STUDY OF A COMPLETE SAMPLE OF COSMIC RADIO SOURCES

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Summary

An examination is made of the redshifts and intrinsic powers of the identified radio sources in a complete sample taken from the Cambridge 3C Revised catalogue. The sample consists of the 89 sources of the catalogue having flux density $S_{178} \geqslant 15 \times 10^{-26}$ W m^{-2} Hz^{-1} and $|b^{\mathrm{II}}| > 15°$, of which 71 are now identified. The subset of the sources having $S_{178} \geqslant 30 \times 10^{-26}$ W m^{-2} Hz^{-1}, in which there are 23 sources with 22 identified, is also considered. Where redshifts for the radio sources were not available (in 16 cases out of the 71 identified) these were calculated from the observed visual apparent magnitudes using the Einstein–de Sitter cosmology, and alternatively the Milne cosmology.

The intrinsic powers of the sources at 178 MHz were calculated for the same two universes, using the given flux density and redshift with an assumed power spectrum common to all sources.

The resulting information presents new evidence on the nature of the local luminosity distribution and the local luminosity function of the sources. In addition, observed distributions of redshift and luminosity such as are found here are likely to be of critical importance in future testing of evolutionary schemes designed to interpret the radio source counts.

I. Introduction

The object of the present paper is to make use of the recently accumulated identifications of radio sources in order to derive new evidence regarding the distribution of the sources in space and in luminosity.

The distribution of the radio sources with regard to redshift and intrinsic power will be of cardinal importance in further attempts to fit cosmological schemes to the radio source counts. Previous efforts in this direction (Davidson and Davies 1964*a*, 1964*b*, 1966; Longair 1966) have shown that the actual number count curve of the sources can be fitted by at least two hypotheses regarding the collective evolution of the sources. There is also, as far as fitting the actual count curve is concerned, a considerable latitude in the choice of the median value in the local luminosity distribution. Therefore, information such as we find here will be necessary to discriminate between these otherwise satisfactory models. This consideration has been the main inspiration of the present paper.

No attempt is made here to set up a new definitive local luminosity distribution or luminosity function of the sources, although the implication of our results for these is indicated. Rather, the properties of a particular sample of sources, chosen in a region of the sky away from the galactic plane and yielding 71 identifications out of 89, is examined for the evidence it can supply in its own right.

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II. Analysis of the Sample

The sample consists of the 89 sources of the 3C R catalogue (Bennett 1962) that have flux density $S_{178} \geqslant 15$ f.u.* and $|b^{\mathrm{II}}| > 15°$. The sample occupies $5 \cdot 11$ sr of the sky and so the mean sky density is approximately $17 \cdot 4$ sr^{-1}. This is in good statistical agreement with the published mean count over the whole sky for $S_{178} \geqslant 15$ f.u. which is 18 ± 2 sr^{-1} (Gower 1966). Accordingly, since 71 of the 89 sources are now identified, the information that the sample provides is likely to be of valuable significance for cosmology.

The 71 identifications are made up of 55 radio galaxies and 16 quasars. The great majority are those sources in the specified area which have been presented by Wyndham (1966) as identifications falling into the categories 1, 2, or 3 defined by him to be "certain", "highly probable", or "probable" respectively. Several of the sources in categories 2 and 3 have been independently identified by the Parkes radio astronomers (Bolton and Ekers 1966*a*, 1966*b*; Clarke, Bolton, and Shimmins 1966). With regard to the "possible" identifications by Wyndham (category 4) only one has been used here, namely the source 3C 313 which has received independent identification by the Parkes group (Bolton and Ekers 1966*a*). Account has also been taken of more recent identifications which have appeared in notices of redshift measurements, and in the case of quasars reference was made to the comprehensive list provided by Burbidge (1967*a*).

Of the 71 identifications, redshifts are available for 55, which include 41 radio galaxies (Maltby, Matthews, and Moffet 1963; Matthews, Morgan, and Schmidt 1964; Schmidt 1965; Sandage 1966; Burbidge 1967*b*) and 14 quasars (Burbidge 1967*a*). Redshifts for the remaining 16 identified sources (14 radio galaxies and 2 quasars) were estimated from the visual apparent magnitudes given in the reports of identifications.

Calculation of the 16 redshifts was performed for two cosmological models, the Einstein–de Sitter model and the Milne model. In the case of the radio galaxies an adequate formula was found to be

$$m_{\mathrm{V}} - K_{\mathrm{V}} - A_{\mathrm{V}} = 21 \cdot 03 + 5 \log_{10} z + (1-q)z, \tag{1}$$

where z is the redshift, K_{V} is the K correction for visual magnitudes, A_{V} allows for visual absorption in the Galaxy, and q is the deceleration parameter of the model. K_{V} was taken to be $3z$ (Humason, Mayall, and Sandage 1956; Sandage 1964) and A_{V} as $0 \cdot 2 \operatorname{cosec}|b^{\mathrm{II}}|$. The constant $21 \cdot 03$ results from taking the Hubble time H^{-1} to be 10^{10} yr and adopting a mean absolute visual magnitude M_{V} for radio galaxies of $-21 \cdot 4$. The latter value was found to be the best fit for the sources whose redshifts are already known, and is very close to the value implied in a recent paper by Sandage (1967). The formula (1) was solved by iteration for z.

The highest redshift calculated for a radio galaxy in this way was $0 \cdot 33$, and in no case did the two values for the cosmological models differ by more than $0 \cdot 02$. Accordingly, no distinction between the two values was made for these sources in presenting the data in Tables 1 and 2, the value corresponding to $q = 0 \cdot 5$ being adopted.

* 1 flux unit $= 10^{-26}$ W m^{-2} Hz^{-1}.

For the z calculation in the case of the two quasars a value for M_V of -26 was chosen. This appeared to be the best mean value calculated for the quasars of known z, assuming big-bang models ranging between the Einstein–de Sitter and Milne cases (cf. McVittie and Stabell 1967). There is a wide scatter about this value and for this reason it was not thought worth while to include the K_V correction for quasars; in fact K_V is known (Sandage 1965) to be quite small for quasars having $z < 4$. The m_V versus z relation for quasars in the Einstein–de Sitter model was therefore taken to be

$$m_V - A_V = 16\cdot43 + 5\log_{10}\big(2(1+z)^{\frac{1}{2}}\{(1+z)^{\frac{1}{2}}-1\}\big)\,, \tag{2}$$

and in the Milne model

$$m_V - A_V = 16\cdot43 + 5\log_{10}\big(z(1+\tfrac{1}{2}z)\big)\,. \tag{3}$$

Table 1

Distribution of redshift for 22 sources having $S_{178} \geqslant 30$ f.u.

Redshift z	Radio Galaxies	Quasars	Total	N (sr^{-1})
0–0·1	12	0	12	2·35
0·1–0·4	4	2	6	1·17
0·4–∞	1	3	4	0·78

For the two quasars in question, namely 3C 216 and 3C 230, equations (2) and (3) gave respectively the values $z = 1\cdot79$ and $1\cdot34$ for 3C 216, and $z = 1\cdot16$ and $0\cdot95$ for 3C 230.* For the purpose of simply but significantly demonstrating the distribution of the sources having $S_{178} \geqslant 15$ f.u. in Table 2, it was considered adequate to tabulate for each of the two sources the average z arising from the two cosmological models. The values $z = 1\cdot57$ and $z = 1\cdot06$ were therefore adopted for 3C 216 and 3C 230 respectively. As only two quasars were involved, this procedure has negligible effect on the distribution of redshift for $S_{178} \geqslant 15$ f.u. In the case of the subset of sources having $S_{178} \geqslant 30$ f.u., all redshifts were as directly measured.

Table 1 shows the distribution of redshift for the 22 identified sources of the complete subset of 23 that have $S_{178} \geqslant 30$ f.u. and lie in the chosen area of the sky. Only one source is missing, namely 3C 363·1, which is so far unidentified. The table shows a breakdown of the totals into radio galaxies and quasars in each range of redshift. Also shown is the total number N of identified sources per steradian in each range of redshift. This information will be valuable for future testing of cosmological schemes designed to fit the counts of the sources, bearing in mind that 1 source in 23 or $0\cdot196$ source per steradian is missing.

* A referee has pointed out that the identification of 3C 230 with a quasar is now doubtful. If it is preferred to exclude this source from the analysis, then the necessary minor modification of the results can easily be calculated. For example, the effect on Table 2 would be to reduce the number of sources identified in the range $0\cdot8 < z < 1\cdot4$ by one and to reduce N (sr^{-1}) for this range by $0\cdot20$.

Table 2 shows the distribution of redshift for the 71 identified sources, 55 radio galaxies and 16 quasars, having $S_{178} \geqslant 15$ f.u. For each total, the number of sources whose redshifts have been calculated is shown in parentheses. It is to be emphasized that this distribution was found to be essentially independent of the geometry of the cosmological model assumed for these calculations. What is likely to be found of far greater significance is the explanation of the observed distribution in terms of an evolutionary scheme of source density and intrinsic power within a given cosmological model. In this connection it is to be borne in mind that 18 sources of the complete sample of 89 are missing, so far unidentified. Nevertheless these results will be valuable for testing evolutionary schemes, since they show the lower limit of source number per steradian in each range of redshift that any satisfactory theory must predict.

TABLE 2

DISTRIBUTION OF REDSHIFT FOR 71 SOURCES HAVING $S_{178} \geqslant 15$ F.U.

Redshift z	Radio Galaxies	Quasars	Total*	N (sr^{-1})
0–0·1	29	0	29(2)	5·67
0·1–0·2	13	1	14(6)	2·74
0·2–0·3	10	0	10(5)	1·96
0·3–0·8	3	5	8(1)	1·56
0·8–1·4	0	7	7(1)	1·37
1·4–∞	0	3	3(1)	0·59

* The number of sources whose redshifts have been calculated is shown in parentheses.

The distribution of intrinsic power of the 22 sources identified in the range $S_{178} \geqslant 30$ f.u., and that of the 71 sources identified in the range $S_{178} \geqslant 15$ f.u., are shown in Figure 1. The emission powers P_{178} ($\mathrm{W\,sr^{-1}\,Hz^{-1}}$) are based on an assumed spectrum $P(\nu) \propto \nu^{-\alpha}$, where the value of α is taken to be 0·8. The results shown are calculated for an Einstein–de Sitter cosmology in which the relation between flux density S_{178} and redshift z for a source of intrinsic power P_{178} is

$$S = P/4c^2T^2(1+z)^\alpha\{(1+z)^{\frac{1}{2}}-1\}^2\,, \qquad (4)$$

in which T $(= H^{-1})$ is the Hubble time.

The luminosity distribution was also calculated for the Milne model, for which the corresponding relation is

$$S = P(1+z)^{1-\alpha}/c^2T^2z^2(1+\tfrac{1}{2}z)^2\,. \qquad (5)$$

However, although the intrinsic powers in this case were systematically higher, the difference was small and the resulting change in the luminosity distribution insignificant. Thus it can be safely asserted that the histograms of Figure 1, just as Tables 1 and 2, are independent of the geometry and kinematics of the cosmological model assumed. This of course may not be the case for flux densities lower than 15 f.u.

Once again, however, a satisfactory explanation of these distributions within a given cosmological model is likely to be critically dependent on the evolutionary scheme assumed for the sources. Consequently, such data provide another valuable means of testing such schemes. For this purpose the number of sources identified per steradian in each histogram power range are listed in Table 3 for $S_{178} \geqslant 30$ f.u. and for $S_{178} \geqslant 15$ f.u. An adequate theory of the collective evolution of the sources must predict numbers in close agreement with the list for $S_{178} \geqslant 30$ f.u. (allowing for one source missing in $5 \cdot 11$ sr), and must be greater than or equal to those listed for $S_{178} \geqslant 15$ f.u. (18 sources missing in $5 \cdot 11$ sr).

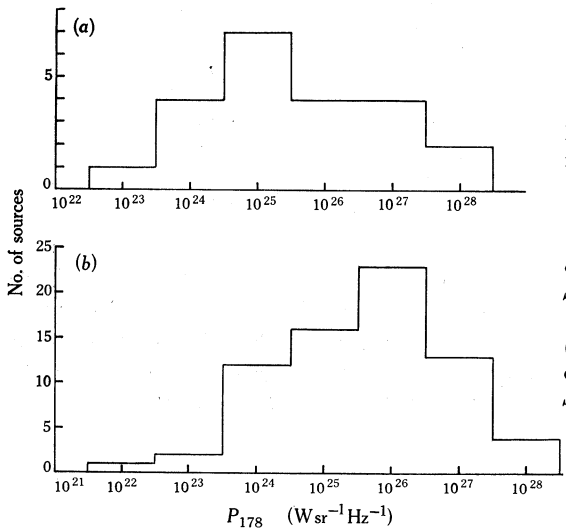

Fig. 1.—Distribution of emission luminosity, normalized to 178 MHz, for the following sources in the 3C R catalogue:

(*a*) the 22 sources identified out of the total sample of 23 having $S_{178} \geqslant 30$ f.u. and $|b^{\mathrm{II}}| > 15°$;

(*b*) the 71 sources identified out of the total sample of 89 having $S_{178} \geqslant 15$ f.u. and $|b^{\mathrm{II}}| > 15°$.

The 18 unidentified sources in this sample from the 3C R catalogue are those in the chosen area of the sky which have been classified by Wyndham (1966) as "unidentified" (his categories I–IV) or else of only "possible" identification with an extragalactic object (category 4). Exceptions to this remark arise for a few of Wyndham's sources which have been identified since his paper was published. The 18 sources (having $S_{178} \geqslant 15$ f.u. and $|b^{\mathrm{II}}| > 15°$) are 3C 6·1, 55, 65, 68·1, 105, 225, 228, 249, 265, 268·1, 274·1, 280, 327·1, 330, 337, 363·1, 427·1, and 437·1.

III. Some Interpretations of the Data

(*a*) *Luminosity Distributions*

The luminosity distribution shown in Figure 1(*a*) may be taken as nearly representative of that expected in any region of the sky for $S_{178} \geqslant 30$ f.u., since only 1 source in the total sample of 23 is missing. The statistics are of course necessarily meagre for $S_{178} \geqslant 30$ f.u., but an area of $5 \cdot 11$ sr away from the galactic plane must be regarded as the best available until a similar investigation is undertaken for radio sources in the southern sky. Detailed analysis of the luminosity calculations shows that the median power for the 22 sources is 3×10^{25} $\mathrm{W\,sr^{-1}\,Hz^{-1}}$ and the mode is at 10^{25} $\mathrm{W\,sr^{-1}\,Hz^{-1}}$.

Since 18 of the 89 sources are missing, Figure 1(*b*) cannot be taken as completely representative of the luminosity distribution for $S_{178} \geqslant 15$ f.u. However, it is interesting to split up the calculated intrinsic powers of the sample in greater detail as shown in Figure 2. A possibility then becomes apparent, because of the unfilled depressions in this detailed histogram, that several of the 18 unidentified sources

TABLE 3

LUMINOSITY DISTRIBUTIONS FOR $S_{178} \geqslant 30$ F.U. AND $S_{178} \geqslant 15$ F.U.

P_{178} ($\mathrm{W\,sr^{-1}\,Hz^{-1}}$)	No. of Sources per Steradian $S_{178} \geqslant 30$ f.u.	$S_{178} \geqslant 15$ f.u.
$3\cdot16\times10^{21}$–$3\cdot16\times10^{22}$	0	0·20
$3\cdot16\times10^{22}$–$3\cdot16\times10^{23}$	0·20	0·39
$3\cdot16\times10^{23}$–$3\cdot16\times10^{24}$	0·78	2·35
$3\cdot16\times10^{24}$–$3\cdot16\times10^{25}$	1·37	3·13
$3\cdot16\times10^{25}$–$3\cdot16\times10^{26}$	0·78	4·51
$3\cdot16\times10^{26}$–$3\cdot16\times10^{27}$	0·78	2·55
$3\cdot16\times10^{27}$–$3\cdot16\times10^{28}$	0·39	0·78

may have $P_{178} < 10^{26}$ $\mathrm{W\,sr^{-1}\,Hz^{-1}}$. Moreover, a smooth envelope curve through the highest ordinates of the histogram would leave sufficient room for all 18 unidentified sources to be contained within it. This would imply that the resulting median and mode of the complete sample would not be greatly in excess of those found here for the 71 identified sources, namely $5\cdot5\times10^{25}$ $\mathrm{W\,sr^{-1}\,Hz^{-1}}$ for the median and 7×10^{25} $\mathrm{W\,sr^{-1}\,Hz^{-1}}$ for the mode.

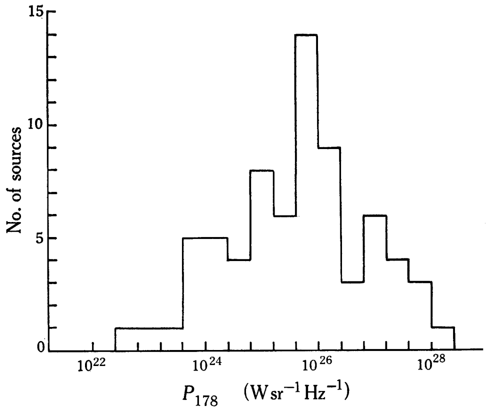

Fig. 2.—More detailed histogram of the emission luminosity at 178 MHz for the 71 sources described in Figure 1(*b*). The median power is at $5\cdot5\times10^{25}$ $\mathrm{W\,sr^{-1}\,Hz^{-1}}$ and the mode at 7×10^{25} $\mathrm{W\,sr^{-1}\,Hz^{-1}}$.

To have $S_{178} \geqslant 15$ f.u., a radio galaxy of $P_{178} < 10^{26}$ $\mathrm{W\,sr^{-1}\,Hz^{-1}}$ must have $z < 0\cdot27$ according to equation (4) or (5). Taking $M_{\mathrm{V}} = -21\cdot4$, as before, this would imply an uncorrected visual magnitude $m_{\mathrm{V}} < 19\cdot4$ according to (1), setting $q = 0\cdot5$, say. It would not be altogether surprising that such sources had eluded identification so far. A galaxy of redshift $z > 0\cdot20$ and $m_{\mathrm{V}} \sim 19$ could be quite difficult to identify with a radio source if the latter were located at a distance several hundred kiloparsecs from it, as would be likely in an "old" radio source. Indeed the sources 3C 6·1, 55, 225, 268·1, 274·1, 330, 337, and 437·1 are all known to be double or more complex in radio structure (Macdonald, Kenderdine, and Neville 1968).

From the appearance of Figure 2 it can be said with somewhat greater probability that a substantial proportion of the 18 missing sources may have $P_{178} < 2{\cdot}5\times10^{26}$ W sr^{-1} Hz^{-1}, and therefore $z < 0{\cdot}4$. Such sources are unlikely to be quasars, as the great optical brightness of the latter would have led to identification in this range of redshift (a radio galaxy having $z \sim 0{\cdot}4$ would have $m_V \sim 20$). Therefore it is possible that several of these sources may yet be identified in the range $0{\cdot}20 < z < 0{\cdot}4$ (cf. 3C 295 at $z \sim 0{\cdot}42$). It may be significant that 4 of the missing sources, namely 3C 68·1, 265, 274·1, and 327·1 have been assigned "possible" identifications with galaxies (Wyndham 1966). Using our formulae and the given values of S_{178} and m_V these 4 sources would all have $P_{178} < 2\times10^{26}$ W sr^{-1} Hz^{-1} and $z < 0{\cdot}33$.

Nevertheless, the possibility cannot yet be entirely excluded that the majority of the missing sources are powerful radio galaxies or quasars beyond their respective optical limits. In their earlier examination of the optical identifications, Longair and Scott (1965) assessed the median and mode of the distribution for $S_{178} \geqslant 15$ f.u. to be at 8×10^{25} W sr^{-1} Hz^{-1}. However, a considerably smaller number of identifications was then available and a very precarious estimate had to be made of the contribution of galaxies and quasars having $P_{178} > 3\times10^{26}$ W sr^{-1} Hz^{-1}. It is also relevant to point out that the contribution in the range

$$3{\cdot}16\times10^{23} < P_{178} < 3{\cdot}16\times10^{24} \qquad \mathrm{W\,sr^{-1}\,Hz^{-1}}$$

shown for our present sample in Figures 1(*b*) and 2 and in Table 3 is significantly greater, by a factor of at least 1·5, than that estimated by Longair and Scott. A revision of the Longair–Scott distribution in this respect would tend to lower their calculated median luminosity.

For the present sample it can be stated that if all 18 unidentified sources have $P_{178} > 10^{26}$ W sr^{-1} Hz^{-1} then the median of the complete distribution for $S_{178} \geqslant 15$ f.u. will be slightly in excess of 10^{26} W sr^{-1} Hz^{-1}, and the mode presumably higher.

(*b*) *"Local" Luminosity Distribution*

Whatever the final median power for $S_{178} \geqslant 15$ f.u. turns out to be, the present investigation supports a recent contention by the author (Davidson 1967) that the "local" luminosity distribution has a median value no higher than 4×10^{25} W sr^{-1} Hz^{-1}.

The local luminosity distribution $n_0(P)$ is theoretically associated with the limit $S\to\infty$, and is related to $\rho_0(P)$ the local space density frequency of the sources (the so-called "luminosity function") in accordance with the Euclidean formula

$$n_0(P) \propto P^{3/2}\rho_0(P)\,. \tag{6}$$

As shown previously (Davidson and Davies 1964*a*, 1966), for an ideally smooth distribution of sources in an isotropic world model this relation between the luminosity distribution and the luminosity function would in fact be realized as $S\to\infty$.

In practice one may approach this limit only as far as the discrete distribution of radio sources will permit an adequate count of sources within a sufficiently small local region of space.

However, if $\rho_0(P)$ is established from the identifications of all sources in a suitable region of space local to the observer, one may determine the theoretical local luminosity distribution $n_0(P)$ by using relation (6) with suitable normalization. Then the actually observed luminosity distribution should approach $n_0(P)$ as S is taken at successively higher values. The limitation of statistically adequate samples will tend to prevent complete coincidence being reached.

The author has previously (Davidson 1967) used the $\rho_0(P)$ function provided at 178 MHz by Caswell and Wills (1967) to calculate the associated $n_0(P)$ function defined by (6). This distribution turned out to be roughly Gaussian in log P_{178}, with standard deviation $\sigma \sim 1$. The median was located at about $3\cdot16\times10^{25}$ W sr^{-1} Hz^{-1} and the mode at $1\cdot5\times10^{25}$ W sr^{-1} Hz^{-1}.

Consider now the evidence of the present samples for $S_{178} \geqslant 15$ f.u. and $S_{178} \geqslant 30$ f.u. As already stated in Subsection (*a*), detailed analysis yields for the median luminosity at $S_{178} \geqslant 15$ f.u. the value $5\cdot5\times10^{25}$ W sr^{-1} Hz^{-1}, with mode at 7×10^{25} W sr^{-1} Hz^{-1}. It seems unlikely that the identification of the complete sample will lower these values. On the other hand, the median power for $S_{178} \geqslant 30$ f.u., for 22 sources out of 23, was found to be 3×10^{25} W sr^{-1} Hz^{-1} with a mode of 10^{25} W sr^{-1} Hz^{-1}. The close agreement of the results for the $n_0(P)$ distribution with those for $S_{178} \geqslant 30$ f.u., and their disparity with those for $S_{178} \geqslant 15$ f.u., strongly support two points of the author's earlier argument (Davidson 1967):

(i) The median power of the local luminosity distribution $n_0(P)$ probably lies between 10^{25} and 4×10^{25} W sr^{-1} Hz^{-1} at 178 MHz.

(ii) The more distant, more powerful, sources that appear in the luminosity distribution for $S_{178} \geqslant 15$ f.u., and even at the higher end of that for $S_{178} \geqslant 30$ f.u., have to be regarded as part of a cosmic evolutionary trend (into the past) away from the local luminosity distribution.

Point (ii) is pertinent since only a sufficiently local region of space can serve to define the local luminosity function $\rho_0(P)$ and the associated distribution $n_0(P)$. This is because the lifetime of the majority of individual radio sources is confined to between 10^6 and 10^7 yr (Ryle and Longair 1967). Hence the observed properties of radio sources seen at redshifts exceeding $0\cdot1$ will belong to an epoch at least 10^9 yr into the past, and so would have shared in any general collective evolutionary trend operating on the radio sources. Fortunately the $\rho_0(P)$ function on which $n_0(P)$ depends was established by Caswell and Wills (1967) up to $P_{178} \sim 3\times10^{25}$ W sr^{-1} Hz^{-1}, mainly from the region $z < 0\cdot1$. It is impossible, however, to obtain adequate statistics for $P_{178} > 3\times10^{25}$ W sr^{-1} Hz^{-1} without considering sources having $z > 0\cdot1$ (cf. Tables 1 and 2), and so some uncertainty must remain for $\rho_0(P)$ and $n_0(P)$ for $P_{178} > 3\times10^{25}$ W sr^{-1} Hz^{-1}. The tendency will be to exaggerate the importance of this region of the $n_0(P)$ distribution, since the information is drawn from more distant space where the radio source counts indicate that sources occur either in greater numbers or with greater intrinsic power.

The significant result established here is that when S_{178} is raised to 30 f.u., at which distant powerful sources still contribute, the median power is no higher than 3×10^{25} W sr^{-1} Hz^{-1} and the mode no higher than 10^{25} W sr^{-1} Hz^{-1}.

(c) *Criteria for Testing Cosmological Models*

Tables 1, 2, and 3 together set a stiff test to be passed by any cosmological model that purports to explain the counts of radio sources. Even allowing for the fact that 18 sources of the representative sample for $S_{178} \geqslant 15$ f.u. are missing it is not difficult to imagine that many otherwise plausible cosmological models will fail to pass this test. The most common reasons for their elimination are likely to be (1) a failure to give the correct luminosity distribution for a given flux density and (2) allowing the main weight of the luminosity distribution to fall in the wrong redshift region.

These considerations are likely to have particular relevance to both the assumed median power of the local luminosity distribution $n_0(P)$ and the assumed evolutionary character of the model. Because so many sources of relatively low power have to appear in the range $z < 0\cdot1$, a fact responsible for the low median and mode of the luminosity distribution for $S_{178} \geqslant 30$ f.u., the assumption of a median power of $n_0(P)$ in excess of 4×10^{25} W sr^{-1} Hz^{-1} is unlikely to provide agreement with Tables 1, 2, and 3. Indeed, considering the range $S_{178} \geqslant 15$ f.u., a further breakdown of the results displayed in Table 2 shows that only 5 of the 29 identified sources in the region $z \leqslant 0\cdot1$ have $P_{178} > 1\cdot5\times10^{25}$ W sr^{-1} Hz^{-1}. Yet all sources in our chosen region of the sky that have $z \leqslant 0\cdot1$ and $P_{178} > 1\cdot5\times10^{25}$ W sr^{-1} Hz^{-1} should have $S_{178} > 15$ f.u. and belong to our sample. Again, only 8 of the 43 sources in Table 2 that have $z \leqslant 0\cdot2$ have also $P_{178} > 5\cdot7\times10^{25}$ W sr^{-1} Hz^{-1}, but all such sources should have $S_{178} > 15$ f.u. and in principle be identified in our present sample. This demonstrates clearly the paucity of high-powered sources in local space. Moreover, whether the fit of the radio source counts relies mainly on evolution of source density, or alternatively on evolution of mean source power, is likely to require different distributions in P and z, for which Tables 1, 2, and 3 provide a gauge.

Finally, and this may not be independent of the above considerations, any model in which the limiting redshift z (beyond which no radio sources are assumed to have existed) is set too high is again unlikely to agree with Tables 1 and 2. For such a model would necessarily imply that an unduly large contribution to the count at a given flux density would arise from very distant sources.

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