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# THE LOW-FREQUENCY SPECTRUM OF CYGNUS A AND CASSIOPEIA A

R. J. LAMDEN AND A. C. B. LOVELL
*Jodrell Bank Experimental Station, University of Manchester, England*

The published measurements of the intensity of the radio sources cover a frequency range down to a lower limit of 22·6 Mc./s., at which measurements have been made on Cygnus and Cassiopeia by Hey and Hughes (1954) [1]. Information about the spectrum at still lower frequencies is difficult to obtain because of interference arising from ionospheric reflexion of distant radio transmitters. Some of this trouble can be alleviated by using a narrow pencil-beam radio telescope for reception and the present communication describes measurements made on frequencies of 16·5, 19·0, 22·6 and 30·0 Mc./s. using the 218 ft. transit radio telescope at Jodrell Bank.

Even with the relatively narrow beam of the transit telescope it was found that observations could be made only during the summer months when Cygnus and Cassiopeia were in transit during darkness. Under these conditions the 30 and 22·6 Mc./s. measurements were straightforward, but the difficulties were severe on 19 and 16·5 Mc./s., and only a small percentage of the total number of runs was sufficiently clear of interfering signals to be used in the analysis.

The direction of the beam of the telescope could be adjusted by altering the tilt of the mast carrying the primary feed so that, in principle, observations on Cassiopeia and Cygnus could be made during the same night. However, the beam was narrow enough to give a complete picture of the transit of both sources in this way only on 30 Mc./s. At the lower frequencies it was found advisable to observe the sources on separate nights.

## 1. RESULTS

The experiment was carried out between 1 May and 12 August 1955, and although the apparatus was run on most nights, only a few of the runs were suitable for analysis either because of the interference problem mentioned



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above or because the presence of scintillations prevented an accurate measurement of the deflexion. The details are given in Table 1 where the intensities refer to both planes of polarization.

Table 1

| Date (1955) | Frequency (Mc./s.) | Intensities w.m.$^{-2}$ (c./s.)$^{-1}$ × $10^{-23}$ Cassiopeia | Cygnus | Ratio Cygnus/ Cassiopeia |
|---|---|---|---|---|
| 2 August to 12 August | 30·0 | 45·0 ± 20 % | 24·0 ± 20 % | 0·53 |
| 1 May to 24 May | 22·6 | 46·0 ± 20 % | 24·4 ± 20 % | 0·53 |
| 30 May to 11 June | 19·0 | 27·2 ± 20 % | 18·9 ± 20 % | 0·69 |
| 26 June to 19 July | 16·5 | < 11 ± 20 % | 14·5 ± 20 % | > 1·0 |

The main source of error in this experiment is a systematic one arising from uncertainty as to the actual collecting area of the transit telescope at these low frequencies. The value of 1000 m.$^2$ taken in the reduction is believed to be correct to within 20 %, and this is substantiated by the good agreement of the 30 Mc./s. measurement with the 38 Mc./s. measurements of Adgie [2] for which an accuracy of ± 10% is claimed. The chief cause for the random errors lies in the uncertainty of the extrapolation of the background radiation necessary to obtain the true deflexion of the source from the recording chart. This is particularly the case for Cygnus which lies on a steep slope of the background radiation. However, the occurrence of scintillation in some of the records provides a satisfactory index on which to base this extrapolation. No deflexion could be measured from Cassiopeia on 16·5 Mc./s. and the value given therefore represents an upper limit for the intensity. The ratio of intensities is of course known much more accurately than the absolute intensities since the systematic error due to the telescope is not involved.

## 2. DISCUSSION

The outstanding feature of these results is the abrupt fall in intensity of both sources at frequencies below 22·6 Mc./s., and the indication that the fall off in the intensity of Cassiopeia is more rapid than that of Cygnus. When the results are compared with those of other workers it is found that the 30 Mc./s. and 22·6 Mc./s. measurements follow naturally the slope of the curve at higher frequencies if the recent accurate results of Adgie at 38 Mc./s. are used. The 22·6 Mc./s. measurement differs markedly from that of Hey and Hughes (1954), their value being well outside the limits of error set in the present measurements. Hey and Hughes exclude the



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systematic error of their aerial gain in the assessment of errors and it is possible that this may be the source of the discrepancy.

These measurements were made at transit of the sources at latitude 53° N. and it is clear that absorption in the ionosphere cannot be the cause of this sudden fall in intensity. It seems most likely that the drop is due either to absorption in the interstellar medium or to some particular feature of the mechanism of generation of the radio energy in the sources.

## REFERENCES


[1] Hey, J. S. and Hughes, V. A. *Nature*, **173**, 819, 1954.
[2] Adgie, R. Unpublished symposium communication.