ON SCINTILLATION OF RADIO SOURCES*

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In a communication concerning scintillation of discrete radio sources and geomagnetic activity, relative to transit observations (within 45° of zenith) Slee (1962) found correlation between scintillation and geomagnetic indices. Scintillation activity was assessed as low if none of the radio sources showed detectable scintillation or if scintillation occurrence was isolated and high when all sources exhibited intense scintillations for several hours during the night.

As mentioned by Slee, recent observations of the Sagamore Hill Radio Observatory (Kidd *et al.* 1962) have shown that during a severe magnetic disturbance (the local magnetic index was $\geqslant 6$) radio star scintillation was temporarily reduced over large apertures at decametre wavelengths. From a 19 Mc/s radar system it was known that an overhead aurora was taking place. During this period of auroral activity when tracking Cygnus and Cassiopeia on a switching program for half an hour at a time, one source would show high scintillation indices at 62 Mc/s and the other would show low indices. The hypothesis was advanced that strong scattering $\overline{|\Delta\phi|^2} \geqslant 1$, was occurring and loss of correlation across the aperture reduced the 62 Mc/s index. The source that was observed closely aligned with the magnetic zenith showed lower indices than the source observed close to perpendicularity.

We did not state that during magnetically quiet or moderately disturbed periods, this phenomenon would occur. In fact one would expect no change relative to the magnetic zenith when single or weak scattering occurs. At that time the ground pattern is a projection of the ionospheric irregularity (perhaps of the order of 1–4 km). Therefore, looking along the lines of force or transverse would probably be unimportant for scintillation index.

Several authors have shown in recent observations of satellite scintillations that the effect of the sub-ionospheric latitude is important. According to Yeh and Swenson (1959), in many cases the marked onset of scintillation occurs at a distinct latitude. The motion of this latitude away from the pole during periods of moderate to high magnetic activity ($K \geqslant 4$) has been shown in 54 Mc/s satellite observations reported by Aarons, Mullen, and Basu (1963). Munroe (1963), describing observations in southern latitudes, records a preponderance of scintillation activity in poleward latitudes. It would thus seem reasonable to incorporate in Slee's analysis an attempt to isolate source declination in order to detect the latitude extent of the irregularity region. Thus the partial correlation of Hydra A with K index and the absence of correlation of Taurus A and Virgo A with K index in observations from Sydney at 33° 52′ S. may well be due to the fact that Hydra A transits at higher geomagnetic latitudes than do the other two sources. The low sub-ionospheric geomagnetic latitudes of all three sources noted is such that auroral effects would not be significant.

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Observing Cygnus and Cassiopeia from a site such as 54° geomagnetic north, where the sub-ionospheric geomagnetic latitudes of these sources is within the auroral zone during some portions of the path, is a completely different type of observation from observing sources from 42·5° geomagnetic south transiting towards the equator.

The inversion effect (lower scintillation index at the longer wavelengths) is short lived, occurring at our latitudes for periods as short as 5 min and for as long as several hours. It would not show up markedly in statistical evaluation of scintillations. A copy of the record of the multichannel unit observed on the 84 ft antenna of

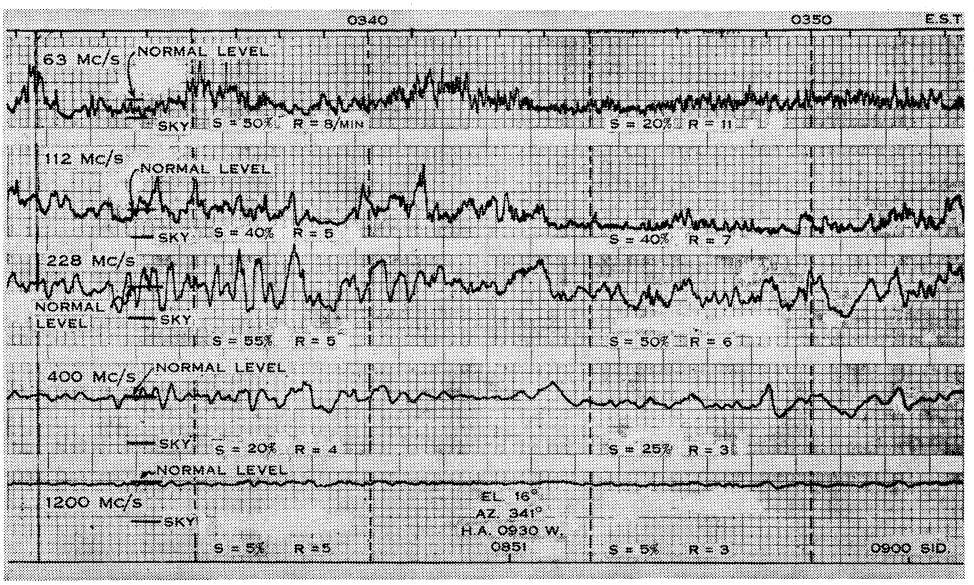

Fig. 1.—Cassiopeia scintillations December 4, 1962 during active magnetic period, $K_F = 4$. Weak scattering at 228, 400, and 1200 Mc/s; strong scattering, $\overline{|\Delta\phi_0|^2} \geqslant 1$, at 112 and 63 Mc/s. Note faster rate (R) as well as reduced scintillation index (S) on 63 Mc/s.

Sagamore Hill Radio Observatory is shown in Figure 1. Even during the 20 min shown the index varies at 63 Mc/s from 50 to 20% on a running mean (eliminating absorption effects). Aurora was observed on the radar in the vicinity.

Although it now appears as if the irregularity region is a large-scale structure tied to geomagnetic activity, Slee has certainly pointed up the wide deviations involved in scintillation observations, even if one understands the general structural variations.

References

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