

A New Early-Morning Ionospheric Phenomenon

EARLY in January 1952, when ionospheric observations were started at Kodaikanal ($10^{\circ} 14' N.$, $77^{\circ} 28' E.$), an interesting phenomenon, which, to my knowledge, has not hitherto been reported, was observed in the vertical-incidence virtual height/critical frequency records. It was found that on most of the mornings ionospheric echoes ceased to return some minutes to several hours before sunrise and reappeared at about ground sunrise time. Systematic daily observations were started early in March and *h/f* records taken at short intervals beginning about an hour before sunrise daily with the view of examining the frequency of occurrence and any possible seasonal characteristics of this 'no echo' phenomenon.

The observations consisted in photographing the *h/f* patterns at 1- or 2-min. intervals with the *C.R.P.L.* type *C-3* recorder of the Kodaikanal Observatory covering 1-25 Mc./s. and with peak pulse power of approximately 10 kW. The antenna system consisted of two multiple-wire deltas having reasonably flat impedance over the operating frequency-range and the desired vertical direction of maximum radiation. The records thus made cover a period of five months (March-July 1952) and on examination indicate that on about 60 per cent of the days during these five months ionospheric echoes ceased for some time during the pre-dawn period. The overnight stratum in the *F*-region present at virtual heights of 200-300 km. disappeared gradually without showing any appreciable sharp drop in critical frequency (which is of the order of 1-3 Mc./s. during early mornings). The 'no echo' condition lasted until about the ground sunrise time, when reflexions began to be received from markedly greater virtual heights of 300-500 km. Records taken at 15-min. intervals on the morning of April 30, 1952, show that pulse returns ceased between 0500 and 0515 hr. and did not begin again until shortly before 0545 hr. (All

times are given in Indian Standard Time, which is 5 hr. 30 min. ahead of G.M.T.)

On other mornings when ionospheric echoes were received throughout, high-speed ionospheric soundings showed remarkably characteristic sunrise effects in the *F*-region. Almost simultaneously with the ground sunrise, a stratum formed somewhere between 300 and 600 km. The virtual height of the new stratum decreased rapidly until it merged with the overnight layer, usually present at a virtual height of about 200-250 km. The photographs overleaf are of a sequence of *h/f* records obtained on one such morning; they were taken at 2-min. intervals on March 9, 1952, and illustrate the characteristic sunrise effect observed at this location.

A study of sunrise effects in the ionosphere has been made by Wells¹ at Derwood Experimental Laboratory, D.T.M., Carnegie Institution of Washington. Sunrise effects have been defined as the initial characteristic rise of ion density in the neighbourhood of sunrise. At Kodaikanal, the abrupt appearance of echoes from relatively great virtual heights, such as shown in the records for March 9, 1952, has enabled the determination of the precise times of these effects. A study of successive *h/f* records at 1- or 2-min. intervals on selected days when such records were available indicates that, notwithstanding a certain amount of scatter, the sunrise effect and the ground sunrise were simultaneous during the month of March; during April, the ionospheric effect occurred 2 min. after the ground sunrise, and during May, June and July it occurred $3\frac{1}{2}$ min., 6 min. and 5 min. respectively before the ground sunrise.

I wish to thank Dr. A. K. Das, director of the Kodaikanal Observatory, for his advice in writing this note.

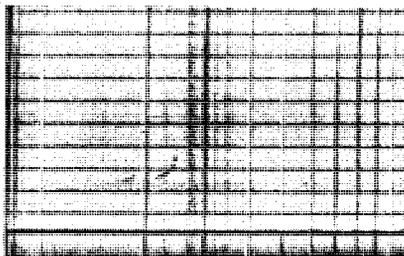
B. N. BHARGAVA

Kodaikanal Observatory,
India. Aug. 15.

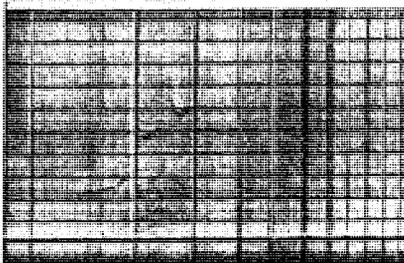
¹Wells, H. W., *J. Geophys. Res.*, 54, 277 (1949).

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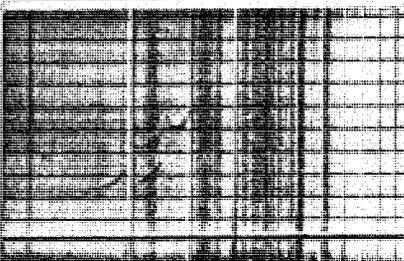
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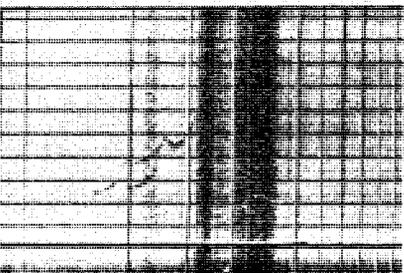
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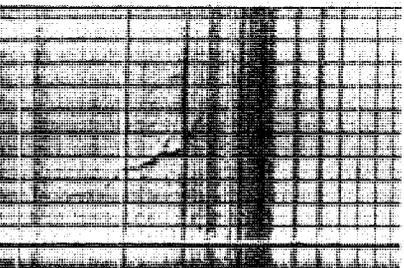
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