Part III

GALACTIC AND EXTRAGALACTIC RADIO SOURCES

PAPER 57

THE FIRST DISCOVERY OF POINT SOURCES
INTRODUCTORY LECTURE by

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The investigations into cosmic radio noise that I made with J. W. Phillips and S. J. Parsons arose from operational studies of the performance of radar equipment at about 5-m wavelength in 1944-45. To obtain greater detection ranges, preamplifier stages of low-noise factor were being tested, but they did not result in the expected improvement in radar performance. J. M. C. Scott, a theoretical physicist now at Cambridge, suggested to me that the limitation in effective noise factor might be attributable to cosmic noise, about which something was already known from the work of Jansky and Reber.

With Phillips and Parsons, I then began to question if the noise on the radar sets had directional properties, and we were soon able to verify that much of the noise came from the Galaxy. We then made a more detailed survey using an aerial consisting of 4 Yagis in a horizontal plane and using ground reflection to narrow the beam in elevation. The resulting beam to halfpower was roughly 12 degrees across and centered at 12 degrees elevation. In observing the distribution of cosmic noise we found a very peculiar feature. The received noise in the direction of Cygnus was often fluctuating rapidly and the average variations were as much as 15 per cent of the mean power received over the beam. We concluded that such fluctuations could only arise from a localized region of high intensity, and we estimated the position of this powerfully emitting region to be near right ascension 20^h00^m, declination +43 degrees. We thought it likely, by analogy with radio emission from solar disturbances, that the fluctuations originated in the source, although we considered it possible that the variations might be imposed by an intervening medium.

Our observations published in 1946 [1] were followed by interferometer measurements in Australia and Cambridge. Bolton and Stanley [2] in 1948 first gave a more accurate position and found that the diameter of the Cygnus source is less than 8 minutes of arc; Bolton [3] also discovered several other discrete sources, and in the same year Ryle and Smith [4] published their first observations that included the stronger discrete source in Cassiopeia. Then followed the discovery of many other sources, and the attempts to identify the radio stars with visual objects, the first generally accepted identification being with the Crab nebula, the remnants of the supernova of AD 1054. Of the various identifications which have subsequently been made, some—such as those with normal external galaxies—have not been unexpected; but others have proved more remarkable, and the first discovered point source, that in

Cygnus, is a striking example. In 1951, F. G. Smith [5] obtained a really accurate location at right ascension $19^{h}57^{m}45\overset{s}{.}3 \pm 1^{s}$, declination $+40° 35' \pm 1'$, and this led to Baade and Minkowski's exciting identification of this source with two distant galaxies in collision. Finally, research at Cambridge, Manchester, and Sydney proved that the fluctuations were not inherent in this source but were caused by irregularities in the terrestrial ionosphere.

Today, thousands of radio stars have been reported, but much of the mystery remains since a large proportion have not been identified with visual objects and their nature is obscure. Our requirements concerning the radio observations of discrete sources are for reliable and accurate data on position, diameters, and structure, on power flux measurements and spectra, and on the state of polarization. The papers in Part III describe some of the recent progress in radio-star observations and their interpretation.

REFERENCES

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