SOURCE FLUX DENSITIES AT 153 MHz

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Summary

This paper gives flux density measurements of 312 sources at 153 MHz obtained from a general continuum survey made with the 210 ft radio telescope of the Australian National Radio Astronomy Observatory, Parkes, N.S.W. The beamwidth of the telescope at this frequency is 2·18°. Some discussion of results for spectra is given and a comparison is made with other measurements of the same sources.

I. Introduction

Details of radio sources in the southern sky have now been published at four frequencies by Mills, Slee, and Hill (1958) at 85 MHz, and in the Parkes catalogue of radio sources at 408, 1410, and 2650 MHz (Bolton, Gardner, and Mackey 1964; Price and Milne 1965; Day *et al.* 1966). Some sources visible from the northern hemisphere have been measured at 159 and 178 MHz (Edge *et al.* 1959; Bennett 1962), at 400 MHz (Davis, Gelato-Volders, and Westerhout 1965), and at 240 and 412 MHz (Conway and Moran 1963), but the sources south of declination —32° have been catalogued at four frequencies only.

It is apparent that measurements are needed at many more frequencies before the source spectra can be accurately defined. This is particularly necessary in the cases of sources with curved spectra.

The results reported here were obtained from records made during a general continuum survey at 153 MHz with the 210 ft telescope of the Australian National Radio Astronomy Observatory at Parkes, N.S.W. This survey is now complete and detailed maps are in preparation. Flux densities are given for 248 sources and upper limits for a further 64 sources are listed.

II. Observations

(*a*) *Equipment*

The receiver used was one of the standard receivers available at the Observatory. It is a solid state total power receiver with a bandwidth of 3·8 MHz. With a time constant of 1 sec, the peak-to-peak noise fluctuations are about 1·5 degK.

The feed consisted of a pair of dipoles and a reflector. The aerial beamwidth to half power was measured to be 2·18°.

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(b) *Calibration of the System*

The sources Hydra A and Hercules A were taken as standards of flux density. The flux densities assumed were 340 and 420 f.u.* for Hydra A and Hercules A respectively, obtained from the measurements of Conway, Kellermann, and Long (1963). (Standard sources from their measurements were also used to calibrate the Parkes catalogue.)

Measurements of the standard sources were used to calibrate a noise signal from a temperature-saturated noise diode. This signal was also compared with hot and cold loads in the course of calibrating the background survey and the two methods were found to give equivalent results.

(c) *Observing Procedure and Data Reduction*

Full details of the observations will be given in the report on the background survey. The flux density measurements were obtained from scans in declination that were made every 12′ in right ascension. The telescope drive rate was 2·5 deg/min throughout.

A consequence of this scanning grid was that very few scans passed directly through a source, and corrections to the observations were accordingly required. The method adopted was as follows. The charts for each scan were examined for sources and the position of each one was determined within the limits of the scanning grid. The Parkes catalogue was then searched for a source within 0·6° of this position. Provided that no other sources were catalogued within 0·6° and, further, that no strong sources were catalogued within a beamwidth of the telescope position, a tentative identification was made.

Measurements of the aerial response pattern showed it to be very close to Gaussian, and the source flux densities were corrected on this basis, using the position given in the Parkes catalogue.

Of the 1300 possible source records, only 312 were retained as reliable profiles free from confusion with neighbouring strong sources. The flux measurements of 64 of these (given in parentheses in Table 1) may include the effects of a weak source catalogued to be within a beamwidth of the source position.

III. Accuracy of the Flux Densities

The overall accuracy of the flux densities listed is probably 10% ± 0·8 f.u. Sources of error are as follows.

(i) *Scanning Grid*

Comparisons between corrected flux densities obtained from records on the scanning grid and measurements from on-source scans of a number of sources indicate that this is a source of error no greater than 2% for the measurements selected as satisfactory.

* 1 f.u. = 10^{-26} W m^{-2} Hz^{-1}.

(ii) *Noise Fluctuations*

Errors due to noise fluctuations on the records are not likely to exceed 0·8 f.u.

(iii) *Calibration*

Variations in the calibration signal will produce errors proportional to the source flux density. Repeated measurements showed variations of up to 6%.

(iv) *Other Errors*

No attempt was made to keep the position angle of the feed constant, and effects due to polarization of source or background have been neglected. However, such errors are likely to be small in relation to those mentioned above.

Most confusion effects have been removed by the selection process applied to the records.

IV. Results

(*a*) *Flux Densities*

Table 1 contains details of the 248 sources selected as reliable records. A further 64 measurements are given in parentheses where the measurement may have included effects due to a nearby weak source. Details of the columns of Table 1 are:

Column 1.—Source catalogue number from the Parkes catalogue.

Columns 2 and 3.—Mean position for epoch 1950·0 (from the Parkes catalogue).

Columns 4, 5, 6, 7, 8, and 9.—Flux densities in f.u. at frequencies of 85·5, 153, 159 (or 178, as indicated by an asterisk), 408, 1410, and 2650 MHz. Observations at 85·5 MHz are from the Mills, Slee, and Hill (MSH) catalogue; at 159 and 178 MHz from the 3C catalogue (Edge *et al.* 1959); and at 408, 1410, and 2650 MHz from the Parkes catalogue.

Column 10.—Spectral index as determined at 400 MHz (C, curved spectrum).

Columns 11 and 12.—Catalogue numbers as given in the 3C and MSH catalogues.

(*b*) *Source Spectra*

Of the 312 sources listed in Table 1, 11 show pronounced curvature in their spectra. Following the notation of Bolton, Gardner, and Mackey (1964), the sources with curved spectra are given under headings of positive or negative source spectra in the following list.

Positive Curvature Sources: 0122−25, 0132+07, 0241−51, 0532−05, 0949+00, 1331−09, 1934−63, 2154−18, 2201−55, 2226−38

Negative Curvature Sources: 0418−05, 0510−04

Negative Curvature Sources with a Minimum: 0220−42, 2216−03

A further 8 sources show signs of curvature at the lower frequencies, but measurements below 100 MHz are needed to confirm this.

Spectra of the sources exhibiting pronounced curvature are given in Figure 1.

TABLE 1

FLUX DENSITIES OF OBSERVED SOURCES

Flux density values shown in parentheses are uncertain

(1) Parkes Cat. No.	(2) Position (1950·0) R.A. h	m	s	(3) Dec. °	′	(4) Flux Densities at (MHz): 85·5	(5) 153	(6) 159	(7) 408	(8) 1410	(9) 2650	(10) Spectral Index α_{400}	(11) Other Cat. Nos. 3C	(12) MSH
0000+00														
2357+00	23	57	22	+00	26·3		18·03		2·3	<0·5	0·3	1·1±0·2		
0003+00														
0000−17	00	00	48	−17	43·9		14·69		5·5	2·2	1·4	0·7±0·2		
0003−42	00	03	28	−42	52·3	17	14·35		4·6	1·7	0·9	0·8		00−*42*
0004−83	00	04	09	−83	22·5		24·70		7·9	2·5	1·3			
0007−44	00	07	58	−44	40·0	31	26·82		6·5	1·7	0·9	1·0		00−*43*
0008−42	00	08	22	−42	10·2		9·31		6·4	5·4	2·6			
0010+00	00	10	34	+00	35·2	20	11·4		5·1	1·6	0·9	0·9±0·1	5	00+*02*
0012−38	00	12	52	−38	21·1	19	12·86		4·9	1·6	0·7	0·9		00−*35*
0013−63	00	13	35	−63	27·6	27	13·84		7·4	1·9	0·7	0·8		00−*61*
0020−25	00	20	38	−25	19·3	21	11·00		4·8	2·4	1·4	0·9		00−*27*
0021−29	00	21	58	−29	45·7	33	19·95		8·2	3·3	1·6	0·9		00−*29*
0022−60	00	22	53	−60	46·6		10·94		3·5	1·4	0·7			
0023−13	00	23	32	−13	04·7		(37·10)		5·0	1·3	0·6	1·1±0·2		
0031+01	00	31	49	+01	05·3	20	(18·3)		(3·0)	0·5	0·3	1·2±0·1		00+*06*
0032−20	00	32	39	−20	20·7	19	7·12		5·9	2·4	1·0	0·7		00−*216*
0036−62	00	36	30	−62	48·2		8·49		3·1	1·4	0·8			
0036+03	00	36	45	+03	03·5	14	(22·3)		4·1	1·6	1·1	0·7±0·1		00+*010*
0037+04	00	37	18	+04	39·0		36·69		3·8	0·8	0·5	1·1±0·2		
0047−02	00	47	12	−02	59·8	18	14·63		4·2	1·3	0·8	0·9±0·1		00−*014*
0048−44	00	48	25	−44	45·1	16	15·68		4·2	1·6	0·7	0·9		
0053−01	00	53	39	−01	34·5		42·23		10·3	2·0	(0·9)	1·2±0·1		00−*413*
0055−01	00	55	01	−01	39·6	(72)	46·16	17·0	12·1	4·7	3·6	0·6±0·1	29	00−*017*
0056−17	00	56	38	−17	16·8	29	12·60		5·5	1·7	0·9	1·0±0·1		00−*126*
0057−18	00	57	42	−18	04·6		(18·57)		3·9	1·2	0·7	0·9±0·2		
0101−12	01	01	53	−12	51·6	18	16·61		4·4	1·8	1·3	0·7±0·1		01−*11*
0103−45	01	03	06	−45	22·0	41	17·29		7·5	2·8	1·5	1·1		01−*41*

0105−16	01	05	48	−16	20·4	53	30·17	20·0	12·3	3·8	2·2	0·9±00	32	01−12
0109+02	01	09	32	+02	40·7		8·60		1·9	0·6	0·3	1·0±0·3		
0110−69	01	10	01	−69	17·2		(24·23)		5·5	2·0	1·0			
0114−21	01	14	26	−21	07·7	18	(25·30)		11·6	4·1	1·9	0·3		01−26
0115+02	01	15	49	+02	42·9		13·01		(4·5)	1·5	1·0	0·6±0·3	(37)	
0116−19	01	16	07	−19	05·3	14	(16·78)		2·6	1·2	0·7	0·8±0·1		01−18
0118+03	01	18	29	+03	28·3	(16)	(8·12)		(5·0)	1·2	0·6	1·1±0·3	(39)	(01+03)
0122−25	01	22	26	−25	33·6	9	8·70		4·2	1·3	0·7	0·5		01−29
0123−01	01	23	28	−01	38·5	88	25·14	26·0	16·4	4·5	(1·9)	1·0±0·1	40	01−05
0125−14	01	25	03	−14	18·7	30	23·3		8·9	2·4	1·5	0·8±0·1		01−111
0126−53	01	26	29	−53	10·4	11	10·4		3·8	0·9	0·6	0·7		01−54
0124−40	01	24	12	−40	59·1		12·26			1·4	2·6			
0128+03	01	28	40	+03	58·6	18	(9·15)		5·3	2·2	1·0	0·8±0·1		01+06
0128−26	01	28	07	−26	25·5	18	10·7		5·7	1·2	0·6	0·7		01−211
0129−07	01	29	35	−07	10·8	19	9·31		(4·7)	1·2	0·7	0·9±0·1		01−06
0129−51	01	29	11	−51	18·5	8	(18·33)		3·1	1·0	0·5	0·6		01−55
0131−36	01	31	42	−36	44·6	56	31·79		16	7·1	3·4	0·8		01−311
0132+07	01	32	39	+07	56·2	15	10·75		6·8	2·4	1·3	0·8±0·1		01+08
0137−10	01	37	44	−10	12·3		4·4		(2·0)	1·2	0·6	0·9±0·4		
0139−14	01	39	17	−14	59·6		13·3		2·2	0·4	0·3	1·0±0·3		
0146+00	01	46	16	+00	07·2		19·0		2·6	(0·5)	(0·5)			
0146+06	01	46	08	+06	06·3	19	11·7		3·4	0·8	0·4	1·1±0·1		01+011
0148−29	01	48	20	−29	46·5		11·8		2·8	1·8				01−217
0150+00	01	50	15	+00	07·3		(20·6)		1·9	0·5	0·3	1·0±0·3		
0152−76	01	52	14	−76	29·8		9·3		3·9	0·8				
0157+01	01	57	38	+01	10·3	16	10·1		4·5	0·6	0·4	1·1±0·1		01+014
0157−31	01	57	57	−31	08·2	26	13·4		9·3	3·7	2·4	0·7		01−315
0202−76	02	02	00	−76	34·1	18	11·2		8·0	2·6	1·3	0·6		01−71?
0213−13	02	13	12	−13	13·4	(42)	(30·6)	(13)	11·9	5·0	2·7	0·7±0·1	(62)	02−15
0214−48	02	14	53	−48	03·4	31	18·5		9·5	2·4	1·3	0·8		02−43
0215+02	02	15	50	+02	44·1		24·7		3·5	0·7	0·3	1·3±0·2		
0216−25	02	16	29	−25	03·1	15	(19·3)		4·7	1·3	0·7	0·7		02−25
0218−02	02	18	21	−02	10·5	74	(73·8)	26	12·4	3·9	1·7	1·0±0·0	63	02−07
0220−42	02	20	21	−43	13·9	17	11·5		4·2	0·9	1·6	0·9		02−45
0222−23	02	22	49	−23	26·3	19	16·5		6·2	1·9	1·1	0·7		02−27
0235+09	02	35	46	+09	59·3		14·5		2·6	1·3	(0·4)	0·6±0·3		
0237+09	02	37	43	+09	44·6				(1·1)	<0·5	0·3			

TABLE 1 (*Continued*)

(1) Parkes Cat. No.	(2) Position (1950·0) R.A. h m s	(3) Dec. ° ′	(4) Flux Densities at (MHz): 85·5	(5) 153	(6) 159	(7) 408	(8) 1410	(9) 2650	(10) Spectral Index α_{400}	(11) Other Cat. Nos. 3C	(12) MSH
0241−51	02 41 52	−51 22·7	37	22·8		11·8	2·9	0·8	0·7		02−*53*
0245−55	02 45 27	−55 54·2	48	35·9		12·2	2·4	1·2	0·9		02−*54*
0246−13	02 46 15	−13 35·3	15	13·7		2·1	0·8	0·6	0·9±0·1		02−*114*
0255+05	02 55 04	+05 50·7	51	37·3	25*	16·2	5·9	3·3	0·8±0·0	75	02+*010*
0257−05	02 57 32	−05 44·3		12·0		2·9	0·4	0·3	1·2±0·3		
0304−12	03 04 34	−12 17·6		36·3		5·5	1·5	0·8	1·0±0·2		
0312−03	03 12 54	−03 27·3	20	15·3		4·0	1·2	0·8	0·9±0·1		03−*01*
0319−45	03 19 39	−45 21·8	19	12·3		9·5	3·4	1·7	0·5		03−*43*
0320−37	03 20 42	−37 25·0	950	474·2		249		89			03−*31*
0332−05	03 32 09	−05 44·8		(18·2)		3·3	1·6	1·0	0·6±0·2		
0331−01	03 31 42	−01 21·2	64	43·8	19·5	11·9	2·5	1·5	1·1±0·0	89	03−*03*
0332−39	03 32 17	−39 10·5	10	(18·7)		4·5	1·7	0·9	0·5		03−*32*
0336−01	03 36 59	−01 56·2		19·5		3·5	1·5	2·2	C		
0344−34	03 44 40	−34 31·5	33	18·9		9·3	3·0	1·7	0·8		03−*36*
0347+05	03 47 08	+05 43·0	15	(27·9)		9·0	3·3	2·0	0·7±0·3		03+*010*
0349−14	03 49 10	−14 38·3	44	16·6	(8·5)	11·6	2·9	(1·4)	0·9±0·4	(95)	03−*19*
0356+10	03 56 15	+10 17·7		44·2	44*	27·5	10·8	(5·8)	0·7±0·1	98	
0410−75	04 10 11	−75 15·3	87	55·30		40	13·5	7·5	0·5		04−*71*
0418−05	04 18 22	−05 44·6		(46·5)		3·8	0·8	0·6	0·9±0·2		
0424−26	04 24 41	−26 49·9		18·2		3·7	1·2	0·6			
0427−36	04 27 52	−36 37·5	35	15·2		7·2	2·1	1·1	1·0		04−*36*
0427−53	04 27 51	−53 56·1	50	39·5		14·6	5·6	2·7	0·8		04−*54*
0431−13	04 31 49	−13 29·0	(38)	17·9				0·4			}04−*112*
	04 31 55	−13 17·0				(7·7)	1·4	0·8	1·1±0·1		
0442−28	04 42 38	−28 14·8	82	66·0		22	7·1	3·9	0·9		04−*218*
0446−20	04 46 25	−20 36·0	19	18·6		4·2	0·9	0·4	1·0		04−*219*
0448−04	04 48 30	−04 36·4	(23)	6·9		(5·0)	(0·7)	0·5	1·1±0·1		04−*117*
0452+10	04 52 20	+10 04·4		13·7		2·8	0·6	0·3	1·2±0·3		
0453−20	04 53 13	−20 40·5	18	(18·1)		9·3	4·7	3·1	0·4		04−*222*
0455−40	04 55 49	−40 29·9	13	9·5		3·7	1·0	0·6	0·8		04−*410*

0456−30	04	56	33	−30	10·8		28·2			2·7	1·6			
0458+01	04	58	08	+01	26·5	15	11·3		3·4	0·8	0·6	0·9±0·1		04+114
0502−10	05	02	30	−10	19·5	20	7·0		4·8	1·4	0·8	0·9±0·1		05−11
0503−28	05	03	42	−28	59·7	30	26·7		5·5	1·1	0·6	1·1		05−22
0508−07	05	08	37	−07	38·1		(21·4)		3·1	1·1	0·6	0·8±0·2		
0510−04	05	10	18	−04	0·18		25·5		3·1	0·6	0·5	0·9±0·3		
0511−30	05	11	44	−30	31·7	29	10·13		8·9	2·7	1·2	0·8		05−35
0511−48	05	11	35	−48	28·0	41	(43·8)		13·2	3·5	2·1	0·7		05−42
0514+10	05	14	05	+10	53·3		(21·3)		3·3	1·1	0·7	0·8±0·2		
0517−56	05	17	36	−56	16·3		30·7		4·6	1·2	0·8			
0518−45	05	18	24	−45	49·8	570	343·0		166	66	30	0·8		05−43
0521−36	05	21	14	−36	30·0	66	54·5		37	18·6	11·4	0·4		05−36
0532−05	05	32	51	−05	25·0	(69)	41·6	45	(213)	(289)	(49·0)	HII region	145	05−011
0604−20	06	04	29	−20	22·2	23	20·0		8·9	3·3	2·0	0·6		06−22
0611−74	06	11	36	−74	30·0		5·4		2·6	1·1				
0612−47	06	12	16	−47	26·1	27	12·2		5·8	1·2	0·7	1·0		06−43
0625−53	06	25	18	−53	39·3	113	73·3		26	6·7	3·5	1·0		06−55
0637−75	06	37	20	−75	14·4	20	13·0		9·7	6·7	4·9	0·4		06−71
0646−39	06	46	33	−39	53·1	26	23·6		7·0	2·6	1·5	0·8		06−312
0651−56	06	51	53	−56	38·3	18	8·6		4·9	1·1	0·7	0·8		06−57
0656−24	06	56	54	−24	12·5	59	50·3		13·0	3·1	1·3	1·0		06−216
0709−20	07	09	39	−20	37·3	33	26·8		8·7	2·0	1·1	0·8		07−23
0710+11	07	10	12	+11	52·1		21·8	17·2*	8·6	2·7	1·3	1·0±0·1	175	
0727−36	07	27	20	−36	34·3		8·3		4·9	2·0	1·3			
0748−44	07	48	08	−44	04·7	27	14·6		8·0	2·3	1·1	0·8		07−413
0800−09	08	00	15	−09	49·8		8·09		6·1	1·7	(1·1)	1·0±0·2		
0806−10	08	06	31	−10	19·1	40	25·44	21·0	13·7	3·4	2·3	0·8±0·0	195	08−14
0809−05·2	08	09	33	−05	10·9		25·17			0·6				
0809−05·7	08	09	35	−05	40·8	22			4·8	1·3	0·8	0·9±0·1		08−04
0812−02	08	12	56	−02	59·3	35	19·54		(9·4)	1·6	0·9	1·0±0·1	196·1	08−05
0812+02	08	12	51	+02	04·8	22	26·66		6·0	2·0	1·0	0·9±0·1		08+02
0818−74	08	18	57	−74	44·6		(47·2)			0·6				
0819+06	08	19	53	+06	06·9	60	(62·76)	17·8*	6·6	2·3	(0·8)	1·1±0·1	198	08+03
0825−20	08	25	07	−20	16·3	26	20·63		11·7	3·7	2·1	0·5		08−24
0832−07	08	32	36	−07	36·0	13	11·13		3·5	0·4		1·1±0·2		08−010

* Flux values measured at 178 MHz.

TABLE 1 (*Continued*)

(1) Parkes Cat. No.	(2) Position (1950·0) R.A. h m s	(3) Dec. ° ′	(4) Flux Densities at (MHz): 85·5	(5) 153	(6) 159	(7) 408	(8) 1410	(9) 2650	(10) Spectral Index α_{400}	(11) Other Cat. Nos. 3C	(12) MSH
0837−12	08 37 27	−12 04·1		27·91		5·7	1·8	1·0	0·9±0·2		
0842−75	08 42 12	−75 29·5	58	51·6		10·5	4·3	2·4	1·1		08−*71*
0843−33	08 43 10	−33 38·3	17	(26·61)		4·6	2·0	1·3	0·8		08−*38*
0850−20	08 50 47	−20 36·0	19	(11·99)		6·2	2·2	1·3	0·7		08−*216*
0850−03	08 50 56	−03 29·3		13·84		4·3	1·2	0·8	0·8±0·2		
0851−14	08 51 28	−14 16·7	24	(48·01)		6·1	1·6	0·9	0·9±0·1	209	
0853+03	08 53 00	+03 24·4		(84·58)		2·6	0·7	0·4	1·0±0·3		
0855−19	08 55 48	−19 39·3	17	(15·49)		3·4	1·3	1·0	0·8±0·1		08−*119*
0859−05	08 59 58	−05 04·4	18	13·93		5·0	1·0	0·6	1·0±0·1		08−*015*
0859−14	08 59 55	−14 04·0	12	8·68		5·4	3·1	2·6	0·4±0·1		09−*11*
0859−25	08 59 37	−25 44·2	54	51·03		16·4	5·8	3·3	0·8		08−*219*
0905+04	09 05 17	+04 26·8		12·27		2·9	0·6	0·3	1·2±0·3		
0905−68	09 05 59	−68 16·9		18·09		6·1	1·7	0·9			
0906+01	09 06 27	+01 33·7		(66·78)		2·6	1·3	1·2	0·3±0·2		
0909+08	09 09 30	+08 23·8	13	7·25		2·3	0·8	0·4	1·0±0·1		09+*01*
0912−16	09 12 53	−16 18·9		13·44		2·7	0·8	0·4	1·0±0·3		
0933+04	09 33 51	+04 36·9	24	(24·32)	9·7*	5·1	0·9	0·3	1·2±0·1	222	09+*03*
0941+10	09 41 34	+10 00·0	32	17·77	14·6*	8·7	2·3	1·0	1·0±0·0	226	09+*05*
0943−76	09 43 25	−76 06·7		48·1		6·6	2·1	1·2			
0944−13	09 44 58	−13 32·5		12·2		3·2	0·6		1·2±0·3		
0945+07	09 45 06	+07 39·9	89	41·0	30·0*	22·1	7·8	4·3	0·8±0·0	227	09+*07*
0949+00	09 49 26	+00 11·8	(36)	33·6	23·0*	(12·0)	(3·2)	1·5	1·0±0·1	230	} (09+*08*)
0950+00	09 50 13	+00 14·4	(36)	37·0		(12·0)	(3·2)	0·5			
0955−28	09 55 50	−28 50·2	18	(27·3)		6·0	1·4	0·7	0·7		09−*212*
0955+03	09 55 33	+03 39·7	18	7·8		4·4	0·9	0·4	1·1±0·1		09+*010*
0957+00	09 57 42	+00 19·5		10·7		3·1	1·0	0·6	0·9±0·2		
1002−21	10 02 52	−21 33·3	48	33·1		7·7	1·8	0·7	1·2		10−*21*
1005+07	10 05 20	+07 46·1	30	22·3	26*	16·4	6·2	3·5	C	237	10+*01*
1008+06	10 08 19	+06 40·0	39	24·0	14·0*	12·3	3·1	1·3	C	238	10+*02*
1011+31	10 11 33	−31 37·6	10	9·1		3·7	1·4	0·9	0·6		10−*33*

1015−31	10	15	55	−31	28·5	14	14·1		5·5	3·5	3·0	0·6		10−35
1023+06	10	23	54	+06	44·4	35	13·0		5·2	0·9	0·4	1·3±0·1	243	10+06
1027+00	10	27	35	+00	51·9		11·2		2·1	1·0	0·9	0·4±0·3		
1030−34	10	30	58	−34	03·4	20	13·7		6·2	1·4	0·8	0·8		10−38
1031−40	10	31	13	−40	48·2		14·0		4·2	1·2	0·4			10−410
1031+11	10	31	23	+11	30·0		(49·5)		5·1	1·3	(0·5)	1·1±0·2		
1056+09	10	56	59			19	17·6		3·2	0·5	0·3	1·2±0·1		10+011
1108+03	11	08	48	+03	25·5	15	12·8		4·7	1·2	0·5	1·0±0·1		11+02
1110−01	11	10	59	−01	56·8	18	10·2	8·0	4·6	1·4	0·9	0·8±0·1	253	11−05
1116−02	11	16	51	−02	46·7	31	19·5	15·0	10·2	1·6	0·6	C	255	11−08
1116−46	11	16	05	−46	17·9		21·4		7·3	2·4	1·6			
1122−37	11	22	56	−37	06·0	7	9·1		4·9	1·3	0·7	0·2		11−32
1123−35	11	23	28	−35	06·7	17	17·7		7·2	2·6	1·6	0·5		11−33
1131−17	11	31	51	−17	12·1	(19)	11·3		4·7	1·5	0·9	0·8±0·1		(11−17)
1131−19	11	31	08	−19	37·9	32	18·0		4·6	1·2	0·5	1·1±0·1		11−16
1134+01	11	34	53	+01	34·1		15·51		3·6	1·1	0·6	1·0±0·2	(262)	
1136−13	11	36	38	−13	34·1	44	42·6		12·8	4·1	2·8	0·8±0·0		11−18
1136−32	11	36	48	−32	05·8	28	23·8		5·8	2·5	1·2	1·0		11−38
1138+01	11	38	37	+01	30·1	15	(17·99)		7·2	2·1	1·6	0·7±0·1	(262)	11+08
1138−26	11	38	02	−26	12·9	28	8·9		4·1	0·9	0·4	1·2		11−27
1143−48	11	43	04	−48	19·3	28	30·1		9·3	3·3	1·8	0·7		11−46
1146+05	11	46	17	+05	12·4	11	7·68		(3·0)	0·6	0·3	1·0±0·1		11+012
1146−11	11	46	36	−11	48·1	17	13·8		4·2	1·4	0·7	0·9±0·1		11−113
1148−00	11	48	10	−00	07·2		7·80		3·5	2·9	2·6	0·1±0·2		
1152+04	11	52	23	+04	40·4	12	(13·74)		4·0	0·8	0·3	1·1±0·1		11+013
1211−41	12	11	39	−41	43·2	18	(21·2)		5·1	1·6	1·0	0·8		12−41
1215−45	12	15	28	−45	45·2	19	11·3		10	5·4	3·2	0·4		12−43
1226+02	12	26	34	+02	19·1	167	(150·1)	72*	55·1	41·2	37·3	C	273	12+08
1232−41	12	32	59	−41	36·5	11	7·3		7·1	2·2	1·0	0·3		12−44
1245−19	12	45	45	−19	43·0		19·1		7·9	5·1	3·5	0·4±0·1		
1245−41	12	45	54	−41	01·7	45	34·6		10·3	4·1	2·4	1·0		12−45
1246+09	12	46	17	+09	33·1	14	8·7		4·2	0·8	0·4	1·1±0·1		12+010
1247−19	12	47	41	−19	29·7		14·3		4·3	1·2	0·7	0·9±0·2		
1249+09	12	49	11	+09	12·2		7·2		5·1	1·8	1·0	0·9±0·1		
1252−12	12	52	00	−12	17·1	53	37·9	42·0	17·6	6·8	4·5	0·7±0·0	278	12−118
1259−44	12	59	38	−44	30·4		8·2		4·2	1·7	0·9			

* Flux values measured at 178 MHz.

TABLE 1 (*Continued*)

(1)	(2)			(3)		(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Parkes Cat. No.	Position (1950·0) R.A.			Dec.		Flux Densities at (MHz):						Spectral Index	Other Cat. Nos.	
	h	m	s	°	′	85·5	153	159	408	1410	2650	α_{400}	3C	MSH
1306−09	13	06	01	−09	34·5	19	(21·1)		10·0	4·4	2·8	0·6±0·1		13−02
1307−001	13	07	14	−00	03·7	(25)			2·7	1·5	0·7	0·9±0·1		
1307+00							20·8							(13−03)
1307−00·7	13	07	51	−00	43·4	(25)				0·7				
1309−22	13	09	00	−22	00·9	61	31·1		22	5·4	2·6	0·7		13−23
1312−18	13	12	24	−18	42·6	22	12·8		(6·4)	1·2	0·6	1·0±0·1		13−14
1313−13	13	13	46	−12	11·0		(26·4)		(4·1)	1·2	0·6	1·0±0·3		
1331−09	13	31	14	−09	52·5	18	(14·0)		(6·7)	(1·6)	0·6	0·9±0·1		13−16
1332−33	13	32	58	−33	37·9	70			32	7·0	3·2			
1333−33	13	33	44	−33	43·0	70	(78·3)		32	7·0	1·4			13−33
1334−33	13	34	47	−33	54·2	70			32	7·0	2·3			
1334−29	13	34	11	−29	36·3	36	22·1		8·5	2·6	1·3	0·9		13−25
1335−06	13	35	31	−06	11·9	35	19·30		10·1	3·2	1·9	0·8±0·1		13−011
1348−12	13	48	09	−12	57·4		20·04		4·2	1·3	0·6	1·0±0·2		
1355−41	13	55	56	−41	38·0	35	22·02		13·2	4·6	2·6	0·7		13−45
1358−11	13	58	58	−11	22·0	13	22·1		5·0	2·0	1·0	0·7±0·1		13−117
1400−33	14	00	58	−33	48·0	57	34·4		10·3	0·8	0·3	1·1		14−32
1401−05	14	01	16	−05	11·6		7·1		3·4	0·6	0·3	1·3±0·3		
1411−30	14	11	44	−30	12·4		17·3		4·2	1·4	0·7			
1416−15	14	16	14	−15	41·9	(22)	12·1		(5·1)	1·7	1·2	0·8±0·1		14−14
1420−27	14	20	06	−26	14·2	40	32·4		8·9	2·6	1·3	1·0		14−28
1424−11	14	24	55	−11	50·9	22	(31·0)		4·4	1·4	0·6	1·0±0·1		14−110
1424+03	14	24	57	+03	29·3		7·5		3·0	0·7	0·4	1·1±0·2		
1425+04	14	25	42	+04	33·3	13	(14·6)		3·1	0·8	(0·3)	1·0±0·2		14+07
1434+03	14	34	24	+03	27·2	31	22·7		8·1	2·7	1·8	0·8±0·1		14+010
1445−16	14	45	30	−16	08·0		11·8		3·0	1·2	1·2	0·4±0·2		
1446+00	14	46	10	+00	30·2		8·7		3·1	1·7	1·0	0·7±0·2		
1446+04	14	46	28	+04	13·8		(23·4)		2·4	0·8	(0·4)	0·9±0·4		
1451−36	14	51	21	−36	28·8	41	(47·4)		11·5	2·9	1·5	0·8		14−38
1459−41	14	59	11	−41	54·3	55	32·9		17·4	4·7	1·4	0·7		14−415

1508−05	15	08	13	−05	31·8	8	(17·2)		8·9	3·9	2·5	C		15−05
1510−08	15	10	09	−08	54·9		(9·7)		3·0	3·0	3·0	−0·0±0·2		
1514+00	15	14	14	+00	26·1	16	(17·7)		4·4	2·5	1·8	0·6±0·1		15+06
1514+07	15	14	18	+07	12·6	140	43·0	46*	26·4	5·6	2·2	1·2±0·0	3·7	15+05
1523+03	15	23	23	+03	19·2		14·8		5·0	2·2	1·2	0·8±0·1		
1539−09	15	39	26	−09	18·3		7·3		2·4	1·2	1·0	0·4±0·3		
1547−79	15	47	45	−79	32·6		33·0			4·0	2·8			
1549−79	15	49	36	−79	06·3		(20·1)			6·2	4·9			
1603+00	16	03	42	+00	08·6	35	30·5		(7·9)	2·2	1·4	0·9±0·1		16+03
1609−14	16	09	17	−14	12·0		(33·6)		2·3	1·2	(0·4)			
1621−11	16	21	13	−11	34·0	20	21·3		8·6	2·2	1·3	0·8±0·1		16−18
1635−14	16	35	55	−14	10·0		9·2		(4·3)	1·2	1·0	0·6±0·3		
1640−15	16	40	59	−15	20·2	30	(27·7)		5·7	1·2	0·5	1·1±0·1		16−117
1648+05	16	48	42	+05	04·5	890	424	350*	161	46·0	24·6	1·0±0·0	348	16+010
1644−10	16	44	43	−10	39·0		(42·9)		6·9	2·2	1·4	0·8±0·1		
1701+05	17	01	08	+05	06·1		5·5		3·1	0·6	0·3	1·2±0·2		
1712−03	17	12	25	−03	17·7	21	(53·0)		8·3	1·5	0·5	C		17−04
1712−12	17	12	51	−12	03·0		(10·0)		3·1	1·0	0·6	0·8±0·2		
1717+00	17	17	56	−00	55·9	475	324·7	180*	138	50·2	27·5	0·8±0·2	353	17−06
1754−59	17	54	35	−59	46·3	25	44·4		15	3·9	1·5	0·4		17−51
1802+11	18	02	44	+11	01·3		(169·9)	15*	4·3	1·1	0·7	1·1±0·1	368	
1914−45	19	14	04	−45	36·5	13	28·1		3·5	0·8	0·4	0·8		19−42
1928−34	19	28	25	−34	01·7		13·1		3·1	1·2	0·4			
1932−46	19	32	20	−46	28·2	141	(157·2)		39	13·4	6·9	0·8		19−46
1933−58	19	33	18	−58	45·9	17	25·4		6·8	3·5	1·8	0·6		19−56
1951−50	19	51	25	−50	09·9	14	(23·2)		4·0	1·5	0·9	0·8		19−42
1954−55	19	54	21	−55	17·8	54	21·6		14·8	7·0	4·0	0·8		19−57
1955−35	19	55	43	−35	43·3	45	17·5		9·6	2·4	1·2	1·0		19−35
2006−56	20	06	31	−56	37·8	81	(87·3)		12·2	1·9	0·4	1·2		20−52
2019+09	20	19	43	+09	52·0	27	15·8	15*	9·4	3·4	1·4	0·9±0·0	411	$20+0_{SI}$
2030−23	20	30	18	−23	02·8	22	13·1		8·2	3·0	1·6	0·6		20−28
2032−35	20	32	35	−35	05·1	41	19·9		12·8	6·4	3·7	0·7		20−37
2044−02	20	44	34	−02	47·5		9·6	9·5	7·2	2·3	1·5	0·7±0·1	422	
2045+06	20	45	40	+06	50·1	22	41·6	13·4*	(9·8)	2·6	1·1	0·9±0·1	424	20+010
2049−36	20	49	08	−36	51·8	19	11·4		4·3	1·4	0·6	1·0		20−38
2058−13	20	58	57	−13	30·6	14	9·1		3·7	1·3	0·6	0·9±0·1		20−119

* Flux values measured at 178 MHz.

TABLE 1 (*Continued*)

(1) Parkes Cat. No.	(2) Position (1950·0) R.A. h m s	(3) Dec. ° ′	(4) Flux Densities at (MHz): 85·5	(5) 153	(6) 159	(7) 408	(8) 1410	(9) 2650	(10) Spectral Index α_{400}	(11) Other Cat. Nos. 3C	(12) MSH
2059−09	20 59 38	−09 33·3		15·1			0·4	0·3	0·6±0·7		
2101−49	21 01 41	−49 01·5		7·3			1·1	0·7			
2104−25	21 04 23	−25 39·0	100	54·1		31	12	7·3	0·8		21−*21*
2105−48	21 05 24	−48 59·1		8·4		3·1	1·2	1·0			
2107−34	21 07 44	−34 03·6	14	15·2		3·8	1·3	0·7	0·8		21−*32*
2119−16	21 19 18	−16 54·6	(30)	(17·2)			0·6	0·3			21−*19*
2120−16	21 20 14	−16 40·8	(30)	(14·5)		(9·0)	1·3	0·6	0·8±0·4		
2123+00	21 23 14	+00 42·4		17·8		1·9	0·7	0·4	0·8±0·3		
2126+07	21 26 34	+07 19·8	27	19·9	10·3*	6·6	2·4	1·1	0·9±0·0	435	21+*04*
2141−81	21 41 14	−81 46·6		14·2		10	3·1	1·7			
2146−13	21 46 46	−13 18·6	(13)	12·3		5·6	1·5	0·9	0·9±0·1		21−1*19*
2149−20	21 49 04	−20 00·4	18	10·7		6·5	2·1	1·4	0·7±0·1		21−1*21*
2149−28	21 49 12	−28 43·0	12	8·3		5·4	3·2	1·9	0·5		21−2*14*
2150−52	21 50 51	−52 04·6	28	14·6		10	4·2	2·1	0·7		21−*58*
2152−69	21 52 58	−69 55·8	253	113·7		80	32	17·5	0·8		21−*64*
2154−11	21 54 03	−11 41·2	28	20·1		6·5	1·1	0·5	1·1±0·1		21−1*14*
2154−18	21 54 12	−18 28·3	25	22·2		8·8	3·6	0·9	C		21−1*23*
2201−55	22 01 44	−55 32·8		8·4		4·9	2·1	1·0			
2203−18	22 03 26	−18 50·3	16	(18·7)		7·8	6·2	4·9	0·3±0·1		22−*11*
2207−43	22 07 57	−43 48·4	13	(14·6)		4·0	1·1	0·7	0·8		22−*42*
2207−45	22 07 15	−45 57·7		17·0		5·9	1·6	0·9			
2210−25	22 10 12	−25 43·3		5·4		3·2	1·3	0·9			
2211+08	22 11 12	+08 59·6	31	(29·0)		2·5	0·8	0·5	1·2±0·1		22+*03*
2213−45	22 13 49	−45 36·4		13·6		5·6	2·3	1·3			
2216−03	22 16 16	−03 50·6	(18)	8·5		2·8	0·9	1·0	C		22−*06*
2216−28	22 16 56	−28 12·1		16·1		6·8	2·6	1·0			
2218−50	22 18 05	−50 33·8		7·2			2·0	0·8			
2219−15	22 19 49	−15 01·5		(20·2)			0·4	0·3	0·6±0·7		
2220−15	22 20 00	−15 26·2		(40·1)		(3·3)	0·6	0·3	1·2±0·4		
2220−50	22 20 26	−50 32·6		7·7			1·2	0·7			

2221−02	22	21	16	−02	21·9	60	19·6	(20·5)	17·5	5·3	(2·3)	0·8±0·1	445	22−*09*
2226+08	22	26	36	+08	58·8	19	17·2		5·0	0·6	0·5	1·1±0·1		22+*06*
2226−38	22	26	52	−38	39·7		13·1		8·4	2·6	0·9			
2226−41	22	26	25	−41	07·3	28	13·1		8·9	3·2	1·6	0·7		22−*43*
2250+03	22	50	07	+03	29·1	11	16·1		1·7	0·5	0·3	1·0±0·1		22+0*11*
2252−53	22	52	48	−53	01·4	22	23·5		7	3·5	1·7	0·7		22−*54*
2253−52	22	53	48	−52	14·9	28	27·2		7·8	3·1	1·3	0·8		22−*55*
2258+08	22	58	59	+08	22·5		4·9		2·3	0·6	0·4	0·9±0·3		
2304+00	23	04	13	+00	38·7		(40·1)		1·6	<0·5	0·3	0·9±0·3		
2305−41	23	05	06	−41	49·3		11·4		4·4	1·9	0·9			
2307+10	23	07	59	+10	39·7		12·8		3·1	0·7	0·7	0·7±0·2		
2309+09	23	09	55	+09	03·5	29	23·4	14*	8·8	2·6	1·5	0·9±0·0	456	23+*03*
2310−41	23	10	07	−41	43·0		11·4		4·4	1·8	0·9			
2313+03	23	13	59	+03	48·3	57	26·9	24*	14·8	4·6	2·3	0·9±0·0	459	23+*05*
2313−18	23	13	09	−18	17·1		20·18		4·7	1·3	0·9	0·8±0·2		
2317−27	23	17	19	−27	44·5	23	22·7		9·2	3·3	1·8	0·7		23−*24*
2319−55	23	19	14	−55	02·5		12·3		4·5	2·2	1·0			
2322−05	23	22	44	−05	14·2		27·4		4·3	1·5	0·8	0·9±0·2		
2323−40	23	23	51	−40	44·3	15	8		8·0	3·9	2·2	0·5		23−*43*
2325−15	23	25	55	−15	11·2	14	12·7		6·1	2·0	1·3	0·7±0·1		23−1*13*
2331−41	23	31	45	−41	42·8	50	24·9		15·6	5·7	2·9	0·9		23−*44*
2331−09	23	31	11	−09	20·9		22·9		6·0	1·2	0·5	1·3±0·2		
2332−66	23	32	15	−66	54·4	26	11·0		7·8	2·5	1·3	0·8		23−*63*
2334−35	23	34	14	−35	01·8	24	13·6		4·5	1·3	0·6	1·1		23−*34*
2335+03	23	35	30	+03	11·6		4·7		3·4	1·4	1·1	0·6±0·2		
2337−06	23	37	13	−06	21·0		11·2		3·4	1·3	0·8	0·7±0·2		
2338+04	23	38	27	+04	14·0		7·4		5·4	1·6	1·0	0·9±0·1		
2338+03	23	38	55	+03	02·2		6·8		3·8	1·0	0·4	1·2±0·2		
2338−16	23	38	37	−16	37·8		17·2		4·2	1·4	0·8	0·8±0·2		
2338−58	23	38	31	−58	32·4	25	11·6		7·4	3·3	1·8	0·6		23−*52*
2354−35	23	54	27	−35	02·4	39	23·5		5·9	1·3	0·5	1·2		23−*37*

* Flux values measured at 178 MHz.

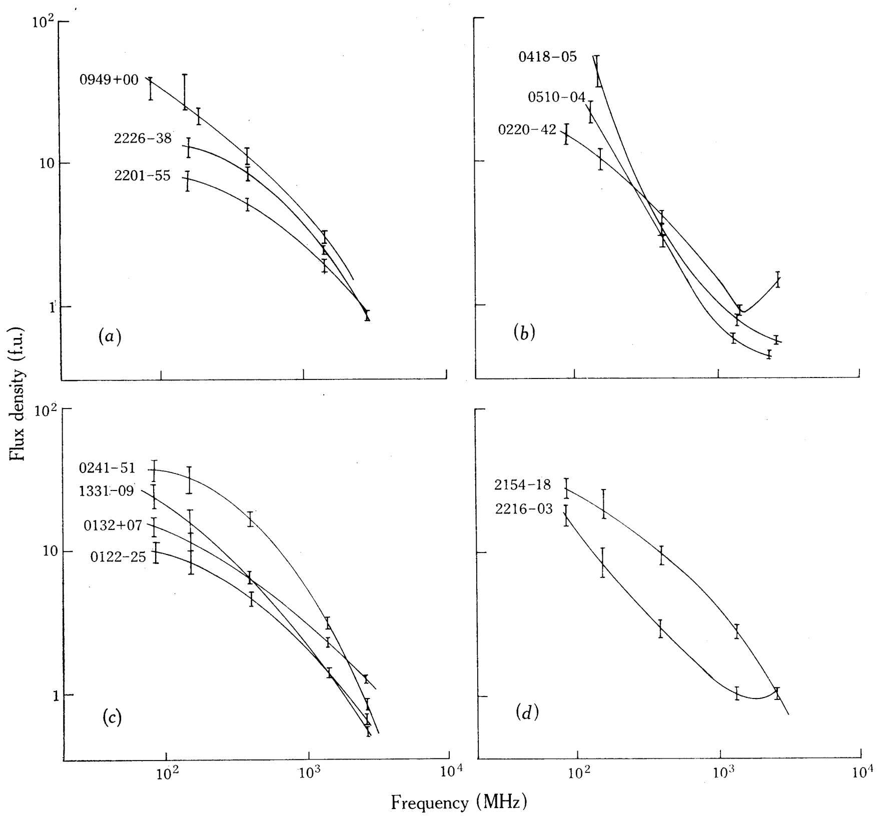

Fig. 1.—Sources showing pronounced curvature in their spectra.

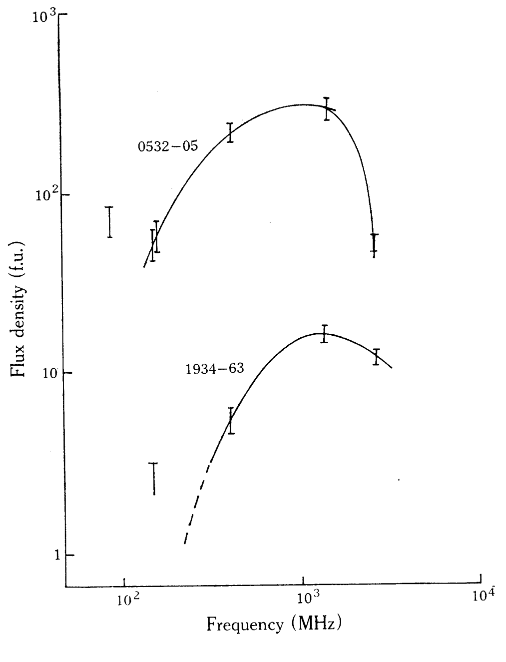

Fig. 2.—Spectra of 1934 − 63 and the Orion nebula.

(c) *Two Interesting Sources*

Two sources were studied in detail, the Orion nebula and the source 1934−63, using on-source scans rather than the scanning grid records. The spectra of these sources are shown in Figure 2.

(i) *Orion Nebula*

Observations of the source 0532−05 (Orion nebula) by Mills, Slee, and Hill (1958) gave a flux density of 65 f.u. at 85 MHz, while the 3C catalogue gives a flux density of 45 f.u. at 159 MHz. We obtained a value of 41·6 f.u. in good agreement with the 3C catalogue at 159 MHz.

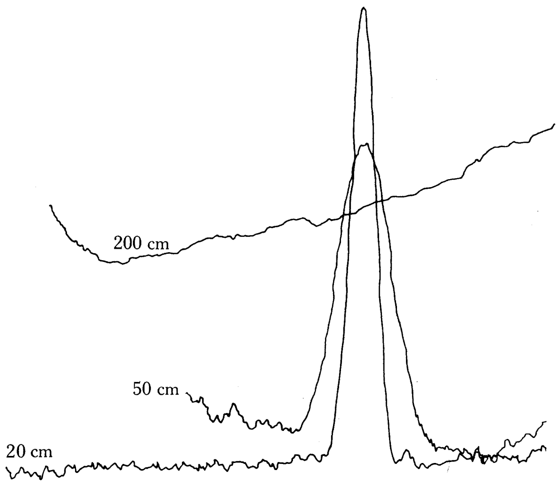

Fig. 3.—Declination scans of 1934−63.

(ii) *The Source 1934−63*

Kellermann (1966) has investigated the source 1934−63 in detail to obtain an explanation of the observed maximum in the spectrum near 1000 MHz. Observations above 350 MHz provide information on the angular size of the source, but measurements down to 100 MHz are necessary to differentiate between the three mechanisms he has proposed to account for the spectrum, namely:

(1) self absorption in the source when the brightness temperature varies across the source;

(2) synchrotron radiation in a region of high density of thermal electrons; and

(3) an ionized hydrogen absorption region between the source and the observer.

Simultaneous scans through the source at 20, 50, and 200 cm are shown in Figure 3, and it is seen that the 200 cm observations are complicated by the slope of the background in the vicinity of the source. Repeated scans were summed in a multichannel memory unit but little improvement resulted. The flux density of the source cannot be greater than 1·5 f.u. at 153 MHz, but this measurement is not sufficiently accurate to permit a decision on the mechanism producing the unusual spectrum.

(d) *Comparison with the 3C Survey*

Of the 312 sources in Table 1, 27 are listed in the 3C catalogue. There is good agreement between the surveys for 20 of these sources, but the flux densities in the 3C catalogue for the remaining 7 are consistently lower than those obtained at 153 MHz. The two values for these 7 sources are compared in Table 2.

TABLE 2

FLUX DENSITIES FOR SOURCES WITH LOW VALUES AS GIVEN IN THE 3C CATALOGUE

Source	Flux Density (f.u.) 3C	153 MHz	Source	Flux Density (f.u.) 3C	153 MHz
0055−01	17·0	46·2	0806−10	21	25
0105−16	20·0	30·2	1008+06	14	24
0331−01	19·5	43·8	1717−00	180	324·7
0349−14	8·5	16·6			

The flux densities obtained at 153 MHz are in better agreement with the previous measurements at 85, 408, 1410, and 2650 MHz. Spectra of two of the sources are given in Figure 4.

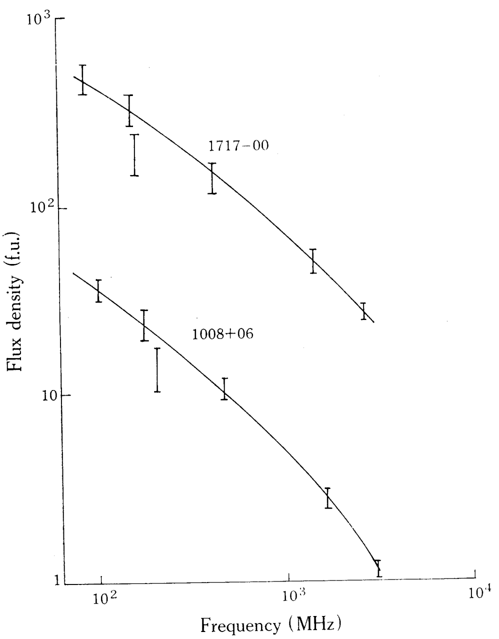

Fig. 4.—Comparison between the results of the 3C survey and the present observations for the sources 1717−00 and 1008+06.

V. Conclusions

The flux density measurements reported here provide a useful addition to source spectral information for radio sources in the southern sky. Of the 312 sources listed, 19 show curvature in their spectra. It is apparent. however, that measurements at more closely spaced frequencies are needed, especially in the region below 100 MHz, before adequate information for theoretical work is available.

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