ACCURATE POSITIONS OF 210 RADIO SOURCES

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Summary

The right ascensions and declinations of 210 radio sources have been determined. For most of the sources the estimated error is less than 16″ arc in each coordinate. The sources were selected from the Parkes catalogue of radio sources and are between declinations +27° and −33°.

I. Introduction

This paper is a supplement to a previous paper giving the accurate positions of 644 radio sources (Shimmins, Clarke, and Ekers 1966; subsequently referred to as SCE). The positions of an additional 160 sources are given, and the positions of 50 sources in SCE have been redetermined more accurately.

The sources were selected from the Parkes catalogue of radio sources (Bolton, Gardner, and Mackey 1964; Day *et al.* 1966; Shimmins *et al.* 1966; Shimmins and Day 1968).

The aim has been to extend the declination limit from +20° to +27° (the maximum declination obtainable with the Parkes radio telescope) and the minimum flux density of a complete sample from 1·0 to 0·8 f.u.† at 2650 MHz. It is thought that all catalogue sources in the declination range +27° to −33° (the latitude of Parkes) down to a flux density of 0·8 f.u. at 2650 MHz have now been accurately positioned. In addition, a number of weaker sources were included either because they have flat spectra or because they were identifications that had been suggested on the basis of their catalogue positions. A few very weak sources were included because one of their coordinates was almost identical to that of a stronger source in the programme and accurate relative positions could be measured.

The sources are thought to be mainly extragalactic, although a number of them are within ±10° of the galactic plane.

The positions have been determined to an average accuracy of ±16″ in both coordinates and as such are useful for identification of optical counterparts as faint as 19th magnitude.

The sources were positioned with the 210 ft radio telescope of the Australian National Radio Astronomy Observatory at Parkes, N.S.W., the observations being restricted to a range of ±10 min in hour-angle about the northern meridian, so that the significant errors are a simple function of zenith angle only.

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

The errors were determined empirically each day by including in the observations approximately 12 calibration sources whose radio positions are accurately known. An additional correction as a function of time of transit (i.e. of right ascension) was applied to correct for diurnal temperature effects on the pointing of the telescope.

Table 1

POSITION CALIBRATORS NORTH OF DECLINATION −33°

(1) Parkes Catalogue Number	(2) Other Catalogue Numbers	(3) Right Ascension h	m	s	s	(4) Declination °	′	″	″	(5) S_{2650}	(6) Remarks*	(7) References†
0021−29	M 00−29	00	22	00·59	(±0·05)	−29	45	27·4	(±1·0)	1·5	19^m QSO	9
0051−03	3C 26	00	51	35·3	(±0·07)	−03	49	51	(±1·0)	1·1	19^m g	7
0157−31	M 01−315	01	57	58·3	(±0·4)	−31	07	54	(±12)	2·1	19^m QSO	1
0222−23	M 02−27	02	22	46·2	(±0·4)	−23	26	12	(±12)	1·3	18^m QSO	1
0240−00	3C 71	02	40	07·10	(±0·03)	−00	13	31·5	(±0·4)	3·1	$9·8^m$ SO	4
0316+16	CTA 21	03	16	09·11	(±0·2)	+16	17	40·3	(±10)	4·7	Occultation	2
0451−28		04	51	14·0	(±0·5)	−28	12	36	(±12)	2·2	19^m QSO	1
0518+16	3C 138	05	18	16·5	(±0·06)	+16	35	30	(±1)	6·4	18^m QSO	8
0855+14	3C 212	08	55	55·7	(±0·3)	+14	21	23	(±2)	1·4	Occultation	5
0915−11	Hydra A	09	15	41·2	(±0·03)	−11	53	04·4	(±0·4)	23·5	16^m E	4
1040+12	3C 245	10	40	05·89	(±0·06)	+12	19	17·6	(±1)	2·0	Occultation	5
1226+02	3C 273	12	26	33·0	(±0·1)	+02	19	38	(±2)	40·4	Occultation C	6
1327−21		13	27	23·7	(±0·1)	−21	26	34·1	(±1)	1·1	17^m QSO	3
1416+06	3C 298	14	16	38·82	(±0·03)	+06	42	21·6	(±0·4)	2·6	18^m QSO (*d*)	4
1453−10	14−121	14	53	12·3	(±0·5)	−10	56	30	(±10)	2·4	Occultation C	5
1648+05	Herc A	16	48	40·0	(±0·8)	+05	04	35	(±12)	21·9	19^m g	11
2115−30	M 21−34	21	15	11·1	(±0·1)	−30	31	50·1	(±0·7)	1·3	17^m QSO	3
2230+11	CTA 102	22	30	07·71	(±0·05)	+11	28	22·8	(±1·0)	5·3	17^m QSO	10

* C indicates that an estimated centroid at 2650 MHz has been used (quoted errors include errors in this estimation); (*d*) indicates object (*d*) in the list of Griffin (1963); other abbreviations are as for Table 2 (see text, Section VII).

† References to positions used are: 1, Bolton, Clarke, and Ekers (1965); 2, Clarke and Batchelor (1965); 3, Ekers and Bolton (1965); 4, Griffin (1963); 5, Hazard, Mackey, and Nicholson (1964); 6, Hazard, Mackey, and Shimmins (1963); 7, Sandage (personal communication); 8, Sandage, Véron, and Wyndham (1965); 9, Véron (personal communication); 10, Véron (1965); 11, Williams, Dewhirst, and Leslie (1961).

II. Equipment Used

The same equipment was used as for the previous measurements, and it is described in SCE. Briefly, observations were made at 2650 MHz using a degenerate parametric switched radiometer (Cooper, Cousins, and Gruner 1964) with a system temperature of 150°K and an i.f. bandwidth of 40 MHz. With an output time constant of 2 sec, the peak-to-peak noise fluctuations were approximately 0·2 degK, and short-term receiver instabilities were of the same order. The beam was approximately Gaussian with a width of 8′·0 arc at half-intensity points.

III. Experimental Procedures

Calibration sources that were used during the measurements and their positions are given in Table 1. Observations were carried out between June 1966 and June 1967. The period of observation for each source is shown in Table 2 (column 14). The gain of the system was calibrated at intervals of approximately 15 min throughout the 24 hr period of observations by injecting a noise signal into the line between the feed and the r.f. switch.

(a) *Right Ascension Measurements*

The telescope was set, under master equatorial control, to the declination of the source, and the hour-angle was set in turn to a number of fixed values (within 10 min of the meridian). Thus a number of drift scans, usually four to six, were obtained for each source. Receiver output was recorded on a paper chart running at 3 in/min. Sidereal time markers were recorded at 10 sec intervals on the same trace. Each right ascension run lasted 24 hr, during which approximately 12 calibration sources were included. In the June 1966 observations a larger number of calibrators (approximately 40) were used in order to define more closely the calibration curve. The feed was set at a position angle of zero during the right ascension measurements.

(b) *Declination Measurements*

All the declination measurements were made under master equatorial control, again keeping within an hour-angle of ± 10 min from the northern meridian. The telescope was set to the right ascension of the source, and from four to six scans in declination were made at 0·25 deg/min through the source position. Receiver output and declination markers at 5′ arc intervals were recorded on a paper chart running at 3 in/min. During the declination observations the feed was set at a position angle of 90°.

IV. Analysis of Observations

The records were analysed by hand. The apparent right ascension or declination of a source was determined from the centre of symmetry of the drift curve or the declination scan, and an average value obtained for each source. These observed right ascensions and declinations were precessed to epoch 1950·0. The flux density was obtained by measuring the peak amplitude of the record relative to the baseline. An average amplitude of the scans through the source was calculated, and converted into flux units by comparison with the amplitude of adjacent noise calibrations. The value of the noise calibration was obtained from measurements of Hydra A, which was taken as 23·5 f.u. at 2650 MHz. The effects of polarization were removed by taking the mean of the flux densities obtained during the right ascension (position angle 0°) and declination runs (position angle 90°).

V. Calibration of Position Measurements and Errors in Position

The calibration was carried out for both right ascension and declination runs as described in SCE. It was found that for each observing session the diurnal variation in pointing, $g(t)$, was approximately 15″ shift over the 24 hr observing period, and, after correcting for this, the scatter of the calibration sources about the calibration line was 5″ arc. As in the previous observations, it was found that the position errors are due mainly to receiver noise. Such errors were estimated by calculating the r.m.s. scatter between repeated scans (for declination) or successive drifts (for right ascension). These scatters are shown in Figure 1, which is identical to that obtained in previous measurements (SCE, Fig. 4).

VI. Optical Identification

The optical fields of all the sources in this paper have been examined by J. G. Bolton, using the prints of the Palomar Sky Survey. Brief optical data are included in Table 2 (column 13) and full details of the optical search are given in Bolton, Shimmins, and Merkelijn (1968; present issue pp. 81–6).

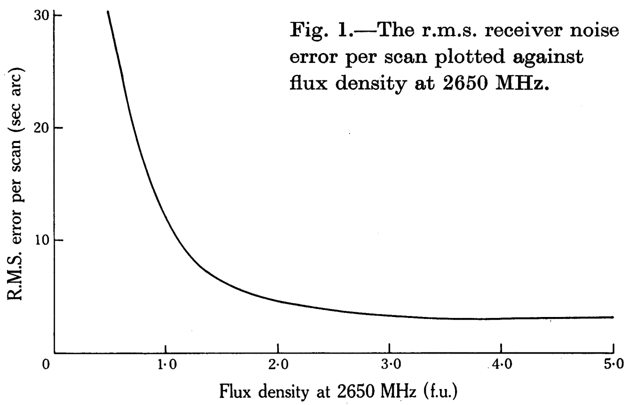

Fig. 1.—The r.m.s. receiver noise error per scan plotted against flux density at 2650 MHz.

VII. Tabulation of Results

The results of the work described in the present paper are contained in Table 2. Information concerning the use of this table is given below.

Column 1. Source number from the Parkes catalogue of radio sources.

Column 2. R means the source is a repeat of a measurement given in SCE.

Column 3. Other catalogue numbers.

Column 4. Measured right ascension (epoch 1950·0).

Column 5. Estimated r.m.s. error in right ascension, given in both seconds of time and seconds of arc.

Column 6. Number of days on which right ascension measurements of the source were made.

Column 7. Total number of drift scans used in deriving the final measurement of right ascension.

Column 8. Measured declination (epoch 1950·0).

Column 9. Estimated r.m.s. error in declination, given in seconds of arc.

Column 10. Number of days on which declination measurements of the source were made.

Column 11. Total number of scans used in deriving the declination.

Column 12. Measured flux density at 2650 MHz in flux units.

Column 13. Classification of optical field within $\pm 1' \cdot 0$ arc from the position of the source and the suggested optical identification. The numerals I–IV are defined as follows:

Class I. Error rectangle includes one or more galaxies brighter than $m_{pg} = 17$.

Class II. Error rectangle includes one or more galaxies brighter than $m_{pg} = 19 \cdot 5$ and fainter than $m_{pg} = 17$.

Class III. Error rectangle includes no galaxies above the plate limit.

Class IV. Field is heavily obscured.

The type and estimated photographic magnitude for optical identifications are as follows: E, elliptical galaxy; D, spherical galaxy with extended envelope; SO, spherical system with dust lane; db, dumb-bell or double system; N, compact galaxy with very bright nucleus; g, galaxy too faint for identification; QSO, confirmed quasi-stellar object; QSO?, suspected quasi-stellar object.

Column 14. Period of observation: T9, June 16–19, 1966; T10, October 8–11, 1966; T11A and T11B, February 1–4, 1967; T12, June 26–27, 1967.

Column 15. Remarks and miscellaneous data: S, spectra; Ext, extended.

For two sources measurements were made in one coordinate only. The other coordinate, taken from the Parkes catalogue, has been included and is in parentheses to distinguish it from the present observations.

VIII. Corrections to Previous Paper (SCE)

Since publication of SCE a number of errors have been found. These are given below.

(a) *Changes in Positional Data*

Table 1(a). The position of 1416+06 (3C 298) as given by Griffin (1963) is R.A. $14^{h}\,16^{m}\,38 \cdot 82^{s}$ ($\pm 0 \cdot 03^{s}$).

Table 2(a). The positions of a number of sources in Table 2(*a*) have been repeated here. The new measurements given in the present Table 2 should replace those given in SCE. These sources are indicated in the present Table 2 by an R in column 2.

In particular it should be noted that source 2154−18 has been resolved into two sources, 2154−18·4 and 2154−18·3, and the present paper gives the positions of both components.

Table 2(b). Correct values for source positions that contain an error in either right ascension or declination as published in Table 2(*b*) in SCE are given in the present Table 3.

TABLE 2

POSITIONS OF RADIO SOURCES NORTH OF DECLINATION −33°

(1) Parkes Catalogue Number	(2) Repeat Obs.	(3) Other Catalogue Numbers	(4) Right Ascension h m s	(5) Error in R.A. s ″	(6) No. of Days Obs.	(7) No. of Scans	(8) Declination	(9) Error in Dec. ″	(10) No. of Days Obs.	(11) No. of Scans	(12) S_{2650}	(13) Identification	(14) Period of Obs.	(15) Remarks
0005−06		4C −06·1	00 05 55·4	1·3 19	1	3	−06 15 29	17	1	4	0·6	II g 19^m	T11A	
0010+20		(4C 20·1)	00 10 42·4	1·4 20	2	16	+20 30 27	30	1	4	0·5	III	T10, T12	
0011+20		(4C 20·1)	00 11 18·9	1·4 20	2	16	+20 28 27	28	1	7	0·3	III QSO? 18^m	T10, T12	
0013−00			00 13 37·2	0·9 14	1	5	−00 31 53	16	1	4	0·7	III QSO? 19·5^m	T11A	
0023−26	R	00−*210*	00 23 17·8	0·3 4	3	10	−26 18 46	4	2	10	5·6	III g 0·2min foll.	T9	
0035+13	R	3C 16, 4C 13·05	00 35 07·1	0·9 12	2	4	+13 03 35	8	2	7	1·0	III	T11A	
0036+03		00+*010*, 4C 03·1	00 36 43·8	1·1 17	1	2	+03 03 21	15	1	2	1·3	I E 14·3^m	T11B	
0038+08		4C 08·5	00 38 17·0	1·5 23	1	2	+08 37 07	20	1	2	0·8	II E 17^m	T11B	
0042+13		4C 13·6	00 42 45·6	0·9 13	1	4	+13 23 41	13	1	3	0·8	III	T11A	
0047−02		00−*014*	00 47 11·5	1·9 28	1	2	−02 58 43	25	1	2	0·6	III	T11B	
0048−09			00 48 09·3	0·7 10	1	3	−09 45 31	10	1	4	1·4	II blue g 18·5^m	T11A	Odd S
0053+26		3C 28, 4C 26·2	00 53 10·8	1·0 14	2	9	+26 08 32	15	1	6	0·6	II E 17·5^m	T10	
0106+01	R	4C 01·2	01 06 03·6	0·5 8	4	12	+01 19 06	7	2	10	1·1	III QSO 18·5^m	T10	
0109+14		4C 14·5	01 09 25·4	1·0 15	1	3	+14 27 39	15	1	3	0·8	III	T11A	
0115+02		4C 02·4	01 15 42·6	1·5 22	1	2	+02 42 42	19	1	2	0·8	III QSO? 17·5^m	T11B	
0119+11			01 19 00·6	1·0 15	1	3	+11 34 00	16	1	4	0·8	II g 19·5^m	T11A	
0125−14	R	01−*111*	01 25 02·5	0·4 6	2	9	−14 18 28	6	2	14	1·5	III	T9	
0127+23		3C 43, 4C 23·6	01 27 15·0	0·6 8	2	8	+23 22 50	9	1	4	1·9	III QSO 19^m	T10	
0128+06	R	3C 44, 4C 06·7	01 28 43·2	0·7 10	3	10	+06 08 19	5	4	16	0·8	III	T11A, T10	
0128+25		4C 25·7	01 28 32·9	0·9 12	1	4	+25 05 02	12	1	4	1·0	III	T10	
0135+22		4C 22·2	01 35 26·4	1·9 26	1	4	+22 46 17	26	1	4	0·4	III	T10	
0156−14			01 56 17·3	0·9 13	1	3	−14 27 38	13	1	4	0·9	III	T11A	
0202+14	R		02 02 07·1	0·3 4	5	20	+14 59 49	5	3	17	2·9	III	T9	
0204+06		4C 06·9	02 04 28·6	0·9 13	1	3	+06 44 38	12	1	3	1·0	III QSO? 16^m	T11A	
0207+09		02+*02*, 4C 09·8	02 07 07·3	0·9 14	1	4	+09 35 43	15	1	4	0·8	II N 17^m	T11A	Odd S

0207−11		02−*13*	02	07	38·4	1·1	17	1	4	−11	12	11	15	1	3	0·9	III			T11B	
0208+21		4C 21·9	02	08	23·3	0·9	12	1	5	+21	05	11	10	2	10	0·9	III			T10	
0216−25	R	02−*215*	02	16	26·6	1·3	18	3	4	−25	02	02	8	3	12	0·7	III			T10	
0229+13		4C 14·13	02	29	02·3	0·8	12	1	2	+13	09	36	10	1	4	1·4	III	QSO	18^m	T11A	
0230−06			02	30	23·0	1·7	25	1	2	−06	59	12	22	1	2	0·7	III			T11B	
0231−23	R	02−*211*	02	31	07·1	0·7	10	3	7	−23	34	08	13	2	6	0·6	III			T9	
0232−04	R	4C −04·6	02	32	36·1	0·5	8	2	12	−04	15	06	7	2	13	0·9	III	QSO	$16{\cdot}5^m$	T9 T11B	
0235−19	R	02−*110*	02	35	25·2	0·4	5	3	6	−19	45	30	5	3	16	2·8	III			T9	
0237−23			02	37	52·1	0·4	5	2	8	−23	22	08	5	3	14	5·0	III	QSO	$16{\cdot}6^m$	T10 T11A	
0253+13			02	53	49·6	1·6	23	1	3	+13	22	29	21	1	4	0·5	III–IV			T11A	
0304−12			03	04	35·7	1·6	23	1	2	−12	17	24	18	1	3	0·8	I	SO	15^m	T11B	
0312+10		4C 10·10	03	12	37·4	0·8	12	1	4	+10	01	36	13	1	3	0·9	II	g	$19{\cdot}5^m$	T11A	
0312−03		03−*01* 4C −03·11	03	12	52·1	1·9	28	1	2	−03	27	57	21	1	3	0·6	III	QSO?	$18{\cdot}5^m$	T11B	
0338+07		4C 07·13	03	38	12·2	1·0	15	1	4	+07	26	05	15	1	4	0·7	III			T11A	
0349+26		4C 26·12	03	49	01·7	0·9	12	1	9	+26	15	20	10	2	17	0·7	III–IV			T10	
0356+14		3C 96 4C 14·10	03	56	11·8	1·2	17	1	4	+14	27	24	17	1	4	0·7	III			T11A	
0404+03	R	3C 105 4C 03·8	04	04	45·2	0·3	5	5	8	+03	33	11	5	2	10	3·4	III			T9	
0406−18	R		04	06	52·0	0·5	7	2	11	−18	05	04	7	2	12	1·3	III			T9	
0408+07		4C 07·14	04	08	32·1	0·8	12	1	4	+07	00	08	12	1	4	0·9	III	QSO?	18^m	T11A	
0417+15		4C 15·13	04	17	30·9	1·2	17	1	3	+15	09	51	15	1	3	0·7	III			T11A	
0417+25		4C 25·14	04	17	46·1	1·1	15	1	9	+25	19	06	12	2	20	0·5	III–IV			T10	
0421+00		4C 00·15	04	21	15·5	1·5	22	2	4	+00	23	51	15	1	4	1·1	III			T11B T12	
0422+00		(04+05)	04	22	11·8	1·5	22	1	4	+00	29	18	15	2	6	0·7	III	QSO	17^m	T11B T12	Odd S
0422+08		4C 08·14	04	22	55·9	1·4	21	1	2	+08	26	29	18	1	2	0·9	III			T11B	
0425+17		4C 17·26	04	25	04·2	1·2	17	1	4	+17	46	24	15	1	4	0·6	III			T12	
0428+01		3C 118 4C 01·10	04	28	31·1	1·0	14	1	3	+01	06	30	14	1	3	0·9	III			T11A	
0431−02	R	3C 121 4C 02·17	04	31	23·0	0·4	6	3	15	−02	36	03	6	3	22	1·0	III			T9	
0453+22		3C 132 4C 22·11	04	53	42·4	0·6	8	1	6	+22	44	40	7	2	20	2·1	II	g	19^m	T10	

TABLE 2 (*Continued*)

(1) Parkes Catalogue Number	(2) Repeat Obs.	(3) Other Catalogue Numbers	(4) Right Ascension h m s	(5) Error in R.A. s ″	(6) No. of Days Obs.	(7) No. of Scans	(8) Declination	(9) Error in Dec. ″	(10) No. of Days Obs.	(11) No. of Scans	(12) S_{2650}	(13) Identification	(14) Period of Obs.	(15) Remarks
0454+06	R	04+01*2*	04 54 20·9	0·9 14	3	9	+06 39 58	9	3	11	0·5	III QSO? 17·5^{m}	T11A, T11B	
0459+25		3C 133, 4C 25·16	04 59 54·7	0·5 7	1	4	+25 12 01	7	1	4	3·6	III–IV	T11A	
0508−22	R	05−2*3*	05 08 53·4	0·4 6	4	18	−22 05 24	5	3	20	0·9	III	T9	
0512+24		3C 136·1, 4C 24·10	05 12 58·3	0·9 12	1	3	+24 55 13	7	2	12	1·6	II D 17^{m}	T10	
0541−24	R	05−2*7*	05 41 04·0	1·2 17	3	7	−24 22 25	8	2	10	0·5	III	T11A	
0545+26		4C 26·18	05 45 36·5	1·4 19	1	4	+26 35 06	13	2	12	0·6	III–IV	T10	
0601+20		3C 152, 4C 20·17	06 01 30·0	1·1 15	1	4	+20 21 26	16	1	3	0·7	IV	T11A	
0601+24		4C 24·11	(06 01 50·8)	— —	0	0	+24 29 38	19	1	4	0·7	III	T10	
0610+26		3C 154, 4C 26·20	06 10 43·2	0·4 6	1	9	+26 05 25	6	2	14	3·4	III	T10	
0615+22		3C 157, 4C 22·15	06 15 00·7	0·5 7	1	4	+22 40 49	8	1	3	(6·6)	IC 443	T11A	Ext α, δ size 24′
0628+25		4C 25·18	06 28 19·9	1·3 18	1	4	+25 02 44	18	1	5	0·6	II E 18^{m}	T11A	
0640+23		3C 165, 4C 23·17	06 40 06·3	0·7 9	1	5	+23 21 59	8	2	10	1·4	III	T10	
0642+21		3C 166, 4C 21·21	06 42 25·6	0·7 9	1	4	+21 25 01	7	2	10	1·8	II g 19^{m}	T10	
0649+22		4C 22·18, NRAO 249	06 49 45·1	1·6 21	1	3	+22 36 07	15	2	8	0·6	II g 19^{m}	T10	
0659+25		3C 172, 4C 25·19	06 59 04·3	0·8 10	1	2	+25 18 05	7	2	9	1·7	III	T10	
0710+11	R	3C 175, 4C 11·26	07 10 15·4	0·8 12	2	2	+11 51 23	5	3	14	1·3	QSO 17·5^{m}	T10	
0711+14	R	3C 175·1, 4C 14·21	07 11 15·4	0·4 7	3	8	+14 41 15	13	1	4	1·2	III	T10	
0721+16		(3C 177), 4C 16·21	07 21 58·3	0·8 11	1	8	+16 07 35	14	1	5	0·8	II D 17·5^{m}	T11A	
0725+14	R	3C 181, 4C 14·24	07 25 20·4	0·7 10	4	4	+14 43 57	8	4	14	1·2	QSO 19^{m}	T10	

0736+21		4C 21·23	07	36	49·1	1·6	21	1	6	+21	01	36	15	2	17	0·4	III			T10	
0741−06	R	4C −06·18	07	41	54·6	0·3	5	2	9	−06	22	20	4	3	17	4·9	III			T9	
0802+24		3C 192 } 4C 24·16 }	08	02	36·6	0·4	6	1	7	+24	18	24	6	2	16	3·3	II	D	15^m	T10	Odd S
0805−07			08	05	50·0	0·7	11	1	5	−07	42	30	11	1	5	1·1	III	QSO?	19·5^m	T11A	
0812+13		4C 13·37	08	11	57·7	0·7	11	1	5	+13	07	07	12	1	3	1·1	II	E	18^m	T11A	
0819+06	R	3C 198 } 4C 06·30 }	08	19	51·1	0·7	10	2	5	+06	06	24	10	2	5	0·9	I	E	17·5^m	T11A	Ext δ
0827+07		4C 07·25	08	27	24·3	1·4	20	1	3	+07	55	52	19	1	2	0·8	III	QSO?	20^m	T11B	
0829+18·7			08	29	25·0	1·0	14	1	2	+18	42	41	13	1	4	0·9	II	N	18^m	{ T11A T12	
0829+18·5			08	29	33·0	1·5	23	1	4	+18	30	15	23	1	4	0·2	III			{ T11A T12	
0834−19	R		08	34	55·7	0·4	5	3	16	−19	41	35	5	3	14	2·6	III			T9	
0835+25		4C 25·22	08	35	53·4	1·1	15	1	8	+25	37	23	12	2	16	0·5	III			T10	
0837−12		3C 206 } NRAO 299 }	08	37	29·5	0·7	10	1	4	−12	03	33	9	1	6	1·0	III	QSO	15·7^m	T9	
0845+09		(4C 09·30)	08	45	24·8	2·0	28	1	3	+09	49	52	25	1	4	0·4	III			T11A	
0850−03		4C −03·34	08	50	56·6	1·4	21	1	3	−03	29	36	17	1	4	0·7	III			T11B	
0855−19	R	08−*119*	08	55	48·9	0·7	10	3	9	−19	39	04	7	4	20	1·0	III	QSO?	19·5^m	{ T10 T11B	
0906+01		(4C 01·24)	09	06	35·7	0·7	10	1	4	+01	33	53	11	1	4	1·2	III	QSO?		T11A	
0909+16	R	4C 16·27	09	09	15·7	2·1	30	2	2	+16	30	55	17	1	4	0·6	III	E	18·5^m	T12A	
0911+17		4C 17·48	09	11	17·0	1·0	15	1	4	+17	28	30	20	1	4	0·8	III			T12A	
0915+22		4C 22·23	09	15	38·4	1·6	22	1	4	+22	45	00	22	1	4	0·4	III			T10	
0940+00		4C 00·30	09	40	45·5	1·0	15	1	5	+00	09	24	15	1	6	0·7	III			T11A	
0947+14	R	3C 228 } 4C 14·34 }	09	47	28·2	0·3	5	5	15	+14	34	02	5	3	12	1·9	III			T9	
0949+24		3C 229	09	49	10·6	0·7	10	1	6	+24	36	27	9	1	8	1·2	II	db	18^m	T10	
0955−01		4C −01·20	09	55	55·4	1·1	17	1	4	−01	26	05	17	1	4	0·7	III			T11A	
1004+13		4C 13·41	10	04	44·0	0·9	13	1	5	+13	03	28	13	1	5	0·8	III	QSO?	16^m	T11A	
1015−31	R	10−*35*	10	15	54·4	0·5	6	4	7	−31	29	30	5	2	8	3·0	III			T9	
1019+22		3C 241 } 4C 22·28 }	10	19	09·2	1·0	14	1	4	+22	14	21	14	1	4	0·8	III			T10	
1022+20	R	3C 242 } 4C 20·22 }	10	22	36·3	1·1	15	3	9	+20	25	37	10	2	8	0·7	III	QSO?	18·5^m	T10	
1027+00		4C 00·35	10	27	34·3	1·7	26	1	2	+00	52	59	15	1	6	0·5	III			T11A	
1055+20		4C 20·24	10	55	36·3	2·1	30	1	2	+20	08	14	8	1	4	1·9	III	QSO?	18·5^m	T10	
1103−20	R	11−*22*	11	03	55·1	0·4	6	5	8	−20	52	46	6	2	11	1·3	III			T9	

TABLE 2 (*Continued*)

(1) Parkes Catalogue Number	(2) Repeat Obs.	(3) Other Catalogue Numbers	(4) Right Ascension h m s	(5) Error in R.A. s ″	(6) No. of Days Obs.	(7) No. of Scans	(8) Declination	(9) Error in Dec. ″	(10) No. of Days Obs.	(11) No. of Scans	(12) S_{2650}	(13) Identification	(14) Period of Obs.	(15) Remarks
1103−24		11−*21*	11 03 45·9	1·4 19	1	3	−24 28 25	17	1	5	0·6	II D 17·5^m	T11A	
1106+25		3C 250 4C 25·34	11 06 10·6	1·6 21	1	3	+25 17 21	19	1	4	0·6	III	T10	
1107+10	R		11 07 09·9	0·4 6	4	18	+10 59 58	7	3	15	0·8	III QSO? 18·5^m	T9	
1110−01		11−*05* 4C −01·25	11 10 58·4	0·8 12	1	4	−01 56 10	12	1	4	0·9	III	T11A	
1118+23		3C 256 4C 23·27	11 18 04·8	1·0 14	1	5	+23 44 24	14	1	5	0·7	II D 17·5^m	T10	
1131−17		(11−*17*)	11 31 52·7	1·0 14	1	4	−17 11 12	14	1	4	0·8	III QSO? 19^m	T11A	
1137+12		4C 12·42	11 37 53·6	0·8 12	1	4	+12 19 41	13	1	5	0·9	I E 16·5^m	T11A	
1138+01	R	11+*08* 4C 01·32	11 38 34·3	0·5 7	3	6	+01 30 51	6	3	10	1·4	III	T9	
1140+22		3C 263·1 4C 22·30	11 40 48·4	0·8 11	1	4	+22 23 36	8	1	8	1·6	III	T10	
1210+20		4C 20·27	12 10 23·2	1·2 16	1	4	+20 49 28	14	1	6	0·8	III	T10	
1212−00		12−*07* 4C −00·48	12 12 13·6	1·2 18	1	5	−00 43 23	17	1	6	0·6	III	T11A	
1222+21		4C 21·35	12 22 24·0	0·7 10	1	5	+21 39 33	13	1	4	1·1	III QSO 18^m	T10	
1226−21		12−*26*	12 26 08·1	1·4 20	1	4	−21 09 44	17	1	4	0·7	II db 20^m	T11B	
1232+21		3C 274·1 4C 21·36	12 32 57·6	0·7 10	1	7	+21 37 10	10	1	7	1·6	III	T10	
1245−19	R		12 45 44·8	0·3 4	4	9	−19 42 55	4	2	9	3·5	III	T9	
1251+15		3C 277·2 4C 15·40	12 51 03·3	0·8 11	1	4	+15 58 40	11	1	6	1·0	III	T11A	
1254−30		12−*38*	12 54 37·0	2·2 28	1	2	−30 05 35	21	1	3	0·6	I db 16^m	T11B	
1318+11	R	4C 11·45	13 18 49·0	0·4 6	3	10	+11 22 16	6	2	14	1·2	III	T9 T10	
1328+25·4		3C 287 4C 25·43	13 28 16·6	0·8 11	1	3	+25 24 30	8	1	3	5·1	III QSO 17·7^m	T11B	
1328−25A			13 28 21·8	1·2 16	2	8	−25 44 26	17	2	10	0·7	III QSO? 20^m	T11A T12	
1328−25B			13 25 57·6	2·0 28	1	4	−25 42 36	25	1	3	0·2		T12	
1329−25			13 29 45·0	1·0 14	2	8	−25 44 24	16	2	8	0·8	II g 19·5^m	T11A T12	
1340−17			13 40 51·8	1·0 15	1	4	−17 33 36	15	1	4	0·7	III	T11A	Odd S

1347+21		3C 291 4C 21·40	13	47	15·4	1·2	17	1	6	+21	22	24	15	1	5	0·5	III	QSO?	16^{m}	T10 T12	
1352+16	R	3C 293·1 4C 16·38	13	52	13·9	0·8	11	3	21	+16	29	33	12	3	19	0·4	I	g	20^{m}	T9	
1355+01			13	55	19·6	0·8	11	1	4	+01	01	06	11	1	4	1·0	III			T11A	
1404−01	R		14	04	14·9	1·7	25	1	2	−01	40	07	13	2	8	0·6	III	QSO?	$19{\cdot}5^{m}$	T10	
1410−06			14	10	56·8	1·3	18	1	4	−06	56	29	18	1	4	0·6	II	E	19^{m}	T11A	
1423+24		4C 24·31	14	23	34·8	0·7	9	2	9	+24	17	13	11	1	4	1·0	III	QSO?	18^{m}	T10	
1434+03	R	14+0*10* 4C 03·30	14	34	25·5	0·3	4	8	22	+03	37	10	5	3	23	1·8	III			T9	
1445−16	R	14−1*18*	14	45	28·6	0·5	7	2	9	−16	08	02	7	2	9	1·1	III			T9	
1449−13·0		14−1*19*	14	49	52·4	1·0	15	1	3	−12	59	10	14	1	6	0·8	II	E	18^{m}	T11A T12	
1449−13·1		14−1*19*	14	50	13·0	1·0	15	1	4	−13	06	52	25	1	6	0·6	III			T11A T12	
1504−16·4		15−1*3*	15	04	03·9	1·5	23	1	2	−16	25	50	20	1	4	0·4	III			T12	
1504−16·7	R		15	04	16·0	0·4	6	2	5	−16	40	51	6	3	15	2·3	II	g	$18{\cdot}5^{m}$	T10	Odd S
1505+01		4C 01·41	15	05	55·5	1·1	17	1	4	+01	13	38	18	1	4	0·6	III	QSO?	$17{\cdot}5^{m}$	T11A	Odd S
1508−05	R	15−0*5* 4C −05·64	15	08	13·9	0·3	4	2	8	−05	31	43	7	2	6	2·8	III			T9	
1514+00		15+0*6* 4C 00·56	15	14	06·2	1·0	15	1	4	+00	25	58	9	1	5	1·7	II	E	$16{\cdot}5^{m}$	T11A	
1529+24		3C 321 4C 24·34	15	29	39·1	0·5	7	2	8	+24	13	20	8	1	5	2·2	III			T10	
1532+01			15	32	19·3	0·7	11	1	4	+01	41	07	11	1	4	1·1	III			T11A	
1535+13		4C 13·56	15	35	11·1	1·2	17	1	3	+13	54	37	14	1	3	1·0	III			T11B	
1539−09	R		15	39	25·8	0·6	9	2	10	−09	18	17	11	1	4	1·0	III			T11A	
1545+21		3C 323·1 4C 21·45	15	45	30·7	0·6	9	2	6	+21	01	37	9	1	5	1·6	III	QSO	16^{m}	T10	
1547+21		3C 324 4C 21·46	15	47	36·0	0·6	8	2	4	+21	34	39	9	1	4	1·5	III			T10	
1553+20	R	3C 326·1 4C 20·38	15	53	57·4	0·4	6	5	8	+20	12	55	10	1	4	1·3	III			T10	
1556−21	R	15−2*13*	15	56	09·5	0·4	6	5	26	−21	31	32	6	4	28	0·9	III			T9	
1606+10		4C 10·45	16	06	22·7	0·8	11	1	4	+10	36	38	11	1	4	1·1	III	QSO?	$18{\cdot}5^{m}$	T11A	Ext
1610+22		3C 331 4C 22·43	16	10	08·7	1·0	14	2	5	+22	29	36	15	1	4	0·7	III			T10	
1615+21		3C 333 4C 21·47	16	15	04·5	0·8	11	1	4	+21	14	46	11	1	4	1·0	III			T10	
1622+23		3C 336 4C 23·43	16	22	32·7	0·7	9	1	4	+23	52	04	9	1	4	1·5	III	QSO	$17{\cdot}5^{m}$	T10	
1622−31			16	22	44·1	1·2	16	1	1	−31	01	38	13	1	3	1·1	III	QSO?	$19{\cdot}5^{m}$	T11A	

TABLE 2 (*Continued*)

(1) Parkes Catalogue Number	(2) Repeat Obs.	(3) Other Catalogue Numbers	(4) Right Ascension h m s	(5) Error in R.A. s ″	(6) No. of Days Obs.	(7) No. of Scans	(8) Declination	(9) Error in Dec. ″	(10) No. of Days Obs.	(11) No. of Scans	(12) S_{2650}	(13) Identification	(14) Period of Obs.	(15) Remarks
1623−22			16 23 18·4	1·3 18	1	3	−22 49 04	17	1	3	0·7	IV	T11A	
1625+21		4C 21·48	16 25 20·7	1·3 18	1	4	+21 19 47	20	1	3	0·6	III	T10	
1627+23		3C 340 } 4C 23·44 }	16 27 29·7	0·7 10	1	3	+23 26 48	10	1	4	1·4	III	{ T10 { T12	
1634+26		3C 342 } 4C 26·49 }	16 34 33·7	0·9 12	2	6	+26 54 03	13	1	4	0·8	III QSO 18^m	T10	
1645+17		(3C 346) } 4C 17·71 }	16 45 28·0	0·7 10	1	3	+17 25 22	10	1	4	1·4	III QSO 19^m	{ T11A { T12	
1712−03		4C −03·62	17 12 23·6	1·0 14	1	6	−03 17 45	16	1	4	0·7	III–IV	T11A	
1730+20		3C 359 } 4C 20·42 }	17 30 39·7	1·0 14	2	11	+20 39 54	17	1	6	0·5	III	T10	
1732−08		NRAO 532	17 32 38·7	1·1 16	1	4	−08 00 38	16	1	4	0·6	III	T11A	
1741−03			17 41 20·4	0·5 8	1	4	−03 48 35	8	1	4	2·4	III	T11A	Odd S
1744+23		4C 23·45	17 44 25·0	0·7 10	2	11	+23 43 49	12	1	6	0·8	III	T10	
1801+01			18 01 44·3	0·7 11	1	5	+01 01 25	12	1	4	0·9	III QSO 19^m	T11A	
1810+26		4C 26·55	18 10 29·0	1·0 13	2	12	+26 28 26	16	1	6	0·5	II g $19{\cdot}5^m$	T10	
1819+22		4C 22·47	18 19 07·9	1·0 13	2	11	+22 49 35	16	1	6	0·6	III	T10	
1821+10			18 21 41·2	0·9 13	1	4	+10 43 12	15	1	5	0·8	III–IV	T11A	
1834+19			18 34 31·2	0·8 11	1	7	+19 39 12	15	1	4	0·8	I E 14^m	T11A	Ext α
1837+23		4C 24·46	18 37 57·3	0·8 10	2	12	+23 59 08	13	1	6	0·7	III	T10	
1859−23			18 59 47·0	0·7 9	1	3	−23 34 00	9	1	4	1·7	IV	T11A	
1915−12		19−*15*	19 15 06·4	0·9 13	1	4	−12 09 19	15	1	4	0·9	II db 18^m	T11A	
1921+14		3C 400	19 21 21·7	0·6 8	2	8	+14 24 00	30	1	2	108·0	IV	T10	Ext α, δ size $< 3'$
1929−19		19−*18*	19 29 12·3	1·1 16	1	5	−19 38 01	17	1	4	0·6	III–IV	T11A	
1945−09			19 45 16·2	1·0 15	1	4	−09 27 52	15	1	4	0·8	III–IV	T11A	
2005−04		4C −04·76	20 05 46·0	1·2 18	1	4	−04 27 17	16	1	6	0·6	III QSO 18^m	T11A	
2012+23		3C 409 } 4C 23·53 }	20 12 18·1	0·4 6	2	14	+23 25 35	6	1	7	7·1	IV	T10	
2023−07			20 22 58·7	0·7 11	1	5	−07 45 23	14	1	4	1·1	III	T11A	
2031+21		4C 21·55	20 31 19·2	0·6 8	2	11	+21 35 58	9	1	7	1·4	II D $18{\cdot}5^m$	T10	
2039−29			20 39 38·0	1·5 20	1	3	−29 06 37	18	1	3	0·6	III QSO? $19{\cdot}5^m$	T11A	
2051+26		4C 26·58	20 51 07·8	1·0 13	2	13	+26 01 35	15	1	7	0·6	III	T10	
2121+24	R	3C 433 } 4C 24·54 }	21 21 30·8	0·4 5	3	14	+24 51 20	6	2	8	7·0	I D 17^m	T10	Ext α, δ

2127+04	R		21	28	02·8	0·3	4	5	19	+04	49	01	4	3	19	2·9	III			T9	Odd S
2138+14		4C 14·78	21	38	24·0	1·0	14	1	3	+14	25	00	15	1	3	0·9	III			T11A	Odd S
2144−17	R		21	44	17·1	0·7	10	3	16	−17	54	05	14	2	11	0·6	III	QSO	$19·5^m$	T10	
2149+17			21	50	01·1	0·9	13	1	3	+17	20	22	15	1	2	1·0	III			T11A	
2149−20	R	21−*121*	21	49	04·4	0·4	5	3	19	−20	00	13	6	3	18	1·3	III			T9	
2154−01		4C −01·57	21	54	12·3	1·2	18	1	4	−01	40	06	15	1	4	0·8	III			T12	
2154−18·4	R	21−*123*	21	54	10·3	1·2	17	1	4	−18	28	06	18	1	5	1·2	III			T12	
2154−18·3	R	21−*123*	21	54	43·2	1·2	17	1	5	−18	21	48	18	1	3	0·9	III			T12	
2201+04		4C 04·77	22	01	43·6	1·1	17	1	3	+04	25	52	17	1	4	0·7	III	QSO?	16^m	T11A	
2203+05		4C 05·82	22	03	49·2	1·5	22	1	4	+05	41	36	20	1	4	0·6	III			T12	
2210−25			22	10	11·9	1·4	20	1	4	−25	44	00	18	1	4	0·9	III			T12	
2215+02			22	15	15·7	1·1	17	1	4	+02	05	19	18	1	3	0·6	III			T11A	
2227−08			22	27	01·1	0·9	13	1	3	−08	48	12	7	1	6	2·0	IV	QSO?	18^m	T11A T11B	
2229−17			22	29	38·5	1·2	17	2	6	−17	14	12	15	1	4	0·6	III			T11A T12	
2234−17			22	34	54·2	1·2	17	1	4	−17	27	36	17	1	4	0·7	III			T12	
2247+13		4C 13·84	22	47	15·0	1·1	15	1	4	+13	15	36	15	1	4	0·8				T12	
2305+18·8		4C 18·68	23	05	18·0	1·4	20	1	4	+18	45	28	17	1	6	0·5	III			T11A	
2313+10		4C 10·71	23	13	03·0	1·2	17	1	4	+10	11	18	17	1	4	0·7	III			T12	
2318+07			23	18	09·7	1·5	22	2	7	+07	55	12	18	2	4	0·4	I	E NGC 7626	$13·8^m$	T12	Ext δ
2318+23		3C 460 4C 23·58	23	18	58·7	0·7	10	2	8	+23	30	31	12	1	4	0·9	III			T10	
2319+07			23	20	05·4	1·5	22	2	4	+07	55	56	15	2	8	0·7	III	QSO?	$17·5^m$	T11A T12	
2322−12	R	23−*112*	23	22	42·5	0·6	9	6	10	−12	23	58	9	2	6	0·8	I	E5	17^m	T10	
2328+10	R	(4C 10·73)	23	28	07·8	0·7	10	2	5	+10	43	53	8	2	6	0·9	III	QSO	18^m	T11A	Odd S
2329−10	R	23−*118*	23	29	50·0	0·4	6	4	29	−10	14	35	6	4	31	0·7	III			T9	
2335+03		4C 03·59	23	35	34·1	1·2	18	1	3	+03	10	21	15	1	3	0·9	III			T11B	
2335+26		3C 465 4C 26·64	23	35	57·4	0·5	6	2	7	+26	44	15	7	1	4	4·0	I	D	12^m	T10	Ext α, δ
2337+22		4C 22·63	23	37	52·6	1·0	14	1	2	+22	04	15	14	1	2	1·4	III			T10	
2338+04		4C 04·81	23	38	24·1	0·8	12	1	6	+04	14	31	15	1	4	0·8	III	QSO?	$19·5^m$	T11A	
2349−01	R	23−*020* 4C −01·61	23	49	22·5	1·0	15	1	4	−01	26	03	9	2	6	0·9	II	N	$17·5^m$	T10	

(*b*) *Changes in Optical Identification*

The following suspected quasi-stellar object identifications given in SCE have been optically confirmed: 0119−04, 0736+01, 0812+02, 0859−14, 1127−14, 1148−00, 1229−02, 1354+19, 1420−27, 1422−29, 1454−06, 1510−08, 2120+16, 2135−14, 2145+06, 2146−13, 2249+18, 2251+11, 2344+09, 2345−16, 2354+14.

TABLE 3

CORRECTIONS TO SOURCE POSITIONS IN SCE

Source	Right Ascension				Declination			
	h	m	s	″	°	′	″	″
0202−76	02	02	04·4	±15	−76	34	41	±14
0842−75	08	41	58·1	±13	−75	29	55	±14
1547−79	15	47	38·9	±13	(−79	32	36)	
2006−56	20	06	23·9	±19	−56	39	58	±17
2354−35	23	54	26·2	±16	−35	01	19	±15

A number of changes in identifications have been made, with some additional identifications. These are given in Table 4.

TABLE 4

MODIFICATIONS AND ADDITIONS TO OPTICAL IDENTIFICATIONS GIVEN IN SCE

Abbreviations used as for Table 2 (see text, Section VII)

Source	Identification given in SCE	New Identification	Source	Identification given in SCE	New Identification
0231−23	15^m QSO	Nil	1107+10	$18·5^m$ QSO?	Nil
0319+12	—	18^m QSO?	1502+26	—	16^m db
0413−21	—	$19·5^m$ QSO?	1511+26	—	$17·5^m$ db
0453−30	—	19^m E	2128−12	—	19^m QSO (confirmed)
0456−30	—	$17·6^m$ E3			
0508−22	$18·5^m$ QSO?	19^m galaxy	2149−20	—	19^m QSO?
0539−01	—	HII region	2154−18	$16·5^m$ QSO?	Nil
0834−20	—	$18·5^m$ QSO?	2216−28	18^m E	19^m QSO?
0949+00	$18·5^m$ QSO?	$18·5^m$ N galaxy	2221−02	—	$15·3^m$ N
1049−09	—	$16·8^m$ QSO (confirmed)	2251+15	—	18^m QSO (confirmed)
1103−20	—	$18·2^m$ E	2322−05	N	$18·5^m$ N

IX. COMPARISON WITH OTHER POSITIONS

Twenty-one of the sources listed in Table 2 have been measured by Adgie and Gent (1966) using the interferometer at the Royal Radar Establishment, Great Malvern. Three of these sources have also been measured by Parker, Elsmore, and Shakeshaft (1966). These measurements are about five times more accurate than the positions given in the present paper, but the latter have been retained for completeness. In general the present positions are in agreement with those of Adgie and Gent within the quoted errors. Two exceptions are 0404+03 (3C 105) and 0725+14, which differ by several times the estimated errors.

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