# A PRELIMINARY SURVEY OF RADIO SOURCES IN A LIMITED REGION OF THE SKY AT A WAVELENGTH OF 3·5 M

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*Summary*

A preliminary catalogue has been prepared of radio sources observed in a sample area of about one steradian near the celestial equator: a total of 383 sources is listed. The brightest nebulae in the area are found to be radio sources. Statistical analysis of the catalogue reveals no obvious cosmological effects except, perhaps, for a significant degree of clustering which may be indicative of metagalactic structure. The catalogue is compared in detail with a recent Cambridge catalogue which includes the sample area; it is found that they are almost completely discordant. A theory is developed which explains this discordance in terms of instrumental effects and it is concluded that a major part of the Cambridge catalogue is affected by the low resolution of their radio interferometer.

## I. Introduction

The analysis by Ryle and Scheuer (1955) of the recently completed survey of radio sources observed at Cambridge with the 3·7 m interferometer (Shakeshaft *et al.* 1955) has raised many interesting questions in cosmology. An independent check on the accuracy of the Cambridge survey is therefore of value. A radio survey of the sky south of Dec. +10° is at present being carried out with the 1500-ft Sydney "cross" aerial at the closely similar wavelength of 3·5 m. From this a catalogue of radio sources is being prepared which will extend to a rather lower intensity than the Cambridge survey and have a convenient overlap of more than 45° in declination. Because the two instruments are completely different in character, the Cambridge instrument being an interferometer with multiple responses and the Sydney one having a single pencil-beam response, the comparison should be valuable for detecting the presence of instrumental effects.

Completion of the Sydney catalogue will take a long time and therefore, to check the Cambridge survey, it was decided to make a preliminary detailed comparison over a limited but representative area. We have chosen an area bounded by declinations +10° and −20° and by Right Ascensions $00^h$ and $08^h$. This area was chosen principally because M. Ryle sent us, in advance of publication, a list of the Cambridge sources in part of it for the purpose of checking. A catalogue has been prepared from our records available up to the present; it is preliminary in nature as single records only are available for about half the sources and this is not considered adequate for complete reliability at the lowest level of intensity, but, as we show later, errors due to this cause will not affect our conclusions.

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The most important conclusion of Ryle and Scheuer was that there exists a very large excess of weak radio sources, much more than would be expected with a uniform spatial distribution; the excess is used to prove that the sources are extragalactic and that the steady-state theory of the universe is untenable. If the excess of faint sources in the Cambridge catalogue is real and not of instrumental origin, their final conclusion seems difficult to avoid. It is well known, however, that radio interferometers are very subject to instrumental effects (e.g. Mills 1952).

Some of our early results, reported by J. L. Pawsey at the Jodrell Bank symposium on radio astronomy, 1955, appeared to contradict the Cambridge observations, but the comparison was a statistical one and, moreover, our data were not very homogeneous; consequently the results could not be regarded as a direct refutation of the Cambridge survey. However, the detailed agreement between the present catalogue and the Cambridge catalogue is also extremely poor, indicating that at least one of them is largely incorrect; from an analysis of the comparative performance of both instruments we conclude that the majority of sources listed in the Cambridge catalogue are affected by the low resolving power of their interferometer, many being simply blends of two or more weaker sources. Likewise, the statistics of the catalogues in the sample area are incompatible, the present results being consistent with our earlier approximate statistics.* We find only a small excess of faint sources, which, when account is taken of instrumental effects, is found to be insignificant as far as any cosmological evidence is concerned: a real excess is *possible* but that suggested by Ryle and Scheuer is impossibly large.

Although the source counts appear to have no cosmological significance there are two observable effects which may be relevant in this connexion. These are (*a*) possible large-scale clusterings of radio sources which may be an indication of metagalactic structure, and (*b*) a rather low value for the fluctuations in background brightness which may indicate a reduction in the flux densities of distant sources due to red shift.

## II. Preparation of the Catalogue

The Sydney cross aerial is a pencil-beam instrument of beamwidth 50 min of arc; the principle of operation has been described by Mills and Little (1953). It is arranged as a transit instrument and altered in declination by phasing the dipoles in the north-south arm of the cross. In our survey, the aerial is switched successively between five adjacent declinations separated by slightly less than half a beamwidth, recording each quasi-simultaneously. Because of the reduced observing time on each declination the sensitivity is less than in the earlier work using a stationary aerial beam (e.g. Mills 1955); it was decided to sacrifice sensitivity and also positional accuracy in this way in order to complete the survey in a reasonable time. A facsimile of a typical record within the comparison area is shown in Figure 1; in this, the vertical deflection of the recorder

* The intensity scale used for the earlier statistics must be approximately doubled (see Appendix II).

pen is proportional to the integral of the power received from the aerial, the integration process being commenced every 12 sec, when the aerial beam is switched to another declination. Thus the upper ends of the repetitive line pattern indicate the brightness at the corresponding declination setting, each declination being observed once a minute at every fifth integration. A bias is applied in the integrating circuit so that a positive-going deflection is obtained in the absence of any signal; this avoids changes in the sign of the deflection which could result from noise fluctuations or negative side lobes and

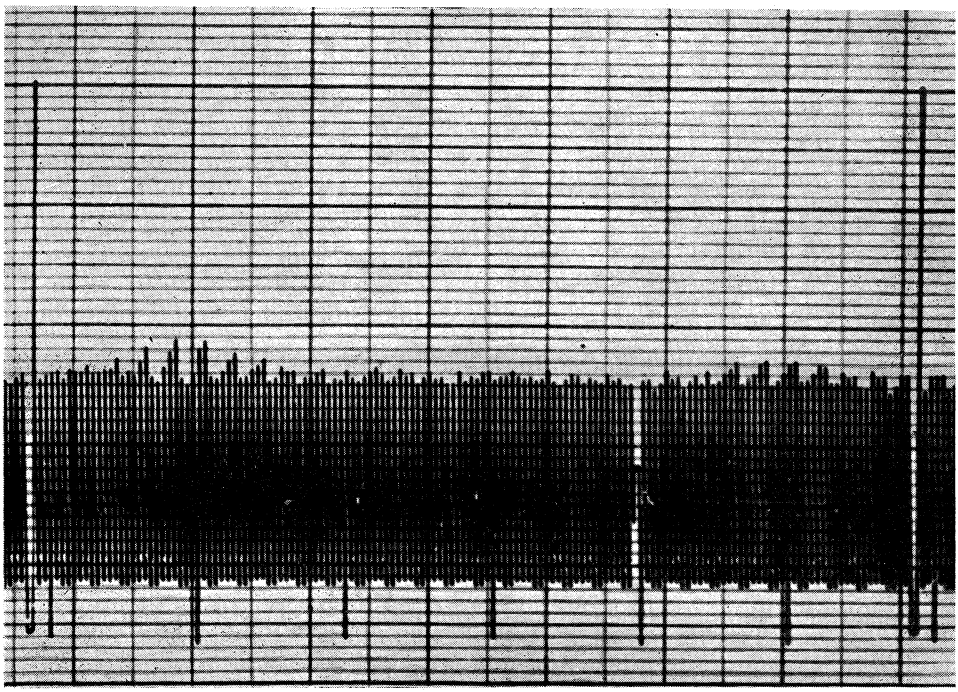

Fig. 1.—A typical record centred on a declination of —2° 17′. Vertical time marks at the right- and left-hand ends indicate the sidereal times $00^{h}\ 30^{m}$ and $01^{h}\ 00^{m}$ respectively. Immediately following the time marks the receivers are connected to dummy loads for a period of 12 sec as a check on stability, other negative-going deflections are added to identify the beam positions. The prominent sources near the right- and left-hand ends are respectively 00–*010* and 00–*018*.

which cause difficulty in reading the record. Time and calibration marks are added at regular intervals. The whole system will be described in detail elsewhere.

As a first step in reduction, the records are traced with each declination displaced vertically; smooth curves are then drawn through the series of points corresponding to each separate declination, and the zero level computed and inserted. Two such tracings at adjacent beam settings are shown in Figure 2. It is arranged that the outer declinations of each setting overlap as shown; this has advantages in tying together calibrations.

After a set of interlocking tracings covering the whole area of interest has been obtained, an examination is made for indications of discrete sources. These appear on the record as humps with a width between half-amplitude points of 50 min of arc (or more if the source is extended). The humps are visible on at least two declinations since the separate declinations are less than half a beamwidth apart. The Right Ascension of a source is obtained from the point of symmetry of its response, and the declination from the ratio of the deflections on adjacent declinations.

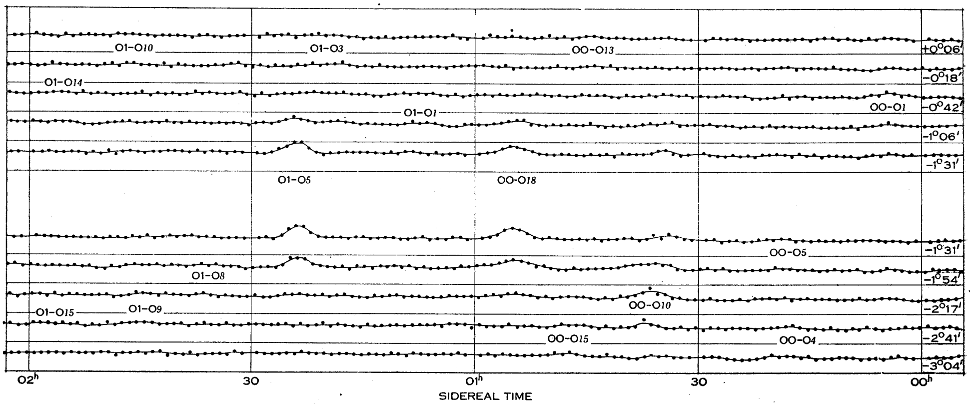


Fig. 2.—Traces obtained by separating vertically the five separate declinations recorded sequentially. The responses of catalogued sources are indicated.

### (*a*) *The Catalogue*

Our catalogue of sources is given in Appendix II. For convenience each source has a reference number in which the first two digits denote the hour of the Right Ascension ; these are followed by the sign and tens digit of the declination in degrees and an italicized serial number arranged in order of increasing Right Ascension within the 1-hr period. The probable errors in position, which are indicated by superscripts, have been estimated provisionally, but with further experience of the survey a correction may be required. Sources listed in the catalogue are indicated on the tracings of Figure 2 ; the weakest are not easily visible on the reproduction although they are reasonably clear on the originals. The gain of the system is deliberately kept low in order that the deflections due to very bright regions should be as much as possible within the range of the recorder.

Although the majority of sources have angular sizes much less than the beamwidth of the aerial and thus cause no widening of the response pattern, there are some for which the response is appreciably widened. These may be either sources of large angular size, or blends of two or more small sources ; in general, it is not possible to distinguish between these possibilities. They are listed as " extended sources " in the catalogue and an estimate of their integrated emission is obtained by multiplying the peak apparent flux density by the ratio of the solid angle of the observed pattern to that of the aerial beam. For strong sources an extension of about $\frac{1}{4}°$ can be detected, but recognition becomes increasingly difficult at the low levels. When the angular size becomes very large, it is often difficult to decide whether an extended source is real or represents merely a structural feature in the background radiation. This problem is particularly difficult in the neighbourhood of the Milky Way, that is, around 6–7$^{\rm h}$ R.A. To reduce uncertainties of this kind, the catalogue is restricted to sources of size less than 2°.

In order to check the reality of the sources listed, the earlier records taken with a stationary aerial beam and of higher signal-to-noise ratio have been used. Although these records are too sporadic for a complete coverage of the area, the existence of humps close to the positions of more than half the sources in the catalogue could be verified; these sources are indicated by an asterisk. A small number (about 3 per cent.) of those checked were found to be fictitious and have been omitted from the catalogue; these were all very weak sources. A greater number (about 5 per cent.) showed discrepancies, but could not be excluded completely because available records were insufficient to decide whether

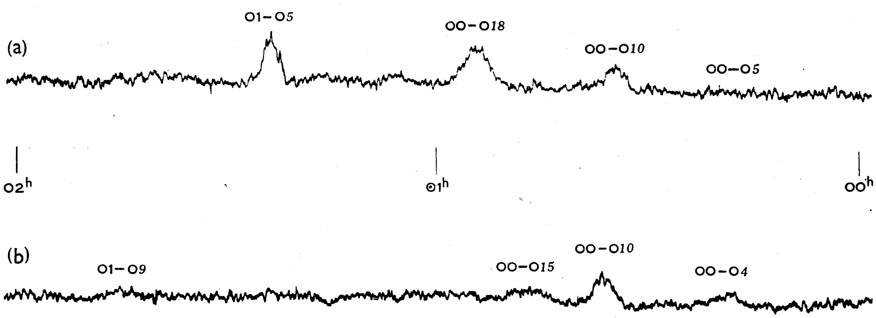


Fig. 3.—Check records obtained for two of the declinations shown in Figure 2. (*a*) refers to Dec. —1° 31′, (*b*) to Dec. —2° 41′. The Right Ascensions of catalogued sources which should appear on the records are indicated.

the discrepancies resulted from variations of position or flux density within the limits of error. These sources are indicated by daggers and must be regarded as doubtful. Of the unmarked sources, it seems probable that the same proportions of fictitious and doubtful sources would be preserved if checking were possible, thus a reliability of better than 90 per cent. might be expected; sources with flux densities greater than $2\times10^{-25}$ W m$^{-2}$ (c/s)$^{-1}$ should all be included and completely reliable except perhaps in the small areas where confusion from side lobes exists. Two of these check records corresponding to declinations shown in Figure 2 are reproduced in Figure 3. Again the responses due to catalogued sources are indicated.

It was shown by Mills and Little (1953) that there is possibility of a spurious response with a cross type aerial when a strong source crosses one of the fan beams of the individual arrays. Each source crosses the beam of the east-west array, which lies in the meridian plane, at the time of its culmination. Two sources, IAU 03S3A and IAU 05N2A, are sufficiently strong to cause trouble in this way within the sample area, and allowance for their effects has been made in preparing the catalogue. This type of spurious response has often been observed amounting to about 1 per cent., and sometimes more, of the flux density of the interfering source. The fan beam of the north-south array cuts the celestial sphere along an east-west small circle intersecting the meridian plane at the declination setting of the aerial ; thus, for this array, it is necessary to compute the times at which each source crosses the beam for every declination setting. The possibility of spurious responses of this type was ignored when compiling the catalogue, since it seemed likely that they would be smaller than in the other case because the adjustment of the east-west arm of the cross is not altered when changing declination and hence it may be set up for minimum side lobes. Subsequently the positions were calculated at which such spurious responses might be expected due to the sources IAU 05N2A, IAU 09S1A, and IAU 12N1A, the only ones likely to produce observable effects in this area. However, no indications were found of any clustering of sources near them, and only one source can possibly be seriously affected (01+0*11*).

It is interesting to check the IAU catalogue of radio sources (Pawsey 1955), which contains two weak sources, 02S0A and 02S1A, in the area of the present catalogue. In both cases the positions and flux densities of the sources, which are in the " least reliable " list, appear to have been badly affected by blending effects in the earlier surveys. In the case of 02S1A, the identification seems clear with our source 02−1*5*, the most prominent in the area, but the IAU position is several degrees in error, and the flux density too high by a large factor. The source 02S0A is clearly a blend of our sources 02−0*6* and 02−0*15* ; it is natural to identify it with the stronger of the pair, 02−0*6*, and again the position error is several degrees.

A number of reasonably certain identifications with bright nebulae of various types are indicated in the catalogue, and several possible identifications with fainter nebulae are also noted, for which the only evidence is a coincidence in position. The latter are bracketed to indicate their provisional nature. The question of identifications is discussed later.

## III. Comparison between the Sydney and Cambridge Catalogues

The Sydney and Cambridge catalogues are compared directly in the maps of Figure 4. Sydney sources are shown at their listed position as solid circles of diameters dependent on their flux densities, while Cambridge sources are shown as corresponding open circles. A source listed as " extended " or " large " in either catalogue is surrounded by an irregular line which is dotted when the extension is not definitely established. The loci of possible spurious sources in the Sydney catalogue due to the passage of a strong source through the east-west fan beam of the aerial are shown as dotted lines labelled with the IAU designation of the source concerned.

Simple inspection of the maps reveals that the two catalogues are almost completely discordant. The conclusion follows that instrumental effects play a decisive part in determining the positions and intensities of sources in at least one of the surveys.

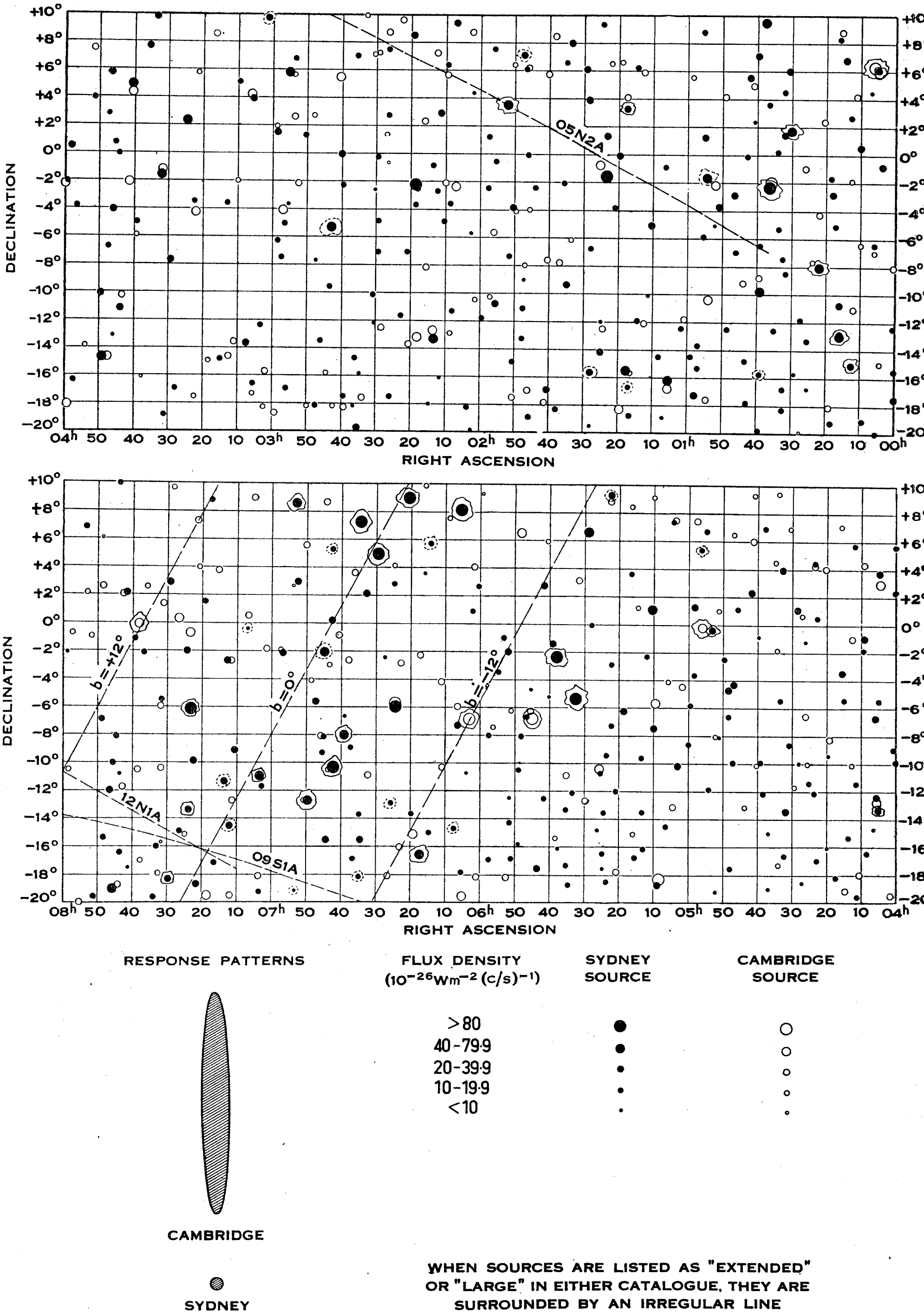


Fig. 4.—Maps of the comparison area showing the distribution of Sydney and Cambridge sources. The half-power response contours of each instrument are indicated on the same scale.

The half-power response contours of each of the aerial diagrams used for the surveys are also shown in Figure 4 ; the response of one of the four Cambridge interferometer aerials is given because this determines the angle over which the system responds.* It is obvious that the Cambridge sources, with an average density of about two per beamwidth, are likely to be affected by confusion, while the effect might be expected to be trivial in the Sydney catalogue, averaging one source per 17 beamwidths. We show later that the discrepancies seem to be quite consistent with inadequate resolution in the Cambridge survey ; first, however, let us begin a quantitative comparison of the surveys by examining their flux density standards.

Because of the very poor general correlation between the catalogues, it is clearly unwise to attempt to compare calibration standards by comparing flux densities of the few sources which appear to agree in position. Instead, it is more convincing to use some sources close to the comparison area which are sufficiently strong to permit the neglect of resolution effects. The only suitable choices appear to be the IAU sources 05N2A, 09S1A, 12N1A, and 16N0A, and in Table 1 their flux densities are compared. The mean ratio between the Sydney and Cambridge flux density standards near zero declination is 1·2, with a probable error of 0·1. The difference is insufficient to require a correction factor when comparing individual sources.

TABLE 1

COMPARISON OF SYDNEY AND CAMBRIDGE OBSERVATIONS OF BRIGHT SOURCES

| Source IAU No. | Flux Density ($10^{-24}$ W $m^{-2}$ $(c/s)^{-1}$) | | Ratio $\frac{\text{Sydney}}{\text{Cambridge}}$ |
|---|---|---|---|
| | Sydney (3·5 m) | Cambridge (3·7 m) | |
| 05N2A | 23·0 | 18·5 | 1·24 |
| 09S1A | 6·7 | 5·7 | 1·18 |
| 12N1A | 24·3 | 17 | 1·43 |
| 16N0A | 8·9 | 9·0 | 0·99 |

Also, we may compare the positional accuracies of each survey, and the mean probable errors of all the sources in each catalogue of the comparison area are listed in Table 2.

It has been suggested by Shakeshaft *et al.* (1955) that a substantial proportion of the Cambridge sources may be placed in the wrong lobe of the interferometer pattern. If a movement of one lobe either way in declination and Right Ascension is allowed, the area of uncertainty of the Cambridge " small " sources is increased ninefold, corresponding to the nine allowed lobe positions. Under these conditions it is easy to show that there is a probability of 0·4 of a

* The response of a uniformly illuminated aperture of the dimensions of the Cambridge aerial, i.e. 320 by 40 ft, has been given (2° by 16°). In fact the response might be expected to be rather wider than this in a north-south direction because the illumination is tapered towards the edges.

coincidence, within an arbitrary limit of three probable errors, between a Cambridge source and any point in the comparison area. It therefore seems futile to consider the possibility of lobe shifts when intercomparing the catalogues, except in the case of sources specifically mentioned in the catalogue as having an ambiguity in their position and also, perhaps, the stronger sources.

Before looking for coincidences it is desirable first to calculate the number to be expected assuming that the catalogues are completely uncorrelated and that the sources are distributed at random. We take as a criterion of coincidence the agreement of two catalogue positions within three times the combined probable errors, that is, on the average, within $\pm 18'$ in Right Ascension and $\pm 99'$ in declination corresponding to an area of 2 square degrees. There are 227 Cambridge and 383 Sydney sources in the area of 3550 square degrees ; it follows that the expected number of chance one-to-one coincidences is 42. The actual number of such coincidences is 62 and accordingly it would appear that a certain proportion represent genuine observations of actual sources. By

Table 2

COMPARISON OF SYDNEY AND CAMBRIDGE POSITIONAL ACCURACIES

| | Mean of Quoted Probable Errors in Each Survey | |
|---|---|---|
| | Right Ascension (min of arc) | Declination (min of arc) |
| Sydney . . . . . . | 5 | 6 |
| Cambridge . . . . | 3 | 32 |

accepting only those coincidences for which both flux densities are high and not too different, we consider it probable that in the following 12 examples the same physical object is being observed in both surveys : 2C6, 00+0*1* ; 2C23, 00−1*7* ; 2C50, 00−0*10* ; 2C92, 01−1*2* ; 2C122, 01−0*5* ; 2C196, 02−1*5* ; 2C280, 03+0*2* ; 2C317, 03−0*4* ; 2C331, 03+0*7* ; 2C338, 03−1*9* ; 2C443, 04−0*22* ; 2C553, 06−0*2*. The source 2C122 requires a lobe shift in Right Ascension to bring it into approximate coincidence with the Sydney source 01−0*5*, but, as the flux densities agree and, moreover, there are no adjacent strong sources likely to cause bad confusion in the Cambridge observation, the lobe shift appears to be legitimate.

Since it would seem that instrumental effects play an important part in the preparation of a catalogue of radio sources, it is clear that the statistics of the distribution of sources in space cannot be investigated without a thorough analysis of all such effects. We have therefore attempted to assess the importance of these effects in our survey and, since we are not aware of any such analysis in connexion with the Cambridge survey, in that also. We begin with an estimation of the effects of finite resolution in the Cambridge survey, since the calculation is easily made and the result is very illuminating.

## IV. Effects of Finite Resolution

The simple model used by Ryle and Scheuer is assumed, i.e. that the radio emission arises in a population of physically discrete sources distributed randomly and without clustering throughout a static Euclidean universe ; later we will investigate some modifications needed with a more realistic model. Logically the investigation of the Cambridge survey must be carried out in two parts, the " small " sources observed with the interferometer and the " large " sources observed with a single aerial being treated separately.

Let us consider the problem of the response of an interferometer to a population of sources too numerous for individual resolution. Each source within the reception angle of the aerial contributes a sine wave response of amplitude proportional to the flux density of the source, of phase dependent on its Right Ascension, and of frequency dependent on its declination. All frequencies within the aerial beam will be closely the same since, except near the celestial poles, the frequency of the pattern is not a rapidly changing function of declination. The combined effect of all the sources is therefore a sinusoidal oscillation, modulated slowly by the response pattern of one aerial and by the frequency dispersion caused by the finite range of declinations to which the system responds ; the number of separate maxima will be of the same order as the number of beamwidths which can be fitted into the sky. The problem of describing the probability distribution of the envelope of the interferometer pattern is therefore essentially that of the two-dimensional random walk, for which the method of solution is well known (e.g. Chandrasekhar 1943). With a very large number of " walks " of small amplitude, the solution is a Rayleigh distribution, but this cannot be assumed here because the number-intensity distribution of the sources is extremely skew. The calculation of the true distribution is very laborious* and we limit ourselves to computing the r.m.s. amplitude of the envelope under various conditions, for which an exact solution is easily obtained ; this is quite adequate for our purpose.

Let us make the simplest assumption that the distribution of sources in space is uniform and isotropic : the number of sources, $\mathrm{d}n$, in the whole sky with flux densities between $S$ and $S-\mathrm{d}S$ is given by

$$\mathrm{d}n=(3/2)S_0^{3/2}S^{-5/2}\mathrm{d}S, \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

where $S_0$ is the flux density of the strongest " average " source of the population, obtained by extrapolating the log $n$ – log $S$ curve to $n=1$.

* Ryle and Scheuer (1955) give curves which they have derived for this probability distribution with various types of source distribution, but no flux density scales are appended and no details of the calculations are given, so that we are unable to check their correctness.

*Note added in Proof.*—We have just received from P. A. G. Scheuer a copy of his paper (1957, in press) giving the theoretical derivations on which the probability distribution curves are based ; however, we have not yet been able to compare the curves directly with our own results because of the lack of essential numerical data.

The mean square amplitude of the output, in flux density units, due to sources of flux density between $S$ and $S-\mathrm{d}S$ and in solid angle $\mathrm{d}\Omega$ is given by

$$\overline{(\mathrm{d}A)^2}=\frac{\mathrm{d}\Omega}{4\pi}\cdot F^2S^2\mathrm{d}n$$

$$=\frac{3}{8\pi}S_0^{3/2}F^2\mathrm{d}\Omega\cdot S^{-\frac{1}{2}}\mathrm{d}S, \quad \ldots\ldots\ldots\ldots\ldots \quad (2)$$

where $F$ is the normalized power response of the aerial in the direction of $\mathrm{d}\Omega$.

The r.m.s. amplitude of the output due to all sources of flux density between $S_1$ and $S_2$ is therefore given by

$$(\overline{A^2})^{\frac{1}{2}}=\left[\frac{3}{8\pi}S_0^{3/2}\int_{4\pi}F^2\mathrm{d}\Omega\int_{S_2}^{S_1}S^{-\frac{1}{2}}\mathrm{d}S\right]^{\frac{1}{2}}$$

$$=(3\Omega_c/4\pi)^{\frac{1}{2}}S_0^{\frac{3}{4}}(S_1^{\frac{1}{2}}-S_2^{\frac{1}{2}})^{\frac{1}{2}}, \quad \ldots\ldots\ldots\ldots\ldots \quad (3)$$

where $\int_{4\pi}F^2\mathrm{d}\Omega$ is written as $\Omega_c$.

If the population of sources is effectively infinite, that is, if $S_2 \ll S_1$, we have

$$(\overline{A^2})^{\frac{1}{2}}=(3\Omega_c/4\pi)^{\frac{1}{2}}S_0^{\frac{3}{4}}S_1^{\frac{1}{4}}. \quad \ldots\ldots\ldots\ldots\ldots \quad (4)$$

We will assume that the population of sources extends much lower than the lowest flux density recorded in the Cambridge survey and estimate the lowest flux density at which the survey is reliable. As a criterion of reliability it will be assumed that the r.m.s. amplitude due to all sources less than the minimum reliable flux density ($S_r$) should be less than $\frac{1}{3}S_r$. While the criterion is arbitrary, it is one which is related to practical experience in the detection of small signals in noise or interference. Even at this level it seems clear that an appreciable proportion of the sources might be expected to be listed in the wrong position and with the wrong flux density. Substituting in equation (4) we have

$$\tfrac{1}{3}S_r=(3\Omega_c/4\pi)^{\frac{1}{2}}S_0^{\frac{3}{4}}S_r^{\frac{1}{4}},$$

or

$$S_r=9(\Omega_c/4\pi)^{2/3}S_0. \quad \ldots\ldots\ldots\ldots\ldots \quad (5)$$

For the Cambridge survey we take $S_0=1\cdot8\times10^{-23}$ W m$^{-2}$ (c/s)$^{-1}$, derived from the uniform distribution curve of best fit in Figure 6, after allowing for the calibration difference of 1·2 between the two surveys. For a uniformly illuminated aperture of area $A$ it may be shown that the value of $\Omega_c$ is approximately equal to $\frac{1}{2}\lambda^2/A$. After allowing a factor of $\frac{1}{2}$, because there are two pairs of aerials in the Cambridge interferometer, we find the value of $\Omega_c$ is equal to $3\times10^{-3}$ steradians. The minimum reliable flux density, $S_r$, for the Cambridge survey should therefore be about $6\times10^{-25}$ W m$^{-2}$ (c/s)$^{-1}$. It is interesting that of the eight Cambridge " small " sources with flux densities greater than $6\times10^{-25}$ W m$^{-2}$ (c/s)$^{-1}$, six agree well in position and flux density with Sydney sources, one agrees well in position but not in flux density, and one agrees well in flux density and also in position if a lobe shift is applied in Right Ascension. Below this level agreement deteriorates rapidly.

The minimum reliable flux density of a pencil-beam survey may be estimated in a very similar way. Again the unresolved sources add together to produce a random deviation of the output and again we may calculate the r.m.s. value of this deviation, although the calculation of the actual probability distribution is too laborious. The number of sources, $dn$, between $S$ and $S-dS$ is given by equation (1) as before. These have a Poisson distribution, of variance $dn$. The total flux density of all sources in the interval is therefore $Sdn$ and the variance of this distribution (now no longer Poissonian) is $S^2dn$. It is therefore easy to see that the r.m.s deviation of the output signal is given by the same expression as before (equation (3)), but where $(\overline{A^2})^{\frac{1}{2}}$ refers to the r.m.s. deviation of the output rather than to the r.m.s. amplitude of the envelope. The other equations are similarly applicable and we may use equation (5) to determine $S_r$.

For the Sydney survey we take $S_0=2\cdot1\times10^{-23}$ W m$^{-2}$ (c/s)$^{-1}$ and $\Omega_c=1\cdot2\times10^{-4}$, the value of $S_r$ is found to be approximately $8\times10^{-26}$ W m$^{-2}$ (c/s)$^{-1}$, or, on the Cambridge flux density scale, $7\times10^{-26}$ W m$^{-2}$ (c/s)$^{-1}$, that is, nearly 10 times lower than in the Cambridge survey. The improvement is the result of the much higher resolving power of the instrument. The survey is limited by sensitivity at about this level.

A similar analysis may be applied to the Cambridge "large" sources, which were observed with a single aerial. This time we take $\Omega_c=6\times10^{-3}$ and find a minimum reliable flux density of about $10^{-24}$ W m$^{-2}$ (c/s)$^{-1}$. The two Cambridge large sources with flux densities greater than this (2C493, 520) do not correspond with Sydney sources, although two with somewhat smaller flux densities agree reasonably well (2C6, 433). The two former sources are, however, close to the galactic plane, where it is clear that the simple model of a random distribution of discrete sources breaks down completely. The brightness distribution is very complex and it is often difficult to separate the discrete sources from fluctuations in the general background radiation. Examination of our records suggests that the Cambridge sources 2C493 and 520 correspond roughly with regions of excess brightness in which, however, the distribution is complex. It is quite unclear whether such regions should be designated as discrete sources and, as mentioned earlier, we partly avoid the problem by limiting our catalogue to sources less than about 2° in size (i.e. about 3 square degrees).

This fluctuation in background brightness can also cause some difficulties in the Cambridge interferometer survey, although it does not seem likely to be a major cause of error. An interferometer responds to one spatial Fourier component of the sky brightness distribution ; any substantial change in brightness within an angle corresponding to the lobe separation of the interferometer will therefore produce an output signal indistinguishable from that of a discrete source. We have not yet sufficient data regarding the background irregularities near the galactic plane for any reliable estimates of their effect on an interferometer survey, but we have estimated from the available data that they are not likely to produce many spurious sources of flux density greater than about 2 or $3 \times 10^{-25}$ W m$^{-2}$ (c/s)$^{-1}$; thus the effect is probably negligible compared with effects of finite resolution.

## V. Analysis of the Sydney Catalogue

It has been shown that the Cambridge catalogue does not agree with ours and that errors in the former due to poor resolution might be expected to occur just at the level where agreement begins to break down. On the other hand, the corresponding level of reliability in our catalogue is nearly 10 times lower at a flux density of $8 \times 10^{-26}$ W m$^{-2}$ (c/s)$^{-1}$. We include very few sources with lower flux density ($\sim$2 per cent.) so it appears that the finite resolving power of our aerial is not a serious drawback. In addition, the existence of a substantial proportion of the sources has been confirmed under very different conditions of observation, and it has been found that side lobe effects are probably quite negligible in the area. It therefore seems safe to assume that practically all our sources represent real concentrations of radio emission, the majority probably being physically discrete. An analysis of the catalogue should therefore give meaningful results.

### (a) *Identifications*

A search through our catalogue for radio sources which can be identified with optical objects is of value in two ways, as a means of acquiring information about the radio and optical objects and as a check on the reliability of the survey. The " Palomar Sky Atlas " appears to be the best source of optical data, for not only is the plate limit very low, but the direct photographs in two colours enable some estimate to be made of peculiarities in any suspected radio emitter. However, we have not yet available sufficient prints of the Atlas in this area to make the comparison worth while, and accordingly we have limited ourselves, for the present, to an examination of the " Skalnate Pleso Catalogue " (Becvar 1951) supplemented for the external galaxies by the revised Shapley-Ames Catalogue of de Vaucouleurs (1952–53).* The limiting magnitude of these catalogues is about 13.

Of the 76 galaxies listed in the area, 6 are coincident with the positions of radio sources within three probable errors. By chance, two or three such coincidences would be expected, and it therefore seems probable that some of the coincidences are real. The brightest galaxy in the area, NGC 1068, appears well identified with the radio source 02−0*14*; this identification has already been noted (Mills 1955). The position of the source agrees closely in Right Ascension with the galaxy, but is about 10 min of arc, or two probable errors, different in declination. It is possible that the nearby bright galaxy NGC 1055 contributes slightly to the emission as it is too close to be separately resolved and such a contribution would help explain the slight discrepancy in position; the appearance of the records is consistent with such an interpretation. None

* A systematic comparison of portion of our catalogue with the " Palomar Sky Atlas " has been carried out by R. L. Minkowski, and several of the possible identifications we quote are included in his much longer list (unpublished data).

of the other possible identifications appears to be of great interest except, perhaps, NGC 157 with the radio source 00−0*7*. This is the third brightest galaxy in the area, an Sc, and the radio position is within two probable errors of the optical centre in both coordinates. The radio emission seems rather high in comparison with other " normal " Sc galaxies as the ratio of radio to optical emission, defined by the magnitude difference, $m_R - m_p$, is −1·0* compared with a mean of +1·6 obtained earlier (Mills 1955). This possible identification, however, does not affect significantly the previous estimate of the radio emission of Sc galaxies as a class, particularly in view of the fact that six other bright Sc galaxies in the area were undetectable.

Close to the galactic plane there are several good identifications with emission nebulae, most of which have already been given (Mills, Little, and Sheridan 1956). The most obvious is the source 06+0*8* which is identified with the Rosette nebula in Monoceros, NGC 2237. The source 05−0*10* which is identified with M42 is also clear and the source 05−0*11* appears well identified with the extended nebulosity around the Horsehead nebula (IC 434 etc.); it appears possible also that the source 05−0*13* is associated with the eastward extension of the M42 nebulosity. The pair of sources 07−*11* and 07−*12* are difficult to disentangle but both could be identified with the IC 2177, NGC 2327 complex; isophotes of the region are desirable to form a definite opinion since there is much complexity of detail. The nebula NGC 2264, for which an identification was also suggested before, is centred within the northern boundary of the area, at a position of $06^h\ 38^m{\cdot}2$, $+09°\ 57'$, but the extended source is outside at a position of $06^h\ 37^m{\cdot}1 \pm 0^m{\cdot}5$, $+10°\ 10' \pm 10'$, and therefore it is not included in the catalogue. As the nebula is very extended, the position we obtain is quite consistent with an identification. To sum up, it would seem that all the bright emission nebulae in the area are accompanied by a radio source close to the position of maximum brightness; none of these sources is included in the Cambridge catalogue.

The lists of globular clusters, planetary nebulae, and novae contained in the " Skalnate Pleso Catalogue " have been searched for coincidences. There are no globular clusters, 11 planetaries, and 2 novae in the area; but none agrees with the position of a radio source.

### (*b*) *Statistics*

It remains to examine the statistics of the sources in our catalogue. In Figure 5 the logarithm of the number density of sources with flux density $S$ or higher is plotted against log $S$; the actual numbers of sources within various flux density ranges from which the figure is derived are given in Table 3. The standard errors in the plotted points due to chance effects in the spatial distribution ($\sqrt{N}$) are shown as vertical wings in the figure. For comparison the corresponding Cambridge data are also included, after adjusting their flux densities to the Sydney standard by multiplying by 1·2; error indicators are omitted from the Cambridge points for clarity.

* Using the earlier flux density scale (see Appendix II).

The greater slope of the straight portion of the Cambridge curve is very clear, and is the result of an excess of sources with flux densities between $2\times10^{-25}$ and $8\times10^{-25}$ W m$^{-2}$ (c/s)$^{-1}$ where the Sydney catalogue is reliable. We consider this excess to be another effect of low resolution in the Cambridge survey, since the total number of sources listed is of the same order as the number of separate maxima that can be obtained from the interference pattern (2 sources

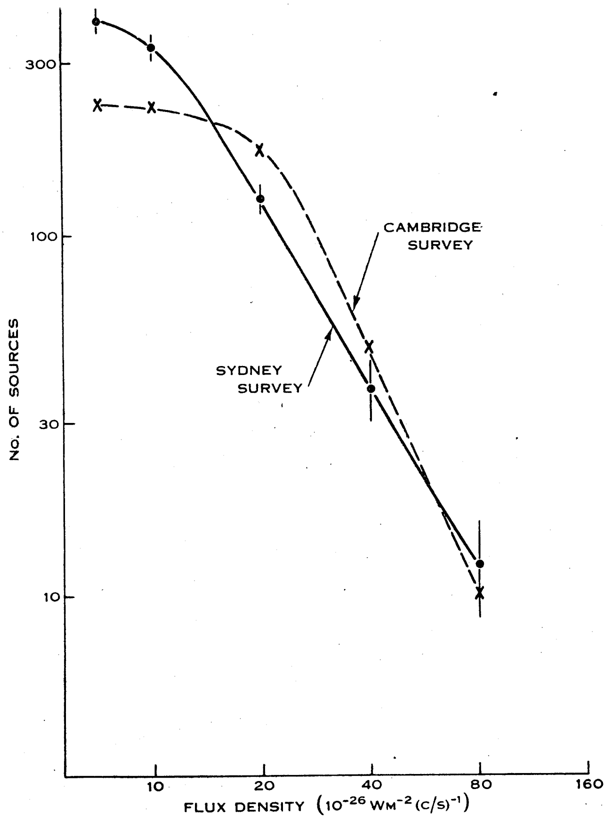


Fig. 5.—A comparison of the Sydney and Cambridge source counts.

per beamwidth) and the flux density range most favoured in Table 3 is that at which a random modulation of the output is expected owing to the effect of unresolved sources.

It is known that a uniform distribution of sources in a static Euclidean universe should, when plotted as in Figure 5, yield a straight line of slope $-1\cdot5$. The slope we obtain, $-1\cdot7$, is sufficiently different to warrant some investigation. From the map of Figure 4 it is seen that near the plane of the Milky Way there is a concentration of moderately strong extended sources, presumably the Class I galactic sources (Mills 1952). These and the Class II sources must be considered separately, but, as there is insufficient area close to the galactic plane for a worthwhile investigation, only the latter will be considered here. Since present evidence strongly favours an extragalactic origin for Class II sources,* their investigation is likely to be of importance to cosmological theory. We take the dividing line at a galactic latitude of $12\frac{1}{2}°$, as before, and in Figure 6 a logarithmic plot is shown of the number density of sources against the flux density for the high latitude area ; the numbers within various flux density ranges are tabulated in Table 4. In estimating the slope of the ogive a difficulty arises because of the small number of sources with high flux densities and the correspondingly large statistical uncertainty. In fact it is well known from previous surveys that there is a conspicuous absence of strong sources in an area near the south galactic pole, which includes a large amount of the sample area. To overcome this difficulty, use has been made of the data in the major part of the Cambridge survey to deduce a mean density for sources stronger than $10^{-24}$ W m$^{-2}$ (c/s)$^{-1}$

TABLE 3

THE NUMBERS OF SOURCES WITHIN VARIOUS FLUX DENSITY RANGES

| Flux Density Range ($10^{-26}$ W m$^{-2}$ (c/s)$^{-1}$) | Number of Sources | |
|---|---|---|
| | Sydney | Cambridge |
| <10 | 49 | 5 |
| 10– 19·9 | 206 | 52 |
| 20– 39·9 | 90 | 121 |
| 40– 79·9 | 25 | 39 |
| 80–159·9 | 10 | 7 |
| >160 | 2 | 3 |

TABLE 4

NUMBERS OF CLASS II SOURCES WITHIN VARIOUS FLUX DENSITY RANGES

| Flux Density Range ($10^{-26}$ W m$^{-2}$ (c/s)$^{-1}$) | No. of Sources |
|---|---|
| <10 | 42 |
| 10– 19·9 | 177 |
| 20– 39·9 | 68 |
| 40– 79·9 | 19 |
| 80–159·9 | 5 |
| >160 | 0 |
| >100 in Cambridge survey | 36 (see text) |

* We are clearly unable to apply the arguments of Ryle and Scheuer for their extragalactic origin, but the many identifications which have been made with abnormal galaxies, and some recent measurements of the angular sizes of the 70 brightest sources by A. W. L. Carter (paper in preparation), leave little room for doubt.

($8 \cdot 3 \times 10^{-25}$ W m$^{-2}$ (c/s)$^{-1}$ in the Cambridge scale); we have shown that their survey should be largely unaffected by finite resolution at this level. Sources have been counted which have declinations north of —20° and galactic latitudes greater than $12\frac{1}{2}°$; there are 36 such sources in the total area of 6·7 steradians, corresponding to a density of $5 \cdot 4 \pm 0 \cdot 9$ sources per steradian. Sources south of —20° have not been included in this count, because it appears that the reliability

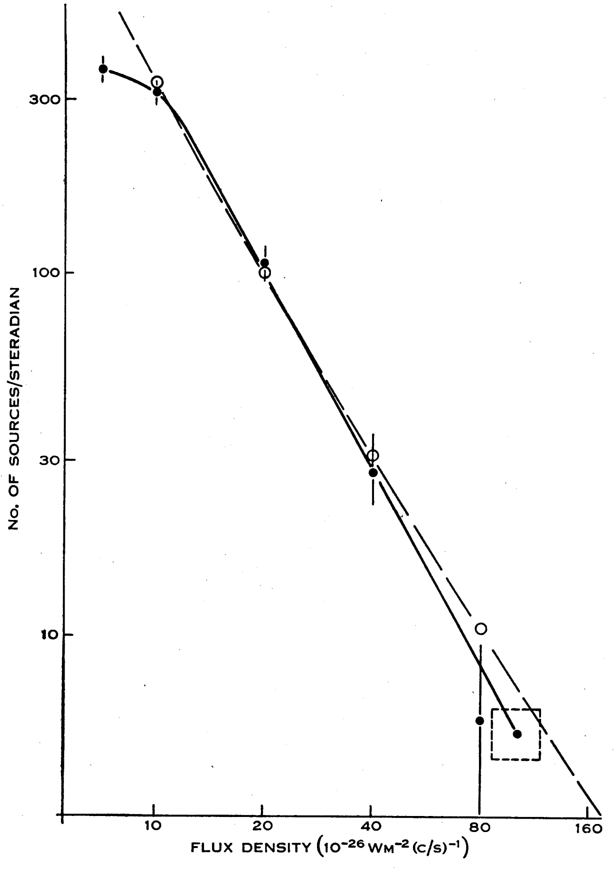


Fig. 6.—Source counts of the Sydney "Class II" sources, compared with a theoretical curve based on a uniform distribution of sources and including approximately the expected instrumental effects.

of the Cambridge survey decreases markedly near the southern horizon; this is indicated by the large probable errors quoted in the catalogue and the omission of the very strong source IAU 03S3A.

The point deduced from the Cambridge data is shown in Figure 6 surrounded by a dotted rectangle indicating the standard errors in both coordinates. The line of best fit is drawn through this and the low-level points derived from the Sydney catalogue; the initial segment is straight with a slope of $-1 \cdot 8$ (P.E. $\pm 0 \cdot 1$) while a curvature is evident at low levels, indicating an apparent reduction in the space density of sources with flux densities less than $10^{-25}$ W m$^{-2}$ (c/s)$^{-1}$; this, however, is quite likely to be due entirely to the operation of instrumental effects near the survey limit. More interesting is the slope of the straight portion which, being three probable errors greater than $-1 \cdot 5$, suggests a possible cosmological effect; it is necessary to estimate the contribution of instrumental effects to this increased slope.

There are two important factors which tend to increase the apparent number of sources with flux densities just above the survey limit. Firstly, confusion or blending effects in which sources below the limit cause a random variation in the output as discussed earlier; large chance excursions are then counted as single sources. Secondly, the effect of observational selection in the presence of noise; the rapid increase in numbers with decreasing flux density provides many more sources, below the limit of visibility, capable of being included owing to the presence of favourable noise fluctuations than sources, above the limit, likely to be excluded through the presence of unfavourable fluctuations. Selection effects may be reduced in importance by taking more observations, but to reduce the blending effects an increase in resolution is required. A further factor which could be of importance is the possible existence of a large number of side lobes, each of which could be counted as a single weak source; in the sample area, however, this effect is probably quite negligible, as explained earlier.

The exact computation of the effects of blending and selection is extremely laborious; fortunately it appears that neither are likely to be very pronounced in the catalogue and accordingly approximate methods may be used. The calculations are outlined in Appendix I. The dotted line through the open circles in Figure 6 is the source count expected, after allowance has been made for instrumental effects, from a uniform distribution of sources in which the strongest "average" source has a flux density of $2 \cdot 1 \times 10^{-23}$ W m$^{-2}$ (c/s)$^{-1}$. The slope of the observed count is clearly not significantly different from the theoretical and it is simplest to assume that the small discrepancy is caused by the local space density of sources being rather lower than average owing to chance fluctuation; there is no need to invoke any special cosmology. Extending our survey is unlikely to affect this conclusion greatly since there are already sufficient sources to define the curve at low levels with little statistical uncertainty, whilst at high levels the numbers are not likely to be modified significantly because the whole of the reliable part of the Cambridge catalogue has been used. The above results agree quite well with our earlier statistics presented by J. L. Pawsey at the Jodrell Bank symposium on radio astronomy, 1955, when 1030 sources of very roughly known flux densities were counted.

Blending effects may actually have greater effect in causing an increased slope if there is a physical clustering of weaker sources. To detect any clustering effects the $\chi^2$ test (e.g. Fisher 1948) has been applied to the catalogue. The area between 00 and 06$^{\mathrm{h}}$ has been chosen in order to confine attention largely to the Class II sources, and smaller areas 1$^{\mathrm{h}}$ by 10° have been used for making the test. Each declination strip has been treated separately to allow for different sensitivities, yielding values for $\chi^2$ of $6 \cdot 25$, $6 \cdot 8$, and $6 \cdot 6$ for the six areas in each of the three declination intervals +10 to 0°, 0 to −10°, and −10 to −20°. The probability of these or higher values arising by chance in a random distribution is 0·02. It therefore appears probable that there is a real clustering of the sources in space, which may be indicative of a metagalactic structure. Examination of Figure 4 suggests possible clustering centres at positions of, roughly, $\frac{1}{2}^{h}$, −2° ; $2^{h}$, −4° ; and $5\frac{1}{2}^{h}$, −14°. Further evidence for clustering is supplied by the large number of extended sources found at high galactic latitudes. From the analysis of Appendix I it may be calculated that the expected chance blends would produce five extended sources with flux densities greater than $2\times10^{-25}$ W m$^{-2}$ (c/s)$^{-1}$ in the portion of the catalogue between 00 and $04^{h}$. There are, in fact, eight such extended sources and seven cases of suspected extension in this area. None of these coincide with large nearby galaxies, and they presumably represent either blends or fluctuations in the brightness of the galactic corona. From the general appearance of our records, the latter explanation appears unlikely for the majority of the sources, and we conclude that blending effects are probably appreciably greater than expected from a random distribution of sources.

## VI. Background Variability

In Section IV we derived an expression for the r.m.s. deviation of the output to be expected as the result of a uniform distribution of sources. As a check on the correctness of our assumptions it is interesting to actually measure this deviation and compare it with that predicted. This has been done by choosing four very good records near the south galactic pole, the records having been taken with a fixed beam position to obtain the maximum sensitivity. The recorded output was averaged over a period of 1 min every 10 min, and the difference between adjacent pairs of readings measured on the appropriate flux density scale. Readings near sources of flux density $10^{-25}$ W m$^{-2}$ (c/s)$^{-1}$ or higher were omitted. The r.m.s. difference between 150 adjacent readings was found to be $4\cdot0\times10^{-26}$ W m$^{-2}$ (c/s)$^{-1}$. Noise fluctuations are important at this level and for the condition of this experiment it was found from tests with dummy loads that the r.m.s. difference due to noise would be $2\cdot2\times10^{-26}$ W m$^{-2}$ (c/s)$^{-1}$ ; after correction for this effect, the differences due to brightness variations alone are found to have an r.m.s. value of $3\cdot3\times10^{-26}$ W m$^{-2}$ (c/s)$^{-1}$.

If the population of sources is sensibly infinite, the r.m.s. deviation is given by equation (4) after putting $S_0=2\cdot1\times10^{-23}$ W m$^{-2}$ (c/s)$^{-1}$, $\Omega_c=1\cdot2\times10^{-4}$, and $S_1=10^{-25}$ W m$^{-2}$ (c/s)$^{-1}$ ; it is equal to $3\cdot0\times10^{-26}$ W m$^{-2}$ (c/s)$^{-1}$. The r.m.s. difference between adjacent uncorrelated points is $\sqrt{2}$ times this value or $4\cdot2\times10^{-26}$ W m$^{-2}$ (c/s)$^{-1}$. The observed deviation is thus of the same order as, but rather less than, that predicted from the model based on an infinite population of sources distributed randomly in a static universe.

If clustering is significant, as appears likely, the deviation would be increased; the low value obtained suggests a possible limiting of the population. This might be expected as the result of a reduction in the flux densities of distant sources due to red shift. If the values above are inserted in equation (3) it is found that $S_2$ is equal to $1\cdot5\times10^{-26}$ W m$^{-2}$ (c/s)$^{-1}$, or, in other words, red shift could have an appreciable effect at this flux density level. It is possible to calculate the source spatial density and absolute intensity from this result for various model universes. However, the values are critically dependent on the measurements, which are as yet uncertain, and on the degree of clustering, which may be appreciable; thus an extensive investigation is not warranted.

As a matter of interest, however, the mean space density, the mean value of $m_R - m_p$, and the total integrated brightness have been calculated from a model in which all Class II radio sources are assumed to be galaxies of absolute optical magnitude −18 and of uniform radio brightness. They are further assumed to have a radio spectrum in which the flux density is proportional to the wavelength, and to be distributed randomly in an expanding universe with Hubble's constant 180 km/s $Mpc^{-1}$ and of zero curvature. We find the space density is one source per $4 \times 10^{22}$ $pc^3$, the value of $m_R - m_p$ is −10, and the total integrated brightness temperature of the background is about 100 °K. All these values appear quite plausible. Clustering effects would tend to decrease the space density and brightness temperature and increase the absolute intensity of radio emission. Since the majority of sources in the area have radio magnitudes between 9 and 10, using this model identifications need only be expected in quantity with galaxies of magnitude 19 and 20, apart from the "normal" galaxies noted.

## VII. Conclusions

We have shown that in the sample area, which is included in the recent Cambridge catalogue of radio sources, there is a striking disagreement between the two catalogues. Reasons are advanced for supposing that the Cambridge survey is very seriously affected by instrumental effects which have a trivial influence on the Sydney results. We therefore conclude that discrepancies, in the main, reflect errors in the Cambridge catalogue, and accordingly deductions of cosmological interest derived from its analysis are without foundation.

An analysis of our results shows that there is no clear evidence for any effect of cosmological importance in the source counts, but there is some evidence for a significant clustering of the radio sources, which may be indicative of metagalactic structure, and the background fluctuations indicate that red shift may be of importance.

All the brightest nebulae in the area are possible radio emitters, but none appreciably more than might be expected from earlier observations. No clear examples of "radio galaxies" were found to a limit of 13 $m$; however, this is not surprising, as it seems likely that such identifications need not be expected in quantity until magnitudes of the order of 19 or 20 are reached.

## VIII. Acknowledgments

A number of people have contributed at different times to the operation of the survey described in part in this paper: to all these, and in particular to Mr. A. G. Little and Mr. K. V. Sheridan, the authors extend their thanks. They are also indebted to Mr. E. R. Hill for cross-checking the majority of our sources against earlier records and to Dr. R. F. Mullaly for useful discussion on some statistical aspects of the work. Finally, the authors wish to thank Mr. M. Ryle for sending them a list of radio sources in advance of publication.

## IX. References

BECVAR, A. (1951).—" Atlas Coeli Skalnate Pleso II." (Prirodovedecke Vydavatelstvi : Prague.)

CHANDRASEKHAR, S. (1943).—*Rev. Mod. Phys.* **15** : 2.

FISHER, R. A. (1948).—" Statistical Methods for Research Workers." 10th Ed., pp. 78 *et seq.* (Oliver and Boyd : Edinburgh.)

MILLS, B. Y. (1952).—*Aust. J. Sci. Res.* A **5** : 266.

MILLS, B. Y. (1955).—*Aust. J. Phys.* **8** : 368.

MILLS, B. Y., and LITTLE, A. G. (1953).—*Aust. J. Phys.* **6** : 272.

MILLS, B. Y., LITTLE, A. G., and SHERIDAN, K. V. (1956).—*Aust. J. Phys.* **9** : 218.

PAWSEY, J. L. (1955).—*Astrophys. J.* **121** : 1.

RYLE, M., and SCHEUER, P. A. G. (1955).—*Proc. Roy. Soc.* A **230** : 448.

SCHEUER, P. A. G. (1957).—*Proc. Camb. Phil. Soc.* (in press).

SHAKESHAFT, J. R., RYLE, M., BALDWIN, J. E., ELSMORE, B., and THOMSON, J. H. (1955).—*Mem. R. Astr. Soc.* **67** : 106.

DE VAUCOULEURS, G. (1952–53).—" A Revision of the Harvard Survey of Bright Galaxies." Australian National University Monograph.

## Appendix I

### Calculation of Instrumental Effects

#### (*a*) *Correction due to Blending*

Corrections in the Sydney counts due to finite resolution are small, and it is legitimate to obtain an approximate correction by calculating the number of blends of two, three, or four sources. The following method is applicable if the proportion of blends is small.

Consider the sources with flux densities greater than $10^{-25}$ W m$^{-2}$ (c/s)$^{-1}$. Two sources will appear as one, possibly " extended ", if they are closer together than the beamwidth, that is $0°{\cdot}83$, and the effect of such a blend in one flux density class (2 : 1 in range) is to produce a single source in the next higher class. Sources with flux densities lower than $2\times10^{-25}$ W m$^{-2}$ (c/s)$^{-1}$ are not always recognized as " extended " and a flux density is usually given as the peak value of the deflection rather than the integrated deflection. Under these circumstances sources must be closer together before blending effects increase the recorded flux density. We will adopt a blending angle of $0°{\cdot}5$ for sources of flux density lower than $10^{-25}$ W m$^{-2}$ (c/s)$^{-1}$ ; since corrections are not large, it is not important to be precise in estimating this angle.

If the total number of sources in the sky in any flux density class is $n$, it is easily shown that the number of two-source blends is given by

$$n_2=(an^2/8\pi)\exp(an/4\pi),$$

where $a$ is the blending area, taken as $6{\cdot}5\times10^{-4}$ steradian (i.e. $0°{\cdot}83$ radius) for sources stronger than $10^{-25}$ W m$^{-2}$ (c/s)$^{-1}$ and $2{\cdot}3\times10^{-4}$ steradian for weaker sources.

Calculation of the blending effect is carried out in Table 5; the second column is the number of sources with flux densities greater than the corresponding flux density in the first column on the assumption that $S_0$, the strongest "average" source, has a flux density of $2 \cdot 1 \times 10^{-23}$ W m$^{-2}$ (c/s)$^{-1}$; the third column contains the corresponding number of sources in each flux density range; the fourth contains the number of two-source blends in each range; the fifth contains the corrected number after allowing for such blends; the sixth contains the blends based on the corrected numbers of column five, i.e. it includes certain classes of three- and four-source blends; the seventh contains the final corrected numbers; the eighth contains the corresponding total numbers and the ninth the ratio between the corrected and original numbers.

TABLE 5

CALCULATION OF THE BLENDING EFFECT

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| $S$ ($10^{-26}$ W m$^{-2}$ (c/s)$^{-1}$) | $N$ | $n$ | $n_2$ | $n'$ | $n_2'$ | $n''$ | $N''$ | Ratio |
| 160 | 47 | | | | | | 47 | 1·00 |
| 80 | 132 | 85 | 0 | 86 | 0 | 86 | 133 | 1·01 |
| 40 | 375 | 243 | 1 | 254 | 1 | 257 | 390 | 1·04 |
| 20 | 1076 | 701 | 12 | 776 | 15 | 791 | 1181 | 1·10 |
| 10 | 3000 | 1924 | 87 | 2105 | 105 | 2244 | 3425 | 1·14 |
| 5 | 8450 | 5448 | 268 | 6850 | 425 | | | |
| 2·5 | 24000 | 15552 | 1670 | | | | | |

The actual increase in sources counted might be expected to be rather greater than the tabulated amounts because not all possible blends have been considered. The error, however, is probably small and certainly not significant.

### (b) *Correction for Noise Fluctuations*

Source counts are carried out to certain flux density boundaries, i.e. $10^{-25}$, $2 \times 10^{-25}$ W m$^{-2}$ (c/s)$^{-1}$, etc. There is, in general, a net change in the number of sources above a boundary due to noise fluctuations. The effect of noise is to introduce an uncertainty in the measured flux density giving it a standard error $\rho$, which is equal to the r.m.s. noise fluctuation averaged over the observing time and is independent of the actual value of the flux density. Consider intervals of flux density $\Delta S$ at flux densities $S+k\Delta S$ and $S-k\Delta S$ where $S$ is the flux density of the boundary and $k$ is an integer. If a uniform spatial distribution of sources and no blending effects are assumed, the number in the lower interval is given by

$$\Delta n_- = \frac{\mathrm{d}n}{\mathrm{d}S} \cdot \Delta S$$

$$= (3/2S)_0^{3/2}(S-k\Delta S)^{-5/2} \cdot \Delta S.$$

Similarly the number in the upper interval is given by

$$\Delta n_{+}=(3/2)S_0^{3/2}(S+k\Delta S)^{-5/2}\,.\,\Delta S.$$

The proportion of these sources found on the wrong side of the boundary is equal to $\frac{1}{2}[1-\text{erf}\,(k\Delta S/\rho)]$. The net result is an increase in the number of sources on the upper side of the boundary and a decrease on the lower side by an amount

$$\begin{aligned}\Delta n&=\tfrac{1}{2}\left[1-\text{erf}\left(\frac{k\Delta S}{\rho}\right)\right](\Delta n_{-}-\Delta n_{+})\\&=\tfrac{3}{4}S_0^{3/2}[(S-k\Delta S)^{-5/2}-(S+k\Delta S)^{-5/2}][1-\text{erf}\,(k\Delta S/\rho)].\end{aligned}$$

The total change at a boundary is therefore given by

$$n'=\tfrac{3}{4}S_0^{3/2}\sum_{k=0}^{k=\infty}[(S-k\Delta S)^{-5/2}-(S+k\Delta S)^{-5/2}][1-\text{erf}\,(k\Delta S/\rho)].$$

In the sample area the mean value of $\rho$ is about $3\cdot5\times10^{-26}$ W m$^{-2}$ (c/s)$^{-1}$ whence, taking $S_0=2\cdot1\times10^{-23}$ W m$^{-2}$ (c/s)$^{-1}$, we find the numbers of sources above each boundary have net increases shown in Table 6.

TABLE 6

NET INCREASES OF SOURCES ABOVE EACH BOUNDARY

| Flux Density at Boundary ($10^{-26}$ W m$^{-2}$ (c/s)$^{-1}$) | Number Ratio |
|---|---|
| 40 | 1·02 |
| 20 | 1·06 |
| 10 | 1·20 |

At levels around $10^{-25}$ W m$^{-2}$ (c/s)$^{-1}$ sources are often not counted if the section of record in which they occur is obviously " noisy " and their existence is doubtful; this reduces the correction needed at this level. At lower levels still, sources are only counted if they occur reasonably free from obvious noise effects, and this results in the rapid decrease in slope of the source count ogive observed in this region. At present it is not considered practicable to calculate these effects quantitatively.

## APPENDIX II

### THE CATALOGUE OF RADIO SOURCES

Table 7 lists sources between declinations +10° and 0°, Table 8 lists those between declinations 0° and −10°, and Table 9 lists those between declinations −10° and −20°.

Sources marked with an asterisk have been confirmed, those marked with a dagger are doubtful. When a source is extended the peak flux density is bracketed and the integrated flux density shown in italics. The probable error in the final digit of a position measurement is indicated by a superscript, e.g. the Right Ascension of the source 00+01 is $00^h\ 04^m{\cdot}9 \pm 0^m{\cdot}3$.

As the result of an improved measurement of the aerial gain by A. G. Little, the flux densities of many of the sources included in the catalogue are different from the values given in earlier papers.

Sources may possibly be identified with bracketed nebulae in the footnotes ; when the identification appears certain the brackets are omitted.

Table 7

SOURCES BETWEEN DECLINATIONS +10° AND 0°

| Reference No. | R.A. h | R.A. m | Dec. ° | Dec. ′ | Flux Density ($10^{-26}$ W m$^{-2}$ (c/s)$^{-1}$) | Notes |
|---|---|---|---|---|---|---|
| 00+01* | 00 | 04·9$^3$ | +06 | 05$^8$ | *38* (22) | 1 |
| 00+02† | 00 | 07·0$^3$ | +04 | 32$^7$ | 8·4 | |
| 00+03 | 00 | 10·0$^3$ | +00 | 32$^5$ | 21 | |
| 00+04† | 00 | 12·8$^4$ | +02 | 40$^7$ | 10 | |
| 00+05* | 00 | 14·4$^3$ | +06 | 48$^7$ | 20 | |
| 00+06* | 00 | 16·0$^4$ | +08 | 20$^8$ | 10 | |
| 00+07* | 00 | 30·0$^6$ | +01 | 40$^{10}$ | *48* (21) | |
| 00+08* | 00 | 30·8$^2$ | +06 | 00$^5$ | 31 | |
| 00+09* | 00 | 32·0$^3$ | +01 | 27$^5$ | 23 | |
| 00+010* | 00 | 32·1$^4$ | +04 | 28$^6$ | 17 | 2 |
| 00+011* | 00 | 34·0$^3$ | +00 | 12$^6$ | 17 | |
| 00+012* | 00 | 36·7$^4$ | +03 | 35$^6$ | 15 | |
| 00+013 | 00 | 37·3$^2$ | +09 | 30$^5$ | 42 | |
| 00+014 | 00 | 39·8$^3$ | +06 | 53$^7$ | 20 | |
| 00+015 | 00 | 40·9$^4$ | +02 | 20$^6$ | 9·5 | |
| 00+016* | 00 | 42·0$^4$ | +05 | 30$^7$ | 21 | |
| 00+017* | 00 | 55·1$^3$ | +01 | 14$^6$ | 23 | |
| 00+018* | 00 | 55·5$^5$ | +08 | 47$^8$ | 16 | |
| 01+01 | 01 | 14·7$^3$ | +06 | 15$^6$ | 14 | |
| 01+02* | 01 | 17·3$^4$ | +03 | 20$^5$ | *35* (17) | 3 |
| 01+03* | 01 | 23·3$^3$ | +01 | 22$^5$ | 23 | 4 |
| 01+04* | 01 | 24·3$^3$ | +09 | 23$^8$ | 18 | |
| 01+05* | 01 | 28·7$^2$ | +03 | 52$^6$ | 29 | |
| 01+06* | 01 | 29·2$^2$ | +06 | 07$^6$ | 25 | |
| 01+07* | 01 | 33·5$^3$ | +08 | 00$^6$ | 31 | |
| 01+08 | 01 | 34·9$^4$ | +06 | 34$^8$ | 11 | |
| 01+09 | 01 | 46·2$^3$ | +06 | 10$^8$ | 16 | |
| 01+010 | 01 | 47·6$^2$ | +07 | 07$^6$ | 31 | 5 |
| 01+011* | 01 | 52·1$^4$ | +03 | 32$^6$ | *52* (29) | 6 |
| 01+012 | 01 | 56·0$^4$ | +07 | 31$^7$ | 15 | |
| 01+013* | 01 | 57·3$^4$ | +01 | 13$^6$ | 14 | |
| 02+01* | 02 | 02·0$^4$ | +04 | 16$^8$ | 8·7 | |
| 02+02 | 02 | 07·1$^5$ | +09 | 25$^{10}$ | 34 | |
| 02+03 | 02 | 09·5$^4$ | +06 | 21$^8$ | 15 | |

TABLE 7 (*Continued*)

| Reference No. | R.A. | | Dec. | | Flux Density ($10^{-26}$ W m$^{-2}$ (c/s)$^{-1}$) | Notes |
|---|---|---|---|---|---|---|
| | h | m | ° | ′ | | |
| 02+*04* | 02 | $11\cdot2^{2}$ | +02 | $54^{4}$ | 25 | |
| 02+*05** | 02 | $19\cdot2^{4}$ | +08 | $30^{8}$ | 23 | |
| 02+*06* | 02 | $26\cdot4^{3}$ | +02 | $46^{6}$ | 13 | |
| 02+*07* | 02 | $26\cdot8^{3}$ | +07 | $28^{6}$ | 18 | |
| 02+*08* | 02 | $35\cdot7^{3}$ | +07 | $01^{8}$ | 17 | |
| 02+*09* | 02 | $50\cdot4^{4}$ | +01 | $19^{6}$ | 11 | |
| 02+*010* | 02 | $53\cdot4^{3}$ | +06 | $48^{8}$ | 12 | |
| 02+*011** | 02 | $55\cdot2^{2}$ | +05 | $50^{5}$ | 57 | |
| 02+*012** | 02 | $58\cdot5^{2}$ | +01 | $30^{5}$ | 22 | |
| 03+*01* | 03 | $01\cdot1^{3}$ | +09 | $45^{6}$ | 23 | 7 |
| 03+*02** | 03 | $05\cdot4^{2}$ | +03 | $53^{5}$ | 36 | |
| 03+*03** | 03 | $09\cdot4^{4}$ | +05 | $04^{8}$ | 17 | |
| 03+*04** | 03 | $24\cdot7^{2}$ | +02 | $15^{4}$ | 50 | |
| 03+*05* | 03 | $33\cdot8^{4}$ | +09 | $51^{7}$ | 27 | |
| 03+*06* | 03 | $35\cdot8^{4}$ | +07 | $40^{7}$ | 21 | |
| 03+*07** | 03 | $40\cdot5^{3}$ | +04 | $55^{5}$ | 44 | |
| 03+*08** | 03 | $45\cdot3^{3}$ | +00 | $44^{5}$ | 16 | |
| 03+*09** | 03 | $46\cdot6^{3}$ | +05 | $42^{6}$ | 25 | |
| 03+*010** | 03 | $51\cdot4^{4}$ | +03 | $58^{6}$ | 17 | |
| 03+*011** | 03 | $58\cdot2^{2}$ | +00 | $27^{5}$ | 23 | |
| 04+*01** | 04 | $00\cdot0^{3}$ | +05 | $35^{8}$ | 17 | |
| 04+*02** | 04 | $00\cdot1^{3}$ | +02 | $21^{5}$ | 15 | |
| 04+*03** | 04 | $04\cdot7^{2}$ | +03 | $45^{4}$ | 39 | |
| 04+*04** | 04 | $11\cdot9^{4}$ | +05 | $43^{7}$ | 12 | |
| 04+*05* | 04 | $22\cdot9^{4}$ | +00 | $30^{8}$ | 11 | |
| 04+*06* | 04 | $23\cdot2^{4}$ | +04 | $26^{6}$ | 14 | |
| 04+*07** | 04 | $28\cdot5^{3}$ | +01 | $07^{6}$ | 21 | |
| 04+*08** | 04 | $32\cdot8^{2}$ | +03 | $57^{5}$ | 27 | |
| 04+*09* | 04 | $38\cdot8^{3}$ | +06 | $55^{7}$ | 16 | |
| 04+*010** | 04 | $41\cdot8^{3}$ | +02 | $21^{5}$ | 31 | |
| 04+*011** | 04 | $45\cdot9^{4}$ | +01 | $07^{6}$ | 17 | |
| 04+*012* | 04 | $54\cdot9^{5}$ | +06 | $43^{8}$ | 19 | |
| 04+*013** | 04 | $56\cdot3^{3}$ | +05 | $20^{8}$ | 11 | 8 |
| 04+*014** | 04 | $58\cdot3^{4}$ | +01 | $18^{6}$ | 22 | |
| 05+*01* | 05 | $04\cdot5^{3}$ | +07 | $20^{7}$ | 18 | |
| 05+*02** | 05 | $10\cdot7^{2}$ | +01 | $08^{5}$ | 40 | |
| 05+*03** | 05 | $16\cdot5^{2}$ | +03 | $39^{5}$ | 18 | |
| 05+*04* | 05 | $22\cdot3^{4}$ | +09 | $16^{7}$ | 23 | 9 |
| 05+*05* | 05 | $28\cdot9^{3}$ | +06 | $35^{6}$ | 40 | |
| 05+*06** | 05 | $41\cdot5^{3}$ | +02 | $46^{6}$ | 23 | |
| 06+*01** | 06 | $00\cdot5^{4}$ | +02 | $29^{8}$ | 12 | |
| 06+*02** | 06 | $02\cdot3^{3}$ | +00 | $54^{5}$ | 13 | |
| 06+*03** | 06 | $05\cdot4^{5}$ | +08 | $08^{10}$ | *120* (31) | |
| 06+*04** | 06 | $14\cdot2^{4}$ | +05 | $43^{8}$ | 19 | 10 |
| 06+*05*† | 06 | $16\cdot1^{4}$ | +03 | $36^{8}$ | 9·5 | |
| 06+*06** | 06 | $20\cdot3^{4}$ | +09 | $00^{10}$ | *200* (50) | |
| 06+*07* | 06 | $24\cdot8^{3}$ | +02 | $50^{5}$ | 19 | |
| 06+*08** | 06 | $29\cdot6^{2}$ | +05 | $01^{3}$ | *270* (94) | 11 |

TABLE 7 (*Continued*)

| Reference No. | R.A. h | R.A. m | Dec. ° | Dec. ′ | Flux Density ($10^{-26}$ W m$^{-2}$ (c/s)$^{-1}$) | Notes |
|---|---|---|---|---|---|---|
| 06+09* | 06 | $32\cdot9^{2}$ | +02 | $09^{4}$ | 31 | |
| 06+010 | 06 | $34\cdot3^{3}$ | +07 | $15^{8}$ | *94* (50) | 12 |
| 06+011* | 06 | $42\cdot7^{4}$ | +05 | $15^{8}$ | 29 | 13 |
| 06+012* | 06 | $42\cdot8^{4}$ | +00 | $10^{10}$ | 22 | |
| 06+013* | 06 | $52\cdot5^{4}$ | +03 | $00^{8}$ | 25 | |
| 06+014* | 06 | $53\cdot0^{6}$ | +08 | $36^{10}$ | *48* (24) | |
| 07+01* | 07 | $17\cdot5^{4}$ | +08 | $48^{8}$ | 18 | |
| 07+02† | 07 | $19\cdot4^{3}$ | +01 | $34^{5}$ | 18 | |
| 07+03* | 07 | $29\cdot1^{5}$ | +03 | $06^{8}$ | 22 | |
| 07+04* | 07 | $41\cdot7^{2}$ | +02 | $05^{5}$ | 38 | |
| 07+05 | 07 | $43\cdot9^{4}$ | +09 | $57^{8}$ | 18 | |
| 07+06 | 07 | $53\cdot4^{3}$ | +07 | $00^{7}$ | 12 | |

1. Perhaps two sources.
2. Perhaps background irregularity.
3. (NGC 470/474).
4. (NGC 533).
5. Perhaps extended.
6. Perhaps two sources, or interference from 05N2A.
7. Perhaps extended.
8. Perhaps extended.
9. Perhaps extended.
10. Perhaps extended.
11. NGC 2237.
12. May be background irregularity.
13. Perhaps extended.

TABLE 8

SOURCES BETWEEN DECLINATIONS 0° AND —10°

| Reference No. | R.A. h | R.A. m | Dec. ° | Dec. ′ | Flux Density ($10^{-26}$ W m$^{-2}$ (c/s)$^{-1}$) | Notes |
|---|---|---|---|---|---|---|
| 00—01* | 00 | $03\cdot8^{2}$ | —00 | $50^{4}$ | 38 | |
| 00—02 | 00 | $06\cdot0^{5}$ | —06 | $30^{10}$ | 10 | |
| 00—03* | 00 | $17\cdot3^{3}$ | —05 | $10^{6}$ | 12 | |
| 00—04* | 00 | $18\cdot0^{3}$ | —02 | $51^{4}$ | 23 | |
| 00—05† | 00 | $18\cdot8^{3}$ | —01 | $42^{6}$ | 16 | |
| 00—06* | 00 | $22\cdot0^{4}$ | —08 | $04^{5}$ | *54* (27) | |
| 00—07 | 00 | $31\cdot8^{3}$ | —08 | $32^{5}$ | 16 | 1 |
| 00—08* | 00 | $32\cdot6^{3}$ | —07 | $26^{5}$ | 13 | |
| 00—09† | 00 | $33\cdot8^{3}$ | —05 | $22^{6}$ | 14 | |
| 00—010* | 00 | $36\cdot4^{2}$ | —02 | $20^{5}$ | *120* (67) | 2 |
| 00—011 | 00 | $39\cdot2^{5}$ | —06 | $30^{5}$ | 12 | |

TABLE 8 (*Continued*)

| Reference No. | R.A. h | R.A. m | Dec. ° | Dec. ′ | Flux Density ($10^{-26}$ W $m^{-2}$ $(c/s)^{-1}$) | Notes |
|---|---|---|---|---|---|---|
| 00—*012* | 00 | $39 \cdot 3^{1}$ | —09 | $46^{3}$ | 63 | |
| 00—*013** | 00 | $42 \cdot 9^{3}$ | —00 | $09^{5}$ | 14 | |
| 00—*014* | 00 | $46 \cdot 0^{3}$ | —07 | $01^{5}$ | 12 | |
| 00—*015** | 00 | $46 \cdot 7^{3}$ | —02 | $52^{6}$ | 20 | |
| 00—*016** | 00 | $51 \cdot 5^{4}$ | —03 | $44^{5}$ | 23 | |
| 00—*017** | 00 | $52 \cdot 2^{4}$ | —05 | $06^{6}$ | 8·5 | |
| 00—*018** | 00 | $54 \cdot 5^{1}$ | —01 | $39^{3}$ | 77 | 3 |
| 00—*019** | 00 | $55 \cdot 6^{4}$ | —05 | $53^{6}$ | 11 | |
| 01—*01* | 01 | $06 \cdot 7^{3}$ | —00 | $57^{6}$ | 17 | |
| 01—*02** | 01 | $10 \cdot 5^{4}$ | —05 | $07^{6}$ | 21 | |
| 01—*03** | 01 | $19 \cdot 8^{5}$ | —00 | $08^{6}$ | 21 | |
| 01—*04** | 01 | $21 \cdot 1^{4}$ | —03 | $50^{6}$ | 18 | |
| 01—*05** | 01 | $23 \cdot 4^{1}$ | —01 | $36^{3}$ | 90 | |
| 01—*06** | 01 | $28 \cdot 0^{5}$ | —06 | $47^{6}$ | 16 | |
| 01—*07* | 01 | $35 \cdot 0^{2}$ | —09 | $25^{4}$ | 21 | |
| 01—*08* | 01 | $35 \cdot 8^{3}$ | —02 | $06^{5}$ | 13 | |
| 01—*09** | 01 | $44 \cdot 0^{2}$ | —02 | $27^{5}$ | 16 | |
| 01—*010** | 01 | $45 \cdot 9^{4}$ | —00 | $06^{8}$ | 17 | |
| 01—*011* | 01 | $47 \cdot 4^{4}$ | —09 | $03^{6}$ | 9·4 | |
| 01—*012** | 01 | $50 \cdot 2^{3}$ | —03 | $52^{5}$ | 23 | |
| 01—*013** | 01 | $51 \cdot 6^{4}$ | —07 | $26^{6}$ | 10 | |
| 01—*014* | 01 | $55 \cdot 4^{3}$ | —00 | $35^{6}$ | 10 | |
| 01—*015* | 01 | $57 \cdot 4^{4}$ | —02 | $31^{6}$ | 10 | |
| 02—*01** | 02 | $02 \cdot 7^{4}$ | —05 | $43^{6}$ | 8·5 | |
| 02—*02*† | 02 | $08 \cdot 6^{4}$ | —03 | $38^{6}$ | 12 | 4 |
| 02—*03** | 02 | $10 \cdot 8^{4}$ | —04 | $54^{6}$ | 11 | |
| 02—*04** | 02 | $12 \cdot 3^{3}$ | —02 | $46^{6}$ | 10 | |
| 02—*05** | 02 | $13 \cdot 7^{3}$ | —00 | $54^{6}$ | 10 | |
| 02—*06** | 02 | $18 \cdot 6^{2}$ | —02 | $15^{3}$ | 86 | 5 |
| 02—*07** | 02 | $18 \cdot 6^{4}$ | —03 | $45^{6}$ | 10 | |
| 02—*08* | 02 | $21 \cdot 1^{4}$ | —07 | $05^{6}$ | 14 | |
| 02—*09** | 02 | $29 \cdot 4^{3}$ | —04 | $55^{5}$ | 12 | |
| 02—*010** | 02 | $29 \cdot 5^{4}$ | —00 | $18^{6}$ | 14 | |
| 02—*011** | 02 | $29 \cdot 6^{3}$ | —07 | $04^{5}$ | 15 | |
| 02—*012** | 02 | $30 \cdot 4^{4}$ | —02 | $37^{6}$ | 9·4 | |
| 02—*013** | 02 | $39 \cdot 4^{4}$ | —02 | $20^{5}$ | 15 | |
| 02—*014** | 02 | $40 \cdot 0^{3}$ | —00 | $04^{5}$ | 30 | 6 |
| 02—*015** | 02 | $43 \cdot 0^{3}$ | —05 | $21^{5}$ | 48 | 7 |
| 02—*016** | 02 | $43 \cdot 6^{3}$ | —09 | $35^{6}$ | 11 | |
| 02—*017** | 02 | $46 \cdot 7^{4}$ | —07 | $46^{6}$ | 9·0 | |
| 02—*018* | 02 | $55 \cdot 4^{4}$ | —03 | $37^{6}$ | 9·4 | |
| 02—*019** | 02 | $56 \cdot 6^{5}$ | —05 | $02^{8}$ | 10 | |
| 02—*020** | 02 | $57 \cdot 4^{3}$ | —07 | $30^{5}$ | 15 | |
| 02—*021** | 02 | $58 \cdot 4^{4}$ | —06 | $22^{5}$ | 17 | |
| 03—*01** | 03 | $12 \cdot 9^{4}$ | —03 | $34^{5}$ | 17 | |
| 03—*02** | 03 | $22 \cdot 2^{4}$ | —03 | $27^{6}$ | 15 | |
| 03—*03** | 03 | $29 \cdot 3^{3}$ | —07 | $40^{5}$ | 23 | |
| 03—*04** | 03 | $32 \cdot 0^{2}$ | —01 | $35^{4}$ | 61 | |

Table 8 (*Continued*)

| Reference No. | R.A. h | R.A. m | Dec. ° | Dec. ′ | Flux Density ($10^{-26}$ W $m^{-2}$ $(c/s)^{-1}$) | Notes |
|---|---|---|---|---|---|---|
| 03—*05** | 03 | $38\cdot9^{4}$ | —05 | $00^{6}$ | 10 | 8 |
| 03—*06* | 03 | $44\cdot2^{4}$ | —00 | $03^{6}$ | 16 | |
| 03—*07** | 03 | $46\cdot0^{4}$ | —04 | $04^{6}$ | 20 | |
| 03—*08** | 03 | $47\cdot4^{3}$ | —06 | $44^{4}$ | 15 | |
| 03—*09** | 03 | $56\cdot5^{5}$ | —03 | $50^{6}$ | 11 | |
| 03—*010** | 03 | $59\cdot2^{3}$ | —02 | $10^{6}$ | 16 | 9 |
| 04—*01** | 04 | $00\cdot1^{3}$ | —09 | $56^{5}$ | 14 | |
| 04—*02** | 04 | $00\cdot8^{3}$ | —09 | $01^{6}$ | 16 | |
| 04—*03* | 04 | $05\cdot0^{4}$ | —05 | $33^{6}$ | 12 | |
| 04—*04** | 04 | $05\cdot9^{3}$ | —06 | $46^{6}$ | 20 | |
| 04—*05** | 04 | $09\cdot4^{2}$ | —00 | $57^{6}$ | 27 | |
| 04—*06** | 04 | $09\cdot5^{3}$ | —01 | $50^{5}$ | 15 | |
| 04—*07** | 04 | $15\cdot1^{3}$ | —05 | $26^{7}$ | 10 | 10 |
| 04—*08** | 04 | $15\cdot6^{2}$ | —03 | $26^{4}$ | 31 | |
| 04—*09** | 04 | $19\cdot6^{4}$ | —09 | $28^{6}$ | 8·5 | |
| 04—*010** | 04 | $26\cdot4^{4}$ | —01 | $15^{6}$ | 9·7 | |
| 04—*011** | 04 | $28\cdot2^{3}$ | —09 | $58^{6}$ | 7·3 | |
| 04—*012** | 04 | $31\cdot0^{4}$ | —08 | $40^{6}$ | 14 | |
| 04—*013** | 04 | $33\cdot3^{3}$ | —05 | $30^{4}$ | 14 | |
| 04—*014** | 04 | $39\cdot1^{2}$ | —09 | $52^{5}$ | 17 | |
| 04—*015** | 04 | $39\cdot8^{4}$ | —00 | $54^{6}$ | 9·3 | |
| 04—*016** | 04 | $47\cdot1^{3}$ | —09 | $55^{5}$ | 19 | |
| 04—*017** | 04 | $47\cdot1^{4}$ | —04 | $20^{6}$ | 25 | 11 |
| 04—*018** | 04 | $47\cdot6^{4}$ | —04 | $45^{6}$ | 23 | 12 |
| 04—*019* | 04 | $48\cdot8^{4}$ | —06 | $38^{5}$ | 12 | |
| 04—*020** | 04 | $49\cdot6^{4}$ | —02 | $31^{5}$ | 13 | |
| 04—*021* | 04 | $51\cdot1^{3}$ | —08 | $10^{6}$ | 8·7 | |
| 04—*022** | 04 | $53\cdot3^{4}$ | —00 | $24^{6}$ | *31* (17) | |
| 04—*023** | 04 | $58\cdot7^{4}$ | —03 | $39^{6}$ | 18 | |
| 04—*024** | 04 | $59\cdot6^{3}$ | —05 | $48^{6}$ | 11 | |
| 05—*01* | 05 | $00\cdot0^{4}$ | —08 | $37^{6}$ | 11 | |
| 05—*02** | 05 | $10\cdot0^{3}$ | —07 | $30^{6}$ | 21 | |
| 05—*03** | 05 | $12\cdot4^{3}$ | —02 | $19^{5}$ | 17 | |
| 05—*04** | 05 | $13\cdot3^{3}$ | —07 | $35^{6}$ | 10 | |
| 05—*05** | 05 | $18\cdot6^{3}$ | —06 | $15^{5}$ | 21 | |
| 05—*06** | 05 | $22\cdot2^{4}$ | —02 | $50^{6}$ | 16 | |
| 05—*07* | 05 | $22\cdot3^{4}$ | —07 | $22^{6}$ | 19 | |
| 05—*08** | 05 | $23\cdot6^{3}$ | —09 | $26^{5}$ | 17 | |
| 05—*09** | 05 | $27\cdot9^{3}$ | —00 | $03^{5}$ | 15 | |
| 05—*010** | 05 | $32\cdot5^{2}$ | —05 | $24^{3}$ | *83* (69) | 13 |
| 05—*011** | 05 | $38\cdot0^{5}$ | —02 | $20^{10}$ | *88* (24) | 14 |
| 05—*012** | 05 | $39\cdot1^{4}$ | —01 | $25^{6}$ | 23 | 15 |
| 05—*013** | 05 | $40\cdot1^{4}$ | —05 | $16^{6}$ | 9·5 | 16 |
| 05—*014*† | 05 | $45\cdot6^{4}$ | —04 | $42^{8}$ | 7·3 | |
| 05—*015*† | 05 | $46\cdot6^{4}$ | —06 | $41^{6}$ | 11 | |
| 05—*016** | 05 | $48\cdot2^{4}$ | —08 | $05^{6}$ | 19 | |
| 05—*017** | 05 | $52\cdot0^{3}$ | —02 | $00^{6}$ | 29 | 17 |
| 05—*018** | 05 | $53\cdot1^{6}$ | —01 | $00^{6}$ | 19 | 18 |

TABLE 8 (*Continued*)

| Reference No. | R.A. h | R.A. m | Dec. ° | Dec. ′ | Flux Density ($10^{-26}$ W m $^{-2}$ (c/s)$^{-1}$) | Notes |
|---|---|---|---|---|---|---|
| 05—019* | 05 | $54\cdot8^{3}$ | —03 | $27^{6}$ | 18 | |
| 05—020* | 05 | $57\cdot1^{3}$ | —08 | $03^{5}$ | 17 | |
| 06—01* | 06 | $06\cdot1^{2}$ | —07 | $21^{4}$ | 23 | |
| 06—02* | 06 | $24\cdot8^{1}$ | —05 | $57^{3}$ | 130 | |
| 06—03* | 06 | $27\cdot7^{4}$ | —02 | $25^{6}$ | 9·5 | |
| 06—04 | 06 | $37\cdot2^{4}$ | —08 | $57^{6}$ | 18 | |
| 06—05* | 06 | $38\cdot9^{5}$ | —06 | $40^{8}$ | 9·5 | |
| 06—06* | 06 | $39\cdot0^{5}$ | —08 | $01^{6}$ | *50* (25) | |
| 06—07* | 06 | $45\cdot0^{4}$ | —02 | $06^{6}$ | 44 | 19 |
| 06—08* | 06 | $45\cdot0^{4}$ | —08 | $10^{6}$ | 17 | |
| 06—09* | 06 | $45\cdot6^{4}$ | —09 | $16^{6}$ | 11 | |
| 06—010* | 06 | $47\cdot2^{3}$ | —05 | $37^{5}$ | 25 | |
| 06—011* | 06 | $56\cdot7^{2}$ | —02 | $12^{5}$ | 27 | |
| 07—01* | 07 | $07\cdot0^{4}$ | —00 | $24^{6}$ | 9·5 | 20 |
| 07—02* | 07 | $10\cdot4^{3}$ | —09 | $06^{5}$ | 21 | |
| 07—03* | 07 | $12\cdot7^{3}$ | —02 | $41^{4}$ | 25 | |
| 07—04* | 07 | $22\cdot3^{3}$ | —09 | $49^{4}$ | 36 | |
| 07—05* | 07 | $23\cdot1^{3}$ | —06 | $10^{6}$ | *94* (47) | |
| 07—06* | 07 | $24\cdot4^{2}$ | —02 | $00^{4}$ | 38 | |
| 07—07* | 07 | $31\cdot4^{4}$ | —05 | $31^{6}$ | 13 | |
| 07—08* | 07 | $36\cdot4^{4}$ | —02 | $05^{6}$ | 19 | |
| 07—09* | 07 | $39\cdot1^{5}$ | —01 | $09^{8}$ | 19 | |
| 07—010 | 07 | $44\cdot4^{3}$ | —08 | $05^{6}$ | 17 | |
| 07—011* | 07 | $48\cdot9^{3}$ | —06 | $52^{6}$ | 13 | |
| 07—012* | 07 | $58\cdot9^{4}$ | —02 | $06^{6}$ | 7·3 | |

1. (NGC 157).
2. Extended source stretching almost N.-S. or two sources.
3. Perhaps slightly extended.
4. Perhaps background irregularity.
5. IAU 02S0A.
6. NGC 1068, (NGC 1055).
7. Perhaps slightly extended.
8. (NGC 1417).
9. Interpretation difficult, complex response.
10. Interpretation difficult, complex response.
11. }
12. } Perhaps one extended source.
13. M42.
14. IC 434 etc.
15. Interpretation difficult, complex response.
16. (M42—eastward extension).
17. }
18. } Perhaps one source.
19. Perhaps slightly extended.
20. Perhaps extended.

TABLE 9

SOURCES BETWEEN DECLINATIONS —10° AND —20°

| Reference No. | R.A. h | R.A. m | Dec. ° | Dec. ′ | Flux Density ($10^{-26}$ W m$^{-2}$ (c/s)$^{-1}$) | Notes |
|---|---|---|---|---|---|---|
| 00—11 | 00 | $00{\cdot}1^{2}$ | —17 | $32^{5}$ | 33 | |
| 00—12 | 00 | $00{\cdot}3^{3}$ | —15 | $28^{6}$ | 15 | |
| 00—13* | 00 | $00{\cdot}6^{3}$ | —12 | $23^{6}$ | 16 | |
| 00—14* | 00 | $05{\cdot}6^{3}$ | —20 | $00^{6}$ | 17 | |
| 00—15 | 00 | $09{\cdot}3^{3}$ | —19 | $04^{6}$ | 13 | |
| 00—16 | 00 | $12{\cdot}4^{3}$ | —15 | $07^{8}$ | *34* (20) | 1 |
| 00—17 | 00 | $15{\cdot}9^{3}$ | —13 | $02^{5}$ | *52* (33) | 2 |
| 00—18* | 00 | $16{\cdot}2^{2}$ | —10 | $46^{5}$ | 23 | |
| 00—19 | 00 | $18{\cdot}5^{4}$ | —19 | $11^{6}$ | 10 | |
| 00—110† | 00 | $25{\cdot}3^{4}$ | —13 | $22^{7}$ | 11 | |
| 00—111 | 00 | $25{\cdot}7^{4}$ | —16 | $48^{6}$ | 8·0 | |
| 00—112* | 00 | $27{\cdot}6^{2}$ | —11 | $50^{10}$ | 14 | |
| 00—113 | 00 | $29{\cdot}4^{3}$ | —15 | $46^{6}$ | 9·7 | |
| 00—114* | 00 | $32{\cdot}5^{3}$ | —16 | $50^{6}$ | 12 | |
| 00—115* | 00 | $32{\cdot}7^{3}$ | —18 | $17^{6}$ | 17 | |
| 00—116 | 00 | $35{\cdot}0^{5}$ | —12 | $38^{8}$ | 11 | |
| 00—117 | 00 | $39{\cdot}1^{5}$ | —15 | $44^{7}$ | 17 | 3 |
| 00—118 | 00 | $39{\cdot}6^{5}$ | —19 | $49^{8}$ | 12 | |
| 00—119* | 00 | $42{\cdot}6^{3}$ | —17 | $48^{7}$ | 11 | |
| 00—120 | 00 | $43{\cdot}5^{4}$ | —14 | $49^{6}$ | 13 | |
| 00—121* | 00 | $48{\cdot}5^{3}$ | —12 | $28^{5}$ | 18 | |
| 00—122 | 00 | $56{\cdot}9^{3}$ | —13 | $40^{6}$ | 13 | |
| 00—123 | 00 | $56{\cdot}9^{3}$ | —15 | $22^{6}$ | 17 | |
| 00—124* | 00 | $57{\cdot}2^{3}$ | —17 | $18^{5}$ | 29 | |
| 00—125 | 00 | $58{\cdot}9^{3}$ | —14 | $30^{6}$ | 12 | |
| 01—11* | 01 | $01{\cdot}8^{2}$ | —12 | $27^{5}$ | 18 | |
| 01—12 | 01 | $05{\cdot}8^{2}$ | —16 | $12^{4}$ | 57 | |
| 01—13* | 01 | $07{\cdot}2$[illegible] | —18 | $51^{6}$ | 9·0 | |
| 01—14 | 01 | $08{\cdot}2^{4}$ | —14 | $33^{6}$ | 18 | |
| 01—15 | 01 | $11{\cdot}7^{4}$ | —10 | $07^{6}$ | 7·8 | |
| 01—16* | 01 | $14{\cdot}6^{3}$ | —11 | $57^{6}$ | 11 | |
| 01—17* | 01 | $16{\cdot}8^{5}$ | —16 | $45^{10}$ | 13 | 4 |
| 01—18* | 01 | $16{\cdot}8^{4}$ | —18 | $46^{7}$ | 14 | |
| 01—19 | 01 | $17{\cdot}8^{2}$ | —15 | $33^{3}$ | 48 | |
| 01—110 | 01 | $24{\cdot}9^{3}$ | —12 | $00^{6}$ | 9·5 | |
| 01—111 | 01 | $25{\cdot}1^{3}$ | —14 | $10^{4}$ | 34 | |
| 01—112 | 01 | $28{\cdot}0^{4}$ | —19 | $33^{8}$ | 7·3 | |
| 01—113 | 01 | $28{\cdot}1^{3}$ | —15 | $38^{5}$ | 20 | 5 |
| 01—114* | 01 | $38{\cdot}0^{5}$ | —18 | $20^{8}$ | 11 | |
| 01—115* | 01 | $40{\cdot}5^{2}$ | —16 | $55^{4}$ | 34 | |
| 01—116* | 01 | $45{\cdot}8^{3}$ | —18 | $54^{7}$ | 16 | |
| 01—117* | 01 | $47{\cdot}6^{3}$ | —11 | $06^{8}$ | 10 | |
| 01—118 | 01 | $47{\cdot}9^{3}$ | —13 | $15^{6}$ | 11 | |
| 01—119 | 01 | $50{\cdot}6^{4}$ | —14 | $51^{6}$ | 16 | |
| 01—120 | 01 | $55{\cdot}4^{3}$ | —10 | $45^{6}$ | 20 | |
| 01—121* | 01 | $59{\cdot}6^{3}$ | —11 | $47^{6}$ | 14 | |
| 02—11 | 02 | $02{\cdot}4^{3}$ | —19 | $51^{6}$ | 9·7 | |

TABLE 9 (*Continued*)

| Reference No. | R.A. h | R.A. m | Dec. ° | Dec. ′ | Flux Density ($10^{-26}$ W $m^{-2}$ $(c/s)^{-1}$) | Notes |
|---|---|---|---|---|---|---|
| 02—12* | 02 | $03\cdot8^{3}$ | —18 | $12^{6}$ | 17 | |
| 02—13* | 02 | $08\cdot0^{2}$ | —11 | $18^{5}$ | 19 | |
| 02—14 | 02 | $11\cdot4^{4}$ | —16 | $04^{6}$ | 8·2 | |
| 02—15 | 02 | $13\cdot2^{2}$ | —13 | $22^{3}$ | 42 | 6 |
| 02—16* | 02 | $14\cdot8^{4}$ | —17 | $58^{8}$ | 9·5 | |
| 02—17* | 02 | $22\cdot9^{3}$ | —11 | $38^{6}$ | 13 | |
| 02—18* | 02 | $26\cdot1^{4}$ | —17 | $28^{6}$ | 18 | |
| 02—19 | 02 | $30\cdot4^{4}$ | —12 | $11^{6}$ | 6·5 | |
| 02—110* | 02 | $30\cdot8^{3}$ | —10 | $12^{5}$ | 17 | |
| 02—111 | 02 | $34\cdot9^{4}$ | —15 | $50^{6}$ | 8·5 | |
| 02—112 | 02 | $35\cdot2^{2}$ | —19 | $44^{5}$ | 36 | |
| 02—113 | 02 | $36\cdot0^{4}$ | —14 | $45^{7}$ | 14 | |
| 02—114* | 02 | $36\cdot3^{4}$ | —18 | $10^{6}$ | 9·5 | |
| 02—115† | 02 | $39\cdot4^{4}$ | —17 | $28^{6}$ | 11 | |
| 02—116 | 02 | $46\cdot2^{4}$ | —13 | $29^{8}$ | 15 | |
| 02—117* | 02 | $47\cdot5^{3}$ | —18 | $10^{5}$ | 13 | |
| 02—118* | 02 | $56\cdot0^{5}$ | —16 | $56^{8}$ | 12 | |
| 03—11* | 03 | $03\cdot5^{3}$ | —12 | $24^{5}$ | 16 | |
| 03—12* | 03 | $05\cdot4^{4}$ | —16 | $39^{6}$ | 17 | |
| 03—13 | 03 | $07\cdot5^{3}$ | —13 | $40^{6}$ | 21 | |
| 03—14 | 03 | $15\cdot1^{3}$ | —14 | $48^{6}$ | 17 | |
| 03—15* | 03 | $27\cdot9^{3}$ | —16 | $51^{5}$ | 16 | |
| 03—16* | 03 | $31\cdot1^{4}$ | —18 | $48^{6}$ | 12 | |
| 03—17* | 03 | $44\cdot1^{2}$ | —11 | $13^{4}$ | 34 | |
| 03—18 | 03 | $46\cdot1^{4}$ | —13 | $08^{6}$ | 7·8 | |
| 03—19 | 03 | $49\cdot2^{2}$ | —14 | $40^{4}$ | 44 | |
| 03—110* | 03 | $49\cdot7^{2}$ | —10 | $08^{5}$ | 21 | |
| 03—111* | 03 | $57\cdot5^{3}$ | —16 | $20^{7}$ | 18 | |
| 04—11 | 04 | $05\cdot0^{3}$ | —13 | $20^{6}$ | *38* (23) | |
| 04—12* | 04 | $05\cdot4^{2}$ | —12 | $26^{6}$ | 31 | |
| 04—13 | 04 | $06\cdot2^{3}$ | —14 | $47^{6}$ | 7·3 | |
| 04—14 | 04 | $08\cdot3^{4}$ | —16 | $27^{6}$ | 10 | |
| 04—15 | 04 | $11\cdot1^{4}$ | —19 | $36^{7}$ | 10 | |
| 04—16* | 04 | $11\cdot6^{4}$ | —11 | $26^{6}$ | 18 | |
| 04—17 | 04 | $13\cdot8^{3}$ | —15 | $22^{8}$ | 15 | |
| 04—18* | 04 | $16\cdot3^{3}$ | —18 | $13^{5}$ | 13 | |
| 04—19 | 04 | $19\cdot8^{3}$ | —16 | $04^{8}$ | 9·2 | |
| 04—110 | 04 | $23\cdot0^{3}$ | —16 | $57^{6}$ | 14 | |
| 04—111* | 04 | $23\cdot7^{3}$ | —12 | $07^{5}$ | 16 | |
| 04—112* | 04 | $25\cdot2^{3}$ | —11 | $25^{6}$ | 11 | |
| 04—113* | 04 | $27\cdot2^{5}$ | —18 | $36^{8}$ | 9·0 | |
| 04—114 | 04 | $32\cdot0^{2}$ | —13 | $26^{5}$ | 38 | |
| 04—115 | 04 | $32\cdot4^{4}$ | —16 | $38^{6}$ | 18 | |
| 04—116 | 04 | $36\cdot8^{4}$ | —18 | $57^{7}$ | 8·2 | |
| 04—117 | 04 | $36\cdot9^{4}$ | —15 | $00^{7}$ | 7·3 | |
| 04—118* | 04 | $38\cdot6^{3}$ | —12 | $10^{6}$ | 10 | |
| 04—119 | 04 | $48\cdot0^{3}$ | —17 | $34^{6}$ | 14 | |
| 04—120 | 04 | $52\cdot1^{4}$ | —19 | $12^{8}$ | 9·8 | |

TABLE 9 (*Continued*)

| Reference No. | R.A. h | R.A. m | Dec. ° | Dec. ′ | Flux Density ($10^{-26}$ W m$^{-2}$ (c/s)$^{-1}$) | Notes |
|---|---|---|---|---|---|---|
| 04—121* | 04 | 54·2$^{3}$ | —11 | 51$^{6}$ | 15 | |
| 05—11 | 05 | 03·0$^{3}$ | —10 | 13$^{5}$ | 20 | |
| 05—12 | 05 | 06·5$^{3}$ | —14 | 29$^{6}$ | 16 | |
| 05—13* | 05 | 09·0$^{2}$ | —18 | 40$^{4}$ | 38 | |
| 05—14 | 05 | 13·0$^{3}$ | —16 | 08$^{6}$ | 13 | |
| 05—15 | 05 | 13·4$^{3}$ | —13 | 41$^{6}$ | 16 | |
| 05—16 | 05 | 15·5$^{5}$ | —16 | 44$^{7}$ | 14 | |
| 05—17* | 05 | 21·0$^{4}$ | —11 | 59$^{6}$ | 15 | |
| 05—18 | 05 | 23·8$^{3}$ | —18 | 31$^{6}$ | 11 | |
| 05—19 | 05 | 24·2$^{3}$ | —13 | 36$^{6}$ | 16 | |
| 05—110 | 05 | 24·7$^{3}$ | —16 | 31$^{7}$ | 16 | |
| 05—111* | 05 | 24·9$^{3}$ | —17 | 35$^{6}$ | 8·2 | |
| 05—112 | 05 | 25·1$^{3}$ | —10 | 45$^{6}$ | 16 | |
| 05—113 | 05 | 26·1$^{4}$ | —14 | 48$^{7}$ | 9·5 | |
| 05—114* | 05 | 33·3$^{3}$ | —12 | 05$^{6}$ | 15 | |
| 05—115* | 05 | 34·6$^{4}$ | —18 | 41$^{8}$ | 12 | |
| 05—116* | 05 | 35·2$^{4}$ | —17 | 18$^{8}$ | 15 | |
| 05—117 | 05 | 35·3$^{3}$ | —13 | 16$^{8}$ | 14 | |
| 05—118* | 05 | 37·3$^{4}$ | —16 | 04$^{8}$ | 8·5 | |
| 05—119 | 05 | 41·6$^{3}$ | —12 | 33$^{8}$ | 14 | |
| 05—120* | 05 | 43·5$^{4}$ | —17 | 33$^{7}$ | 20 | |
| 05—121* | 05 | 49·0$^{3}$ | —15 | 48$^{6}$ | 9·6 | |
| 05—122* | 05 | 49·3$^{2}$ | —10 | 32$^{4}$ | 17 | |
| 05—123 | 05 | 51·0$^{3}$ | —16 | 51$^{6}$ | 14 | |
| 05—124 | 05 | 51·7$^{5}$ | —14 | 19$^{7}$ | 12 | |
| 05—125 | 05 | 51·9$^{3}$ | —12 | 29$^{6}$ | 9·5 | |
| 05—126 | 05 | 57·6$^{3}$ | —16 | 57$^{10}$ | 13 | |
| 06—11 | 06 | 03·8$^{3}$ | —10 | 45$^{6}$ | 9·2 | |
| 06—12* | 06 | 05·3$^{4}$ | —17 | 49$^{7}$ | 15 | |
| 06—13 | 06 | 07·3$^{4}$ | —14 | 40$^{7}$ | 14 | 7 |
| 06—14 | 06 | 14·8$^{5}$ | —15 | 00$^{7}$ | 19 | |
| 06—15 | 06 | 17·3$^{5}$ | —16 | 36$^{10}$ | *63* (21) | |
| 06—16 | 06 | 19·9$^{4}$ | —13 | 39$^{8}$ | 14 | |
| 06—17 | 06 | 25·8$^{3}$ | —12 | 52$^{8}$ | 16 | 8 |
| 06—18* | 06 | 34·4$^{4}$ | —15 | 33$^{6}$ | 20 | |
| 06—19* | 06 | 34·7$^{3}$ | —18 | 10$^{6}$ | 16 | 9 |
| 06—110 | 06 | 34·9$^{4}$ | —13 | 41$^{6}$ | 14 | |
| 06—111 | 06 | 36·3$^{3}$ | —16 | 50$^{6}$ | 18 | |
| 06—112* | 06 | 42·2$^{4}$ | —10 | 19$^{6}$ | *84* (27) | 10 |
| 06—113* | 06 | 44·1$^{3}$ | —15 | 33$^{6}$ | 20 | |
| 06—114 | 06 | 49·7$^{5}$ | —12 | 43$^{10}$ | *55* (11) | 11 |
| 06—115 | 06 | 53·2$^{3}$ | —19 | 08$^{7}$ | 9·8 | 12 |
| 07—11* | 07 | 02·9$^{3}$ | —11 | 40$^{6}$ | 19 | 13 |
| 07—12* | 07 | 03·6$^{3}$ | —10 | 55$^{8}$ | *40* (29) | 14 |
| 07—13 | 07 | 03·6$^{4}$ | —19 | 13$^{7}$ | 12 | |
| 07—14 | 07 | 12·0$^{3}$ | —14 | 28$^{6}$ | 20 | 15 |
| 07—15* | 07 | 13·5$^{4}$ | —11 | 20$^{7}$ | 25 | 16 |
| 07—16 | 07 | 16·2$^{4}$ | —17 | 07$^{7}$ | 17 | |

TABLE 9 (*Continued*)

| Reference No. | R.A. h | R.A. m | Dec. ° | Dec. ′ | Flux Density ($10^{-26}$ W $m^{-2}$ $(c/s)^{-1}$) | Notes |
|---|---|---|---|---|---|---|
| 07—17* | 07 | $21\cdot4^{3}$ | —18 | $38^{5}$ | 21 | |
| 07—18 | 07 | $23\cdot8^{3}$ | —13 | $23^{7}$ | *31* (21) | |
| 07—19 | 07 | $26\cdot2^{3}$ | —14 | $51^{6}$ | 17 | |
| 07—110* | 07 | $29\cdot7^{4}$ | —18 | $17^{8}$ | *29* (17) | |
| 07—111* | 07 | $32\cdot9^{3}$ | —15 | $59^{6}$ | 12 | |
| 07—112 | 07 | $34\cdot0^{4}$ | —19 | $35^{6}$ | 11 | |
| 07—113* | 07 | $41\cdot2^{4}$ | —17 | $43^{7}$ | 9·8 | |
| 07—114* | 07 | $43\cdot4^{5}$ | —16 | $25^{7}$ | 13 | |
| 07—115 | 07 | $43\cdot5^{3}$ | —10 | $48^{6}$ | 9·8 | |
| 07—116* | 07 | $45\cdot6^{4}$ | —10 | $01^{6}$ | 13 | |
| 07—117 | 07 | $45\cdot9^{2}$ | —19 | $00^{4}$ | 52 | |
| 07—118 | 07 | $46\cdot5^{4}$ | —11 | $58^{7}$ | 20 | |
| 07—119 | 07 | $48\cdot1^{3}$ | —15 | $22^{6}$ | 11 | |
| 07—120 | 07 | $51\cdot3^{5}$ | —19 | $22^{8}$ | 17 | |

1. May be two sources.
2. Extended N.-S., may be two sources.
3. Perhaps slightly extended.
4. Perhaps extended.
5. Perhaps extended.
6. IAU 02S1A.
7. Perhaps extended.
8. Perhaps extended.
9. Perhaps extended.
10., 11. } Perhaps one extended object elongated parallel to galactic plane.
12. Perhaps extended.
13., 14. } May be one complex source (IC 2177, NGC 2327).
15. Perhaps extended.
16. Perhaps extended.