Letters to the Editor

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NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 292.

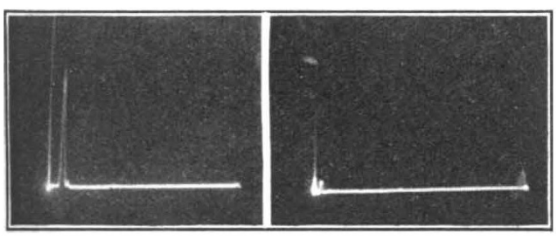
CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Some Observations on the *C* Regions of the Ionosphere

RECENT observations at Calcutta[1,2], at Morgantown (U.S.A.)[3] and Orfordness (England)[4] have established beyond doubt the existence of ionized layers much below the Kennelly-Heaviside *E* layer. Not infrequently these layers act as good reflectors of radio waves. The topmost of these layers (sometimes called the *D* layer) is situated at an average equivalent height of 55 km. The next one lies between 20 km. and 35 km., and the lowest ones appear to be situated within the tropospheric region between heights of 5 km. and 15 km. (It has recently been suggested by Mitra[5] that since the designation *D* is usually applied to the non-deviating absorbing 'tail' of the *E* region, the new regions be called *C* regions. It would perhaps be convenient to call them, starting from the top, C_1, C_2, and C_3 regions.)

Since data regarding the properties of these regions —particularly of the lower ones—are still lacking, we have recently carried out a series of 24-hour observations, at intervals of one hour and a half, using a frequency range of 1–15 mc./sec. The results of our observations are summarized below.

(1) Echoes from C_1 (55 km.) are much more frequent and are of greater strength than those from C_2 and C_3. C_2-echoes (25–30 km.) are also strong and are more frequent than C_3-echoes; the latter are weak and are observed on rare occasions. C_1, *E*- and *F*-echoes of moderate strength have been observed on several occasions to occur side by side.



a *b*

FIG. 1. Echoes from: (*a*), C_1 region (55 km.); (*b*), C_2 region (20 km.).

(2) Echoes recorded during day-time are invariably weaker than those recorded during the night. The intensities of C_1- and C_2-echoes have occasionally been found at night to be comparable with those of fairly strong *E*- and *F*-echoes.

Fig. 1*a* shows a C_1-echo (55 km.) with 3 mc./sec. frequency as received at midnight of June 5. Fig. 1*b* shows a C_2-echo (20 km.) with a frequency of 2·18 mc./sec. recorded at 1900 hours on June 12. A closer examination will reveal the presence in Fig. 1*b* of another very low height echo (8 km.) and traces of single and double reflections from the *E* region.

(3) Echoes have been observed at all times of the day and night; but they seem to be more frequent during the afternoon and are usually too weak to be detected at about midday.

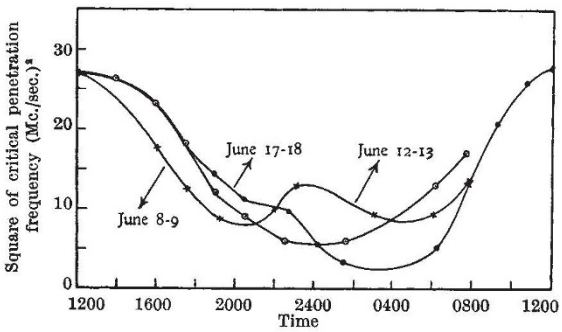


FIG. 2. Hourly variation of the square of the critical penetration frequency (noon to noon) of the C_1 region (55 km.) on three typical days.

(4) Curves in Fig. 2 represent hourly variation of the square of the penetration frequency (f^2) for the C_1 region for three selected days and are typical of those usually obtained in the course of our observations. It is evident that the ionization in general attains its daily maximum at about noon, and tends to a minimum during the small hours of the morning. There are also at times abnormal variations which appear to be more pronounced at night. The general nature of the hourly variation, however, leads one to conclude that the ionization is of solar origin.

(5) The critical penetration frequencies of the C_2 and C_3 regions have been obtained occasionally. But the occurrence of these echoes, particularly those from C_3, is not frequent enough to enable one to study the hourly variation of ionization of the corresponding regions. It may, however, be mentioned that the average values of the penetration frequencies are of the same order as those for the C_1 region.

The observations described here were carried out at the suggestion of Prof. S. K. Mitra.

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June 22.

[1] S. K. Mitra and P. Syam, NATURE, **135**, 953 (1935).
[2] S. K. Mitra and J. N. Bhar, *Science and Culture*, **1**, 782 (1936).
[3] R. C. Colwell and A. W. Friend, NATURE, **137**, 782 (1936).
[4] R. A. Watson Watt, L. H. Bainbridge Bell, A. F. Wilkins and E. G. Bowen, NATURE, **137**, 866 (1936).
[5] S. K. Mitra, NATURE, **137**, 867 (1936).

IN connexion with the above observations of Dr. Rakshit and Mr. Bhar on the *C* regions, I would like to point out that it is not justifiable to take the hourly variation of f^2 as proportional to the variation