a measure of the elongation and orientation of the irregularities in the ionosphere. When the characteristic ellipse could be found, it was not usually very elongated; on only three of the nine occasions was the axial ratio greater than 2·0, and there was no evidence of any preferred direction of elongation. This is in contrast with the systematic elongation found at high and low latitudes.

On all the occasions when the fading of waves reflected from the E_s layer was observed at Cambridge, E_s was also found on ionograms obtained at Slough, 90 km. to the south-south-west. There was, however, no apparent association between the scale of the irregularities in the diffraction pattern at Cambridge and the type of E_s (*c*, *f*, *h* or *l*) as determined by its appearance on the Slough ionogram[5]. There was also no association between the scale of the pattern and the magnetic *K*-index (*K* was in the range of 0–4 for the occasions observed).

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108–216 Mc./s. Radio Signals from Satellites below the Horizon

SMYTH RESEARCH ASSOCIATES have been conducting an experimental programme on low-angle refraction of radio waves penetrating the atmosphere.

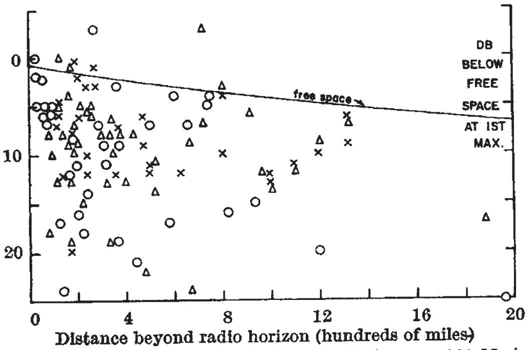

Fig. 1. Precursor signal-levels. ○, 108 Mc./s.; ×, 162 Mc./s.; △, 211 Mc./s.

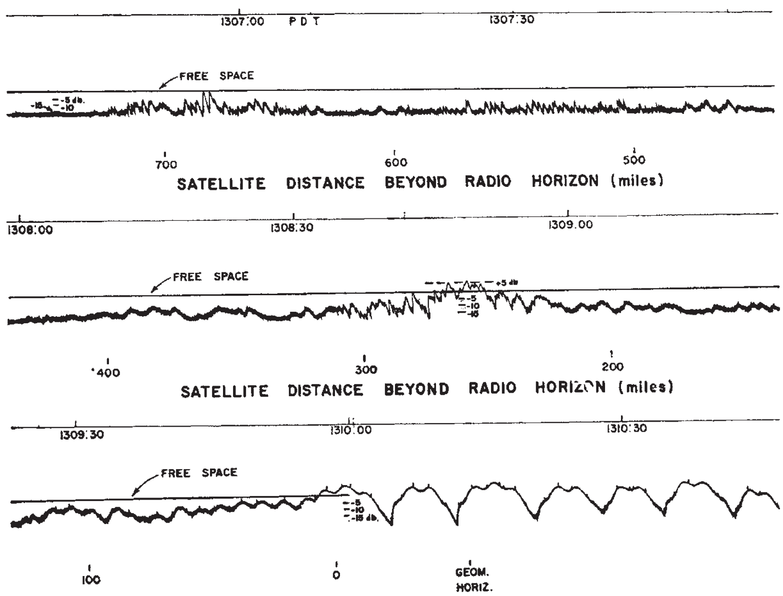

Fig. 2. Satellite precursor signals. Tiros I, 108 Mc./s. June 13, 1960

Satellite transmitters at 108, 162, and 216 Mc./s. have been used as signal sources in these studies. During the course of the measurements (June, July and August 1960) it was found that, on the majority of passes, signals were received while the satellite was well beyond the radio horizon. Out of a total of 49 cases when such 'precursor' signals were sought, only 14 failed to yield signals for at least one minute beyond the radio horizon.

In two cases, signals were first received when the satellite was 1,900–1,950 miles beyond the radio horizon point at orbit height. On these passes the satellite was roughly twice as far away as the distance to the horizon. The signal strength on these occasions was 11 db. below the free space-level on 216 Mc./s. and 18 db. below the free space-level on 108 Mc./s. As can be seen in Fig. 1, there appears to be no distinct dependence of received signal strength on frequency. Even simultaneous data on 162 and 216 Mc./s. show no consistent dependence on frequency.

The combination of low attenuation and no frequency-dependence suggests a tropospheric ducting mechanism. Correlation of local radiosonde data with signal strength and maximum path-length supports this view. The duct thickness and intensity in all cases when signals were observed exceeded the trapping requirements for frequencies greater than 100 Mc./s.

Fig. 2 shows the data record for one of these cases, together with a scale of the great circle distance of the satellite below the radio horizon. The record was taken at the Smyth Research Associates Point Buchon field site on the coast-line near San Luis Obispo, California, with a sea-interferometer system, giving rise to the pattern of maxima and minima above the horizon. Relatively minor tumbling nulls can also be seen superimposed on the interferometer trace.

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