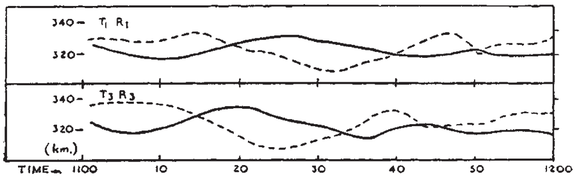

Fig. 4. Changes in virtual heights at points 1 and 3 (30 miles apart)

per minute. The observations have been made between 9 a.m. and 5 p.m. local time on a frequency of 5·8 Mc./s.

Changes in virtual height of the type shown in Figs. 3 and 4 appear most likely to be produced by changes in the ionization gradient. The effects observed might be due to either a horizontal drift in the atmosphere, with superimposed local variations in ionization gradient, or to progression of a wave motion of such a nature as to cause changes in ion concentration (for example, a pressure wave). Present evidence seems to favour the second alternative.

The time difference in the occurrence of the changes in the two rays in Fig. 4 suggests that there may be also a vertical component in the progression. This is supported by some $h'f$ observations which have been made at R_4 during occurrences similar to those of Fig. 4. They show a progression of such changes along the $h'f$ curve for the F region from the higher to the lower frequencies, corresponding to a progression from a greater to a lesser height.

Further observations are in progress to extend and clarify the information already obtained. The results will be reported more fully elsewhere.

This work has been carried out as part of the programme of the Radio Research Board of the Commonwealth Council for Scientific and Industrial Research, and is published with the consent of the Council. I wish to acknowledge the invaluable help of the staff of the Sydney Section of the Radio Research Board in carrying out the observations and to express appreciation of the keen interest of Sir John Madsen, chairman of the Board, which has made this work possible.

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Evidence of Horizontal Motion in Region F_2 Ionization

During the winter periods of 1942 and 1943, a series of relative field-strength measurements were made at the Radio Research Station, Slough, on signals from the German short-wave sender Zeesen situated 990 km. east of Slough[1]. Subject to the assumption that local time variations corresponded with longitude variations in the ionosphere, it was observed that the time of the initial appearance of the oblique ray signal at sunrise agreed closely with the value to be expected from calculations based on normal incidence ionospheric observations at Slough[2]. These sharp sunrise variations in the ionosphere occurred at Slough some thirty minutes later than at the mid-point of the oblique trajectory; this corresponds closely to the local time difference between Slough and this mid-point. It was noted, however, that in addition to these regular sunrise ionospheric changes of large magnitude, there were small irregularities in the F_2 layer occurring near the mid-point of the oblique trajectory, which were repeated overhead at Slough some 60–75 minutes later.

It is interesting to speculate on the reason for the repetition of small changes in region F_2 at two sites 500 km. apart along a line of latitude with a delay of one hour or more. It seems possible that the explanation lies in a rapid east–west motion of or within region F_2 ionization. An examination of many records indicates an average value of about 70 minutes for the delay time, requiring a velocity of 430 km./hr. in a direction east to west at the level of the F_2 layer at the time of such observations.

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Oct. 20.

[1] Beynon, W. J. G., *Proc. Phys. Soc.*, **59**, 521 (1947).
[2] Appleton, E. V., and Beynon, W. J. G., *Proc. Phys. Soc.*, **52**, 518 (1940); **59**, 58 (1947).

Latitude Effect of Penetrating Cosmic Ray Showers

It has been shown by Broadbent and Jánossy[1] that penetrating cosmic ray showers are of two types: (*a*) local penetrating showers; (*b*) extensive penetrating showers. Local penetrating showers are supposed to be produced by primary nucleons, and they give rise to a transition effect which is proportional to mass. Extensive penetrating showers appear to be parts of extensive air showers. They show a strong transition effect in lead but almost none in paraffin.

From theoretical considerations, Jánossy[2] has suggested that local penetrating showers are produced mainly by nucleons that are latitude-sensitive. It is therefore expected that the transition effect of local penetrating showers might show a marked latitude effect.

In order to test this prediction, we have set up a penetrating-shower recorder situated at geomagnetic latitude 4° S. at sea-level in Colombo. This recorder is illustrated in Fig. 1 and is identical with that used by Broadbent and Jánossy[1] in Manchester. It consists of three trays of eight counters each, arranged as shown. Each tray covers an area of 1,000 cm.^{2}. The trays are separated by 15 cm. of lead absorbers, and in addition the middle and the bottom trays are shielded at the sides and ends by about 50 cm. of lead. The top tray is divided into three independent groups of counters, while the middle and the bottom trays are each divided into two groups as shown. Sevenfold coincidences (designated P) consisting of the simultaneous discharge of at least one counter of each group were recorded. These coincidences are due to the occurrence of showers of at least two particles capable of penetrating 30 cm. of lead absorber.

In order to select the local penetrating showers, a fourth tray of unshielded counters (not shown in the

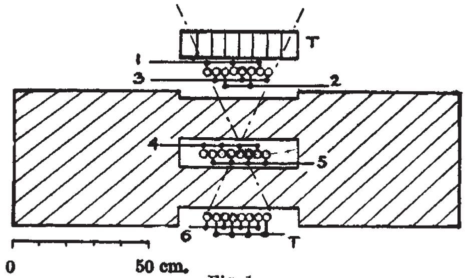

Fig. 1