

LATITUDE VARIATIONS OF FREQUENCY OF OCCURRENCE OF "SPREAD- F " SATELLITE TRACES*

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Night-time "spread- F " satellites, revealed as discrete extra traces of range greater than the main F -region echo on ionograms ($h'f$ records) have been recorded by McNicol, Webster, and Bowman (1956)‡ as part of the spread- F phenomenon at Brisbane. This report is an investigation of the relative frequency of occurrence of such satellites at different latitudes.

Ionograms for a group of stations mainly in the northern hemisphere, but ranging south as far as Huancayo, were made available for examination by one of the authors at the National Bureau of Standards, U.S.A., by courtesy of the Bureau. No attempt was made to carry the analysis to higher latitudes than 50° since this brought the stations into or near the auroral zone, and here the records were so much more complicated than, and so different from, the records of stations of lower latitude that it was felt that no useful comparison would exist between the two groups. The records examined were those for the complete month of January 1956 for which the average sunspot number was 70. No exact quantitative measure of the relative frequency of occurrence of F satellites at the various stations was possible; instead a count was made of the number of individual ionograms on which well-defined satellites were visible. This number was expressed as a percentage of the total number of frames examined. This gave an approximate measure of the proportion of the time for which range multiplicity was detectable at the particular station. It was not a measure of the number of separate disturbances in the ionosphere which produce range multiplicity at any given place, since any one disturbance, if large, might produce effects for up to 2 hr, and hence appear on up to eight frames (taken at quarter-hour intervals), whereas a weaker disturbance might give rise to satellites visible on one or two frames only.

When the relative frequencies for these stations were plotted (as dots) as a function of geographic latitude, as has been done in Figure 1 (*a*), a very irregular distribution was disclosed. Specific serious inconsistencies exist; for example, Washington and San Francisco, which have approximately the same geographic latitude, have very different numbers of satellites; also Panama, the station at which satellites were most frequent, fell between Talara and Huancayo, stations for which no satellites were observed in the month's records examined.

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When, however, the relative frequencies were plotted (again as dots) as a function of geomagnetic latitude, a skew, but reasonably smooth, distribution resulted, as shown in Figure 1 (b).

The southern hemisphere analysis consisted of an investigation of the relative frequency of occurrence of the phenomenon at Townsville, Brisbane, and Hobart, as determined by all the ionograms for 1952, for which year the average sunspot number was 31. The summer and winter results show no significant

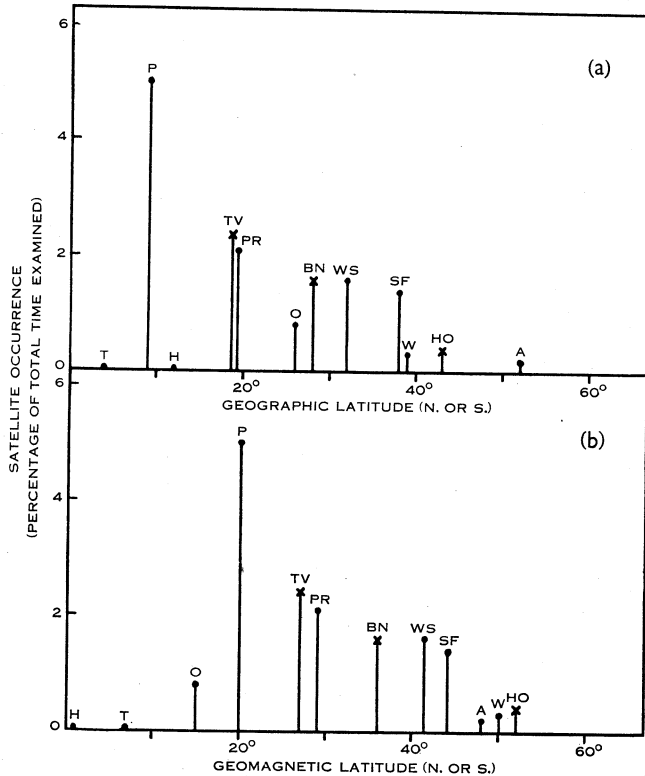


Fig. 1 (a).—Satellite occurrence versus geographic latitude.

Fig. 1 (b).—Satellite occurrence versus geomagnetic latitude.

Stations used: Adak (A), Huancayo (H), Okinawa (O), Panama (P), Puerto Rico (PR), San Francisco (SF), Talara (T), Washington (W), White Sands (WS), Townsville (TV), Brisbane (BN), Hobart (HO).

difference. These have therefore been combined and are shown plotted (as crosses) against geographic and geomagnetic latitude in the figures. The results are roughly consistent with those for the northern hemisphere group of stations, although it must be pointed out that no exact quantitative comparison between the dots and crosses is intended, owing to the different numbers of records involved in the two sets of results.

Figure 1 (b) shows that the phenomenon of the occurrence of F_2 region satellites is most common in the range of geomagnetic latitudes between

20 and 45°, i.e. at places where the value of the magnetic dip lies between about 40 and 70°. At very low latitudes the phenomenon is almost non-existent. At geomagnetic latitudes near 50° the frequency of occurrence of satellites falls to a very low value; it is not possible to say from the present analysis what happens at latitudes greater than this. One curious feature noted was that, while the phenomenon hardly ever showed up on the first-order F_2 reflection at Washington and Adak, it was visible, on a number of occasions, on the second-order traces at those stations.

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