PAPER 20

SPECTRA OF SOME RADIO SOURCES

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At the tenth General Assembly of U.R.S.I. held in The Hague, Netherlands, in August 1954, the author presented a set of curves showing spectra of five bright, non-thermal, discrete radio sources. The spectra were based

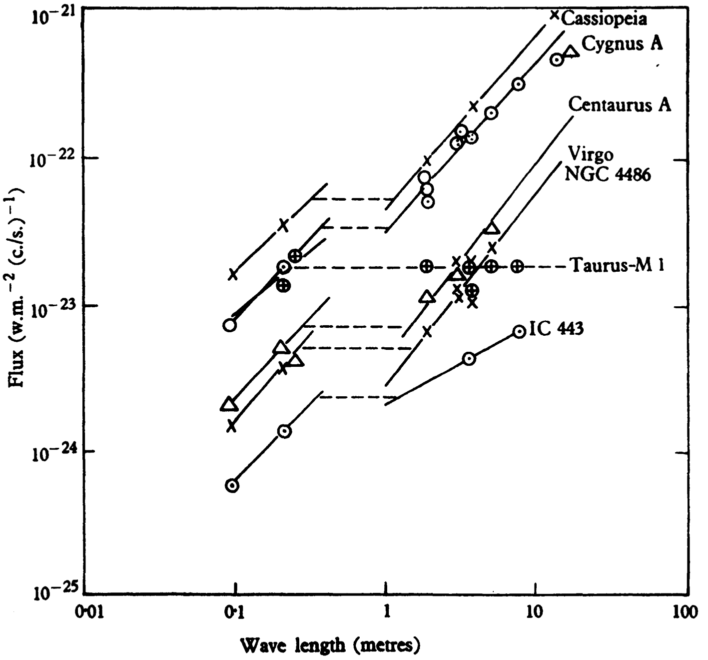

Fig. 1. Spectra of discrete radio sources.

on the recent measurements at centimetre wave-lengths made with the 50-ft. antenna at the Naval Research Laboratory and on earlier published values for the flux at longer wave-lengths. The spectra are shown in Fig. 1. It is seen that there is in each case a discontinuity in the region between 30 and 100 cm. wave-length. Unfortunately, there had been no measurements made in this middle region. The slope of the two ends of the curve is nearly the same. There was considerable doubt at the time as to whether the spectra were in fact S-shaped as they would be if the two ends were joined in the simplest fashion. One possibility was that, due to the different techniques used in the centimetre and metre regions both in antennas and receivers, there might exist a calibration error of sufficient magnitude to cause the offset. For many reasons, this was hard to believe. In particular, measurements of solar flux at long and short wave-lengths yield a consistent picture.

To establish the validity of the curve, it was decided to measure at least one of the sources using the 50-ft. antenna at some metre wave-length using receiver calibration techniques at that wave-length similar to those used at centimetre wave-lengths. Mr C. Grebenkemper and Mr E. McClain assisted in making such a measurement at 155 cm. wave-length of Cygnus A and Cassiopeia A. The feed for the antenna consisted of a dipole with a reflector which gave a primary pattern of a type necessary to illuminate properly the $f/0{\cdot}5$ reflector. The flux from Cygnus A can be estimated fairly accurately from the measured flux but removing the effect of nearby Cygnus X leaves some uncertainty. Cassiopeia A is, however, in a much clearer region and so it was decided to use its spectrum for the check. The measured values for the flux in each case were:

Cygnus A	$35{\cdot}4 \times 10^{-24}$	w.m.$^{-2}$ (c./s.)$^{-1}$,
Cassiopeia A	$62{\cdot}4 \times 10^{-24}$	w.m.$^{-2}$ (c./s.)$^{-1}$.

A new set of measurements at 3·2 cm. by Haddock and McCullough provides a further point in the centimetre region and gives greater weight to the slope of the lower end of the curve.

Fig. 2 shows the spectrum of Cassiopeia A using points at 3·2, 9·4, 21 and 155 cm. obtained at the Naval Research Laboratory with the 50-ft. antenna, points at 1·2, 1·9, 3·7 and 13·9 metres from earlier published information. The data are given in Table 1.

Table 1

Wave-length (m.)	Flux w.m.$^{-2}$ (c./s.)$^{-1}$ $\times 10^{-24}$	Observer
0·0315	4	Haddock and McCullough
0·094	12	Haddock, Mayer and Sloanaker
0·21	26·6	Hagen, McClain and Hepburn
1·2	57	Kraus and Ko
1·55	62	Grebenkemper, McClain and Hagen
1·9	93	Brown and Hazard
3·68	220	Ryle, Smith and Elsmore
13·9	950	Hey and Hughes

It is seen that the new point at 1·55 metres is in good agreement with nearby measurements by Kraus and Ko and Brown and Hazard.

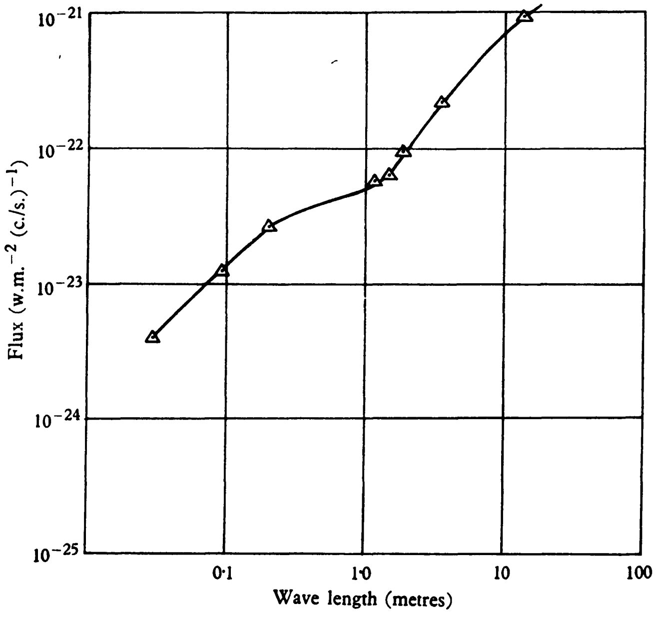

Fig. 2. Spectrum of the Cassiopeia source.

Since the techniques used at 1·55 metres were the same as those used in the centimetre region, one can now join the two sections of the curve with the resultant S-shaped spectrum. Referring to Fig. 1, it should thus be concluded that the spectra of the bright non-thermal sources, with the exception of Taurus A, are S-shaped.