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OBSERVATIONS OF SOUTHERN PLANETARY NEBULAE

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ABSTRACT

An Hα survey of the entire southern sky south of −25° declination with the Mount Wilson 10-inch objective-prism camera has resulted in a catalogue of 459 objects classifiable as planetary nebulae or possible planetary nebulae. Of these, approximately 150 are newly discovered. The catalogue gives for both old and new nebulae basic data including intensity of the Hα image, intensity of the continuum, degree of resolution of the Hα image, and presence of emission lines other than Hα. Where possible, nebular diameter and the intensity ratio of [N II] λ6584 to Hα are also listed. Since one of the more significant features of this catalogue is its broad coverage and its observational uniformity, a careful study of its purity and completeness has been made.

The surface distribution of these nebulae shows, in addition to the well-known concentration toward the galactic center, significant concentrations in Norma and Crux. An analysis of the frequency of [N II] shows that 22 per cent of the nebulae which might show [N II] have [N II]/Hα ratios greater than 0.5, 22 per cent have ratios between 0.1 and 0.5, and 56 per cent show no [N II].

I. INTRODUCTION

In the course of the Hα survey conducted at Mount Wilson Observatory by Paul W. Merrill and his colleagues (Merrill and Burwell 1949) numerous isolated emission lines were observed which were suspected to be planetary nebulae. R. Minkowski undertook to confirm these objects by means of direct photographs and low-dispersion spectra taken with the Mount Wilson 60-inch and 100-inch reflectors and consequently published lists containing 216 new planetary nebulae (Minkowski 1946, 1947, 1948). By 1948 the survey of the northern Milky Way with the Mount Wilson 10-inch objective-prism camera had been completed, and the camera was lent to the Observatory of the University of Michigan in order that the survey might be extended to the southern Milky Way from their Lamont-Hussey Observatory in Bloemfontein, Union of South Africa. The camera was erected in Bloemfontein in early 1949, the observing program was carried out by the author in 1949–1951 and the camera was subsequently returned to Mount Wilson in late 1951. This survey has been previously referred to either as the "Michigan–Mount Wilson Southern Hα Survey" or as the "LHα Survey." LHα, which stands for "Lamont-Hussey Hα," is the code name used for designating the plate series. The writer is indebted to Dr. George Herbig for altering the letter code for his own list of Hα-emission stars to LkHα after it became evident in 1954 that we had chosen identical designations for our catalogues.

The searching of the main series of plates (2-hour exposures south of −25°) was completed at the University of Michigan in the years 1952–1954 and the preliminary discussion of the southern planetary nebulae constituted the major portion of the author's doctoral dissertation, which was completed late in 1954. Catalogues of 171 previously known and 137 newly discovered nebulae were given in the dissertation. Subsequently a number of plates taken in regions north of −25° were searched and the selection criteria were slightly altered so that the present catalogue contains a total of 459 nebulae. The catalogue also contains nine peculiar objects which recent evidence shows to be probably not planetary nebulae.

II. THE OBSERVATIONS

The Mount Wilson 10-inch camera employs a red-corrected Cook Triplet lens with a focal length of 52 inches and a plate scale of 159″/mm. The 15° objective prism gives a dispersion of 450 Å/mm at Hα. Good image quality is obtained from λ5500 to the sensitivity limit of 103aE plates at λ6800. All exposures were taken with Kodak 103aE emulsion on glass plates 15 inches on a side. The resulting field is 16° square but image quality at the plate edge is quite poor, and a value of 12° × 12° has been adopted as the effective plate area for medium-exposure plates.

Three series of plates were obtained. The main or "medium-exposure" series has a spectrum width of 0.40 mm and an exposure time of 120 min. These plates reach to a limiting magnitude of approximately 11.0 for the continuum of an A0 star near Hα and cover the entire southern sky in duplicate with plate centers commencing at −30° and spaced at intervals of 6° in declination. Yellow and orange plexiglass filters were used in alternate declination zones. The cutoff of the yellow filter is near λ4800 and allows the observation of Hβ and [O III] λλ5007, 4959 lines in planetary nebulae. Although these lines are in poor focus, they provide a valuable criterion for the positive identification of planetary nebulae. The cutoff of the orange filter is near λ5500, and the problem of overlapping spectra and plate fogging is thus reduced on these plates.

Medium-exposure plates were also taken in two northern regions in order to provide a comparison with the Mount Wilson survey. The centers of plates taken in these regions are given in Table 1.

TABLE 1

PLATE CENTERS OF MEDIUM-EXPOSURE PLATES TAKEN OUTSIDE THE LIMIT OF THE MAIN SURVEY

R.A. 1950	Decl. 1950	R.A. 1950	Decl. 1950	R.A. 1950	Decl. 1950
17^h10^m.......	−18°	18^h14^m.......	−24°	20^h16^m.......	+23°
17 22........	−24	19 30........	+23	20 19........	+35
18 00........	−18	19 50........	+29	20 45........	+29

A long-exposure plate series was obtained with a spectrum width of 0.20 mm, an exposure time of 240 min, and red plexiglass filter providing a wavelength cutoff near λ6200. The limiting magnitude is approximately 13.0. A band of sky between galactic latitudes +10° and −10° was covered in duplicate in the region south of −25° declination. Although the nebulae discovered in the search of this series of plates (Wray 1966) are not included in this catalogue, all the catalogued nebulae which fall in this region of the sky have been examined on the long-exposure plates for the presence of a continuous spectrum or for other characteristics which may not have appeared on the medium-exposure plates. These data are included in the present catalogue.

A short-exposure series of plates was also obtained, but these are of little importance in the discussion of the planetary nebulae.

To improve the quality of the spectra obtained with this camera, a sliding plate holder was constructed which allowed for a smoother and more uniform widening of spectra than had previously been possible. In addition, after some experimentation, a 5-inch diaphragm was placed over the rear element of the lens, which resulted in a larger field of good image quality and also reduced vignetting effects. Since the beam diameter has decreased by the time it exits the rear element, the effective aperture was somewhat greater than 5 inches and is estimated to be about 7 inches. A 7-inch diameter diaphragm was used with the long-exposure series, the effective aperture being approximately 10 inches in this case.

The resulting improvement in image quality has made possible the resolution of [N II] λ6584 from Hα in stellar nebulae on plates of good quality. The estimated wavelength resolution on good plates is 15 Å, which corresponds to a linear resolution of 30 microns and an angular resolution of 5″ (see Table 9). The general appearance of planetary nebulae on LHα plates is illustrated in Figure 1.

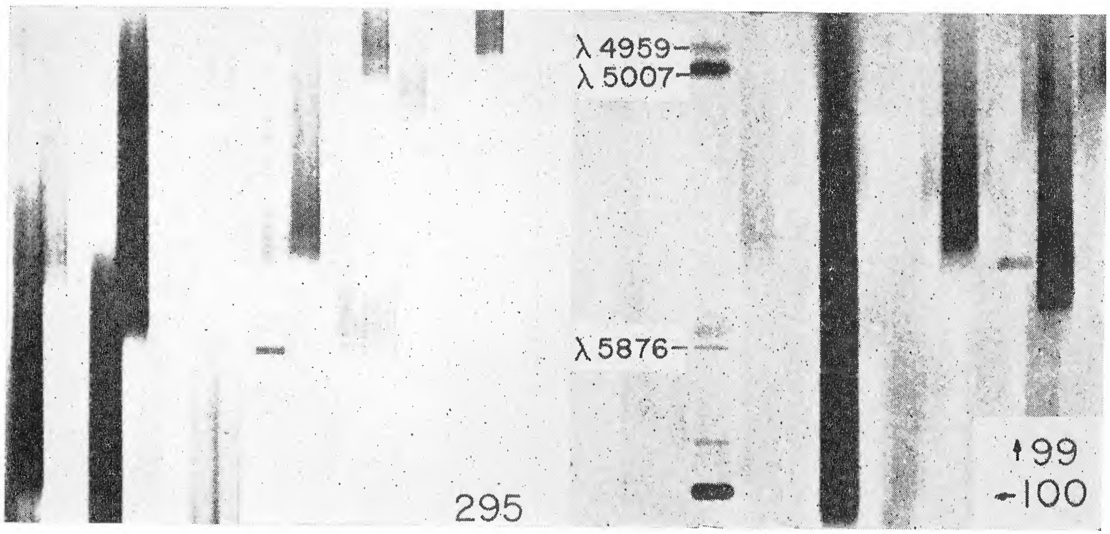

FIG. 1.—Representative spectra of planetary nebulae on LHα plates. North is at top, east is at left. The area covered by each field is 16′ × 16′.

III. THE CATALOGUE

All observations are listed in a single catalogue (Table 2) regardless of whether the nebulae are newly discovered or previously known, or whether their classification is well-confirmed or doubtful. Observational catalogues of this sort are more convenient if they are not broken into several sub-catalogues. Other observers wishing to compare data will thus be required to sort through only one table rather than several, and investigators analyzing these data will undoubtedly wish to categorize it in many ways not foreseeable by the author.

The catalogue is arranged in order of 1900 right ascension and serial numbers in this order are given in the first column. Serial Nos. 11, 17, 61, 113, 134, 172, 174, 177 and 269 are inclosed in parentheses to indicate that these objects probably are not planetary nebulae. They are retained in Table 2 because they were found not to be planetaries after the final serial numbers had been assigned and made available to other investigators. Eleven nebulae marked with an asterisk (*) after the serial number were discovered on long-exposure plates and are significantly fainter than other nebulae in the catalogue. These nebulae, therefore, are to be excluded from statistical discussions depending upon a uniform limiting magnitude.

The second column gives the previous designation of the nebula, if any. The following reference code has been used.

ABL	Abell (1955)
APR	Apriamasvili (see Frantsman 1962)
AS	Merrill and Burwell (1950)
CNN	Cannon (1921)
CPD	*Cape Photographic Durchmusterung*
HD	*Henry Draper Catalogue*
HFL	Hoffleit (1953)
HNZ	Henize (1961)
HRO 1	Haro (1952), Table I
HRO 2	Haro (1952), Table II
IC	*Index Catalogue*
KHT 1	Kohoutek (1962)
KHT 3	Kohoutek (1964)
MNK 1	Minkowski (1946), Table I
MNK 1 DN	Minkowski (1946), Table II
MNK 2	Minkowski (1947), Table I
MNK 3	Minkowski (1948), Tables I and II
MNK 4	Minkowski (unpublished)
MYL	Mayall (1951)
MWC	Merrill, Burwell (1933, 1943, 1949)
NGC	*New General Catalogue*
PB	Peimbert and Batiz (1960)
PC	Peimbert and Costero (1961)
PRK 1	Perek (1960), Table 1
PRK 2	Perek (1960), Table 2
THE 2	The (1962)
THE 3	The (1964*a*)
THE 4	The (1964*b*)
TKY	Thackeray (1950)
VDV	Vandervort (1964)
VLG	Velghe (1957)
VV	Vorontsov-Velyaminov (1948)

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Table 2

Observations of Southern Planetary Nebulae

No.	Desig.	1900 R.A.	1900 Dec.	l^{II}	b^{II}	Old Sp.	LHα D	LHα CT	LHα H	LHα Sp.	NII/Hα	Oth. Em.	Diam.	Res.
		h m	° '	°	°								"	
1	MNK 3 1	659.1	-3126	242.65	-11.59	P	1	00	4		0.0	1	L10	R
2	MNK 3 2	710.8	-2738	240.33	-7.61	P	2	00	1		U		L25	R
3	MNK 4	725.3	-3533	248.87	-8.56	P	1	00	2	P	0.0		L10	R
4	NGC 2452	743.4	-2706	243.40	-1.04	P	2	00	4		U	1	L25	R
5		744.7	-5101	264.43	-12.78		1	00	3	P	0.0	1	L10	R
6	MNK 3 5	758.4	-2724	245.41	1.64	P	2	00	2		U		L25	R
7		808.5	-4825	264.16	-8.15		2	00	2	P	U	1	L25	R
8	PB 2	817.4	-4604	263.05	-5.58	P	1	00	2	P	0.0		L10	R
9	AS 200	824.8	-3904	258.14	-0.40		1	00	3	P	D		L10	R
10	MNK 4	832.0	-2604	248.57	8.57	DN	1	02	3	P*	0.0		L10	R
(11)		833.4	-3904	259.15	0.94		3	00	2		U		65	R
12	MNK 3 6	836.4	-3200	253.93	5.75	P	2	00	4		U	1	L25	R
13	VLG 26	840.1	-4545	265.16	-2.23	P	4	00	1	P	1.0		L 5	R
14	VLG 27	848.6	-4555	266.23	-1.19	P	1	00	2	P	D		L10	S
15	AS 204	849.7	-3942	261.62	2.98		3	00	4	P	U		20	R
16	PB 3	851.2	-5010	269.75	-3.62	P	2	00	2	P	U		L25	R
(17)		853.2	-4601	266.83	-0.65		1	00	3		0.0		L10	
18		905.6	-5255	273.30	-3.79		2	00	1	P	U		L25	R
19	IC 2448	906.1	-6932	285.80	-14.95	P	1	00	4		0.0	1	L10	R
20	NGC 2792	908.7	-4201	265.76	4.10	P	2	00	3		U	1	L25	R
21		910.9	-5503	275.39	-4.69		1	00	1	P	0.0		L10	R
22	PB 4	912.1	-5428	275.09	-4.16	P	1	00	2	P	0.0	1	L10	R
23	NGC 2818	912.2	-3612	262.00	8.62	P	3	00	3		U		35	R
24	PB 5	912.5	-4504	268.43	2.47	P	4	00	2	P	0.2		L 5	S
25		914.9	-5414	275.21	-3.71		0	00	2	P	0.0		L 5	S
26	MYL 47	916.6	-5847	278.61	-6.76	PD	1	00	3	P	0.0	1	L10	S
27	NGC 2867	918.6	-5753	278.16	-5.93	P	2	00	5		U	123	L25	R
28		919.0	-5344	275.29	-2.93		2	00	1	P	U		L25	R
29		921.6	-5411	275.88	-2.99		3	00	3	P	U		20	R
30	NGC 2899	923.9	-5541	277.15	-3.85	PD	3	00	4	P	U		120	R
31	PRK 2 4	927.5	-5244	275.53	-1.33	PD	1	00	1	P	0.0		L10	R
32*		927.9	-5710	278.57	-4.55		3	00	T	P*	U		40	R
33	IC 2501	935.9	-5938	281.01	-5.69	P	2	00	5		D	123	L25	S
34		937.6	-4856	274.20	2.57		1	00	2	P	0.0		L10	S
35		938.0	-4931	274.63	2.17		0	00	2	P	0.0		L 5	S
36	CPD 2466	940.3	-5649	279.61	-3.18		2	1	4	P	U	1	L25	R
37		943.7	-4830	274.69	3.55		3	00	2	P	U		30	R
38		951.4	-5651	280.81	-2.25		1	01	5	PD	0.0		L10	S
39		1000.7	-6015	283.83	-4.24		2	00	1	P	U		L25	R
40	NGC 3132	1002.8	-3957	272.11	12.39	P	3	2	5		U	12	60	R
41		1004.4	-6325	286.04	-6.55		1	00	2	P	0.0	1	L10	S
42	IC 2553	1006.2	-6207	285.46	-5.37	P	1	00	5		0.0	1	L10	R
43	PB 6	1009.4	-4950	278.86	5.00	P	2	00	3	P	U	1	L25	R
44	NGC 3195	1010.6	-8022	296.64	-20.04	P	3	0	4		U	1	35	R
45	HFL 4	1012.2	-5821	283.95	-1.84	P	3	00	2	P	U		30	R
46	NGC 3211	1014.6	-6209	286.29	-4.85	P	2	00	4		U	1	L25	R
47	MYL 59	1019.6	-6002	285.66	-2.74	PD	4	00	5	P	1.0		L 5	S
48		1027.6	-5302	282.98	3.82		3	00	1	P	U		30	R
49	MYL 60	1027.6	-5450	283.89	2.27	P	1	00	3	P	0.0	1	L10	R
50		1030.3	-5310	283.40	3.91		2	00	3	P	U		L25	R
51		1032.3	-6348	288.88	-5.21		2	00	1	P	U		L25	R
52	PRK 1 1	1034.6	-5615	285.45	1.52	P	4	00	3	P	0.1		L 5	R
53	PRK 1 2	1035.6	-5635	285.73	1.30	P	1	00	1	P	0.0		L10	R
54	PRK 1 3	1040.8	-6108	288.47	-2.40	P	2	00	1	P	U		L25	R
55		1044.6	-5531	286.35	2.83		2	00	1	P	U		L25	R
56	HFL 38	1050.8	-5838	288.48	0.40	P	3	00	2	P	U		30	R
57		1052.0	-6055	289.59	-1.61		2	00	1	P	U		L25	R
58	TKY	1052.2	-5955	289.19	-0.69	P	3	5	4		U		35	R
59	IC 2621	1056.5	-6442	291.64	-4.83	P	4	00	5		0.5	12	L 5	S
60	HFL 48	1059.8	-6003	290.11	-0.42	P	3	00	2	P	U		20	R
(61)		1102.1	-5416	288.11	5.02		1	00	1		0.0		L10	S
62		1113.8	-7016	295.32	-9.33		1	00	2	P	0.0		L10	S
63		1119.3	-5218	289.81	7.78		1	00	1	P	0.0		L10	R
64		1122.8	-5645	291.74	3.74		1	00	1	P	0.0		L10	R
65	NGC 3699	1123.2	-5925	292.64	1.22	P	3	00	4		U		70	R
66	VV 60	1124.0	-5223	290.52	7.94	P	3	00	3		U		30	R
67		1124.2	-5933	292.80	1.14		4	00	3	P	0.5		L 5	R
68		1127.3	-6525	294.94	-4.34		1	00	3	P	0.0		L10	S
69	PB 8	1128.7	-5633	292.45	4.18	P	1	00	3	P	0.0		L10	R
70		1130.6	-5943	293.62	1.22		3	00	3	P*	U		30	R

Table 2—continued

Observations of Southern Planetary Nebulae

No.	Desig.	1900 R.A.	1900 Dec.	l^{II}	b^{II}	Old Sp.	LHα D	LHα CT	LHα H	LHα Sp.	NII / Hα	Oth. Em.	Diam.	Res.
		h m	° ′	°	°								″	
71		1134.6	-6819	296.47	-6.91		4	00	3	P	0.2		L 5	S
72*	HFL 69	1136.9	-6155	294.97	-0.68	DN				PD			65	
73		1143.8	-6434	296.39	-3.05		4	00	3	P	0.1	1	L 5	R
74	NGC 3918	1145.4	-5637	294.69	4.72	P	2	01	5		U	123	L25	R
75	NGC 4071	1159.1	-6645	298.40	-4.85		3	00	2	P	U		75	R
76		1203.2	-6338	298.27	-1.70		2	00	2	P	U		L25	R
77		1203.8	-6242	298.19	-0.77		2	00	1	P	U		L25	R
78		1204.0	-5809	297.46	3.72		4	00	1	P	0.8		L 5	R
79		1209.9	-6305	298.93	-1.04		0	00	2	P	0.0		L 5	S
80		1216.9	-6244	299.68	-0.59		1	00	1	P	0.0		L10	S
81		1217.5	-6328	299.83	-1.32		2	00	1	P	U		L25	R
82		1218.4	-5940	299.51	2.47		3	00	1	P	U		30	R
83		1223.1	-6132	300.27	0.67		2	00	2	P	U		L25	R
84		1223.2	-6311	300.44	-0.97		2	00	2	P	U		L25	R
85		1224.6	-6320	300.61	-1.10		1	00	2	P	0.0		L10	R
86		1224.8	-6418	300.71	-2.07		4	00	3	P	0.1		L 5	R
87		1239.9	-6227	302.30	-0.13		1	00	2	P	0.0		L10	S
88		1259.7	-5707	304.86	5.17		1	00	1	P	0.0		L10	S
89	IC 4191	1302.2	-6706	304.59	-4.81	P	1	00	4		0.0	1	L10	R
90		1303.4	-6048	305.12	1.47		1	00	4	P	0.0		L10	S
91		1303.7	-6239	305.03	-0.38		0	01	5	PD	0.0		L 5	S
92*	THE 2 A	1315.9	-6249	306.41	-0.67	P	3	00	T	P	U		25	R
93	THE 2 B	1321.8	-6318	307.01	-1.24	P	1	00	1	P	0.0		L10	S
94	NGC 5189	1326.7	-6529	307.22	-3.47	PD	3	00	4	P*	U		140	R
95	VV 66	1332.3	-6652	307.55	-4.93	P	4	00	5		0.8	2	L 5	R
96		1335.8	-6053	309.02	0.88		1	00	3	P	0.0		L10	R
97		1337.4	-7059	307.23	-9.06		4	00	3	P	0.1	1	L 5	S
98	NGC 5307	1344.6	-5043	312.35	10.57	P	2	00	4		U	1	L25	R
99		1345.0	-6554	309.00	-4.24		3	00	3	P	U		25	R
100	NGC 5315	1346.5	-6601	309.12	-4.39	P	2	01	5		U	123	L25	R
101		1348.2	-5756	311.19	3.43		1	00	1	P	0.0		L10	S
102		1351.3	-5825	311.47	2.86		1	00	2	P	0.0		L10	R
103		1358.1	-6412	310.76	-2.93		3	00	2	P	U		20	R
104		1405.3	-5058	315.49	9.47		0	00	4	P	0.0		L 5	S
105		1406.2	-7345	308.67	-12.28		3	0T	3	P*	U		35	R
106		1406.6	-6258	312.02	-2.02		1	00	3	P	0.0		L10	S
107		1411.2	-6239	312.62	-1.89		2	00	3	P	D		L25	R
108	CPD 6744	1411.4	-5143	316.16	8.46		2	T	5	P	U		L25	R
109		1413.9	-5500	315.44	5.23		1	00	1	P	0.0		L10	R
110	IC 4406	1416.1	-4341	319.69	15.76	P	3	00	5		U	12	35	R
111		1425.8	-6023	315.04	-0.36		3	00	5	P	U		30	R
112		1433.6	-5209	319.22	6.81		2	00	3	P	D		L25	R
(113)		1452.6	-5354	321.05	4.00		4	T	4		0.8		L 5	
114		1456.2	-6030	318.38	-2.06		3	00	2	P	U		30	R
115		1457.9	-5448	321.30	2.84		0	00	3	P	D		L 5	R
116		1458.0	-6058	318.35	-2.57		3	00	2	P	U		45	R
117		1458.5	-5536	320.99	2.10		4	00	3	P	0.2		L 5	R
118		1459.6	-4237	327.57	13.34		0	00	2	P	0.0	1	L 5	S
119		1502.2	-6418	317.14	-5.72		3	00	3	P	U		50	R
120		1504.5	-5517	321.89	1.96		3	00	3	P	U		30	R
121	NGC 5873	1506.3	-3743	331.32	16.88	P	1	00	4		0.0	1	L10	R
122	NGC 5882	1510.0	-4516	327.82	10.10	P	1	T	5		0.0	123	L10	R
123		1514.9	-5347	323.96	2.46		2	00	3	P	U		L25	R
124	PRK 2 8	1515.9	-5648	322.46	-0.17	PD	1	00	1	P	0.0		L10	R
125		1516.2	-5330	324.27	2.59		2	00	2	P	D		L25	R
126	VV 72	1516.5	-2316	342.15	27.54	P	1	00	3		0.0	1	L10	
127		1517.6	-5128	325.55	4.19		0	00	3	P	0.0		L 5	S
128		1517.9	-5058	325.87	4.58		4	00	2	P	0.2		L 5	S
129		1518.2	-5229	325.08	3.29		1	00	2	P	0.0		L10	R
130	VV 73	1526.2	-5849	322.49	-2.60	P	3	00	4		U		50	R
131	TKY	1526.7	-7134	315.12	-13.06	P	2	2	5		U	2	L25	R
132		1530.0	-5825	323.13	-2.56		2	00	1	P	U		L25	R
133		1534.1	-5617	324.82	-1.16		1	00	1	P	0.0		L10	R
(134)		1537.9	-6610	319.23	-9.34		1	01	5		0.0		L10	S
135	NGC 5979	1539.3	-6053	322.60	-5.24	P	2	00	3		U	1	L25	
136	MYL 91	1543.6	-6213	322.18	-6.61	PD	1	00	3	P	0.0	1	L10	
137	VV 75	1543.7	-5112	329.03	2.03	P	3	00	1		U		80	
138	MWC 238	1546.7	-6552	320.13	-9.66	Q	2	1	5	P	D		L25	R
139		1546.9	-5512	326.91	-1.39		1	00	2	P	0.0		L10	S
140		1550.3	-5525	327.15	-1.87		4	00	2	P	0.8		L 5	R

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Table 2—continued

Observations of Southern Planetary Nebulae

No.	Desig.	1900 R.A.	1900 Dec.	l^{II}	b^{II}	Old Sp.	LHα D	LHα CT	LHα H	LHα Sp.	NII/Hα	Oth. Em.	Diam.	Res.
		h m	° '	°	°								"	
141		1550.9	-5806	325.50	-3.99		2	00	3	P	U	1	L25	R
142		1552.1	-5538	327.21	-2.20		4	00	3	P	0.8		L 5	R
143		1553.2	-5448	327.86	-1.66		2	00	1	P	D		L25	R
144	NGC 6026	1554.9	-3415	341.61	13.72	P	3	01	3		U		55	R
145	PRK 1 4	1601.4	-5046	331.44	0.58	P	2	00	1	P	U		L25	R
146		1602.7	-5441	328.98	-2.47		3	00	2	P*	U		20	R
147		1605.9	-5644	327.93	-4.29		2	00	1	P	D		L25	S
148	NGC 6072	1606.4	-3559	342.17	10.86	P	3	00	4		U		70	
149		1606.5	-5432	329.48	-2.73		0	00	1	P	0.0		L 5	R
150	VV 78	1606.6	-5442	329.38	-2.87	P	3	00	3		U	1	25	R
151		1607.2	-5939	326.05	-6.54		4	01	4	PD	0.1		L 5	S
152	PRK 1 5	1607.9	-4858	333.43	1.20	P	4	00	4	P	1.2		L 5	R
153		1609.4	-5317	330.65	-2.11		3	00	3	P	U		20	R
154	VV 80	1609.6	-5144	331.74	-1.00	P	3	00	5		U		35	R
155		1612.4	-4201	338.80	5.70		2	00	3	P	U		L25	R
156		1614.2	-4209	338.95	5.37		1	00	1	P	0.0		L10	S
157		1614.4	-5326	331.09	-2.74		4	00	2	P	0.5		L 5	S
158		1615.1	-5805	327.89	-6.12		4	00	2	P	0.1		L 5	R
159		1616.4	-5422	330.64	-3.61		2	00	1	P	U		L25	R
160	PRK 1 6	1616.6	-4629	336.21	1.98	P	1	00	1	P	0.0		L10	R
161		1616.8	-5308	331.55	-2.77		2	00	2	P	U		L25	R
162		1619.9	-5348	331.41	-3.57		4	00	2	P	0.3		L 5	S
163		1621.0	-5856	327.83	-7.27		2	00	1	P	U		L25	R
164		1622.0	-5310	332.08	-3.35		2	00	1	P	U		L25	R
165		1622.1	-5357	331.53	-3.91		3	00	2	P	U		35	R
166	PRK 1 7	1623.2	-4549	337.48	1.64	P	4	00	3	P	0.8		L 5	S
167	NGC 6153	1624.7	-4002	341.85	5.44	P	3	00	5		U		25	R
168	NGC 6164-5	1626.5	-4754	336.37	-0.21	DN	3	00	4	P	U		370	R
169		1626.7	-4908	335.50	-1.09		2	00	1	P	U		L25	R
170		1627.4	-5337	332.31	-4.24		0	00	2	P	0.0		L 5	S
171		1627.5	-3453	346.02	8.56		1	00	2	P	0.0		L10	S
(172)	PC 11	1629.6	-5530	331.14	-5.76	P	0	00	3		0.0	1	L 5	S
173		1629.6	-3939	342.78	5.02		1	00	2	P	0.0		L10	S
(174)		1631.2	-4511	338.91	1.05		0	00	1		0.0		L 5	S
175		1632.8	-3623	345.64	6.75		4	00	2	P	1.2		L 5	R
176		1634.3	-4502	339.39	0.75		1	00	1	P	0.0		L10	S
(177)	CNN	1635.5	-6226	326.42	-10.94	P	0	T	5		0.0		L 5	S
178	VDV 3	1635.7	-3843	344.27	4.77	P	1	00	2	P	0.0		L10	S
179		1636.0	-4549	339.00	0.00		1	00	1	P	0.0		L10	S
180	PC 12	1638.1	-1846	0.17	17.25	P	1	0	3	P	0.0		L10	
181	HRO 1 2	1642.4	-3537	347.50	5.79	P	0	00	3	P	0.0		L 5	
182	MWC 242	1645.1	-6404	325.84	-12.81	Q	1	00	4	P	0.0	1	L10	S
183		1646.2	-4443	341.01	-0.63		1	00	1	P	0.0		L10	S
184	VV 83	1649.5	-2942	353.06	8.40	P	0	00	3		0.0	1	L 5	
185		1650.3	-6957	321.31	-16.78		1	0	3	P	0.0	1	L10	S
186		1651.8	-5133	336.31	-5.69		2	00	2	P	U		L25	R
187		1653.9	-5014	337.55	-5.13		1	00	1	P	0.0		L10	R
188	MNK 2 4	1654.3	-3442	349.76	4.49	P	4	00	3		0.1		L 5	
189	IC 4634	1655.6	-2140	0.38	12.23	P	1	0	5		0.0		L10	
190	MNK 2 5	1655.8	-3300	351.29	5.30	P	2	00	3		U		L25	
191	MNK 1 19	1657.2	-3321	351.20	4.85	P	1	00	3		0.0		L10	
192	MNK 2 6	1657.8	-3045	353.34	6.34	P	1	00	2		0.0		L10	
193	IC 4637	1658.1	-4044	345.48	0.17	P	2	T	5		U		L25	R
194	HRO 2 1	1658.1	-3350	350.93	4.41	PD	4	00	4	P	0.2		L 5	S
195	PC 14	1658.3	-5222	336.28	-6.98	P	1	00	2	P	0.0	1	L10	R
196	MNK 2 7	1658.8	-3022	353.78	6.41	P	2	00	2		U		L25	
197	MNK 2 8	1659.0	-3221	352.22	5.17	P	1	00	2		0.0		L10	
198	PRK 1 8	1659.1	-4404	342.96	-2.02	P	2	00	1	P	U		L25	R
199	HRO 1 6	1659.9	-4233	344.25	-1.21	P	2	00	1	P	D		L25	
200	HRO 1 7	1703.3	-4143	345.30	-1.20	P	4	00	3	P	0.5		L 5	
201	IC 4642	1703.5	-5516	334.40	-9.33	P	2	00	3		U		L25	R
202	THE 3 2	1704.5	-2701	357.24	7.42	P	1	00	2	P	0.0		L10	S
203	MNK 3 36	1706.5	-2538	358.63	7.87	P	0	00	1		0.0		L 5	
204	NGC 6302	1707.0	-3659	349.51	1.06	P	3	00	5		U	123	45	
205	MNK 2 10	1707.6	-3113	354.23	4.38	P	1	00	2		0.0		L10	
206	NGC 6309	1708.4	-1248	9.64	14.83	P	2	1	5		U		L25	
207		1712.1	-4547	342.96	-4.89		3	00	2	P*	U		35	R
208	NGC 6326	1712.8	-5138	338.21	-8.35	P	2	01	5		U	1	L25	
209	MNK 3 37	1713.1	-2513	359.84	6.90	P	2	00	1		U		L25	
210	MNK 2 11	1714.3	-2852	357.00	4.58	P	1	00	2		0.0		L10	

Table 2—continued

Observations of Southern Planetary Nebulae

No.	Desig.	1900 R.A.	1900 Dec.	l^{II}	b^{II}	Old Sp.	LHα D	LHα CT	LHα H	LHα Sp.	NII/Hα	Oth. Em.	Diam.	Res.
		h m	° '	°	°								"	
211	MNK 3 38	1714.8	-2856	357.01	4.45	P	2	00	1		U		L25	
212	MNK 3 39	1714.9	-2705	358.54	5.49	P	2	00	1		U		L25	
213	AS 226	1715.1	-3015	355.96	3.64		1	0T	4	PD	D		L10	S
214	HRO 1 11	1715.3	-2215	2.59	8.17	P	1	0	2	P	0.0		L10	
215	NGC 6337	1715.4	-3825	349.33	-1.12	P	3	00	2		U		60	
216	MNK 3 40	1716.0	-2702	358.72	5.32	P	1	00	1		0.0		L10	
217	MNK 2 12	1717.9	-2551	359.94	5.65	P	4	00	2		0.5		L 5	
218	MNK 3 7	1718.2	-2918	357.13	3.63	P	0	00	2		0.0		L 5	
219	MNK 3 8	1718.5	-2802	358.21	4.30	P	2	00	2		U		L25	
220	HD 157595	1719.0	-4406	345.04	-4.93	P	0	00	3	P	0.0	1	L 5	
221	MNK 3 9	1719.6	-2604	359.98	5.21	P	1	00	2		0.0		L10	
222	HRO 1 12	1719.8	-3456	352.69	0.15	P	2	00	1	P	U		L25	
223	MNK 3 41	1719.8	-2916	357.36	3.36	P	2	00	1		U		L25	
224	HD 157796	1720.3	-4650	342.90	-6.65	P	1	00	2	P	0.0	1	L10	
225	MNK 3 10	1720.9	-2822	358.24	3.67	P	1	00	2		D		L10	
226	HRO 2 10	1721.2	-2825	358.23	3.59	PD	0	00	T	PD	0.0		L 5	
227	HRO 1 13	1721.9	-3502	352.85	-0.26	P	2	00	2	P	U		L25	
228	THE 3 18	1722.1	-2833	358.23	3.35	P	1	00	1	P	0.0		L10	S
229	HRO 1 15	1722.4	-2444	1.44	5.43	P	1	00	2	P	0.0		L10	
230	MNK 2 13	1722.9	-1321	11.14	11.57	P	1	0	2		0.0		L10	
231	HRO 1 16	1723.2	-2622	0.18	4.37	P	0	00	1	P	0.0		L 5	
232	NGC 6369	1723.2	-2341	2.42	5.86	P	3	00	5		U		35	
233	HRO 1 17	1723.3	-2834	358.37	3.12	P	0	00	2	P	0.0		L 5	
234	HRO 1 18	1723.3	-2927	357.63	2.63	P	2	00	1	P	U		L25	
235	MNK 1 20	1723.3	-1911	6.22	8.33	P	1	0	3		0.0		L10	
236	ABL 29	1723.3	-1509	9.65	10.52	P	2	0	2		U		L25	
237	HRO 1 19	1723.8	-2754	358.98	3.41	P	2	00	1	P	U		L25	
238	HRO 1 20	1724.4	-2800	358.97	3.24	P	2	00	1	P	U		L25	
239*	THE 3 25	1724.5	-2701	359.81	3.77	P	1	00	T	PD	0.0		L10	S
240*	THE 3 26	1724.8	-2810	358.88	3.07	P	2	00	T	P	U		L25	R
241	HRO 1 22	1725.7	-3749	350.97	-2.45	P	2	00	1	P	U		L25	
242	HRO 1 23	1726.4	-2956	357.61	1.80	P	1	00	1	P	0.0		L10	
243*	THE 3 30	1727.4	-2803	359.30	2.66	P	1	00	T	PD	0.0		L10	S
244	HRO 1 24	1727.5	-2140	4.67	6.14	P	1	0	2	P	0.0		L10	
245	THE 3 31	1727.9	-2925	358.22	1.82	P	0	00	T	PD	0.0		L 5	S
246	PC 17	1728.2	-4656	343.56	-7.84	P	0	00	2	P	0.0	1	L 5	R
247	MNK 1 21	1728.3	-1904	6.97	7.40	P	1	0	3		0.0		L10	
248		1728.4	-4921	341.52	-9.16		0	00	1	P	0.0		L 5	S
249	HRO 2 15	1728.4	-2249	3.81	5.34	PD	2	00	1	P	U		L25	R
250*	MNK 4	1728.7	-2632	0.73	3.25	P	1	00	T	P*	0.0		L10	R
251	HRO 1 25	1729.0	-2940	358.14	1.48	P	0	00	2	P	0.0		L 5	
252	MNK 1 22	1729.3	-1824	7.66	7.56	P	2	0	3		U		L25	
253	HRO 1 26	1729.4	-3916	350.16	-3.86	P	2	00	1	P	U		L25	
254	MNK 3 11	1729.5	-2051	5.61	6.20	P	2	0	2		U		L25	
255	MNK 3 12	1730.4	-2127	5.22	5.70	P	1	0	2		0.0		L10	
256	MNK 1 23	1731.6	-1841	7.72	6.95	P	2	0	2		U		L25	
257	VV 106	1732.0	-4406	346.33	-6.88	P	0	00	3		0.0	1	L 5	
258	MNK 1 24	1732.3	-1932	7.08	6.35	P	1	0	3		0.0		L10	
259	MNK 1 25	1732.5	-2204	4.96	4.95	P	2	0	4		U		L25	
260	AS 235	1733.1	-1814	8.29	6.89		1	0	2	P	0.0		L10	
261	HRO 2 16	1733.7	-2110	5.87	5.20	PD	2	0	1	PD	U		L25	
262		1734.0	-2641	1.25	2.18		1	00	1	P	0.0		L10	R
263	HRO 2 17	1734.0	-2421	3.21	3.43	PD	2	00	1	P	U		L25	S
264	KHT 1 4	1734.2	-2657	1.05	2.00	P	3	00	1	P	U		35	R
265	HRO 1 27	1734.4	-2216	5.03	4.47	P	1	0	1	PD	0.0		L10	
266	VV 110	1735.8	-2438	3.20	2.94	P	1	00	3		0.0		L10	
267	MNK 2 14	1735.8	-2407	3.63	3.21	P	2	00	3		U		L25	
268	HRO 1 28	1735.9	-3933	350.59	-5.07	P	1	00	2	P	0.0		L10	
(269)		1737.3	-6436	328.55	-17.84		1	0	3		0.0		L10	R
270	HRO 1 29	1737.6	-3417	355.25	-2.55	P	1	00	1	P	0.0		L10	
271	MNK 3 14	1737.7	-3404	355.44	-2.46	P	4	00	2		0.5		L 5	
272	HRO 1 30	1737.9	-3805	352.05	-4.62	P	2	00	1	P	U		L25	
273	IC 4663	1738.1	-4452	346.25	-8.21	P	2	00	3		U	1	L25	
274	TKY	1738.2	-4603	345.24	-8.83	P	N	T	5		U		N	R
275*		1738.6	-3837	351.67	-5.02		1	00	T	PD	0.0		L10	S
276	HRO 1 31	1738.9	-3432	355.18	-2.91	P	0	00	1	P	0.0		L 5	
277	MNK 1 26	1739.5	-3010	358.95	-0.71	P	4	T	5		0.5		L 5	S
278	HRO 1 32	1739.6	-3400	355.71	-2.75	P	0	00	2	P	0.0		L 5	
279	MNK 3 15	1739.6	-2056	6.80	4.16	P	1	0	2		0.0		L10	
280	MNK 1 27	1740.1	-3307	356.51	-2.38	P	4	00	3		0.3		L 5	

Table 2—continued

Observations of Southern Planetary Nebulae

No.	Desig.	1900 R.A.	1900 Dec.	l^{II}	b^{II}	Old Sp.	LHα D	LHα CT	LHα H	LHα Sp.	NII/Hα	Oth. Em.	Diam.	Res.
		h m	° ′	°	°								″	
281	THE 4 2	1740.3	-1837	8.87	5.23	P	2	0	1	P	U		L25	R
282	THE 4 1	1740.4	-2011	7.54	4.39	P	1	0	1	PD	0.0		L10	
283	HRO 1 33	1741.1	-3407	355.77	-3.08	P	1	00	1	P	0.0		L10	
284	MNK 2 15	1741.2	-1616	11.00	6.27	P	1	0	2		0.0		L10	
285	MNK 1 28	1741.5	-2204	6.07	3.19	P	3	0	3		U		30	
286	VV 116	1741.6	-2954	359.42	-0.95	P	3	01	5		U	2	20	
287	NGC 6439	1742.5	-1627	11.00	5.91	P	4	0	4		0.2		L 5	
288	HRO 1 35	1742.6	-3421	355.73	-3.47	P	4	00	4	P	0.1		L 5	
289	HRO 1 36	1742.8	-3659	353.50	-4.87	P	1	00	2	P	0.0		L10	
290	NGC 6445	1743.3	-1959	8.07	3.92	P	3	0	5		U		50	
291	HRO 1 37	1743.6	-3914	351.65	-6.17	P	2	00	2	P	U		L25	
292	MNK 1 29	1743.8	-3035	359.08	-1.71	P	2	00	3		U		L25	
293	THE 4 5	1744.6	-1901	9.06	4.16	P	1	0	1	P*	0.0		L10	R
294*		1745.2	-3253	357.27	-3.17		1	00	T	PD	0.0		L10	S
295	MNK 1 30	1746.0	-3438	355.86	-4.21	P	4	00	3		1.0		L 5	
296	MNK 3 16	1746.1	-3054	359.07	-2.30	P	2	00	1		U		L25	
297	MNK 2 16	1746.1	-3244	357.50	-3.25	P	4	00	2		0.5		L 5	
298	MNK 2 17	1746.2	-1736	10.47	4.56	P	1	0	2		0.0		L10	
299	MNK 1 31	1746.6	-2219	6.47	2.05	P	2	0	3		U		L25	
300	HRO 1 39	1746.7	-3357	356.52	-3.98	P	4	00	2	P	0.2		L 5	
301	MNK 2 18	1747.0	-3257	357.41	-3.52	P	4	00	1		0.1		L 5	
302	MNK 2 19	1747.4	-2941	0.26	-1.91	P	2	00	1		U		L25	
303	VV 126	1747.9	-3421	356.30	-4.40	P	4	00	3		0.1		L 5	
304	MNK 2 20	1748.1	-2936	0.41	-2.00	P	2	00	2		U		L25	
305	VV 128	1749.2	-2144	7.28	1.83	P	2	0	4		U		L25	
306		1749.4	-4303	348.88	-9.04		0	00	2	P	0.0		L 5	R
307	MNK 3 17	1749.9	-3102	359.37	-3.07	P	4	00	1		0.3		L 5	
308	HRO 1 41	1750.6	-3410	356.74	-4.79	P	1	00	2	P	0.0		L10	
309	MNK 1 32	1750.6	-1623	12.06	4.28	P	4	0	5		1.5		L 5	
310	HRO 1 42	1750.8	-3333	357.30	-4.51	P	1	00	3	P	0.0		L10	
311	THE 4 10	1751.3	-1806	10.66	3.26	P	2	0	1	P	U		L25	S
312	MNK 3 18	1751.3	-2142	7.56	1.43	P	0	0	3		0.0		L 5	
313	HRO 1 43	1751.7	-3347	357.19	-4.79	P	2	00	1	P	D		L25	
314*	HRO 1 44	1751.7	-3143	358.98	-3.75	P	4	00	T	P	0.8		L 5	
315	MNK 2 21	1751.8	-2942	0.73	-2.74	P	1	00	2		0.0		L10	
316	MNK 2 22	1751.9	-3325	357.53	-4.64	P	2	00	1		U		L25	
317	HRO 1 45	1752.0	-2815	2.00	-2.04	P	1	00	2	P	0.0		L10	
318	HRO 1 46	1752.5	-3221	358.52	-4.21	P	1	00	3	P	0.0		L10	
319	MNK 3 20	1753.1	-2811	2.18	-2.22	P	1	00	1		0.0		L10	
320	VV 133	1753.3	-3849	352.97	-7.59	P	2	00	4		D	1	L25	
321	MNK 1 33	1753.4	-1531	13.15	4.13	P	4	0	3		0.3		L 5	
322	THE 4 11	1754.3	-1741	11.38	2.86	P	0	0	2	P	0.0		L 5	
323	HRO 1 47	1754.3	-2920	1.32	-3.03	P	4	00	1	P	1.0		L 5	
324	MNK 1 34	1754.8	-3317	357.95	-5.10	P	2	00	3		U		L25	
325		1754.9	-2621	3.97	-1.64		2	00	1	P	U		L25	S
326	MNK 2 23	1755.4	-2825	2.24	-2.77	P	1	00	3		0.0		L10	
327	MNK 2 24	1755.4	-3428	356.98	-5.80	P	2	00	3		U		L25	
328	MNK 3 21	1755.8	-3639	355.11	-6.95	P	4	00	3		0.1	1	L 5	
329	MNK 3 49	1755.8	-3512	356.38	-6.23	P	2	00	1		U		L25	
330	MNK 2 25	1756.2	-3210	359.07	-4.80	P	2	00	2		U		L25	
331	HRO 1 49	1756.9	-3241	358.69	-5.18	P	1	00	3	P	0.0		L10	
332	MNK 2 26	1756.9	-2658	3.66	-2.33	P	2	00	1		U		L25	
333	IC 4673	1757.1	-2705	3.58	-2.43	P	1	00	3		0.0		L10	
334	HRO 1 50	1757.3	-3240	358.75	-5.25	P	1	00	3	P	0.0		L10	
335	MNK 2 27	1757.4	-3115	0.00	-4.56	P	4	00	3		0.5		L 5	
336	MNK 1 35	1757.5	-2642	3.96	-2.32	P	2	00	3		U		L25	
337	MNK 3 51	1758.4	-3253	358.68	-5.56	P	2	00	1		U		L25	
338	MNK 2 28	1758.6	-3059	0.36	-4.66	P	2	00	3		D		L25	
339	MNK 1 37	1759.1	-2823	2.67	-3.46	P	2	00	2		U		L25	
340	NGC 6537	1759.3	-1951	10.10	0.75	P	4	0	5		1.0	2	L 5	
341	VV 145	1759.5	-5102	342.52	-14.32	P·	3	00	4		U		35	
342	HRO 1 53	1759.7	-2629	4.39	-2.63	P	2	00	1	P	U		L25	S
343	HRO 2 38	1759.7	-2818	2.81	-3.54	PD	1	00	T	PD	0.0		L10	
344	MNK 1 38	1759.7	-2842	2.46	-3.73	P	4	00	2		0.1		L 5	
345	MNK 2 29	1800.4	-2653	4.12	-2.97	P	0	00	1		0.0		L 5	
346	HRO 1 54	1800.8	-2916	2.09	-4.22	P	4	00	2	P	0.1		L 5	
347	HRO 1 55	1800.8	-2943	1.70	-4.44	P	4	00	1	P	0.8		L 5	
348	MNK 3 23	1800.8	-3035	0.94	-4.87	P	1	00	1		0.0		L10	
349		1800.9	-3606	356.10	-7.58		1	00	3	P	0.0		L10	S
350	MNK 3 24	1801.7	-2524	5.56	-2.49	P	2	00	1		U		L25	

Table 2—continued

Observations of Southern Planetary Nebulae

No.	Desig.	1900 R.A.	1900 Dec.	l^{II}	b^{II}	Old Sp.	LHα D	LHα CT	LHα H	LHα Sp.	NII/Hα	Oth. Em.	Diam.	Res.
		h m	° ′	°	°								″	
351	MNK 1 39	1801.8	-1328	15.95	3.39	P	1	0	3		0.0		L10	
352	AS 278	1802.4	-2218	8.33	-1.10		4	0	3	P	1.2		L 5	R
353	HRO 1 57	1803.1	-3546	356.61	-7.81	P	2	00	1	P	U		L25	
354	AS 280	1803.3	-3320	358.78	-6.67		1	00	1	P	0.0		L10	S
355	MNK 1 41	1803.4	-2413	6.78	-2.24	P	3	0	3		U		30	
356	APR 9	1804.2	-2809	3.43	-4.32	P	1	0	1	PD	0.0		L10	S
357	APR 10	1804.4	-2759	3.60	-4.28	P	1	00	2	P	0.0		L10	S
358	APR 11	1804.7	-2835	3.11	-4.63	P	0	00	1	P	0.0		L 5	S
359	MNK 1 42	1804.8	-2901	2.74	-4.86	P	2	00	3		U		L25	
360	APR 12	1805.2	-2824	3.32	-4.64	P	2	00	2	P	U		L25	S
361	NGC 6563	1805.5	-3353	358.52	-7.34	P	3	00	4		U	2	60	
362	NGC 6565	1805.6	-2812	3.54	-4.62	P	2	00	5		U	2	L25	
363	MNK 1 43	1805.8	-1846	11.80	-0.05	P	1	0	2		0.0		L10	
364	HRO 1 61	1806.3	-2452	6.53	-3.13	P	2	00	1	P	U		L25	
365	MNK 2 30	1806.3	-2759	3.80	-4.65	P	1	00	2		0.0		L10	
366	HRO 2 43	1806.5	-2821	3.50	-4.86	PD	1	00	1	P	0.0		L10	S
367	HRO 1 62	1806.7	-3222	359.98	-6.83	P	2	00	3	P	U		L25	
368	MNK 2 31	1807.1	-2532	6.04	-3.62	P	0	00	3		0.0		L 5	
369	NGC 6567	1807.8	-1906	11.74	-0.63	P	1	0	5		0.0		L10	
370	AS 293	1808.2	-2951	2.36	-5.91		1	00	1	P	0.0		L10	S
371	MNK 2 32	1808.3	-3238	359.91	-7.26	P	1	00	2		0.0		L10	
372	MNK 2 33	1808.7	-3018	2.02	-6.22	P	0	00	2		0.0		L 5	
373	HD 319167	1808.9	-3034	1.80	-6.39	P	1	00	3	P	0.0		L10	
374		1809.5	-2137	9.73	-2.20		1	0	2	P	0.0		L10	
375	MYL 118	1809.6	-5714	337.30	-18.26	PD	1	00	4	P	0.0	13	L10	
376	AS 294	1809.6	-2756	4.20	-5.26		0	00	1	P	0.0		L 5	R
377	VV 164	1809.7	-3054	1.59	-6.70	P	4	00	5		0.1	23	L 5	S
378	MNK 3 26	1809.9	-2716	4.82	-5.00	P	1	00	2		0.0		L10	
379	MNK 1 44	1810.0	-2708	4.95	-4.96	P	2	00	3		U		L25	
380	HRO 1 63	1810.2	-3011	2.27	-6.45	P	0	00	2	P	0.0		L 5	
381		1810.3	-2029	10.82	-1.81		1	0	3	P	0.0		L10	R
382	MNK 2 34	1811.0	-2400	7.81	-3.65	P	2	00	2		U		L25	
383	IC 4699	1811.1	-4602	348.02	-13.85	P	1	00	2		0.0	1	L10	
384	MNK 2 35	1811.1	-3158	0.78	-7.46	P	2	00	2		U		L25	
385	MNK 2 36	1811.3	-2910	3.29	-6.18	P	4	00	3		0.2		L 5	
386	HRO 1 64	1812.2	-2328	8.41	-3.64	P	2	00	1	P	U		L25	
387	MNK 2 37	1812.3	-2810	4.28	-5.90	P	2	T	2		U		L25	
388	MNK 2 38	1813.1	-2636	5.75	-5.31	P	1	00	1		0.0		L10	
389	HRO 1 65	1814.1	-2420	7.86	-4.43	P	2	00	2	P	U		L25	
390		1814.7	-2652	5.68	-5.75		1	00	T	PD	0.0		L10	S
391	MNK 2 39	1815.9	-2414	8.14	-4.75	P	1	00	2		0.0		L10	
392	MNK 2 41	1816.1	-3046	2.36	-7.85	P	3	00	2		U		25	
393	MNK 2 42	1816.4	-2410	8.25	-4.81	P	1	00	2		0.0		L10	
394	NGC 6620	1816.6	-2653	5.87	-6.13	P	2	00	3		D		L25	
395	MNK 1 45	1817.2	-1920	12.61	-2.68	P	1	0	2		0.0		L10	
396		1817.5	-2156	10.35	-3.98		1	0	1	PD	0.0		L10	
397	HRO 1 66	1818.7	-2545	7.10	-6.02	P	1	00	1	P	0.0		L10	
398	HRO 1 67	1819.0	-2235	9.94	-4.59	P	2	0	2	P	U		L25	
399	NGC 6629	1819.6	-2315	9.41	-5.03	P	2	0T	5		U		L25	
400	VV 181	1821.8	-2614	6.99	-6.86	P	1	1	4		D		L10	
401	MNK 1 46	1822.3	-1537	16.46	-1.99	P	1	0	4		0.0		L10	
402	HD 170124	1822.7	-3133	2.30	-9.46	P	4	00	4	P	1.0	1	L 5	
403	MNK 1 47	1823.2	-2147	11.10	-5.08	P	1	0	2		0.0		L10	
404	MNK 1 48	1823.7	-1911	13.46	-3.96	P	1	0	2		0.0		L10	
405	MNK 1 49	1824.6	-1358	18.18	-1.70	P	1	0	1		0.0		L10	
406		1825.7	-2451	8.64	-7.00		2	00	1	P	U		L25	R
407	HFL	1826.3	-2849	5.13	-8.93	P	2	00	2	P	U		L25	
408	NGC 6644	1826.4	-2512	8.40	-7.31	P	1	00	4		0.0		L10	
409	MNK 1 50	1827.5	-1815	14.71	-4.32	P	1	0	2		0.0		L10	
410	IC 4732	1827.9	-2243	10.78	-6.47	P	1	00	3		0.0		L10	
411	MNK 1 51	1827.9	-1111	21.01	-1.10	P	1	0	2		0.0		L10	
412	MNK 1 53	1829.9	-1739	15.51	-4.55	P	1	0	1		0.0		L10	
413	MNK 1 54	1830.4	-1703	16.10	-4.38	P	2	0	4		U		L25	
414	MNK 1 55	1830.6	-2149	11.87	-6.62	P	2	0	3		U		L25	
415	MNK 1 56	1832.0	-1706	16.23	-4.74	P	1	0	2		0.0		L10	
416	MNK 3 29	1832.8	-3047	3.97	-11.06	P	1	00	3		0.0		L10	
417	AS 316	1836.6	-2123	12.90	-7.66		1	0	3	P	0.0		L10	
418		1837.8	-3025	4.78	-11.87		2	00	1	P	U		L25	R
419	MNK 3 31	1838.2	-2000	14.31	-7.37	P	1	0	1		0.0		L10	
420	MNK 3 32	1838.5	-2526	9.43	-9.85	P	1	00	2		0.0		L10	

Table 2—continued

Observations of Southern Planetary Nebulae

No.	Desig.	1900 R.A.	1900 Dec.	l^{II}	b^{II}	Old Sp.	LHα D	LHα CT	LHα H	LHα Sp.	NII/Hα	Oth. Em.	Diam.	Res.
		h m	° '	°	°								"	
421	IC 4776	1839.3	-3327	2.10	-13.44	P	1	01	5		0.0	23	L10	
422	HRO 2 48	1840.5	-2333	11.34	-9.43	PD	4	00	4	P	1.0		L 5	S
423	MNK 3 33	1841.9	-2537	9.60	-10.62	P	2	00	2		U		L25	R
424	MNK 1 62	1844.3	-2241	12.52	-9.84	P	1	0	2		0.0		L10	
425	VV 212	1848.7	-3223	3.93	-14.81	P	0	00	4		0.0		L 5	
426	VV 218	1858.7	-3319	3.89	-17.10	P	0	00	2		0.0	1	L 5	
427	MNK 1 67	1907.0	1638	50.14	3.29	P	3	0	4		U		45	
428	MNK 4	1908.6	1537	49.42	2.48	P	1	0	2	P	0.0		L10	
429	MNK 4	1909.1	1449	48.77	2.00	P	1	0	2	P	0.0		L10	
430	AS 345	1909.6	1721	51.07	3.08		1	0	2	P	0.0		L10	
431	IC 1297	1910.5	-3947	358.35	-21.59	P	1	0	5		0.0	1	L10	R
432		1919.1	2057	55.31	2.82		1	0	1	PD	0.0		L10	S
433	HNZ 1 1	1919.5	2056	55.34	2.73		2	0	1	P	U		L25	R
434		1921.1	-7445	320.35	-28.88		1	0	3	P	0.0	1	L10	R
435	HNZ 1 2	1922.3	2057	55.67	2.16		2	0	2	P	U		L25	R
436		1925.6	-3427	4.85	-22.73		1	0	1	PD	0.0		L10	S
437	MNK 1 DN	1928.8	2642	61.42	3.66	DN	2	0	2	P	U		L25	
438	VV 235	1930.8	3018	64.79	5.03	P	?	1	5		U		L25	
439	MNK 1 71	1932.0	1929	55.50	-0.54	P	1	0	3		0.0		L10	
440		1934.0	2502	60.55	1.82		2	0	2	P	U		L25	S
441	VV 237	1934.7	1543	52.55	-2.97	P	1	0	4		0.0		L10	
442	MNK 4	1935.6	2616	61.80	2.12	P	1	0	2	P	0.0		L10	S
443	MNK 1 73	1936.4	1441	51.86	-3.84	P	1	0	3		0.0		L10	
444	MNK 1 72	1937.0	1730	54.37	-2.56	P	1	0	3		0.0		L10	
445	MNK 1 74	1937.7	1454	52.20	-4.01	P	1	0	3		0.0		L10	
446		1939.8	2313	59.64	-0.24		0	0	2	P	0.0		L 5	S
447		1941.0	2105	57.95	-1.56		2	0	2	P	U		L25	S
448	HNZ 1 3	1944.1	2154	59.02	-1.77		1	0	1	P*	0.0		L10	R
449	MNK 2 48	1946.4	2540	62.52	-0.28	P	2	0	2		U		L25	
450	PC 23	1948.1	3244	68.75	3.07	P	1	0	1	PD	0.0		L10	
451	NGC 6842	1950.9	2901	65.90	0.62	P	3	0	2		U		55	
452	NGC 6853	1955.3	2227	60.84	-3.69	P	3	0	4		U		355	
453	HNZ 1 4	1955.4	3137	68.62	1.17		2	2	2	P	U		L25	R
454	MNK 1 75	2000.7	3111	68.86	-0.02	P	2	0	3		U		L25	
455	NGC 6879	2005.9	1638	57.24	-8.91	P	1	0	3		0.0		L10	
456	NGC 6881	2007.2	3707	74.56	2.12	P	4	0	3		0.3		L 5	
457*	HNZ 1 5	2007.5	2003	60.34	-7.38		2	0	T	P	U		L25	R
458	NGC 6886	2008.3	1941	60.14	-7.74	P	4	0	4		1.0	2	L 5	
459		2009.9	2915	68.34	-2.74		1	0	1	PD	0.0		L10	S
460	NGC 6894	2012.4	3016	69.49	-2.62	P	3	0	3		U		55	
461	MNK 1 76	2012.7	3646	74.88	1.01	P	1	0	1		0.0		L10	
462	HNZ 1 6	2013.1	2504	65.27	-5.68		2	0	2	P	U		L25	R
463	HNZ 1 7	2015.4	2641	66.90	-5.19		1	0	2	P	0.0		L10	R
464	IC 4997	2015.6	1625	58.33	-10.98	P	1	0	5		D	23	L10	
465	MNK 3 35	2017.1	3210	71.63	-2.36	P	0	0	2		0.0		L 5	
466	NGC 6905	2017.9	1947	61.49	-9.56	P	3	0	3		U		30	
467		2031.5	1950	63.39	-12.16		1	0	2	P	0.0		L10	S
468		2037.4	3423	75.94	-4.45		1	0	2	PD	0.0		L10	S

NOTES TO TABLE 2

3. 4′.4 southeast of CD − 35°3620.
4. VV 46 = Rodgers 17 (Rodgers, Campbell, and Whiteoak 1960; cited as "Rodgers"). Rodgers' data indicate the presence of a faint background 120″ in diameter.
5. 4′.9 south of CD−50°2983; 2′.5 east of CD−50°2974.
7. 4′ west and slightly north of CD−48°3586. May be CD−48°3584.
8. 8′.5 southeast of CD−45°4014; 2′.4 north of CD−46°4069.
9. 6′.5 south and slightly east of CD−38°4509; 7′ southeast of CD−38°4497.
10. 5′ southeast of CD−25°6303; 6′.5 east and slightly south of CD−25°6296. Minkowski's classification of this nebula is probably based on its low-excitation spectrum. On the basis of its compact, symmetrical form on 74-inch direct plates it would seem better to class it as a low-excitation planetary.
11. On LHα plates this nebula is generally round with a slight protuberance on its least edge. It is centrally cut in an east-west direction by a dark streak. Its irregularity on 74-inch reflector plates leads to the conclusion that this should not be classed as a planetary nebula. Lies 1′ east of CD−38°4666.
15. 1′.5 north of CD−39°4916.
17. 2′ directly north of CD−45°4717. The overlapping spectrum of this star may possibly obscure a faint continuum. A Mount Stromlo spectrum by Henize shows a strong continuum with Hβ, γ, δ emission. Not a planetary nebula.
19. VV 49.
20. VV 50.
21. 4′.5 directly north of CD−55°2583. [O III]λ5007 is suspected. A faint continuum may belong to the emission line. If so, the description is 1-01-4.
23. VV 51 = MYL 45. The VV right ascension differs from that of MYL and NGC. My measures agree with the VV value.
25. 6′ north and very slightly west of CPD−54°2162. Nearby stars lie 0′.8 to the northwest and 1′.1 to the southwest.
27. VV 52.
29. 6′.4 southeast of CPD−54°2255. The emission line is overlapped by the continua of 1 or 2 faint stars which lie about 0′.5 south.
30. MYL 48 = Gum 27 (1955) = Rodgers 43 (1960). Consists of an elliptical background of faint nebulosity on which are superposed small intense knots at each end of the minor axis. The minor axis is somewhat pinched giving a bowtie effect. The symmetry leaves no doubt that this object should be classed as a planetary.
32. 3′ northwest of CD−57°2687. Superposed on a small obscured area. Elongated in a northwest-southeast direction. A faint continuum may be present. Possibly a small diffuse nebulosity.
33. VV 53.
35. 0′.9 west of CD−49°4609.
37. 2′.3 northeast of CD−48°4999.
40. VV 54. A photograph has been published by Evans and Thackeray (1950). It is uncertain whether the apparent central star (HD 87892, class A) is physically related to the nebula.
42. VV 55.
44. MYL 56. Although *NGC* clearly classifies this as a planetary nebula, it has not been included in the VV list. A photograph of this object has been published by Evans and Thackeray (1950).
45. The position given by Hoffleit appears to be somewhat in error. 6′ southeast of CPD−58°2031; 8′ west of CPD−58°2049.
46. VV 56.
48. 10′.4 north of CPD−53°3909; 3′.5 east of CPD−52°3642.
49. PB 17.
58. The central star is AG Carinae. The nebula is nearly obscured by the spectrum of the central star and was missed in the initial survey. The Hα intensity relative to the sky background is 4. Its contrast with the continuum is impossible to judge due to overexposure.
59. VV 58.
61. 4′.5 west of CPD−54°4320. Nearby stars lie 1′ to the southeast, 1′ to the southwest, and 2′ to the southwest. A Mount Stromlo spectrum by Webster (1966) indicates that this is not a planetary nebula.
62. 9′.5 north and slightly west of CPD−70°1356. Moderately bright stars lie 2′ to the southwest and 3′ to the northwest.
64. 2′ northeast of CPD−56°4513.
65. HFL 62 = HD 306491.
66. A photograph has been published by Evans and Thackeray (1950).
68. 8′.5 southwest of CPD−65°1680; 9′.5 north and slightly west of CPD−65°1677.
69. MYL 68. 2′ west and slightly north of CPD−56°4593. A faint continuum is present but probably belongs to a star slightly to the west.
70. 4′ southwest of CD−59°3823. A faint star lies 2′ directly east. A direct plate shows a bi-nuclear

structure oriented in a northeast-southwest direction with a small faint extension to the north. Perhaps a diffuse nebula.

71. 3′ north and slightly east of CPD−68°1544. A faint continuum, probably due to an overlapping spectrum, is present.
72. Not visible on LHα spectrum plates. However, on a direct plate in Hα light it shows a strikingly regular circular form and no conspicuous exciting star. Hoffleit considers it a Strömgren sphere.
73. 5′.5 west and slightly south of CPD−64°1714. Nearby stars lie 1′.5 to the northeast and 1′.5 to the east.
74. VV 61. A photograph has been published by Evans and Thackeray (1950).
75. This is a ring planetary with a bright knot in its northwest rim. 8′ southwest of CPD−66°1701; 16′ south and slightly west of CPD−66°1697.
76. 7′.5 southeast of CPD−63°2149. An appreciable continuum is present but is probably due to an overlapping spectrum.
77. 4′.5 southwest of CPD−62°2593. Nearby stars lie 0′.8 to the south, 1′ to the northeast, and 1′ to the southwest.
78. 0′.6 due west of CPD−58°4111.
79. 8′.5 south and very slightly west of CPD−62°2647. A moderately bright star lies 0′.7 directly to the west.
80. 2′.7 north and slightly east of CPD− 62°2709; 3′.0 southwest of CPD−62°2713. A faint star lies 0′.5 to the southeast. A faint continuum is suspected, but this may arise from an overlapping spectrum.
82. 9′ south and slightly west of CPD−59°4198. A moderately bright star lies 1′.5 to the northwest. Round and very regular in shape.
84. 15′ north of CPD−63°2302; 6′.5 northeast of CPD−63°2287. Lies at the edge of the Coalsack. A direct plate with the 10-inch camera shows a nebulous image with an intense central knot.
87. 7′ east and slightly south of CPD−62°2914; 18′.5 south of CPD−62°2917.
89. VV 64.
92. 0′.4 due east of CPD−62°3200. This object, barely suspected on medium-exposure plates, shows a somewhat diffuse, round shape on long-exposure plates.
94. Gum 47 (1955) = Rodgers 76 (1960). This peculiar object is best classified as quasi-planetary. Evans and Thackeray (1950) have published a photograph and noted "probably not a planetary."
95. Rodgers 77 (1960).
98. VV 67
99. 1′.6 northeast of CPD−65°2496.
100. VV 68.
102. 0′.8 northeast of CPD−58°5301; 4′ northwest of CPD−58°5304.
103. 5′ northwest of CPD−64°2714; 9′ east of CPD−64°2698.
105. 2′.5 north of CPD−73°1254. A faint star lies 0′.5 to the west. The continuum is not associated with the entire nebula but seems to arise from a star slightly east of center. The intensity relative to the sky background is 2.
110. VV 69. This object is discussed by Evans (1950).
111. 4′ south of CD−60°5240; 3′.5 northwest of CPD−60°5423. This object has a very high surface brightness. It consists of two nuclei oriented in a north-south direction. Bears a strong resemblance to 154 VV (80).
113. 9′.5 southeast of CPD−53°6181; 3′.5 northwest of CPD−53°6185. A blue spectrum obtained at Mount Stromlo by Henize shows a peculiar spectrum unlike that of a planetary nebula. The only evidence of forbidden lines is the appearance of [N II] on the objective-prism plates.
114. 4′.4 southeast of CPD−60°5607; 4′.0 southwest of CPD−60°5612.
116. 5′.4 northwest of CPD−60°5629. A large round nebular disk is visible. Possibly annular in structure.
117. 6′.4 northwest of CPD−55°6353. 4′.1 southwest of CPD−55°6354. A moderately bright star lies 1′.4 to the northwest. It is possible that this object is identical to Rodgers 90 (1960).
119. 3′.0 southwest of CPD−64°3107. Shaped like a reversed "Z".
120. 3′ southwest of CPD−55°6418; 5′.2 southeast of CPD−55°6411.
121. VV 70.
122. VV 71. The intensity of Hα relative to the sky is 5.
127. 7′.5 northeast of CPD−51°7955; 5′.6 north of CPD−51°7976. A very weak continuum is suspected on one long-exposure plate.
129. 8′.5 east of CPD−52°8272; 10′.0 northeast of CPD−52°8293.
130. MYL 89 = Rodgers 93 (1960). A photograph has been published by Evans and Thackeray (1950).
131. MYL 90 = MWC 236 = HD 138403. On LHα plates this object shows very strong emission at Hα, moderate emission at Hβ, weak emission at [O I]$\lambda\lambda$6300, 6364, and perhaps a trace of emission at He I, λ5873, and at [O III]λ5007. All lines are superposed on the continuum of the central star.
134. 4′.5 northwest of CD−66°1799. Brighter stars, not in the CD or CPD, lie 0′.5 to the east and 1′.0 to the west. A Mount Stromlo spectrum by Webster (1966) indicates that this is not a planetary nebula.
135. VV 74.
137. Rodgers 100 (1960). A photograph has been published by Evans and Thackeray (1950).

138. HD 141969. Widened, very intense emission is visible at Hα and Hβ. The widening of Hα may be due to the presence of [N II]. [O III]λλ5007, 4959 are conspicuously absent. Probably an object similar to 131.
139. 3′ directly west of CPD−55°6787; 2′ southwest of CPD−55°6782. A faint star lies 0′.5 to the northwest.
140. 2′.3 east and slightly south of CPD−55°6842; 9′ south and slightly west of CPD−55°4846. A faint star lies 0′.8 to the southeast.
141. 5′.4 northeast of CPD−58°6528. A star which may be CPD−58°6541 lies 1′.0 to the east.
142. 4′ southeast of CPD−55°6891; 5′.2 east and slightly south of CPD−55°6876. A moderately bright star lies 1′.4 to the northeast.
143. 5′ southeast of CPD−54°6915; 5′.5 east of CPD−54°6904. [N II] is suspected with [N II]/Hα = 0.1.
144. De Vaucouleurs (1955) has reported this object to be a planetary nebula. The continuum is diffuse and seems to arise from the nebula. The intensity of the Hα emission relative to the plate background is 1.
145. 2′.5 south and very slightly west of CD−50°10165.
146. 4′ northeast of CPD−54°7130. A faint irregularity extends some 40″ to the south. The diameter listed is for the main body. Perhaps a diffuse nebula.
147. 5′ northeast of CPD−56°7420; 4′.0 north of CPD−57°7425. [N II] is suspected with [N II]/Hα = 0.8.
148. VV 77 = MYL 93. The MYL declination is in error. My measure agrees with that of VV and NGC.
149. 3′ southwest of CPD−54°7281; 8′ directly north of CPD−54°7269.
150. A photo has been published by Evans and Thackeray (1950).
151. 9′.5 southeast of CPD−59°6665; 1′.0 directly south of CD−59°6076. The emission intensity relative to sky background is 2.
152. 1′.0 southwest of CD−48°10644; 0′.6 northeast of CD −48°10643.
153. 5′.2 west and slightly north of CPD−53°7650; 5′ south and very slightly west of CPD−53°7577. Faint stars lie 0′.2 to the northeast and 0′.5 to the southeast.
154. Rodgers 101 (1960). A photograph has been published by Evans and Thackeray (1950). [O III]-λλ5007, 4959 are conspicuously absent.
155. 2′.2 northwest of CD−41°10610; 2′.5 northeast of CD−41°10607.
156. 3′.5 west of CD−42°11215. A faint continuum is suspected. If real, the description is 1-OT-5.
157. 9′ west of CPD−53°7879; 6′.5 northeast of CPD−53°7838.
158. 2′.5 west and slightly south of CPD−58°6775.
159. 4′ northwest of CPD−54°7638. A star lies 20″ to the northwest.
160. 5′ northeast of CD−46°10690. A faint star lies 1′ south and slightly to the east. Brighter stars not in the CD or CPD lie 3′ to the northeast, 4′ north and slightly west, and 4′ to the northwest.
161. 5′.6 north and slightly west of CPD−53°7928.
162. 4′ northeast of CPD−53°7992. A moderately bright star lies 0′.8 to the northwest. A faint continuum is probably due to an overlapping spectrum.
163. 8′.5 east and slightly south of CPD−58°6803; 14′ south of CPD−58°6806.
164. 6′.8 southwest of CPD−53°8027; 2′.1 northeast of CPD−53°8023.
165. A round mass of nebulosity without structure. The edges are not sharp. Possibly a diffuse nebula? 4′ northeast of CPD−53°8024.
166. 5′.2 northwest of CD−45°10709.
167. VV 81 = HD 148687. A photograph has been published by Evans and Thackeray (1950).
168. Cederblad 135 a,b. (1946) This peculiar planetary-like nebula is discussed by Henize (1959). A photograph appears in *Sky and Telescope*, April, 1959, p. 315. The listed diameter is the maximum dimension, measured in a northwest-southeast direction. Westerlund (1960) has investigated this object in greater detail and presents evidence that the central star lies on or above the main sequence.
169. 4′ west and slightly south of CD−49°10784; 5′.7 north of CD−49°10777.
170. 7′ southwest of CPD−53°8069; 11′ south of CPD−53°8064.
171. 14′.5 south of CD−34°11082; 6′.0 west of CD−34°11086.
172. 5′.4 northeast of CPD−55°7615; 6′.5 northwest of CPD−55°7622. A faint star lies 0′.5 to the northeast. [O I]λ6300 is suspected. A Mount Stromlo spectrum by Webster (1966) indicates that this is not a planetary nebula.
173. 9′.5 north of CD−39°10507. A faint continuum is probably due to an overlapping spectrum.
174. 12′ directly north of CD−45°10803; 5′ northeast of CD−45°10798. A trace of continuum on long-exposure plates probably arises in an overlapping spectrum. A Mount Stromlo spectrum by Webster (1966) indicates that this is not a planetary nebula.
175. 10′ southwest of CD−36°10893; 4′.5 northwest of CD−36°10887.
176. 6′ southwest of CD−44°11059; lies at edge of a conspicuous absorption lane. Possibly a T Tauri star?
177. 12′ south of CPD−62°5427; 5′ east of CPD−62°5426. A bright star not in the CD or CPD lies 2′.0 to the southwest. Hβ emission is suspected. The spectrum as described by Miss Cannon is peculiar. He II λ4686 is strong while [O III]λ5007 is weak or absent. Spectra obtained by Feast (private communication) and Webster (1966) indicate that this is not a planetary nebula.

178. 1ʹ.8 north and slightly east of CD−38°11145.
179. 6ʹ directly north of CD−45°10861. Nearby stars lie 2ʹ to the east, 3ʹ to the east and 2ʹ south and slightly to the west.
180. MNK 4. Lies 5ʹ north and slightly west of BD−18°4314.
181. AS 208.
182. HD 151895. 5ʹ.5 due north of CPD−64°3574. Faint stars lie 1ʹ.0 to the west and 2ʹ.0 to the east.
183. 2ʹ west of CD−44°11234. A faint star lies 1ʹ.5 to the south.
185. 3ʹ.0 southwest of CPD−69°2671. A faint star lies 1ʹ.2 to the southeast.
186. 4ʹ northwest of CD−51°10628; 2ʹ.5 northwest of CD−51°10624.
187. 5ʹ northeast of CD−50°10953. Faint stars lie 1ʹ.0 and 0ʹ.5 to the southeast.
189. VV 85 = HD 153655.
193. VV 89 = HD 154072. The intensity of Hα relative to the sky is 4.
194. MWC 247. 5ʹ.5 northeast of CD−33°11699; 5ʹ.5 southwest of CD−33°11709. A 100-inch direct plate by R. Minkowski shows a somewhat irregular nebulosity.
195. 1ʹ.2 directly south of CPD−52°10438.
198. 10ʹ.5 northeast of CD−44°11432; 5ʹ.0 northeast of CD−44°11431.
199. [N II] is suspected with [N II]/Hα = 0.5.
200. AS 219. [O I]λ6300 is suspected. This is not HD 326971.
201. VV 93 = HD 154952. A photograph has been published by Evans and Thackeray (1950).
202. MNK 4. Lies in obscured region. 8ʹ south and slightly east of CD−26°11970.
204. VV 94 = HD 155520 = Cederblad 139 = Rodgers 124 (1960). The irregularity of this object has caused some observers to class it quasi-planetary. R. Minkowski considers it to be a planetary nebula (private communication).
206. VV 96 = HD 155752. The continuum may arise from an overlapping spectrum. The intensity of the emission line relative to the sky is 4.
207. 5ʹ.5 north and slightly west of CD−45°11393; 5ʹ.5 east of CD−45°11385. The form is somewhat irregular with a faint extension to the southeast.
208. VV 97 = HD 156531. The intensity of the emission line relative to the sky is 4. A photograph has been published by Evans and Thackeray (1950).
209. 5ʹ northeast of CD−25°12080.
213. A star of moderate brightness lies 0ʹ.2 to the northwest. It is possible that the continuum belongs to a nearby star. If so, the designation is 1-00-2.
214. Lies in obscured area. 9ʹ.5 southeast of BD−22°4325.
215. HRO 1 10.
216. Lies in heavy obscuration. 8ʹ northeast of CD−27°11605. A faint star lies 2ʹ to the southeast.
220. Hoffleit (1953) has confirmed the planetary nature of this object. 9ʹ southeast of CD−43°11684; 13ʹ southwest of CD−43°11700.
221. 2ʹ.7 north of CD−26°12130.
224. 2ʹ.0 north and slightly east of CD−46°11524. The planetary nature of this object has been confirmed by Hoffleit (1953).
225. [N II] is suspected with [N II]/Hα = 0.1.
226. 3ʹ.5 southeast of CD−28°13166; 8ʹ.5 northeast of CD−28°13167.
228. 2ʹ.5 southeast of CD−28°13183; 2ʹ.5 north and slightly west of CD−28°13187.
229. 8ʹ southwest of CD−24°13364; 9ʹ southeast of CD−24°13359. Nearby stars lie 0ʹ.8 to the northeast and 2ʹ.0 to the southeast.
231. Lies in very strong obscuration. 13ʹ northwest of CD−26°12149.
232. VV 101 = HD 158269 = MYL 101. A faint continuum is suspected. Lies in heavy obscuration.
234. Lies between CD−29°131613 and a faint star 0ʹ.5 directly to the west of the CD star. The overlapping continua of these stars may conceal a faint continuum in the emission object.
236. 8ʹ.5 directly west of BD−15°4566.
239. 7ʹ northeast of CD−27°11692; 9ʹ.5 southeast of CD−27°12150. Lies in heavy obscuration. The emission intensity is 1 on long-exposure plates. The identification with THE 3 25 is confirmed by The's chart. The LHα position appears to be more nearly crrrect than The's.
240. 13ʹ southwest of CD−28°13259; 4ʹ.5 southeast of CD−28°13235.
243. 7ʹ south of CD−27°11716; 6ʹ north and slightly west of CD−28°13293.
244. 4ʹ.5 southwest of BD−21°4646; 7ʹ east and slightly south of BD−21°4641.
245. 7ʹ southeast of CD−29°13716; 9ʹ.5 south and slightly west of CD−29°13730. A faint star lies 0ʹ.9 to the southwest.
246. 7ʹ.5 east of CD−46°11646; 6ʹ.5 southwest of CD−46°11667.
248. 2ʹ directly west of CD−49°11567. This weak line was over looked in the original survey and was first noted on a long-exposure plate.
249. 5ʹ northeast of CD−22°12103. This object is very red on *Palomar Atlas* plates. The blue image is diffuse with a diameter of about 7ʺ.
250. Very red on *Palomar Atlas* plates. The blue image is diffuse. The red image shows a narrow tail to the southwest. Lies in heavy obscuration. 9ʹ north of CD−26°12163. 10ʹ.5 west of CD−26°12172.
261. 8ʹ northwest of BD−21°4695. 8ʹ.5 southwest of BD−21°4694. *Palomar Atlas* plates show a small

round nebula with a diameter of 15″. The structure is somewhat knotty and suggests that this may be a diffuse nebula.

262. 16′ southwest of CD−26°12233; 14′ directly north of CD−26°12230. Faint stars lie 0′.6 to the northwest and 1′.0 to the northeast. This object is very red on *Palomar Atlas* plates. The blue image is slightly diffuse.
263. 5′.5 northwest of CD−24°13417. Faint stars lie 1′.4 to the northwest and 2′.0 to the southeast.
264. 2′ southwest of CD−26°12234. Appears as a large rectangular planetary on *Palomar Atlas* plates with a maximum dimension of 47″.
269. 6′.5 northwest of CPD−64°3669; 10′.5 northeast of CPD−64°3662. A star lies 1′.0 to the northwest. Hα may be slightly diffuse. A direct plate with the Mount Stromlo 74-inch reflector indicates that this is probably not a planetary nebula.
273. VV 111.
274. On LHα plates this object shows very strong emission at Hα and weak emission at Hβ. Hα shows a barely resolved duplicity originally interpreted as due to the presence of [N II]λ6584 with [N II]/Hα = 0.3. However, Thackeray's data indicate that the double line is due to the sharp edges of the nebular ring whose diameter, 9″.6, is very nearly equivalent to the spacing produced by the Hα, λ6584 combination.
275. 7′.5 northwest of CD−38°12172; 3′.5 southeast of CD−38°12166. The emission intensity is 2 on long-exposure plates.
277. MWC 270 = HD 316248 = Rodgers 135 (1960). On LHα plates weak Hβ emission is visible and [O I]λ6300 is suspected. [O III]λλ5007, 4959 is not visible. The HD class is P Cyg. Minkowski (1946) finds a nebular disk 4″ in diameter. This object is probably similar to the low-excitation planetary nebulae typified by HD 138403 (131 in this table).
281. 9′ directly south of BD−18°4640. A faint star lies 0′.2 to the west. This object appears as a ring planetary 19″ in diameter on *Palomar Atlas* plates. The identification with THE 4 2 is confirmed by The's chart. The's position is slightly in error.
282. 10′ east and slightly south of BD−20°4865; 9′.2 west and slightly north of BD−20°4869. A red star is visible in this position on *Palomar Atlas* plates.
287. VV 117.
288. MYL 103 = HD 320623.
290. VV 118.
293. 2′.1 east of BD−18°4654. This object is very red on *Palomar Atlas* plates. The blue image is slightly diffuse. Identification with THE 4 5 is confirmed by The's chart. The LHα position is correct to ±1′.
294. 1′.9 northwest of CD−32°13431. A slight diffuseness of Hα is suspected.
295. The R.A. listed by Minkowski is slightly in error. This object is superposed on the open cluster M7.
299. VLG 59 (Table 3).
303. HD 320843. This object lies very near the open cluster M7.
305. VLG 60 (Table 3).
306. 20′.5 south of CD−42°12644; 10′.6 northeast of CD−43°12126.
309. Probably identical to Rodgers 152 (1960).
311. 1′.6 southwest of BD−18°4715.
312. VLG 61 (Table 3).
313. [N II] is suspected with [N II]/Hα = 0.5.
320. [N II] is suspected with [N II]/Hα = 0.3.
321. The 1900 declination of this object is −15°31′, not −15°48′ as given by Minkowski.
322. 7′ north and slightly east of BD−17°4981. A moderately bright M star lies 0′.2 to the northeast. The presence or absence of a continuum is difficult to determine due to an overlapping spectrum.
325. 4′.5 southwest of CD−26°12672; 5′.5 directly east of CD−29°12660. The blue image on *Palomar Atlas* plates is suspected to be slightly diffuse. A weak continuum, visible on LHα plates, probably arises from a neighboring star.
326. MYL 112. Minkowski's right ascension appears to be more nearly correct than Mayall's.
331. AS 269.
333. MNK 1 36. The 1900 R.A. is closer to 1757.1 than to 1757.8 as given by Minkowski. This is confirmed by Frantsman (1962).
337. 1′.4 northwest of CD−32°13699; 3′ northeast of CD−32°13696.
338. [N II] is suspected with [N II]/Hα = 1.2.
340. VV 147 = HD 312582 = MYL 115.
341. 5′.8 northwest of CD−51°11366; 7′.3 north of CD−51°11362. Neither Evans and Thackeray (1950) nor I find a planetary in the position given for VV 145 (see Shapley 1936). It seems likely that object 341 is also the one observed by Shapley. An annular structure is suspected on LHα plates.
342. 5′ northeast of CD−26°12789. A star not in the CD, lies 3′ directly to the south.
343. 1′.4 northeast of CD−28°14127.
349. 2′.5 due north of CD−36°12240.
351. A resolved nebular image is suspected at Hα.
352. It seems probable that AS 278 is identical to MNK 1 40. No emission line is visible in the position given for MNK 1 40.

355. VLG 62. This object was not considered to be a planetary nebula in the original survey of LHα plates due to its nearness to diffuse nebulosity of which it appeared to be a knot.
356. 0.'4 east of CPD−28°6348; 2′ south of CPD−28°6349.
360. AS 283. 4.'4 northeast of CD−28°14254; 8.'5 southeast of CD−18°14240. No nebulous or very red object is visible on plates taken with the Mount Wilson 100-inch reflector by R. Minkowksi. However, Hα emission is definitely diffuse, an effect which probably indicates the presence of [N II]λ6584.
361. VV 154 = HD 166449.
362. VV 155 = HD 166468.
363. 3.'5 east of BD−18°4825.
367. AS 290.
369. VV 160 = HD 166935.
372. The 1900 declination is −30°18′ not −30°11′ as given by Minkowski.
374. 4.'5 southeast of BD−21°4923; 7′ southwest of BD−21°4925.
377. MWC 288 = HD 167362. Swings and Struve (1940) classify this as a planetary on the basis of its spectrum. Thackeray (1950) finds no nebulosity.
381. 7.'5 northwest of BD−20°5068; 0.'3 east of HD 313109. On an objective-prism photograph taken with the Michigan Curtis Schmidt telescope, [O III]λλ4959, 5007 are suspected.
383. VV 167 = HD 167672.
387. The spectrum does not resemble that of a normal planetary nebula on LHα plates but appears similar to the spectra of faint Wolf-Rayet stars. This object deserves further investigation.
390. 8.'5 south of CD−26°13061. A star of medium brightness not in the CD lies 1.'5 to the southwest.
394. VV 173. [N II] is suspected with [N II]/Hα = 1.0. The 1900 RA is closer to 1816.6 than to 1815.6 as given by VV.
395. 8.'5 southeast of BD−19°4980. A medium bright star lies 2′ to the southwest. The 1900 declination is closer to −19°20′ than to −19°15′ as given by Minkowski.
396. 5′ northwest of BD−21°4976; 6.'8 south and slightly west of BD−21°4972.
399. VV 179 = HD 169460. The intensity of the line relative to the sky is 5.
400. [N II] is suspected with [N II]/Hα = 0.2. The continuum is unusually strong for a planetary nebula. It may possibly arise from a star displaced about 0.'1 to the west. The intensity of Hα relative to the sky is 4.
406. This object is very red on *Palomar Atlas* plates. The blue image is slightly diffuse.
408. VV 188 = HD 170839.
410. VV 191 = HD 171131.
415. An overlapping spectrum somewhat obscures the character of this line.
418. 2.'7 east of CD−30°16118; 5.'7 northwest of CD−30°16127. This object is diffuse with a diameter of about 14″ on *Palomar Atlas* plates.
421. VV 204 = HD 173283. The intensity of Hα relative to the sky is 5.
422. MWC 957 = MYL 121. Vyssotsky, Miller, and Walter (1945) in classing this a Be star observe an appreciable blue continuum and apparently see no trace of [O III] λλ5009, 4959. Since little or no continuum is visible on LHα plates, the continuum must be very blue or else variable. The MYL class (P?) indicates that a forbidden line, probably [O II]λ3727, is visible in the photographic region. The lack of conspicuous [O III] implied by Vyssotsky's observation indicates that the nebular spectrum is of very low excitation.
425. HD 175194 = AS 330.
427. Appears to be an intense central knot with a somewhat diffuse halo of nebulosity. The diameter is difficult to estimate. He I, λ5875, is probably present in emission.
428. 10.'5 southwest of BD+15°3733; 17.'5 southeast of BD+15°3723.
429. 5.'7 northeast of BD+14°3830; 6.'5 southeast of BD+14°3829.
431. VV 225.
432. 3.'0 southeast of BD+20°4125. A 60-inch direct photo shows a stellar image.
433. 5.'7 southeast of BD+20°4125; 10.'4 southwest of BD+20°4127.
434. 5′ southwest of CPD−74°1809; 12′ southeast of CPD−74°1805.
435. 2.'5 due west of BD+20°4139.
436. 2′ northeast of CD−34°13742.
437. Minkowski (1946) classifies this as a diffuse or peculiar nebulosity. *Palomar Atlas* plates show a bright star between two teardrop-shaped fans of nebulosity. The maximum (east-west) dimension is 33″, the north-south dimension is 10″. This is probably a planetary nebula similar in form to VV 80.
438. Campbell's Hydrogen Envelope Star. The emission-line spectrum of the central star is unusually prominent. It appears to be of type WC 8 with C III λ5696 unusually intense.
440. 1.'5 due south of BD+24°3817. A direct plate with the Naval Observatory 40-inch reflector shows a stellar image. The widening of Hα must be due to [N II]. Appears as a very red star on *Palomar Atlas* plates.
442. 15.'8 south of BD+26°3628; 12.'0 southwest of BD+26°3635. A direct plate with the Naval Observatory 40-inch reflector shows a stellar image. Appears as a very red star on *Palomar Atlas* plates.

NOTES TO TABLE 2—*Continued*

446. 6'.4 north and slightly east of BD+23°3752. Lies near the nebulous open cluster NGC 6820. A direct photo with the Naval Observatory 40-inch reflector shows a stellar image.
447. 8'.5 northwest of BD+20°4265; 15' due east of BD+20°4252. A direct plate with the Naval Observatory 40-inch reflector shows a stellar image. Appears as a very red star on *Palomar Atlas* plates. The widening of Hα is probably due to [N II].
448. 3'.5 southeast of BD+21°3921; 3'.5 northeast of BD+21°3919.
451. VV 245 = Sharpless 95 (1959).
452. VV 246 = Dumbbell Nebula.
453. AS 375. The continuum observed on LHα plates is the overlapping spectrum of a nearby star.
455. VV 249.
456. VV 250.
457. This object and its peculiar central star are described by Henize (1961). The nebula was discovered on *Palomar Atlas* plates. Peculiar variations in the character of the Hα emission of the central star led to the examination of the *Palomar Atlas* plates and thus to the discovery of the nebula. The very low surface brightness of this object suggests that it may be more closely related to novae shells than to planetary nebulae.
458. VV 252.
459. 6'.5 southwest of BD+26°3956; 6'.0 northwest of BD+29°3947. A direct plate with the Naval Observatory 40-inch reflector shows a stellar image.
460. VV 254.
462. 13'.5 east of BD+24°4072; 13'.0 northeast of BD+24°4078.
463. PC 24. 8'.0 northeast of BD+26°3863; 6'.0 northwest of BD+26°3866.
464. VV 256. [N II] is suspected with [N II]/Hα = 0.3.
466. VV 257.
467. 4'.4 southwest of BD+19°4656; 14' northeast of BD+19°4454. A faint star lies 0'.6 to the southeast. A direct plate with the Naval Observatory 40-inch reflector shows a stellar image.
468. 10'.8 southeast of BD+34°4115; 14'.5 southwest of BD+34°4126. This emission line may vary. It was not observed in July, 1944, or October, 1945. However, both plates are rather weak. A direct plate with the Naval Observatory 40-inch reflector shows a stellar image.

Apparent inconsistencies in the numbering of multiple publications by one observer are due to an attempt to follow the system initiated by Perek and Kohoutek (1963).

The third through sixth columns give the equatorial coordinates for 1900 and the galactic coordinates for each object. The galactic coordinates have been computed with the Northwestern University CDC 3400 computer.

For nebulae published prior to 1953 the published coordinates have been adopted unless a significant discrepancy in position has been detected. For objects published in 1953 or later, the position measured independently on the present survey plates is given. These positions have been measured relative to nearby CD stars and are estimated to have a probable error of $\pm 1'$. Errors exceeding 2' are expected to be rare. In most instances in which discrepancies with other catalogues exceed 2', the present position has been checked and found to be the more nearly correct. A quantitative estimate of the accuracy of the positions in Table 2 may be obtained by comparing them with the accurate positions measured by Frantsman (1962) for the Apriamasvili nebulae 9, 10, 11, and 12. The mean error of the Henize positions computed from eight residuals is $\pm 0'.8$.

The seventh column gives the previous classification of the object by the following system: "P" = planetary nebula, "PD" = tentative or doubtful planetary nebula, "DN" = diffuse nebula, and "Q" = P Cygni star. All objects with no notation in this column or with DN or Q are objects newly discovered or newly designated as planetary nebulae from data arising from the present survey. It may be noted that many of the objects for which reference is given to the APR, KHT, PB, PC, PRK, THE, VDV, and VLG lists were first published in 1954 in the author's doctoral thesis. Those objects designated as MNK 4 have been discovered and investigated by Minkowski but have not been previously published.

The eighth through tenth columns give a quantitative description of the spectrum of each object as it appears on LHα plates. "D" gives the structure or diffuseness of the

Hα emission line on a scale from 0 to 4, where "0" = very sharp line, "1" = line of average sharpness, "2" = line definitely widened relative to other nearby emission lines, "3" = a nebular image clearly resolved, and "4" = Hα and [N II] λ6584 clearly resolved. Those cases in which [N II] is only suspected are indicated by a "D" in the twelfth column.

"CT" gives the intensity of the continuum near Hα on a scale from 0 to 5 where "0" = no continuum observed, "T" = trace, "3" = optimum exposure and "5" = overexposed. The first of the two numbers refers to medium-exposure plates, the second to long-exposure plates. If only one number is given, it refers to the medium-exposure plates, and it is implied that the long-exposure plates do not cover this region of the sky.

"H" gives the intensity of the combined Hα and [N II] emission on a scale from T to 5 where "T" = trace and "5" = very strong. If no continuum is observed this intensity is relative to the sky background and should be directly related to the Hα + [N II] flux received from the nebula. If a continuum is present, the intensity of Hα is estimated relative to the continuum and is a measure of line-to-continuum contrast.

The eleventh column indicates the certainty with which the classification of "planetary nebula" is given: "P" = planetary or probable planetary, "PD" = possible or doubtful planetary and "P*" = doubtful planetary by LHα criteria but confirmed to be planetary by later observations with large reflectors. A classification is given in this column for all nebulae which had not been confirmed prior to 1960 by observations with large reflectors. It has been assumed that all nebulae published prior to 1950 (those listed by Vorontsov-Velyaminov and by Minkowski), by Thackeray, and by Abell, are so confirmed. The remaining objects are classed "P" or "PD" largely on the basis of the purity data given in Table 4 (see below). A classification of "PD" is assigned to those objects falling in categories 2, 6 and 8 and those in category 9 with line intensities of "T" or with a line intensity of 1 and a location outside the region of the long-exposure plates.

The twelfth column gives the estimated ratio of intensity of [N II] λ6584 to Hα in those instances where the lines are resolved. If [N II] seems to be clearly absent (the emission line is sharp and single), this ratio is given as 0.0. If the presence of [N II] is obscured by the presence or possible presence of a nebular disk this is designated by "U" (uncertain). If the presence of [N II] is suspected but not certain a "D" (doubtful) is recorded.

The thirteenth column indicates the presence in the LHα spectrum of emission lines other than Hα and [N II] λ6584. There, "1" = [O III] λ5007, "2" = [O I] λ6300, and "3" = He I λ5876.

The fourteenth column gives the diameter of the nebula in seconds of arc as measured on the survey plates. A diameter is given only if a nebular disk is clearly resolved; otherwise the upper limit to the diameter is given and is designated by the prefix "L" (for "less than"). "N" in this column indicates that a special remark is given in the notes following Table 2.

In the fifteenth column "R" indicates that the object is resolved on plates taken with the Mount Stromlo 74-inch reflector (Westerlund and Henize 1967) or with the Mount Wilson 60-inch and the Naval Observatory 40-inch reflectors (Henize 1961). "S" indicates that the object has been observed with one of these reflectors but has not been resolved.

IV. STATISTICAL CHARACTERISTICS OF THE CATALOGUE

Since one of the useful attributes of the present catalogue is its observational uniformity, it is desirable to estimate its limiting magnitude, purity, and completeness as carefully as possible.

Limiting magnitude is a valid concept only for those nebulae which are unresolved on LHα plates. For resolved objects (only sixty objects in Table 2 are clearly resolved) the plate limit is defined in terms of surface brightness. A comparison with the nebular photometry available in the Large Magellanic Cloud indicates that the limiting surface brightness detectable on medium-exposure plates is about 2.5×10^{-4} ergs sec^{-1} cm^{-2}.

In order to compare the limiting magnitude of the LHα survey with that of northern surveys, particularly the Mount Wilson survey, plates were taken in two regions north of $-30°$. These plates are listed in Table 1, and the data derived from them are included in Table 2. Inspection of data in the region centered on $20^{h}00^{m}$, $+29°$ shows a total of thirty-eight nebulae detected in the LHα survey (object 457, detected on the *Palomar Atlas* is not included in this number). Of these, ten are listed by Vorontsov-Velyaminov, nine by Minkowski, and one by Peimbert and Costero. Since the remaining eighteen are newly discovered objects, it is evident that the LHα survey has a somewhat fainter limiting magnitude than the Mount Wilson survey. This conclusion is supported by inspection of continuous spectra which indicates that the LHα survey limit is about 0.5 mag fainter than the Mount Wilson limit. The average image quality of the LHα plates is also slightly better.

Although the eighteen new objects have been selected by the same criteria as the objects in the southern sky, it is to be expected that their purity is somewhat less than that of the southern nebulae, since no long-exposure plates are available to confirm the absence of a faint continuum. Direct photographs with large reflectors of thirteen of the new objects show that six are resolved (Henize 1961) and seven are stellar. Four of the five remaining objects have been investigated by Minkowski (unpublished) who finds that three (428, 429, and 442) are planetary nebulae and that one (437) is a diffuse or peculiar nebula. Since his description of 437 indicates a structure similar to some planetaries, this object is still retained in Table 2. We then find that ten of the eighteen new objects are reasonably well confirmed. Even if the purity of the remaining objects is as low as 50 per cent, it is clear that the LHα survey has detected approximately 1.7 times as many nebulae as the Mount Wilson survey in this region. This factor must be taken into account when comparing statistics of the southern Milky Way with those of the northern Milky Way.

In investigating purity it is useful to define three classes of objects: (*a*) "well-confirmed planetary nebulae" which are confirmed by either direct photography or by slit spectroscopy with a large reflector; (*b*) "tentative planetary nebulae" which appear to be planetary nebulae on short-focus survey plates but are not yet confirmed with large reflectors; and (*c*) "interloping objects" which appear to be planetary nebulae on survey plates but which after further investigation are found not to be planetary nebulae. It is then possible to calculate the purity of the well-investigated objects $(a + c)$ as the ratio $a/(a + c)$. If the well-investigated nebulae and tentative nebulae are both random samples of the original survey list, then we may assume that the purity (P_b) of the remaining "tentative planetary nebulae" is the same as that of the well-investigated objects. Although this is not an entirely safe assumption it is not an unreasonable one. We may then estimate the purity (P) of Table 2 to be $(a + bP_b)/(a + b)$. Since this value depends on the random sampling assumption, it may also be useful to calculate the lower limit (P_L) to the purity of Table 2 as $a/(a + b)$.

In classifying objects into these three groups we define "well-confirmed planetary nebulae" to be those nebulae listed by Vorontsov-Velyaminov (1948), Minkowski (1946, 1947, 1948), Abell (1955), Thackeray (1950), Henize (1961), and Westerlund and Henize (1967). Table 3 lists the "interloping objects" found in the LHα survey. Those objects noted by parentheses in Table 2 are also listed in Table 3 and are classed as interloping objects in this discussion.

The resulting statistics on purity are displayed in Table 4. Here the planetary nebulae are subdivided according to the criteria used to identify them as planetary nebulae, since it may be expected that purity will depend on the reliability of these criteria. The basic criterion by which objects were originally included in Table 2 is the presence of an emission line with little or no continuous spectrum. However, in many cases auxiliary criteria are present which tend to give additional confirmation of the identification as planetary nebulae. These are: (1) the presence of a resolved nebular image of reasonable regularity; (2) the presence of forbidden lines in the spectrum ([N II] λ6584, [O I] λλ6300, 6364, or [O III] λλ5007, 4959); and (3) a combination of the above two effects in which the Hα line shows a distinct broadening or diffuseness (diffuseness = 2). With these criteria in mind the nebulae have been divided into the nine categories defined in Table 4.

Categories 4, 6, and 8 include objects that show a weak continuum. Although the presence of a continuous spectrum generally is sufficient cause to class an emission-line object as a star rather than as a nebula, in a few cases when other criteria are available or when the contrast between the emission line and the continuum is very great, objects with a weak continuum have been classed as possible planetaries. This procedure is justified mainly by the fact that 8 per cent of the well-confirmed planetaries show an appre-

TABLE 3

EMISSION-LINE OBJECTS WHICH WOULD HAVE BEEN CLASSED AS PLANETARY NEBULAE WITHOUT OUTSIDE DATA

CATEGORY*	DESIGNATION	1900 R.A.	1900 Decl.	LHα SPECTRUM	TYPE
1	MNK 1 DN 7	17h55m1	−33°15′	3 01 4	Dif neb?†
2	(11)	08 33.4	−39 04	3 00 2	Dif neb?
	GUM 50	15 50.0	−53 25	3 00 5	Dif neb
	MNK 3 DN 2	17 25.4	−28 35	3 00 2	Dif neb
	NGC 6813	19 34.5	+26 58	3 0 3	Dif neb
	....	19 40.7	+24 52	3 0 3	Dif neb‡
3	CP Pup	08 08.0	−35 03	2 00 2	Nova
	MNK 3 DN 4	17 44.4	−34 52	2 00 1	Dif neb
	Roberts 81	17 56.7	−18 05	2 0 2	WR?
	....	18 10.4	−21 16	2 0 1	Nova?§
	MNK 3 DN 5	20 00.6	+33 26	2 0 1	Dif neb
4	AS 210	16 45.1	−25 49	2 01 5	Symb star?‖
5	(172)	16 29.6	−55 30	0 00 3	Pec#
6	RX Pup	08 10.7	−41 24	1 0T 5	Symb star
	(113)	14 52.6	−53 54	4 1 4	Symb star?**
7	RT Ser	17 34.3	−11 53	1 0 3	Nova
	(269)	17 37.3	−64 36	1 0 3	Dwarf galaxy?
	MWC 939	18 28.5	−17 41	1 0 4	Bep
8	(17)	08 53.2	−46 01	1 02 4	Bep?††
	(134)	15 37.9	−66 10	1 01 5	Pec#
	(177)	16 35.5	−62 26	0 T 5	Pec#
	V455 Sco	17 00.8	−33 57	1 01 5	Symb star
	YCrA	18 07.2	−42 52	0 01 5	Symb star
	AS 302	18 15.0	−31 35	0 0T 5	Pec
	AS 327	18 47.2	−24 30	1 0T 5	Symb star‡‡
9	(61)	11 02.1	−54 16	1 00 1	Pec#
	(174)	16 31.2	−45 11	0 00 1	Pec#
	AS 221	17 05.7	−32 28	1 00 1	Pec
	AS 245	17 45.0	−22 17	1 0 1	Pec

* See Table 4 for explanation of this column.

† The compact binuclear appearance of this object on the *Palomar Sky Atlas* suggests that it may be a planetary.

‡ A small diffuse nebula in the *Palomar Sky Atlas*. It has not been noted by either Minkowski or Sharpless.

§ This previously unreported object was visible in 1951 but had disappeared by 1962.

‖ See *Pub. A.S.P.*, **77**, 208, 1965.

\# A Mount Stromlo spectrum by Louise Webster (1966) shows peculiar features.

** A Mount Stromlo spectrum by Henize shows features similar to some symbiotic stars.

†† A Mount Stromlo spectrum by Henize shows no forbidden lines.

‡‡ Private communication from Minkowski.

ciable continuum on LHα plates. It is probable that this arises mainly from the presence of bright central stars or of superposed stars. If all objects showing a continuum were excluded from discovery catalogues, it is to be expected that a corresponding incompleteness will arise from this arbitrary exclusion. Table 4 indicates that 84 per cent of the investigated objects in categories 4 and 6 are planetary nebulae. On the other hand the corresponding purity of category 8 is very low, thus indicating that criteria other than great line strength should be present before objects with continua are admitted to a catalogue of planetary nebulae.

Table 4 indicates that the estimated purity of Table 2 is 0.97 and that the lower limit

TABLE 4

THE PURITY OF PLANETARY NEBULAE AS A FUNCTION OF CLASSIFICATION CRITERIA

Classification Category	Well-Confirmed (a)	Tentative (b)	Interlopers (c)	P_b $[a/(a+c)]$	P $[(a+bP_b)/(a+b)]$	P_L $[a/(a+b)]$	New Tentative	New Total
1. Hα image clearly resolved and regular	52	0	1	0.98	1.00	1.00	0	16
2. Hα image clearly resolved but somewhat irregular.....	6	1	5	0.55	0.94	>0.86	1	6
3. Hα diffuseness=2; no continuum.....	95	28	5	0.95	0.99	>0.77	6	39
4. Hα diffuseness=2; weak continuum...	13	0	1	0.93	1.00	1.00	0	4
5. Hα sharp but forbidden lines are present; no continuum...........	57	23	1	0.98	0.99	>0.71	9	21
6. Same as 5 but with weak continuum...	3	1	2	0.60	0.90	>0.75	1	1
7. No confirming criteria; Hα intensity >1; no continuum	65	48	3	0.96	0.98	>0.58	23	32
8. Same as 7 but with weak continuum...	2	3	7	0.22	0.53	>0.40	3	4
9. No confirming criteria; Hα intensity=1 or T; no continuum........	26	36	4	0.87	0.92	>0.42	17	27
Total...........	319	140	29	0.92	0.97	>0.70	60	150

to the purity is 0.70. In view of the low purities of tentative nebulae in categories 2, 6 and 8 and since only 5 objects in these categories remain unconfirmed, these will be excluded from statistical discussion in later sections. Table 5 lists those objects which are to be excluded from further statistical discussions.

Since the purity of tentative nebulae in category 9 is expected to be relatively low, it is surprising to find P_b as high as 0.87. This may be partly due to a selection effect in which only the more promising of the faint objects have been chosen for confirming observations.

Of the 140 tentative nebulae in Table 2, 80 have been observed in other surveys and 60 are observed only in the LHα survey. It is fair to assume that any remaining impurities are strongly concentrated in these 60 objects. The distribution of these objects by classification category is given in the eighth column of Table 4. The ninth column gives the total number of newly discovered objects, both confirmed and tentative in each category.

Incompleteness in the catalogue may result from two independent causes. The first is that some planetaries of irregular form may be mistaken for diffuse nebulae while others may be overlooked due to the presence of a strong continuous spectrum. This we may term "recognition" incompleteness. The second cause of incompleteness arises from variations in plate quality and from variations in the alertness of the plate searcher. This we term "search" incompleteness.

Recognition incompleteness is difficult to evaluate. The scope of the problem can be illustrated by noting that seven objects (10, 58, 204, 355, 387, 400, and 453) among the well-confirmed planetary nebulae were not initially recognized as planetaries in this survey. In 10, 58, 387, 400, and 453 the nebular nature of the object was masked by the strength of the continuous spectrum. Objects 355 and 204 were mistaken for diffuse nebulae—355 primarily due to its nearness to the diffuse nebula M8 and 204 because of its extreme irregularity of form. Thus, recognition incompleteness in the group of 319

TABLE 5

OBJECTS IN TABLE 2 TO BE EXCLUDED FROM STATISTICAL DISCUSSION

Number	Number	Number	Number	Number	Number
11*	61†	113†	174†	240‡	275‡
17†	72†‖	134†	177†	243‡	294‡
32‡	91§	151#	213§	250‡	314‡
38§	92‡	172†	239‡	269*	457‡

* Form indicates probably not a planetary
† Spectrum indicates probably not a planetary.
‡ Not visible on medium-exposure plates.
§ Category 8.
‖ Category 2.
Category 6.

well-confirmed nebulae amounted to 2.2 per cent. Some incompleteness must remain in the total survey for similar reasons, but the present data do not give us any insight into its degree.

It is possible to be more precise in estimating the "search" incompleteness. Since the sky south of $-30°$ has been searched in duplicate, it is possible to estimate the incompleteness of the search by noting those nebulae south of $-30\overset{\circ}{.}0$ which were not independently detected at least twice. Table 6 displays the available data analyzed according to the Hα intensity. Hα intensity "T" has been omitted since these objects are not expected to be seen on medium-exposure plates.

The incompleteness of a duplicate search is insignificant for Hα intensities of 2 and brighter. At Hα intensity 1 there is significant incompleteness amounting to approximately 5 per cent in a duplicate search. It might be suspected that a serious incompleteness in both intensities 1 and 2 exists, since the frequency in these two classes has not increased appreciably over that for nebulae with Hα intensity 3. However, it seems clear that the relatively low frequency of nebulae with Hα intensity 2 cannot be ascribed to search incompleteness and therefore must be ascribed to cosmic effects. Both interstellar absorption and a fall-off in the space density of planetary nebulae with increasing distance from the galactic plane probably contribute to the leveling off of frequencies as fainter intensities are reached.

Finally, Table 2 has been compared with the data of Vorontsov-Velyaminov (1948), Minkowski (1946, 1947, 1948), and Haro (1952, Table 1) to detect possible omissions. Of the planetary nebulae from these lists which lie in our region of survey (including the marginal areas where search duplication was not possible) 5, 13, and 21 objects, respectively, are not included in Table 2.

The missing Vorontsov-Velyaminov objects are 25, 183, 187, 277, and 280. VV25 is an H II region in the Large Magellanic Cloud. The remaining objects are not visible on LHα plates and are considered to be either doubtful planetaries or non-planetaries by Evans and Thackeray (1950).

During the comparison with the VV catalogue it became evident that the coordinates of VV145 are in error. Evans and Thackeray find no planetary in the given position, but LHα plates, while showing no planetary in the given position, show a large planetary of the expected dimensions about $\frac{3}{4}°$ southeast of the VV position. It seems reasonable to assume that this object is VV145. One previously recognized planetary nebula, NGC 3195 (Evans and Thackeray 1950), was not included in the list of Vorontsov-Velyaminov.

Of the thirteen missing Minkowski objects, eight were discovered on plates taken with an 18-inch Schmidt and are therefore probably too faint to be detected with the 10-inch camera. The remaining five objects include MNK 1 3, MNK 3 13, MNK 3 19, MNK 3 22, and MNK 1 40. MNK 1 3 is a large nebula of low surface brightness and shows

TABLE 6

SEARCH INCOMPLETENESS FOR PLANETARY NEBULAE SOUTH OF −30°0

	Hα Intensity				
	1	2	3	4	5
Total nebulae	63	72	68	30	28
Visible but not detected on med.-exp. plates	1	0	0	0	0
Detected only once on med.-exp. plates	27	5	0	0	0
Total trials	126	144	136	60	56
Total misses	29	5	0	0	0
Incompleteness of 1 search	0.23	0.03	0.00	0.00	0.00
Incompleteness of duplicate search	0.05	0.001	0.00	0.00	0.00

only a faint smudge on LHα plates. MNK 3 19 is visible on long-exposure plates. MNK 3 22 is not visible on long-exposure plates, and MNK 3 13 is not visible on medium-exposure plates. Both may be suspected of light variation. No object appears at the position given for MNK 1 40, but it is probable that this object is identical to AS 278 if a small error is allowed in Minkowski's right ascension. A sample of the missing Haro nebulae was investigated and found to be not visible on LHα medium-exposure plates. This is to be expected since the Tonantzintla Schmidt should detect fainter nebulae than the 10-inch camera.

V. THE GALACTIC DISTRIBUTION OF THE NEBULAE

The galactic distribution of the nebulae in Table 2 is given in Figure 2, and the surface density of nebulae between galactic latitudes $\pm 10°$ is plotted in Figure 3. The twenty-four objects in Table 5 (except for 172) have been omitted from these figures. The plot differs from the one recently published by Minkowski and Abell (1963) in that it has a uniform limiting magnitude and constitutes a complete survey of those regions of the sky within the survey limits. Studies of distribution in galactic latitude and galactic longitude based on all available data may be somewhat misleading due to concentration of the searches to special regions of the sky, particularly to the galactic center.

These data confirm the well-known concentration of planetary nebulae to the galactic center and the tendency pointed out by Minkowski (1950) for the nebulae not to appear

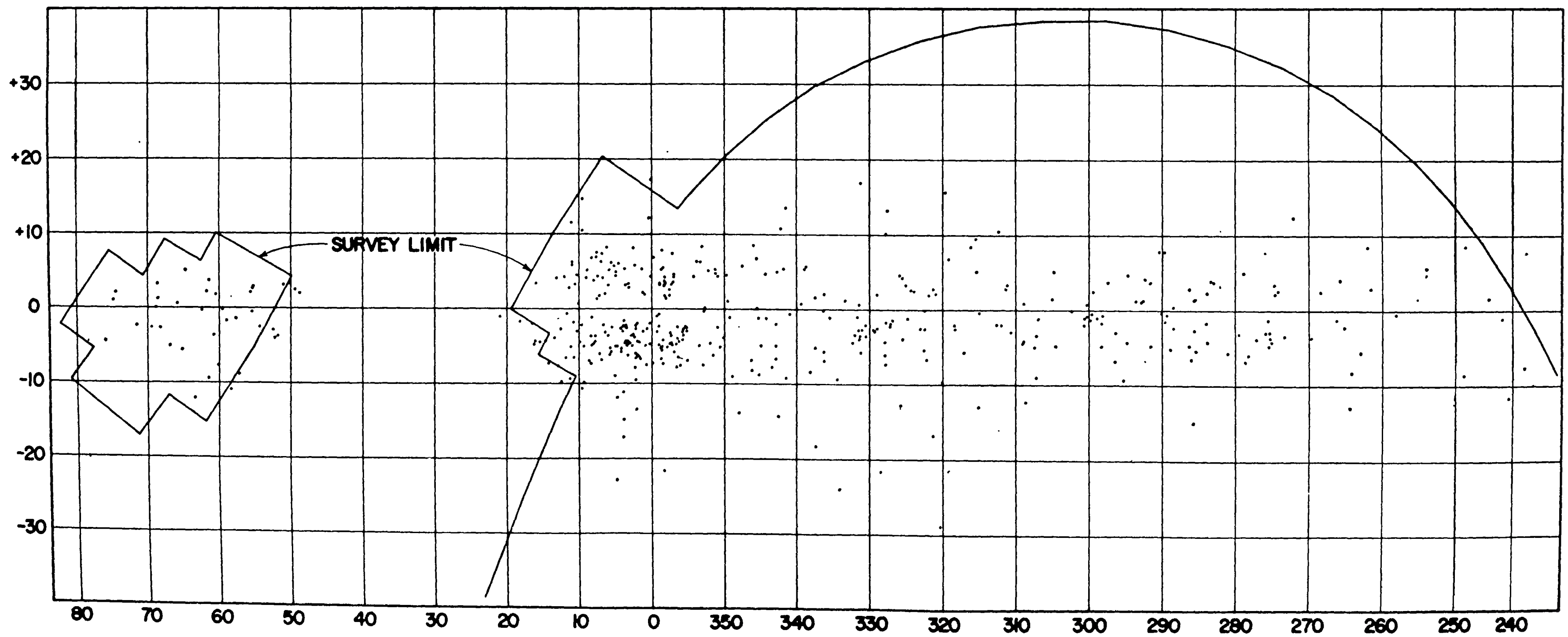

FIG. 2.—The galactic distribution of planetary nebulae observed on LHα plates

in the denser regions of obscuration. Indeed, the nebulae have a tendency to concentrate in the denser star clouds such as those in Sagittarius, Norma, and Carina. Since planetary nebulae are known to be very distant objects (as is evidenced by their deficiency in obscured areas) and since they are not expected to be members of associations, it is evident that concentrations of planetary nebulae near the galactic plane probably mark regions of exceptionally low interstellar absorption. Noticeable concentrations of planetary nebulae in the southern Milky Way which may be worthy of further study are listed in Table 7.

Of particular interest is the concentration found in Norma, since it is the highest concentration in the southern Milky Way outside the center of the galaxy. The concentration coincides closely with the bright Norma star cloud. Although it might be suspected that impurities have enhanced this concentration, a study of the sixteen nebulae which lie within the outline of the Norma cloud shows that twelve have been resolved with the 74-inch reflector, two show [N II], and the remaining two have Hα intensities of 2. All but the last two may thus be considered to be well-confirmed planetaries.

TABLE 7

CONCENTRATIONS OF PLANETARY NEBULAE IN THE SOUTHERN MILKY WAY

Constellation	l^{II}	b^{II}	Diameter	No. of Nebulae
Sagittarius	3	−4	5°	39
Ophiuchus	358	+4	3°	14
Norma	330	−2	4°	16
Crux	300	−1	3°	9
Vela	276	−3	2°	5

Of the nine nebulae in the Crux concentration, seven are resolved, one has Hα intensity 2, and one has Hα intensity 1. Again, there can be little doubt that the concentration is significant, but in this case the concentration does not correspond with a prominent star cloud.

The densities indicated in Figure 3 are roughly twice those found by Minkowski (1950) for the northern Milky Way from the Mount Wilson survey data. Although there may remain a suspicion that the southern Milky Way is richer in planetary nebulae than the northern Milky Way, it is probable that the difference is accounted for entirely by the fainter limiting magnitude of the LHα survey. This conclusion is supported by the LHα data which show densities at 60° and 70° which are slightly but not significantly less than densities at 290° and 300°. The plot of Minkowski and Abell (1963), which includes deeper and more recent surveys in the northern Milky Way, likewise shows roughly equal densities in the northern and southern Milky Way. However, it should be noted that this plot omits approximately 10 per cent of the new nebulae shown in Figure 2 in an attempt to allow for expected impurities.

The abrupt break in the densities of planetary nebulae at longitude 275° is a striking feature of Figure 3. This phenomenon strongly suggests that the space density of planetary nebulae is falling off very rapidly at the Sun's distance from the center of the galaxy. However, the effect is undoubtedly enhanced by the strong obscuration evident at galactic longitudes between 273° and 257° (see Rodgers, Campbell, and Whiteoak 1960).

VI. THE FREQUENCY OF [N II] IN PLANETARY NEBULAE

The Hα surface brightness of planetary nebulae is frequently used to estimate their densities and masses or, alternatively, their distances. However, the possible presence of unresolved [N II] λλ6584, 6548 is a complicating factor in measuring the Hα surface brightness. It can be allowed for if slit spectra at Hα are available, but for statistical discussions of many objects, slit spectra are not usually available for more than a few objects. Therefore it is important to know the statistical frequency with which moderate to strong [N II] occurs in planetary nebulae. The uniformity and extent of the present survey suggests that the data derived from it concerning the frequency of [N II] should be significant.

Fifty-five nebulae in Table 2 show [N II], and [N II] is suspected in an additional eighteen objects. The nebulae in which [N II] is clearly visible are further analyzed in Table 8. Since it is not possible to detect [N II] in those nebulae with resolved images,

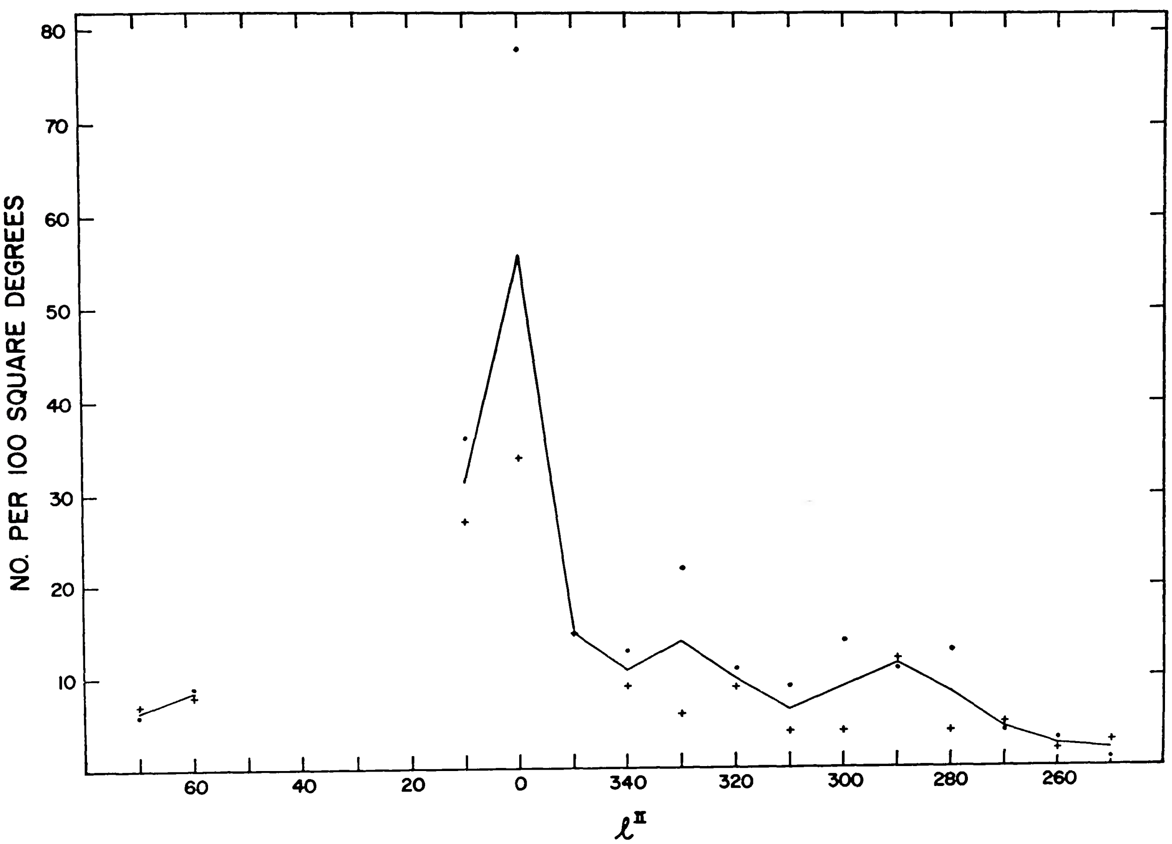

FIG. 3.—The surface density of planetary nebulae between galactic latitudes ±10°

only nebulae with a diffuseness of 0 or 1 (except those noted by parentheses in Table 2) are included in the first row of this table. Allowing for this selection alone we find that 21 per cent of the 258 unresolved nebulae show [N II]. However, due to two other selection effects, this must be considered only a lower limit to the true frequency of [N II].

Table 8 shows that the frequency of [N II] increases with the combined intensity of Hα and [N II]. This might be a physical effect depending on the absolute magnitude of the nebula, but it is more probably an observational effect in which weak [N II] is missed in the fainter nebulae. In the author's judgment such an effect may operate at intensities of 2 or less, and therefore we exclude these from further discussion. The statistics of the remaining ninety-nine nebulae are given in the last two columns of Table 8, where 35 per cent of nebulae show [N II]. The uncertainties noted in the table are 100 times the square roots of the numbers of objects in each category divided by the total number of objects in the table.

A second observational effect must be considered—the tendency of fair-to-poor image quality to blend moderate-to-strong [N II] with Hα, thus producing an object with diffuseness 2. Such an effect does not operate if only Hα is present, since it would require extremely poor image quality to give a single line a diffuseness of 2. This is made clear in Table 9, which gives an analysis of the resolution characteristics of the Mount Wilson 10-inch camera. Resolution of λ6584 is clear-cut on "good" plates but marginal on "fair" plates. Frequent blending must be expected on "fair" plates, particularly near the edge of the field where the image quality deteriorates. This effect, however, is somewhat offset by the duplication of the survey.

It is possible to evaluate the magnitude of this effect by considering the diffuseness of an independently selected group of nebulae with well-measured diameters equal to or less than 5″. Such a group is available from the observations of Westerlund and Henize (1967) if we select from their data those nebulae whose main bodies have diameters of 5″ or less. The results are shown in Table 10. This table includes those objects found to be stellar as well as twenty-seven small resolved nebulae. All objects showing a continuum on LHα plates are excluded in order to avoid purity effects. We may assume that objects in this table with diffuseness = 2 are nebulae in which [N II] has blended with Hα due to poor image quality. It is to be expected that the majority of these nebula have a [N II]/Hα intensity ratio ≥0.5.

TABLE 8

THE FREQUENCY OF [N II] IN NEBULAE WITH LHα DIAMETERS <10″

[N II]/Hα	Hα+[N II] Intensity						Total	Intensity 3, 4, 5	
	T	1	2	3	4	5		No.	Per Cent
0.5	9	53	77	44	12	8	203	64	65±8
<0.5	0	2	7	13	4	1	27	18	18±4
≥0.5	1	4	6	7	4	6	28	17	17±4
Total nebulae	10	59	90	64	20	15	258	99	....
Total with [N II]	1	6	13	20	8	7	55	35	....
Per cent with [N II]	10	10	15	31	40	47	21	35±6	....

TABLE 9

ANGULAR AND WAVELENGTH RESOLUTION OF THE MOUNT WILSON 10-INCH CAMERA

Image Quality	Image Diameter (mm)	Angular Resolution	Wavelength Resolution (Å)
....	1.000	159″.0	450.0
"Good"	0.030	4.8	13.5
"Fair"	0.045	7.1	20.2

In this table, we again find a dependence of [N II] frequency on line intensity, and it seems more evident in this case that the effect is observational, since blending of λ6584 and Hα appears to be more frequent for fainter images. If we again exclude intensity classes T, 1, and 2 to avoid this effect we are left with twenty-seven nebulae of which 48 per cent show [N II]. If we assume that the [N II]/Hα ratio is ≥0.5 for those nebulae in which the lines are blended we find that 26 per cent of the nebulae have weak [N II] while 22 per cent have moderate to strong [N II]. In view of their natural uncertainties these values are in reasonable agreement with Table 8, but there is good indication that allowance for the line-blending effect may raise the observed frequency of nebulae showing [N II] by about 10 per cent.

Finally a comparison of these data with those of White (1952) is given in Table 11. The results agree remarkably well. If we combine the data of Table 10 (which are presumed to be freer of systematic effects than those of Table 8) with White's data we get the values listed under "Adopted." Thus the values derived by White are confirmed and their uncertainties are considerably reduced.

TABLE 10

FREQUENCY OF [N II] IN NEBULAE WITH WD-HEN DIAMETERS <5″

[N II]/Hα	Hα+[N II] Intensity						Total	Intensity 3, 4, 5	
	T	1	2	3	4	5		No.	Per Cent
0.0	7	25	24	11	3	0	70	14	52±14
<0.5	0	0	4	5	1	1	11	7	26±9
≥0.5	0	1	2	2	1	2	8	5}	22±9
D=2, ≥0.5?	0	6	5	0	0	1	12	1}	
Total nebulae	7	32	35	18	5	4	101	27	....
Total with [N II]	0	7	11	7	2	4	31	13	....
Per cent with [N II]	0	22	31	39	40	100	31	48±13	....

TABLE 11

A COMPARISON OF MEASURES OF THE PER CENT FREQUENCY OF [N II]

[N II]/Hα	Table 8	Table 10	White	Adopted
<0.1	65±8	52±14	59±16	55±11
0.1 to 0.5	18±4	26± 9	18± 9	22± 7
≥0.5	17±4	22± 9	23±10	22± 7
No. of Nebulae	99	27	22	49

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