

A CATALOGUE OF EMISSION NEBULAE NEAR THE GALACTIC PLANE

STEWART SHARPLESS*

MOUNT WILSON AND PALOMAR OBSERVATORIES
CARNEGIE INSTITUTION OF WASHINGTON
CALIFORNIA INSTITUTE OF TECHNOLOGY*Received April 23, 1953*

ABSTRACT

A catalogue is given of 142 emission nebulae within several degrees of the galactic equator and between galactic longitudes 315° and 105° . Known early-type stars associated with these nebulae are listed.

The 48-inch Schmidt telescope of the Mount Wilson and Palomar Observatories has the greatest resolving power of existing wide-field instruments and thus provides the most complete material available at the present time for a survey of distant emission nebulae. The 48-inch plates on which this survey is based were kindly put at the author's disposal by Drs. Baade and Minkowski. The survey extends between galactic longitudes 315° and 105° . The limits in galactic latitude vary between 1° and 5° , averaging about 3° , on either side of the galactic equator. Red plates were taken on Eastman 103a-E emulsion behind a red Plexiglas filter, and blue plates on 103a-O emulsion. The exposures

TABLE 1
PLATE CENTERS

α	δ	α	δ	α	δ	α	δ
17 ^h 10 ^m	-39°	18 ^h 20 ^m	-10°	19 ^h 45 ^m	+25°	22 ^h 10 ^m	+58°
17 20	-33	18 35	- 5	20 00	+30	23 00	+60
17 35	-29	18 45	0	20 10	+35	23 40	+61
17 55	-24	18 55	+ 6	20 35	+40	0 20	+62
18 05	-19	19 05	+11	20 45	+45	1 00	+62
18 10	-15	19 15	+16	21 15	+50	1 50	+61
18 15	-26	19 30	+21	21 45	+53	2 25	+60

were such as to produce a background density of several tenths. The plate centers are listed in Table 1. Each plate covers 40 square degrees of the sky, with a scale of approximately 2 inches per degree.

In listing the nebulous objects on these plates, an attempt was made to exclude all planetary and reflection nebulae. The latter were identified on the basis of their blue color as revealed by a comparison of the red and blue plates. The doubtful cases are indicated as such in the notes following the catalogue.

The nebulae are listed in Table 2. The co-ordinates of the center of each nebula were measured to 1 minute of arc with respect to a near-by star and, for ease in identification, are given for the same epoch as the corresponding section of the BD or CD catalogue. The angular diameters are given in the third column. Owing to the diffuse nature of many of these nebulae, their diameters cannot be defined with an accuracy of better than about 20 per cent. The maximum diameters of irregular objects are given. In the fifth, sixth, and seventh columns the nebulae are classified according to their form (1 = cir-

* Now at the U.S. Naval Observatory, Washington, D.C.

TABLE 2
CATALOGUE OF EMISSION NEBULAE

No.	α	δ	Diameter	Form	Structure	Brightness	Stars	Notes
1.	16 ^h 54 ^m 3	-37° 56'	60'	3	2	2	1	NGC 6281*
2.	17 3.8	-38 19	12	2	3	2-3	.....
3.	17 5.3	-36 56	4	3	2	3	.....	NGC 6302
4.	17 9.4	-33 56	60	3	2	1-2	1	
5.	17 9.8	-39 11	5	2	3	3	.....
6.	17 10.1	-38 16	100	3	2	2	9	NGC 6337
7.	17 11.7	-35 51	50	3	3	3	4	NGC 6334*
8.	17 16.9	-34 4	90	3	3	2-3	2	NGC 6357*
9.	17 21.0	-30 9	2	3	1	2	.....
10.	17 21.1	-31 26	40	2	2	2	1	
11.	17 26.5	-32 30	120	1	2	2	9	NGC 6383*
12.	17 36.9	-28 47	25	3	2	2	.....
13.	17 38.6	-29 15	20	3	2	2	.....	*
14.	17 39.5	-29 12	4	1	2	2	.....
15.	17 40.0	-28 37	10	3	2	2	.....
16.	17 40.1	-29 4	12	1	1	2	.....
17.	17 41.2	-31 13	30	2	2	2	3	
18.	17 42.4	-28 51	5	3	2	2	.....
19.	17 46.1	-25 0	60	3	2	2	5	S 181
20.	17 50.2	-23 18	20	3	2	1	.....
21.	17 53.9	-23 35	40	1	2	1	.....
22.	17 54.8	-23 1	20	3	3	3	1	NGC 6514
23.	17 56.8	-24 24	90	3	3	3	14	NGC 6523*
24.	17 57.7	-21 40	90	3	2	2	1	S 186
25.	17 57.9	-14 10	25	2	2	2	1	S 185
26.	18 0.3	-18 17	3	3	2	1	.....
27.	18 1.7	-24 1	40	3	2	2	3	NGC 6559*
28.	18 1.9	-16 50	3	3	1	2	.....
29.	18 2.1	-23 40	8	1	2	2	2	IC 1274
30.	18 2.5	-23 49	8	1	1	2	1	IC 1275
31.	18 3.6	-17 46	15	3	2	2	.....
32.	18 7.2	-20 18	20	3	1	2	5	
33.	18 7.4	-18 17	90	3	2	2	6	
34.	18 8.0	-17 27	15	2	1	2	.....
35.	18 8.1	-16 47	60	3	2	2	2	IC 4701*
36.	18 8.3	-19 50	2	3	2	2	1	NGC 6589*
37.	18 8.3	-18 42	3	3	1	2	.....
38.	18 8.5	-19 55	2	3	2	3	1	NGC 6590*
39.	18 9.1	-19 43	20	3	2	2	3	IC 1284
40.	18 9.4	-15 40	5	1	2	2	1	*
41.	18 9.8	-11 47	40	3	3	2-3	7	NGC 6604*
42.	18 10.5	-14 0	25	3	3	3	10	NGC 6611*
43.	18 12.4	-16 14	60	3	3	3	6	NGC 6618*
44.	18 14.1	-14 39	10	3	2	2	1	S 194*
45.	18 17.1	-13 18	15	3	2	2	.....	S 195*
46.	18 17.2	-14 47	35	3	2	2	1	*
47.	18 22.6	- 8 43	2	3	2	1	1	
48.	18 23.1	- 9 49	7	1	2	1	.....
49.	18 23.5	- 8 34	8	3	2	2	.....
50.	18 24.1	-11 52	5	3	2	1	1	
51.	18 25.2	- 5 8	2	3	2	2-3	.....
52.	18 28.9	- 6 49	20	3	2	2	.....	S 198
53.	18 29.9	- 7 27	20	3	2	1	.....
54.	18 36.8	- 3 16	25	3	1	1	.....
55.	18 37.0	- 0 25	20	2	2	2	1	*
56.	18 38.0	- 2 8	8	3	2	2	.....
57.	18 39.3	- 3 54	7	3	2	2	.....
58.	18 49.4	+ 7 38	7	1	2	1	.....	*
59.	18 52.2	+ 6 56	10	1	2	1	.....	*
60.	18 56.5	+13 55	12	1	1	1	.....
61.	19 1.7	+ 5 23	3	3	2	2	.....	*
62.	19 5.0	+16 38	2	3	2	3	.....
63.	19 16.6	+13 42	40	3	2	1	.....
64.	19 18.3	+20 31	2	1	2	2	.....	*
65.	19 37.0	+22 57	40	1	2	1-2	3	NGC 6823*

TABLE 2—Continued

No.	α	δ	Diam-eter	Form	Struc-ture	Bright-ness	Stars	Notes
66.....	19 ^h 39 ^m 9	+25° 0'	25'	3	2	2	1	S 43
67.....	19 40.3	+24 17	10	3	1	1	1	
68.....	19 40.8	+27 54	50	1	1	1	4	S 44
69.....	19 43.2	+26 30	6	3	2	2	.....	S 45
70.....	19 44.0	+26 7	5	1	2	1	.....
71.....	19 49.0	+26 50	1	3	2	3	.....
72.....	19 49.2	+28 55	1	1	2	2	.....	*
73.....	19 50.2	+29 49	10	1	2	1	.....
74.....	19 53.0	+31 2	15	1	1	1	1	
75.....	19 54.5	+34 54	20	3	2	2	1	
76.....	20 6.8	+37 55	18	2	3	3	1	NGC 6888*
77.....	20 12.3	+36 18	7	1	2	2	.....	*
78.....	20 17.0	+39 48	180	3	3	2-3	.....	*
79.....	20 26.2	+43 31	60	3	2	2	1	S 73
80.....	20 27.7	+46 52	2	1	2	2	.....	S 76
81.....	20 29.0	+45 10	15	1	2	2	1	
82.....	20 29.8	+46 23	50	3	2	2	.....	S 78*
83.....	20 33.9	+41 41	30	3	2	1	.....	S 217*
84.....	20 37.7	+38 58	50	3	2	1-2	.....	S 220*
85.....	20 39.9	+40 27	40	3	2	1-2	.....	*
86.....	20 51.5	+44 23	240	3	3	2	1	{NGC 7000, IC 5067-8}
87.....	20 58.8	+49 18	1	1	1	1	.....
88.....	21 0.4	+49 4	1	3	2	1	.....
89.....	21 9.0	+47 9	2	3	2	3	.....
90.....	21 33.2	+49 42	15	1	2	2	.....	S 92
91.....	22 13.4	+55 24	90	3	3	2	3	*
92.....	22 16.9	+58 0	15	3	2	2	.....	S 94*
93.....	22 27.2	+57 44	1	3	2	2	.....
94.....	22 29.5	+57 28	10	3	2	1	.....	S 96
95.....	22 39.3	+59 8	4	3	2	1	.....
96.....	22 41.8	+57 18	30	3	3	2-3	3	NGC 7380
97.....	22 43.7	+59 10	2	3	2	2	.....	S 97
98.....	22 44.4	+56 57	4	3	1	1	.....	S 98
99.....	22 45.7	+60 25	60	3	2	2	.....
100.....	22 49.6	+57 42	2	1	1	1	.....
101.....	22 50.3	+57 45	2	3	2	3	.....
102.....	22 50.5	+57 46	1	1	1	2	.....
103.....	22 51.0	+61 51	60	3	2	2	9	
104.....	22 52.7	+58 1	2	3	2	3	.....
105.....	22 53.2	+57 58	5	1	2	2	.....	S 11
106.....	22 59.1	+59 28	2	1	2	3	.....
107.....	23 7.5	+60 43	10	2	3	3	.....	NGC 7538*
108.....	23 9.5	+60 21	7	3	2	2	.....
109.....	23 9.8	+59 15	90	3	3	2-3	5	S 13, 14*
110.....	23 14.3	+60 24	40	3	3	2-3	2	NGC 7635*
111.....	23 26.6	+59 59	10	3	2	2	.....	S 102
112.....	23 31.6	+59 10	3	3	2	2	.....	S 273
113.....	23 33.0	+61 8	10	2	2	2	1	S 103*
114.....	23 35.3	+60 10	10	1	1	1	1	
115.....	23 45.9	+59 40	7	2	2	2	.....	S 104
116.....	23 46.8	+59 34	5	1	1	1	1	
117.....	23 54.3	+63 49	20	1	2	2	1	S 105*
118.....	0 0.0	+64 9	2	3	2	1	.....
119.....	0 7.1	+63 6	15	3	1	1	.....
120.....	0 7.8	+60 27	1	1	1	1	.....	*
121.....	0 14.0	+60 56	30	1	2	2	1	S 21
122.....	0 19.2	+63 54	2	1	2	2	.....	*
123.....	0 19.6	+60 35	15	3	1	1	.....
124.....	0 23.4	+61 40	40	3	1	1	2	
125.....	0 28.6	+62 42	2	3	2	1	.....
126.....	0 32.0	+62 4	1	1	1	1	.....
127.....	0 40.2	+62 8	15	3	1	1	.....
128.....	0 40.5	+64 25	15	3	1	1	.....
129.....	0 41.5	+63 57	2	3	1	1	.....
130.....	0 51.2	+60 12	120	3	2	2	1	IC 63, 59*
131.....	0 52.2	+62 7	2	1	1	1	.....

TABLE 2—Continued

No.	α	δ	Diameter	Form	Structure	Brightness	Stars	Notes
132.....	0 ^h 59 ^m 7	+62° 21'	1'	3	2	2	.....
133.....	1 13.7	+61 6	10	3	3	2	.....	*
134.....	1 21.3	+57 37	9	3	3	2	.....	S 22*
135.....	2 1.3	+63 29	2	1	1	1	.....
136.....	2 22.5	+60 48	150	3	3	2-3	8	IC 1805*
137.....	2 25.9	+59 0	2	3	1	3	.....
138.....	2 29.3	+59 0	3	3	1	1	.....
139.....	2 31.1	+59 0	5	3	2	1	.....
140.....	2 36.0	+61 17	2	1	1	2	.....
141.....	2 36.0	+61 20	1	1	1	1	.....
142.....	2 36.3	+61 21	2	2	2	1	.....	*

NOTES TO TABLE 2

- 1 Cluster of A stars southeast of center.
- 7 Several detached portions; lane of emission extending about 2° toward west.
- 8 Very bright central portion.
- 11 Cluster around central O-star.
- 13 May contain faint cluster.
- 23 M8; appears to be connected with M20 = NGC 6514.
- 27 Appears to be connected with M8.
- 35 May be connected with NGC 6618.
- 36 May be connected with IC 1284.
- 38 May be connected with IC 1284.
- 40 May be connected with NGC 6618.
- 41 Very bright central portion; cluster.
- 42 Appears to be connected with NGC 6604 and NGC 6618.
- 43 Very bright central portion, about 25' in diameter.
- 44 May be connected with NGC 6611.
- 45 About six detached portions.
- 46 May be connected with NGC 6611.
- 55 Contains faint cluster.
- 58, 59, 61 May be reflection nebulae.
- 64 Very small faint cluster in center.
- 65 Cluster in center.
- 72 Faint star in center.
- 76 Peculiar filamentary structure.
- 77 May be very compact cluster in center.
- 78 γ Cygni nebula; consists of several bright condensations, including NGC 6914, NGC 6910, IC 1318 and condensations at 20^h14^m, +38°45', and 20^h22^m, +39°20'.
- 82 Cluster near brightest part.
- 83, 84, 85 These appear to be condensations in a connecting lane between the P Cygni nebulae and NGC 7000.
- 91 Very small cluster around HD 211853.
- 92 Appears to be small cluster around +57°2513.
- 107 Peculiar turbulent structure.
- 109 Small cluster in center.
- 110 Very bright central portion containing +60°2522; appears to be small cluster around this star.
- 113 Small cluster in center.
- 117 Small cluster in center.
- 120 Two detached circular regions, each with star in center.
- 122 Star in center.
- 130 γ Cas nebulosity; in addition to bright nebulae to north and east of γ Cas, there is also a faint arc about 2° to the east.
- 133 Small cluster in center.
- 134 Crescent-shaped; filamentary.
- 136 Extends northwest as far as 3° from center; cluster in central part; bright condensations at 1^h49^m1, +60°7'.
- 142 Very small cluster in center.

In addition to the discrete nebulae listed above, there are several extended regions of faint emission:

- A. 17^h00^m to 17^h30^m, -35° to -33°. This region also contains NGC 6383 and Nos. 4 and 8.
- B. 18^h10^m to 18^h20^m, -18° to -12°. This region also contains NGC 6611, NGC 6618, and Nos. 34, 35, 40, 41, and 44.
- C. 19^h35^m to 20^h35^m, +32° to +44°. This is the P Cygni nebulosity and is probably ionized by the Cygnus concentration of early-type stars.
- D. 20^h20^m to 20^h40^m, +45° to +48°. This consists of faint emission to north and southeast of No. 82.
- E. 22^h00^m to 22^h20^m, +58° to +60°. This consists of faint emission to north and west of No. 92.
- F. 22^h50^m to 23^h15^m, +61° to +63°. This consists of faint emission between Nos. 103 and 110.

TABLE 3
CATALOGUE OF ASSOCIATED O- AND B-TYPE STARS

Nebulae	Star	Mag.	Spectral Type	Nebulae	Star	Mag.	Spectral Type
1.....	153919	6.73	Od	32.....	167263	6.02	B1, OB
4.....	156327	9.4	Oa		167379	8.7	B9
6.....	156468	8.0	B3		E312973	9.4	(B0)
	156688	7.14	B3		E312974	9.7	B5
	157038	6.3	B8p		E312989	10.6	B3
	E323015	.....	B	33.....	167336	9.4	B5, OB
	E323016	9.5	B2		167411	8.6	B3, OB
	E323019	10.7	B0		167412	9.4	B5
	E323025	.....	B0		167478	10.3	B5
	E323110	10.7	B0		167771	6.37	Oe5, OB
	E323117	.....	B5		E312875	11.0	B0
7.....	E319699	10.2	B0	35.....	167633	8.7	Oe5, OB
	E319701	.....	B		167657	9.4	B3
	E319702	9.5	B	36.....	167638	10.3	B5
	E319703	10.4	B5	38.....	E313094, 5	10.3	B5
8.....	157504	11.8	Oa	39.....	167722	10.1	B5
	E319881	10.7	B		167815	7.59	B2
10.....	158186	6.81	B3		E313098	.....	B5
11.....	159176	5.71	Oe5	40.....	-15°4914†	10.7	.....
	E317828	.....	B5	41.....	167834	9.2	B
	E317837	.....	B5		167971	7.34	B0, OB
	E317842	.....	B5		168112	8.7	B0, OB
	E317844	8.7	B5		168206	8.87	Oa
	E317845	9.5	B5		-11°4586	9.2	OB
	E317846	.....	B5		-12°4970	8.9	OB
	E317858	10.4	B		-12°4982	9.4	OB
	E317861	10.7	B	42.....	167451	7.9	B2, OB
17.....	161839	10.2	B5		167497	9.4	B3, OB
	161853	8.0	B3		167519	10.1	B
	E318406	.....	B0		167543	8.8	B2, OB
19.....	162718	9.0*	B0		168015	8.9	B8, OB
	162978	6.13	B2		168075, 6	8.5	B, OB
	E314700	.....	B5		168137	9.4	B, OB
	E314701	10.2	B5		168183	8.3	B0, OB
	E314704	.....	B		168207	10.1	B0
22.....	164492	6.91	Oe5, OB		168504	9.2	B, OB
23.....	164794	5.86	Oe5	43.....	168163	9.1	B3
	164816	7.9	B0		168302	9.9	B5
	164865	8.3	B		168607	8.9	B, OB
	164906	9.0	B		168625	9.2	B
	164947	10.0	B5		168726	9.7	B5
	165052	6.79	Oe5		168987	8.3	B
	E315023	.....	B3	44.....	168894	9.7	B
	E315024	10.2	B5	46.....	-14°5037	8.3	OB
	E315026	10.9	B5	47.....	-8°4623†	10.1	.....
	E315031	9.0	B3	50.....	-11°4665†	9.7	.....
	E315032	.....	B5	55.....	173371	6.80	B9
	E315033	.....	B3	65.....	E344775	10.0	B, OB
	E315034	.....	B5		E344776	8.8	B
	E315035	10.2	B3		E344783, 4	9.5	B, OB
24.....	165516	6.22	B1, OB	66.....	E338916	10.0	B
25.....	165319	8.1	B0, OB	67.....	E338936	9.8	B2
27.....	165921	7.7	B0, OB	68.....	186943	9.98	Oa
	166056	9.7	B		E332737	.....	B5
	166192	8.9	B5		E332755	9.0	B0, OB
29.....	166033	9.0	B		E332757	8.7	B5, OB
	E314031	.....	B5	74.....	E331626	.....	B9
30.....	166107	7.64	B5				

* Variable Star.

† Central Star.

TABLE 3—Continued

Nebulae	Star	Mag.	Spectral Type	Nebulae	Star	Mag.	Spectral Type
75.....	E227018	9.5	B		219460	9.2	Oa
76.....	192163	7.44	Ob		E240234	9.1	B0
79.....	195592	7.15	B, OB		E240250	8.6	B0, OB
81.....	+45°3216	8.9	OB	110.....	220057	6.8	B5
86.....	199579	6.01	Oe5, OB		+60°2522	8.0	OB
91.....	211564	11.07	Oc	113.....	+61°2494†	10.2	.....
	211853	9.0	Ob	114.....	+60°2607†	10.2	.....
	+54°2726	9.4	OB	116.....	+59°2786†	9.7	.....
96.....	215605	9.5	B, OB	117.....	+63°2093†	9.4	.....
	215806	9.4	B, OB	121.....	+60°39	9.4	OB
	215835	8.6	B, OB	124.....	+61°105	8.9	B, OB
103.....	216532	8.0	B3, OB		2928	8.7	G, OB
	216658	8.6	B, OB	130.....	γCas	1.6-2.3	B0p
	216711	9.4	B, OB	136.....	15558	7.82	B, OB
	216898	8.0	B2, OB		15570	8.0	B, OB
	217035	7.76	B5, OB		15629	8.4	B, OB
	217061	9.0	B		+60°493	8.5	OB
	217086	7.70	B0, OB		+60°497	8.7	OB
	217312	7.7	B8, OB		+60°498	10.2	OB
	217463	8.9	B2		+60°501	9.5	OB
109.....	219286	8.6	B		+60°512	10.2	OB
	219287	8.5	B, OB				

cular, 2 = elliptical, 3 = irregular); the amount of inherent structure (ranging from 1 = amorphous to 3 = filamentary); and the surface brightness (on an arbitrary scale of 1-3, ranging, respectively, from the faintest perceptible images to the densest). The eighth column gives the number of known early-type stars associated with the nebula. The true number may be considerably in excess of this. The last column lists previous designations, including those of the recent survey of Hase and Shain.¹

The stars associated with these nebulae are listed in detail in Table 3. Most of the stars of type B listed here cannot contribute appreciably to the ionization. Their concentration within the boundaries of a nebula, however, leaves little doubt of their physical connection with it. The visual magnitudes and spectral types in Table 3 are taken from the *Henry Draper Catalogue* and its extensions.² For stars not contained in these catalogues, the corrected³ BD magnitude is given. Those stars which appear in the Case survey⁴ of O and B stars of high luminosity are indicated as OB in the last column.

Figure 1 shows the apparent distribution of these nebulae with respect to the galactic equator. The scarcity of nebulae north of the equator between longitudes 315° and 30° is clearly due to the obscuring effects of the Great Rift and the Ophiuchus nebulosities. The scarcity of nebulae between longitudes 60° and 70°, however, is evidently real, since the number of faint O and B stars⁵ of high luminosity in this region is appreciable. This suggests a rather spotty distribution of interstellar hydrogen along the more remote spiral arms of our galaxy, similar to the distribution found by Baade⁶ for emission regions in the outer arms of M31.

¹ *Simeis Izvestiya*, 7, 93, 1951; 9, 52, 1952.

² *Harvard Ann.*, Vol. 100, 1936; Vol. 112, 1949.

³ *Harvard Ann.*, Vol. 78, 1916.

⁴ Nassau and Morgan, *Ap. J.*, 113, 141, 1951.

⁵ Nassau and Morgan, *Pub. Michigan U. Obs.*, 10, 43, 1951.

⁶ Private communication.

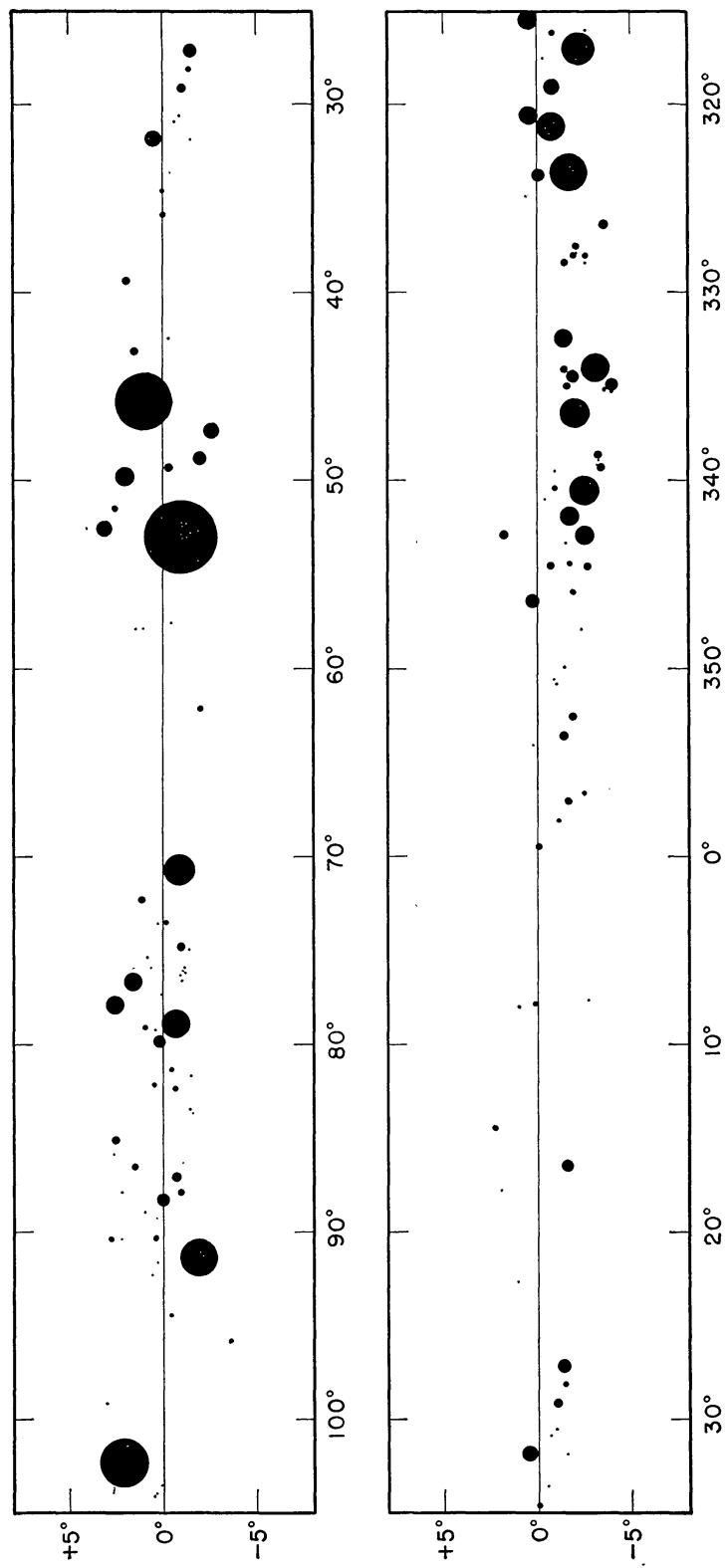


FIG. 1.—The distribution of emission nebulae between $l = 315^\circ$ and $l = 105^\circ$

While reliable distances for these objects cannot be obtained from their average characteristics, nevertheless certain qualitative information on their spacial distribution can be inferred from Figure 1. The gradual decrease in the angular sizes of the nebulae from $l = 315^\circ$ to $l = 360^\circ$ is consistent with the suggestion⁷ of an inner spiral arm going off in perspective in the direction of Scutum. Similarly, the difference in the angular sizes of the nebulae near $l = 50^\circ$ and $l = 30^\circ$, respectively, is qualitatively in keeping with the curvature of the arms, as illustrated by Oort⁸ on the basis of observations of the 21-cm line of hydrogen.

Individual spectroscopic parallaxes of the stars associated with these objects will be necessary in order to obtain further information on the details of their distribution in space. Such programs are now in progress at the United States Naval Observatory and the Yerkes Observatory.

The author is indebted to Drs. Baade and Minkowski for the observational material upon which this paper is based. An appointment as Carnegie Fellow permitted him to make use of the facilities of the Mount Wilson and Palomar Observatories.

⁷ Morgan, Sharpless, and Osterbrock, *A.J.*, 57, 3, 1952.

⁸ *Sky and Telescope*, 12, 60, 1953.