PAPER 22

# PRELIMINARY OBSERVATIONS OF POINT SOURCES AT 12·5 AND 15·5 MC./S.*

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At frequencies much below 30 Mc./s. radio astronomy is substantially affected by the earth's ionosphere. The principal effects of the ionosphere are to absorb signals from extra-terrestrial sources, and to propagate earthbound interfering signals over long distances. Successful observation at these relatively low frequencies requires (1) a clear observing channel, or (2) operation during the interval immediately preceding sunrise when the maximum usable frequency for oblique-incidence ionospheric propagation has fallen below the operating frequency. Since early attempts to locate a clear channel between 10 and 20 Mc./s. were fruitless, we accepted the condition in (2) realizing that ionospheric absorption would also be minimized, since the observing frequency, under these conditions, is more than three times greater than the ionospheric critical frequency at vertical incidence.

The useful time interval depends on the operating frequency and local ionospheric conditions. Our experience during the spring and summer of 1955 in the vicinity of Washington, D.C., revealed about 4 to 5 hours of potential observing time in the pre-sunrise period for 12·5 Mc./s. with a somewhat longer interval at 15·5 Mc./s.

However, this interval free from direct interference often included other unstable conditions which confused the observations. These may be described as (1) scintillations, (2) surges of short duration, and (3) bays lasting several hours. It has been established by Little, Lovell and Smith that scintillations are caused by irregularities in the terrestrial atmosphere. Undoubtedly the other effects are related to additional transient conditions in the outer atmosphere.

Other nights, however, were reasonably undisturbed and permitted the identification of several point sources. Although the 12·5 Mc./s. records seldom presented much of the classical interference patterns characteristic

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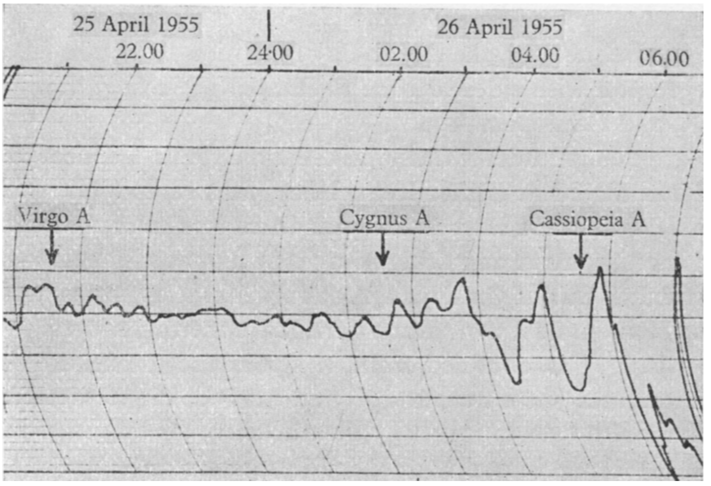


Fig. 1. Record showing interference pattern of Virgo A, Cygnus A, and Cassiopeia A at 12·5 Mc./s., obtained at Derwood, Maryland. (D.T.M.–C.I.W., 1955.)

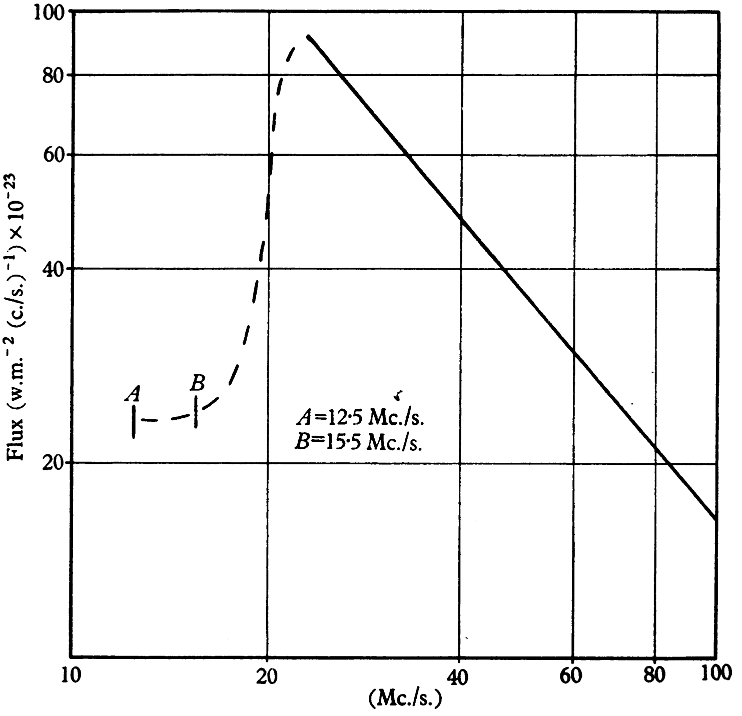


Fig. 2. Drop in flux of Cassiopeia A below 20 Mc./s. Derwood, Maryland. (D.T.M.–C.I.W., 1955.)

(*Note.* Subsequent developments reveal that values reported here are *too low* as a result of receiver saturation effects. Revised estimates are several times greater. However, ionospheric conditions resulting from the new sunspot cycle will prevent new measurements at these frequencies for 8–10 years[3].)



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of the higher frequencies, the day-to-day repetition of certain features and their progression with sidereal time facilitated the recognition of Virgo, Cygnus A, and Cassiopeia A as in Fig. 1.

The relative magnitudes of Cassiopeia A and Cygnus A appear to be in the same ratio observed at higher frequencies; that is, roughly two to one. This may be confirmed later in the year when flux measurements will be made on the Cygnus A and other sources at frequencies below 20 Mc./s.

The estimated flux of Cassiopeia A at 12·5 Mc./s. is plotted at $A$, Fig. 2. The value of about $22 \times 10^{-23}$ watts per square metre per cycle per second (w.m.$^{-2}$ (c./s.)$^{-1}$)* is obtained from a systematic procedure involving (1) selection and measurement of undisturbed interferometer traces, (2) regular daily calibrations, (3) measurement of loss in transmission lines, and (4) a determination of effective antenna aperture.

Antennas of the interferometer array were separated 946·5 ft. providing spacings of 12 and 15 wave-lengths at 12·5 and 15·5 Mc./s. respectively. Each antenna was a folded dipole with simple reflector. The effective antenna aperture was determined from observations at 27 Mc./s. with the same basic folded dipole-reflector antenna. Assuming the flux at 27 Mc./s. to be $80 \times 10^{-23}$ w.m.$^{-2}$ (c./s.)$^{-1}$ after the Hey–Hughes report [1] the antenna aperture was found to be 1/2 square wave-length. Pending determination of the effective antenna aperture by other means, the internal accuracy is believed to be within ±20 %.

Ionospheric absorption is considered as negligible under these selected conditions because the vertical-incidence penetration frequencies have fallen well below one-third of the operating frequency [2].

In August 1955 the recording frequency was shifted to 15·5 Mc./s. and the antennas were scaled accordingly. The flux measures only slightly higher than at 12·5 Mc./s., being $24 \times 10^{-23}$ w.m.$^{-2}$ (c./s.)$^{-1}$* as shown by $B$ of Fig. 2. The same estimate of over-all accuracy applies. In Fig. 2 the solid line from 22 to 100 Mc./s. is due to observations compiled by Hey and Hughes. Compared to their results at 22 Mc./s. these values at 12·5 and 15·5 Mc./s. are down by a factor of four.

Subsequent measurements will be made at somewhat higher frequencies to 'fill-in the gap' followed by a return to the 12 to 15 Mc./s. region for observation of other point sources while certain basic assumptions are being verified.

## REFERENCES

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* See 'Note' under Figure 2.



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