LETTERS TO THE EDITORS

RADIOPHYSICS

Trans-Equatorial Backscatter Observations of Magnetically Controlled Ionization

A ROTATING backscatter equipment operating at Brisbane on a frequency of 16 Mc./sec. with a highly directional aerial[1] has been modified to record echoes with ranges up to 15,000 km. It is found that on 95 per cent of afternoons echoes are returned from a north-easterly direction with ranges of 6–12,000 km. Typical sequences are shown in Figs. 1 and 2, where the plot is one of range versus magnetic azimuth from Brisbane.

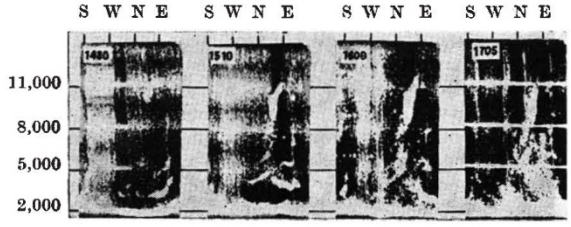


Fig. 1. Range–azimuth records of trans-equatorial backscatter. 6/10/60

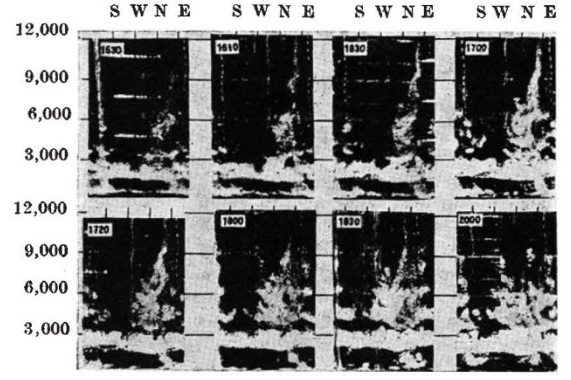
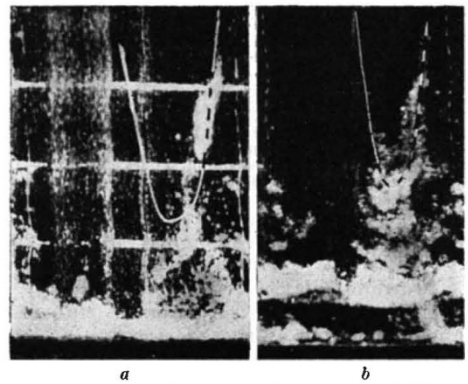


Fig. 2. Range–azimuth records of trans-equatorial backscatter. 2/1/61

It is well known that the electron density of the *F* region in the afternoon is less near the magnetic equator than in two sub-tropical belts at geomagnetic latitudes of about ± 20°, and several theories have been put forward to account for this phenomenon[2–5]. These theories involve the electrodynamic uplift of ionization at the equator and its subsequent down-flow along the magnetic field lines to the sub-tropical regions near ± 20° M. In addition, Wright[6] has produced meridianal sections of the quiet day iono-sphere, showing the extremely rapid variations of the ionization contours as a function of height and latitude.

If one compares the locations of the long-range echoes referred to here with the parallel of magnetic latitude 20° N. (that is, computed from the actual dip values), it is found that the echoes generally lie very close to this line. Two specific instances from the sequences of Figs. 1 and 2 are shown in Fig. 3.



a *b*

Fig. 3. Range-azimuth records for *a*, 1600/6/10/60 and *b*, 1700/2/1/61 with overlay plots of the 20° N. parallel of magnetic latitude

The question of the propagation mechanism is rather involved as the echoes come from regions in which the local time may be up to 6 hr. ahead of the local time of observation at Brisbane. It is believed, however, that the main mechanism is that of 'tilt-mode' propagation proposed by Villard *et al.*[7], some-times with a single hop to the *F* region before the equatorial jump. This hypothesis is being examined further by computing the expected oblique profiles of ionization density at various times and in various directions from Brisbane.

The fact that the eastern limb of the echo is the predominant feature is probably due to the changing ionospheric conditions as one proceeds from east to west with changes in time of several hours. By the time the western limb should be visible at long ranges, the electron density south of the equator is too low for the necessary propagation conditions to be set up.

It appears probable that such observations of the whole length of the belt of high-density ionization are only possible with highly directive antennæ. The signal is often weak and scattered and with a broad beam antenna may well merge into the background noise. This point is to be checked shortly, and further tests will be made with a swept-frequency backscatter sounder operating at 15–30 Mc./sec. and with an additional fixed-frequency sounder operating at a higher frequency.

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