THE LUMINOSITY FUNCTION OF EXTRAGALACTIC RADIO SOURCES

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Except for the neighborhood of the galactic plane, radio sources are uniformly distributed over the sky. The isotropic distribution suggests that these sources are external galaxies which are indeed among the first objects that were identified as radio sources. Positions of relatively moderate accuracy pointed clearly to some nearby bright galaxies that were long known as peculiar. But the second strongest small source in the sky, Cygnus A, turned out to be a faint extragalactic object. Since sources of the intrinsic strength of Cygnus A may be expected to be observable at distances beyond the reach of the 200-inch telescope, it was clear that not all the sources can be expected to be optically observable.

Precise positions have now been obtained for a large number of sources, but all attempts to identify them have led to the conclusion that, even with positions of an accuracy of the order of a few minutes of arc, only a fraction of all sources can be identified [1]. The main reason for the difficulty of finding identifications always has been sought in the assumption that most sources are intrinsically strong sources of the Cygnus A type at distances where the galaxies are too faint to permit identifications. Sufficient progress has now been made to put this assumption to a quantitative test by a determination of the luminosity function of radio sources.

A preliminary quantitative study of the problem was first made by Ryle [2]. Essentially the argument was that the small sizes found for many of the unidentified sources indicate large distance and therefore small space density. The number-intensity relation of radio sources then requires that most of the sources have high luminosity, comparable to that of the strongest sources known.

Since radio methods do not yet permit the determination of distances, the luminosity function can be determined only with the aid of optical data, and therefore only for identified sources. For the comparison of optical and radio data it is convenient to use radio magnitudes instead of flux density. The radio magnitude is defined as

$$m_r = -53.4 - 2.5 \log S_{158}, \tag{1}$$

where S_{158} is the flux density in $\mathrm{Wm}^{-2}(\mathrm{c/sec})^{-1}$ at a frequency of 158 Mc/sec. All logarithms are to the base 10. The spectrum of the extragalactic sources