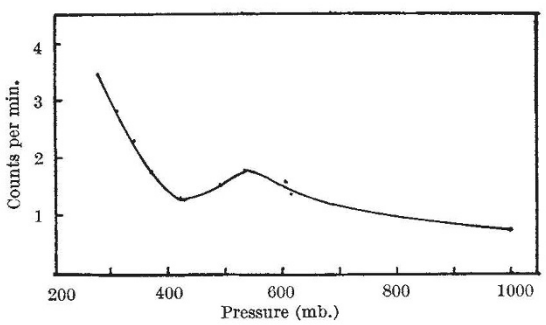


Fig. 2. VARIATION OF CRITICAL FREQUENCY WITH MAGNETIC DIP

Mesotron Intensity as a Function of Altitude

DURING July 1945, measurements of the intensity of mesotrons passing through 8 cm. of lead at various heights in the Himalayas up to an altitude of 16,800 ft. were made by me and Mela Ram[1]. During November 1945, I extended these measurements up to 33,000 ft. above sea-level in an aeroplane flight over Lahore. The apparatus used in the flight was the same as that used in the hills. The duration of the flight between 17,000 ft. and 33,000 ft. was one hour and forty minutes. The results are shown in the figure in the form of a curve in which the number of triple coincidences per minute are plotted against the pressure in millibars.



The intensity versus pressure curve for mesotrons is generally given as an exponential. The data as given here are certainly not represented by a simple exponential. In the neighbourhood of 550 millibars, there occurs a sudden break in the curve which suggests that the data can best be represented either by two exponential curves or by a continuous curve giving a hump at this pressure. Two more flights were made, extending the measurements to 35,000 ft. The data collected in these flights also indicate a similar shift in the mesotron intensity versus pressure curve at about the same altitude. This would mean that the effect is a real one. I will deal with this point in greater detail after the projected flights throughout India during April beginning from the magnetic equator to about 24° N. magnetic latitude are completed.

I am deeply indebted to Air Commodore A. H. Wheeler of the R.A.F. for putting at my disposal a 'Mosquito' in which the flights at Lahore were carried out. My thanks are also due to Wing Commander E. S. Fallick, Squadron Leader R. H. Allen, Flight Officer I. D. Gregory and other officers and men of the R.A.F. for their uniform courtesy and co-operation in these flights.

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March 16.

[1] Gill, P. S., and Ram, Mela, *Indian J. Phys.*, **19**, 71 (1945).