

PHOTOGRAPHS OF NEBULAE WITH THE 60-INCH REFLECTOR, 1917-1919¹

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ABSTRACT

Photographs of nebulae with the 60-inch reflector.—About 330 of the nebulae found on the 66 plates taken by the author during the years 1917-1919 are listed or described in this article, and 27 of these are illustrated on the 18 plates reproduced. The most remarkable are: N.G.C. 2146, Camelopardus, with its handlike dark marking, a spiral with an abnormal center; N.G.C. 3379, resembling an unresolved star cluster; N.G.C. 3384, with a dual, Saturn-like nucleus and symmetrical wings; N.G.C. 4395-4399-4400-4401, which together form a remarkable spiral; N.G.C. 4656-4657, which constitute a single right-handed spiral without a well-defined nucleus; and I.C.II 5146 Cygnus, a unique array of light and dark markings. In addition the following are described: (1) Spirals: N.G.C. 48, 1186, 1699, 2290, 2291, 2964, 2968, 3310, 3367, 3389, 3395-3396, 3786, 3788, 5257, 5258, 5278-5279, 5544, 5545, 6014 (?), 6906, 6928, 6930, 7722; I.C.II 1441, 2233. (2) Round or elongated: N.G.C. 49, 51, 1700, 2274, 2275, 2288, 2289, 2970, 3377, 3391, 5557, 5868, 5869, 6017, 6927, 7240, 7242, 7435, 7436, 7611, 7615, 7617, 7619, 7621, 7623, 7627, 7631; I.C.I 922, 928; I.C.II 5192, 5194, 5195. (3) Misc.: N.G.C. 955, 2294 (spindles); 1491, 1555, 2024, 2245, 2247, 2359, 2403, 2537, 6820, 6888, 7023 (irregular); 3357 (stellar); 6703(?), 7048 (planetary); I.C.I 931 (stellar); 1470 (irregular); I.C.II 5191 (spindle). (4) Uncatalogued nebulae numbering 255. *Variations from N.G.C.*—The positions for N.G.C. 48, 49, 51, 2247, 5544, 5545, 6927, 6928, and 6930 were given incorrectly. N.G.C. 5865, 5871, and 7433 were not found. N.G.C. 6823 is a cluster and N.G.C. 6846 is a group of stars. In four cases, indicated above by dashes, two or more nebulae seem to form parts of a single system. *Variable nebulae.*—The changes in N.G.C. 1555 are described and also possible differences in the nuclear region of N.G.C. 2245, which will be investigated further. Other nebulae, N.G.C. 955, 1186, 2024, and 7023, showed no change.

Spectra of two nebulae.—N.G.C. 1700 is of type Go or later and has a large radial velocity. The spectrum of the nucleus of N.G.C. 3379 is Go or later and the radial velocity is +850 km per sec.

This series of observations of nebulae covers the writer's work in direct photography with the 60-inch reflector during the years 1917-1919. The program included (a) peculiar nebulae, e.g., N.G.C. 3395-3396; (b) groups of nebulae with a view to future measurement, e.g., N.G.C. 48, 49, 51; I.C.I 922, etc.; (c) variable nebulae such as N.G.C. 1555; (d) previously observed nebulae requiring additional photographic data, these being indicated with

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an asterisk thus: N.G.C 955*; (e) a few objects for special purposes, and several affording data for classification photographed during intervals in the regular program. In addition a search for spirals was made along the Milky Way among the smaller nebulae with no success thus far.

Trails for orientation were made on practically all the plates. Many of the measures have been made with a polar co-ordinate machine; and while this serves admirably for the determination of orientation and distances, the magnification (12) is too high for use in determining the size of the objects. For these data recourse was had to the polar co-ordinate réseau and a low-power magnifier. Many objects appearing near the edges of the plates have been listed; but it is to be remembered that at 10' from the center of the field a star image is oval, and at 15' it is comate or arrow-shaped, although poor seeing rounds out these forms, with some increase in size. The smaller nebulae not listed in the N.G.C., or the *Index Catalogue*, are listed as *a*, *b*, *c*, etc., in order of their right ascension.

The descriptions apply to a particular plate or to the general results from a number of plates of the same object, and are not co-ordinated into a homogeneous series of intensities corresponding to the N.G.C. The nebulae have been separated into four orders of brightness: faint, F; medium faint, MF; medium bright, MB; bright, B. The following abbreviations have also been used in the descriptions: R, round; Irr., irregularly; gbM, gradually brighter in the middle; lbM, little brighter in the middle; Nu., nucleus; sbM, suddenly brighter in the middle. All illustrations are placed with N at the top, *p* on the right.

As before, the positions are those of the N.G.C. brought forward to the year 1920. A number of these have been found incorrect, and recourse has been had to Bigourdan's *Observations des Nebuleuses et d'Amas Stellaires* to obtain the correct data.

Photographs of several objects taken with the 100-inch reflector have been used in this paper and are designated with the prefix 100—. Several of Mr. Shapley's photographs showing nebulae have been used in compiling the descriptions. These are designated as *Shapley 2968*, etc.

TABLE I
NEGATIVES WITH THE 60-INCH REFLECTOR

N.G.C.	α 1920	δ 1920	Constellation	G.C.	H and Others	h	Type	Plate No.	Illustration	Remarks
48.....	$\alpha^h 0^m 52^s$	$+47^\circ 47' 18''$	Lacerta	.....	Barnard	.....	Spl.	309		8 additional
49.....	0 10 13	48.0	Lacerta	.....	A.N.	.....	Elong.	309		Nebulae on plate
50.....	0 10 26	48.0	Lacerta	.....	4136	.....	Elong.	309		15 additional
95c*.....	2 26 20	- 1 27.8	Perseus	551	IV 278	220	Spe.	310		20 additional
1186*.....	3 0 16	$+42^\circ 30' 9''$	Perseus	639	I 43	281	Spl.	310		
1491.....	3 57 21	$+51^\circ 5' 6''$	Perseus	791	I 258	.....	Irr.	308		
1555*.....	4 17 17	$+19^\circ 20' 1''$	Perseus	839	.....	.....	Var.	312, 322		
1699.....	4 53 3	- 4 52.8	Perseus	.....	.....	.....	Spl.	314, Hoge 3		
1700.....	4 53 0	- 4 59.3	Perseus	.....	.....	.....	Spl.	314, Hoge 3		
2024.....	5 37 49	- 1 53.6	Orion	932	IV 32	336	R	316		
2146.....	6 5 53	$+78^\circ 23' 2''$	Camelopardus	1227	V 28	.....	Irr.	358		
2245.....	6 28 17	$+10^\circ 13' 2''$	Monoceros	5357	IV Winnecke	TI	Spl.	323, 329		
2247.....	6 28 45	$+10^\circ 23' 7''$	Monoceros	1425	IV 3	393	Fan.	323, 329		
2274.....	6 42 2	$+33^\circ 39' 0''$	Gemini	1448	Ld. R, SWI	.....	Irr.	313		
2275.....	6 42 3	41.0	Gemini	1449	II 615	406	R	313		
2288.....	6 45 28	29.1	Gemini	1455	II 614	407	R	313		
2289.....	6 45 29	30.9	Gemini	1456-7	Ld. R	.....	R	311, 315		12 additional
2290.....	6 45 33	27.7	Gemini	5360	III 898	410	Elong.	311, 315		
2291.....	6 45 35	33.0	Gemini	1458	III 897?	409	Spl.	311, 315		
2294.....	6 45 47	33.2	Gemini	1460	Ld. R	3075	Spe.	320		
2359.....	7 13 50	$-13^\circ 4' 1''$	Canis Major	1511	V 21	.....	.....	307		
2403*.....	7 29 7	$+65^\circ 46' 5''$	Camelopardus	1541	V 44	.....	Irr.	359, Sh.2968		
2537.....	8 7 35	$+46^\circ 14' 2''$	Lynx	1861	I 56	6041	Single	282		No text given
2603.....	9 27 39	$+21^\circ 51' 2''$	Leo Major	1863	I 57	6042	Spl.	321, 324		15 additional
2605.....	9 27 41	$+21^\circ 52' 3''$	Leo Major	1896	I 114	622	Spl.	321, 324		
2606.....	9 38 11	$+32^\circ 12' 8''$	Leo Minor	1899	II 491	624	El. Spl.	321, 324		
2608.....	9 38 28	$+32^\circ 17' 7''$	Leo Minor	1901	IV 60	627	Elong.	356		
2670.....	9 38 48	$+32^\circ 20' 7''$	Leo Minor	2158	.....	731	Spl.	291		No text given
3310.....	10 33 48	$+53^\circ 55' 1''$	Ursa Major	5533	II 78	748	Neb. Star	289, 327		9 additional
3357.....	10 40 6	$+14^\circ 30' 3''$	Ursa Major	2501	II 99	754	Spl.	289, 327		4 additional
3367.....	10 42 21	$+14^\circ 10' 2''$	Ursa Major	2503	II 99	754	Elong.	290, 334		
3377.....	10 43 28	$+13^\circ 24' 4''$	Ursa Major	2201	I 17	757	R	290, 334		
3379.....	10 43 37	$+13^\circ 0' 2''$	Ursa Major	2203	I 18	758	Elong.	290, 334		
3384.....	10 44 4	$+12^\circ 3' 1''$	Ursa Major	2207	II 41	761	Spl.	289, 327		
3389.....	10 44 14	$+12^\circ 57' 0''$	Ursa Major	2311	.....	.....	Spl.	290, 334		
3391.....	10 44 45	$+14^\circ 38' 6''$	Ursa Major	5535	I 116	765	Double	286, 332		See text 3377
3395.....	10 45 23	$+33^\circ 24' 4''$	Ursa Major	2216	I 117	766	Spiral	337, 338		
3396.....	10 45 28	$+33^\circ 24' 9''$	Ursa Major	2217	.....	.....	Spiral	337, 338		26 additional
3786.....	11 35 29	$+32^\circ 21' 3''$	Ursa Major	2470	.....	.....	Single	330, 331, 333		
3788.....	11 35 32	$+32^\circ 22' 8''$	Ursa Major	2480	.....	.....	.....	.....
4395.....	12 21 51	$+33^\circ 59' 4''$	Canes Venatici	2958	V 29.1	1232	Spiral	.....	
4399.....	12 22 2	$+34^\circ 34' 3''$	Canes Venatici	2959	V 29.2	.....	.....	.....
4400.....	12 22 2	$+34^\circ 34' 3''$	Canes Venatici	2960	.....	.....	.....	.....
4401.....	12 22 1	$+33^\circ 57' 5''$	Canes Venatici	2962	.....	.....	.....	.....

4656	12 40	5	+32 30.2	Canes Venatici	3189	I	176	I414	Single	336, 339	XVIIIb	11 additional
657	12 40	14	+32 30.4	Canes Venatici	3190	I	177	I415	Spl.			
527	13 35	49	+1 14.7	Virgo	3624	II	895	I654	Spl.	345	XIXb	
528	13 35	53	+1 14.3	Virgo	3625	II	896	I655	Spl.	345		
529	13 38	40	+56 4.3	Ursa Major	3639	II	798	I665	Single	341, 342	XIXa	
530	13 38	45	+56 4.5	Ursa Major		Ld. R		I665a	Spl.	127, 260, 261	XXb	13 additional
531	13 38	45	+36 56.5	Boötes	3833	II	419	I771	Spl.	127, 260, 261		
532	14 13	41	+36 56.8	Boötes	3834	Ld. R			Spl.	127, 260, 261		
533	14 13	41	+36 51.6	Boötes	3835	I	99	I776	Elong.	328, 335		Not on plate
534	14 15	5	+0 48.8	Serpens	4057	II	684		R	328, 335		
535	15 5 43		+0 49.2	Serpens	4060			I968	Elong.	328, 335		
536	15 5 44		+0 40.6	Serpens	4061	II	545	I V		328, 335		Not on plate
537	15 5 57		+0 49.1	Serpens				I940	Spl?	328, 335		
538	15 52 1		+0 49.1	Serpens				I941	Plan?	325		10 additional
539	15 53 10		+6 13.6	Serpens	4148				Irr.	311		
540	15 53 10		+6 13.6	Serpens	4150				Cluster	308		
541	15 53 10		+6 13.6	Serpens	5031	VII	18	2049	Group of stars	205	XXc	
542	15 53 10		+22 53.3	Vulpecula	5945				Irr.	209, 301, 348		
543	19 39	3	+23 0.5	Vulpecula	4512	IV	72		Spl.	352		
544	19 39 48		+32 8.4	Cygnus	5948	m	40		Elong.	317, 350	4 additional	
545	20 9 33		+38 9.1	Sagitta	4561				Spl.	317, 350		
546	20 10 36		+6 12.3	Dolphin	5956				Spl.	317, 350		
547	20 28 46		+0 38.6	Dolphin	5962				Spl.	317, 350		
548	20 28 46		+0 39.2	Dolphin	5963				Spl.	317, 350		
549	20 28 58		+0 39.2	Dolphin	5964				Irr.	313		
550	20 29 7		+0 34.6	Dolphin	4034	IV	74		Plan.	209	19 additional	
7033*	21 0 37		+67 51.4	Cygnus		St. IV			Elong.	202, 354, 357	Star on plate	
7018	21 11 23		+45 57.4	Lacerta	6033	St. V			Elong.	202, 354, 357	Not on plate	
7210	22 11 53		+36 52.7	Lacerta	6035	St. V			Elong.	202, 354, 357	14 additional	
7212	22 12 10		+36 53.7	Pegasus		Bigourdan						
7431	22 53 47		+25 44.2	Pegasus		Ld. R			R			
7432	22 54 2		+25 43.2	Pegasus	4872	Ld. R			R			
7433	22 54 2		+25 42.2	Pegasus	4873				R			
7153	22 54 6		+25 42.2	Pegasus	4871	III	243	2195	R			
7140	22 54 6		+25 43.3	Pegasus	4934	dA			Elong.			
7611	23 15 33		+7 22.5	Pegasus	4935	m 572		2229	Elong.			
7615	23 15 53		+7 58.5	Pegasus	6186	II	439	2230	R			
7617	23 16 2		+7 43.7	Pegasus	6186	m	574	2231	Elong.			
7610	23 16 12		+7 40.6	Pegasus	4936	m	574	2231	R			
7621	23 16 20		+7 55.7	Pegasus	6188	III	435	2233	R			
7623	23 16 27		+7 57.5	Pegasus	4938	II	440	2233	Elong.			
7620	23 16 39		+7 40.7	Pegasus	4940	Ld. R			Spl.			
7631	23 17 24		+7 40.7	Pegasus	4942-3							
7722	23 34 41		+15 31.0	Pegasus	6216	Barnard						
922	23 40 17		+56 0.4	Ursa Major	AN							
I 1	I 028		+56 1.2		4136	Bigourdan				341, 342	72 additional	
I 1	I 931		+56 1.3			Barnard 3110						
I 1	I 1441		+36 53.8	Lacerta		Spatialer 62					XXa	See text N.G.C. 7240
I 1	I 1470		+59 48.9	Cassiopeia		Wolf					XIXc	3 additional
I 1	I 2233		+45 59.5	Lynx	Espin							
I 1	I 5140		+46 53.2	Cygnus								
II 5101	II 5101		+36 52.8±	Lacerta								See text N.G.C. 7240
II 5102	II 5102		+36 53.8									
II 5103	II 5103		+36 53.8									

To increase their sensitiveness, the plates were given a preliminary exposure. Before use at the telescope they were exposed to an 8 c. p. red lamp at a distance of six feet. The amount varied from twenty to forty seconds, depending upon the length of exposure to be given at the telescope.

Mr. W. P. Hoge, Mr. J. C. Duncan, Mr. Hugo Benioff, and Mr. Milton Humason have assisted in making the plates, and to them the writer wishes to express his gratitude for the help rendered. I am indebted to Mr. Ellerman for the preparation of the positives for the half-tones.

N.G.C. 48, 49, and 51, Lacerta

$$\left. \begin{array}{l} \text{N.G.C. 48 } a=0^h 9^m 52^s, \delta=+47^\circ 47' 8'' \\ \text{N.G.C. 49 } a=0 10 13, \delta=+47 48.0 \\ \text{N.G.C. 51 } a=0 10 26, \delta=+47 48.9 \end{array} \right\} (1920); \lambda=84^\circ, \beta=-14^\circ$$

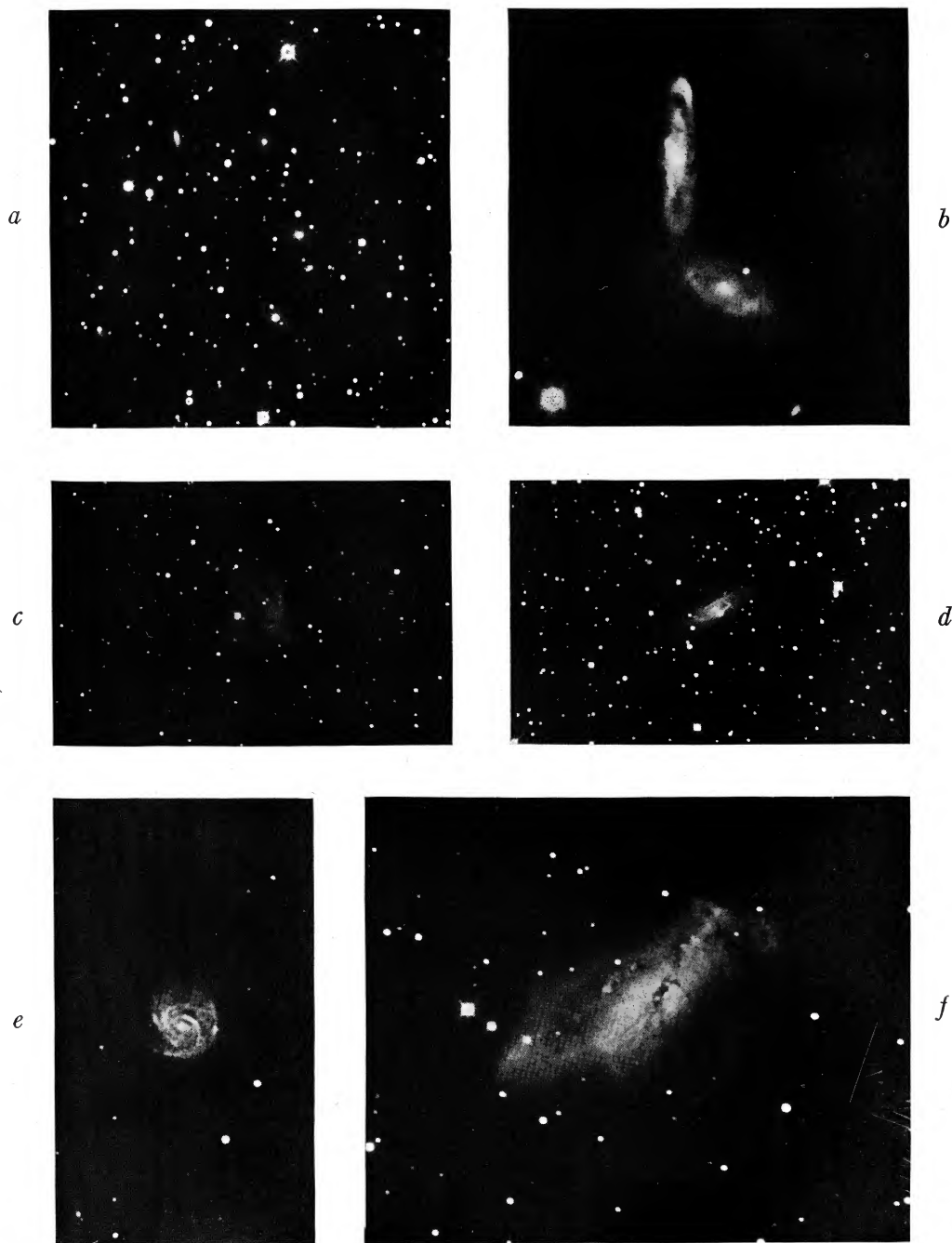
Plate No. 309, 1917, November 16, 130^m. Images large

A group of eleven nebulae, six of which are described by Barnard in *A.N.* 4136. Eight are elliptical in shape, the other three irregularly round. Two have distinct spiral structure, four have strong bright almost stellar nuclei. Two are medium-faint, almost uniform spindles, and the remainder, faint patches with slightly brighter middle.

The positions given in the N.G.C. are not correct, those above being obtained from Barnard's corrected values. The following is a description of the nebulae, measures being referred to the nucleus of N.G.C. 51.

<i>a</i> ,	<i>p</i> 250°	<i>d</i> 15'5	MF	12"×6", <i>p</i> 161°.
<i>b</i> ,	234	10.5	MB	20"×10", <i>p</i> 65°, almost stellar Nu.; Barnard No. 1.
<i>c</i> ,	227	8.7	MB	Spiral, 45"×15", <i>p</i> 168°, gbM, vs almost stellar Nu.; Barnard No. 2.
<i>d</i> ,	257	5.7	MB	Spiral, 45"×30", <i>p</i> 11°, N.G.C. 48, Barnard No. 3.
<i>e</i> ,	202	7.3	MF	9" diameter with almost stellar Nu., Barnard No. 4.
<i>f</i> ,	308	2.7	F	10" diameter gbM.
<i>g</i> ,	256	2.1	MF	12"×9", <i>p</i> 161°, gbM, B almost stellar Nu., N.G.C. 49, Barnard No. 5.
<i>h</i> ,		0	MB	30"×18", <i>p</i> 59°, B, almost stellar Nu. on sp edge of central B patch 10" diameter, N.G.C. 51, Barnard No. 6.

PLATE XV



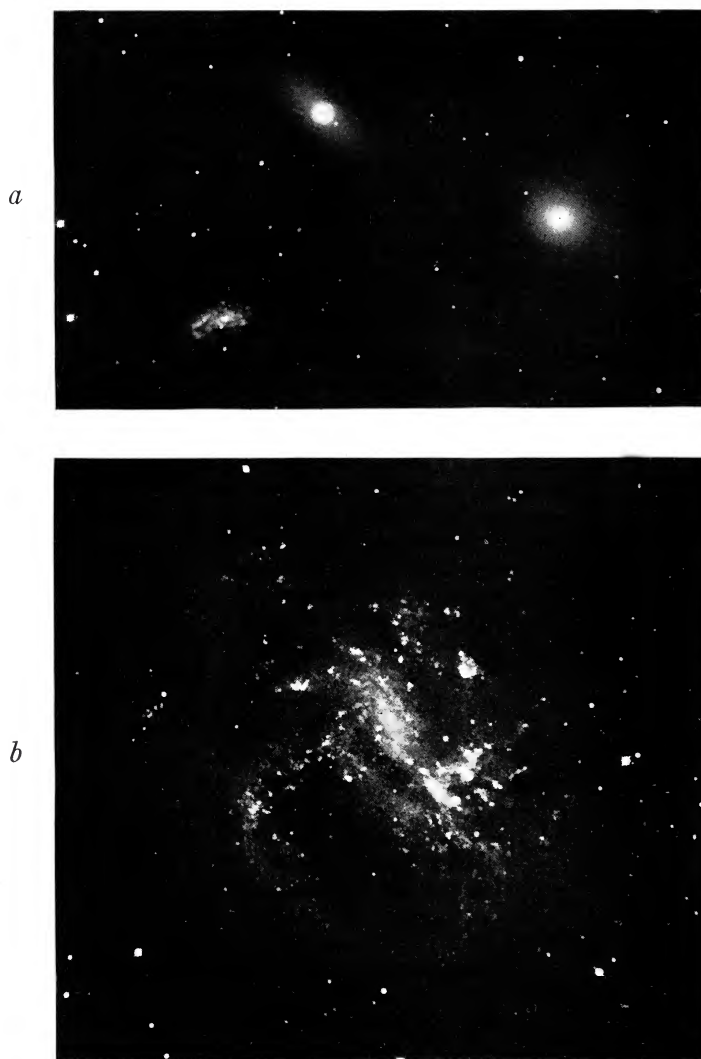
- a.* N.G.C. 2288, 2289, 2290, 2291, 2294, Exposure, 210^m S 27, Enlargement, 1.9, 1 mm = 14".4
b. N.G.C. 3786, 3788 Exposure, 135 S 27, Enlargement, 5.6, 1 mm = 4.9
c. N.G.C. 1491 Exposure, 160 S 23, Enlargement, 1.9, 1 mm = 14.4
d. N.G.C. 1186 Exposure, 220 S 27, Enlargement, 1.9, 1 mm = 14.4
e. N.G.C. 3367 Exposure, 150 S 30, Enlargement, 2.4, 1 mm = 11.2
f. N.G.C. 2146 Exposure, 258 S 23, Enlargement, 3.5, 1 mm = 7.8

PLATE XVI

a*b*

- a.* N.G.C. 2245, 2247, Exposure, 95^m S 30, Enlargement, 1.9, 1 mm = 14".4
b. N.G.C. 2359, Exposure, 210 S 23, Enlargement, 2.5, 1 mm = 11.0

PLATE XVII



a. N.G.C. 3379, 3384, 3389, Exposure, 120^m S 23, Enlargement, 1.9, 1 mm = 14".4
b. N.G.C. 4395, 4399, 4400, 4401, Exposure, 450 S 30, Enlargement, 2.0, 1 mm = 13.3

PLATE XVIII

a

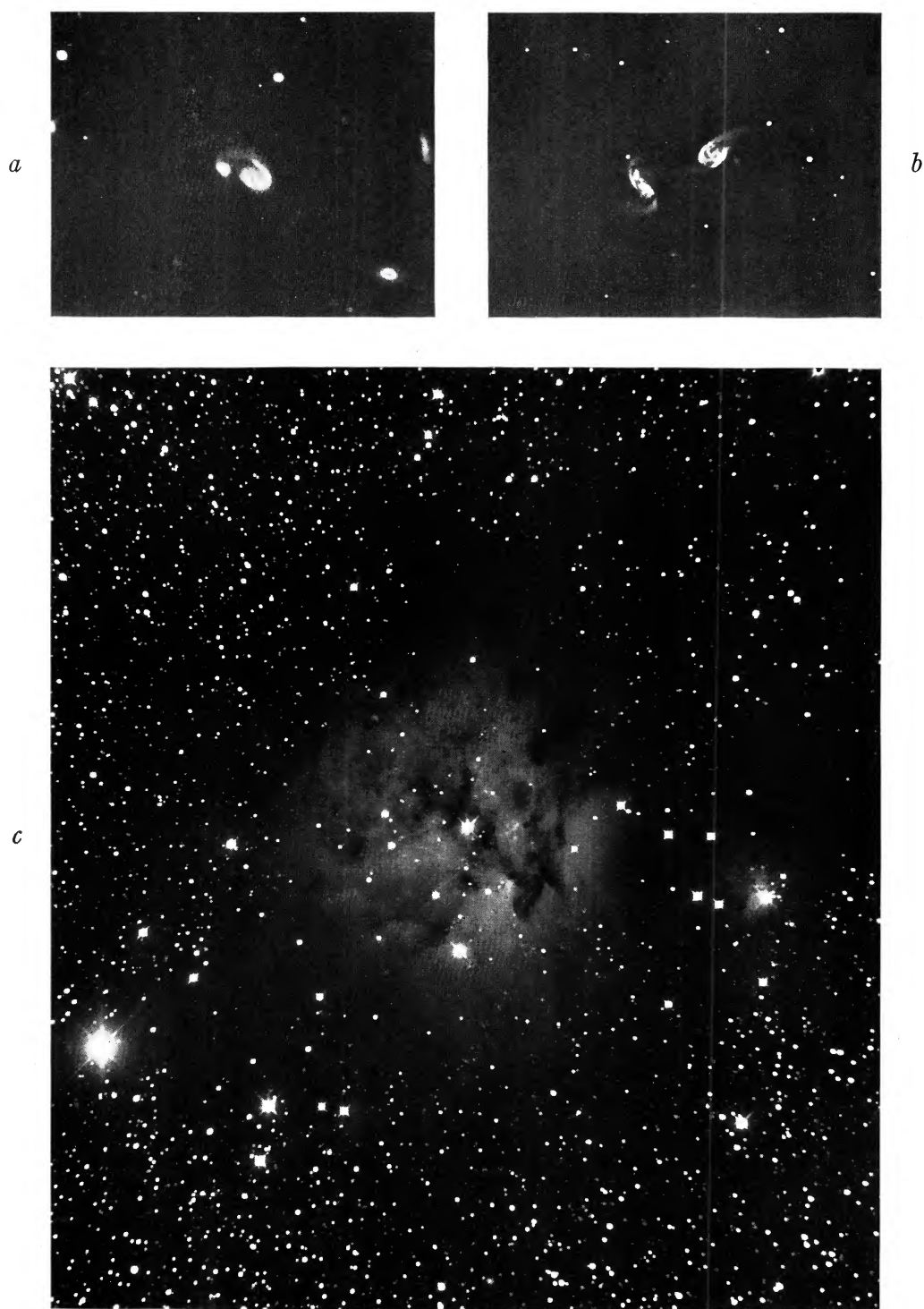


b



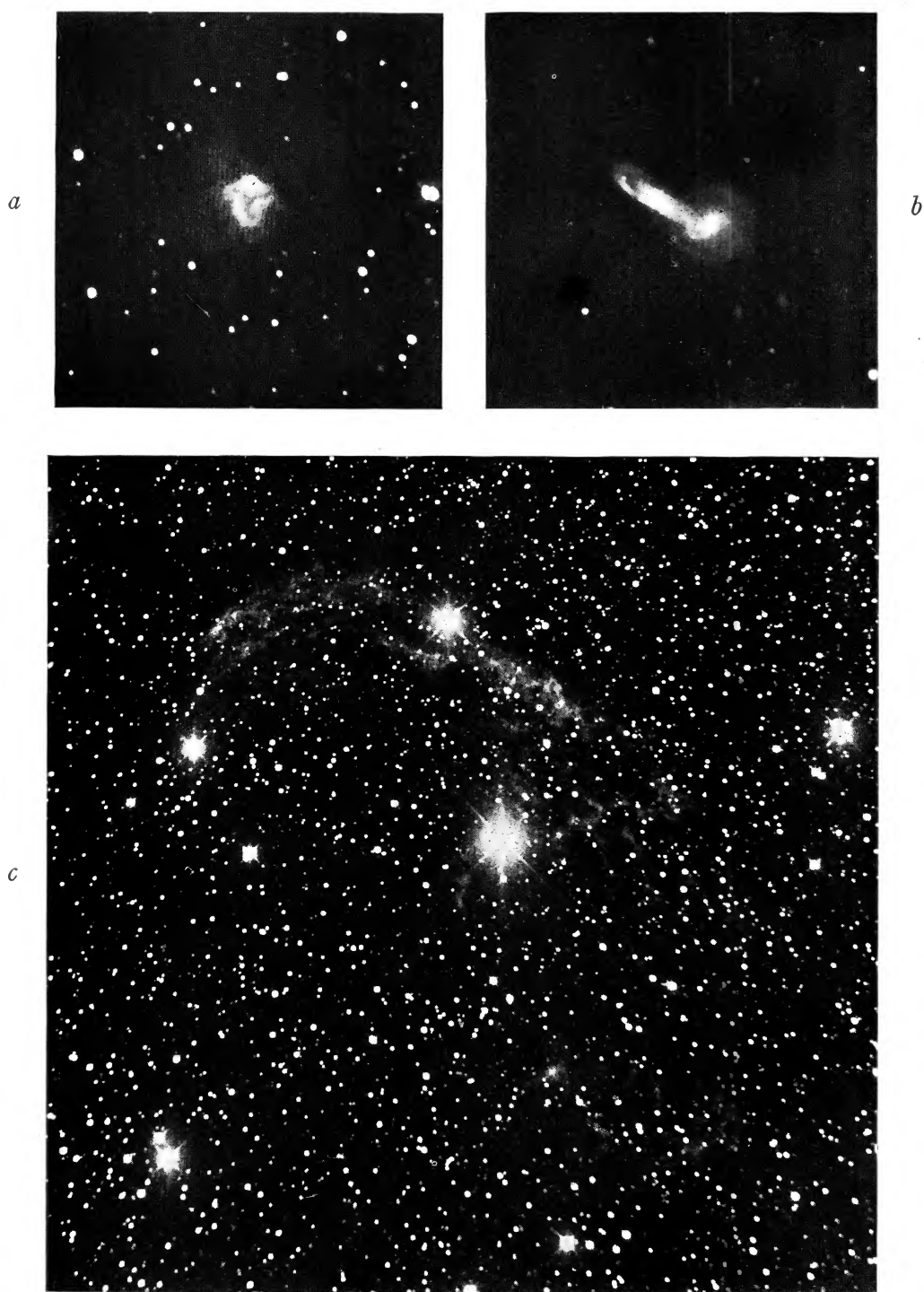
- a.* N.G.C. 3395-96, Exposure, 120^m S 23, Enlargement, 5.6, 1 mm = 4".9
b. N.G.C. 4656-57, Exposure, 240 S 30, Enlargement, 1.9, 1 mm = 8.5 (100-inch)

PLATE XIX



a. N.G.C. 5278-79, Exposure, 160^m S 30, Enlargement, 3.5, 1 mm = 7".8
b. N.G.C. 5257, 5258, Exposure, 50 S 30, Enlargement, 3.5, 1 mm = 7.8
c. I.C. II 5146, Exposure, 300 S 23, Enlargement, 1.9, 1 mm = 14.4

PLATE XX



a. I.C. I 1470, Exposure, 190^m S 23, Enlargement, 5.5, 1 mm = 5".0
b. N.G.C. 5544, 5545, Exposure, 360 S 27, Enlargement, 5.5, 1 mm = 5.0
c. N.G.C. 6888, Exposure, 300 S 30, Enlargement, 2.4, 1 mm = 11.2

<i>i</i> ,	0	8.0	F	Patch 10'' diameter.
<i>j</i> ,	13	6.4	MF	Patch 10'' gbM.
<i>k</i> ,	18	10.7	MF	Spindle 30''×6'', <i>p</i> 19°, gbM.

N.G.C. 955,* Cetus

$$\alpha = 2^{\text{h}}26^{\text{m}}29^{\text{s}}, \quad \delta = -1^{\circ}27'8'' (1920); \quad \lambda = 138^{\circ}, \quad \beta = -54^{\circ}$$

Plate No. 319, 1917, December 17, 30^m; 18, 65^m. Total 95^m. Images large

A so-called variable nebula, but thought by Dreyer to be unchanging. This plate was made for comparison with No. 229. It is stronger than the 1913 plate; the general dimensions are increased to 113''×10'', but there is no change of relative intensity in the different parts of the nebula. Many small nebulae are shown on both plates; 15 of the more important ones are as follows, the measures referring to the nucleus of N.G.C. 955:

<i>a</i> , <i>p</i>	249°	<i>d</i> 16.3	Nebulous spot.	
<i>b</i> ,	346	15.1	F, uniform, 8'' diameter.	
<i>c</i> ,	214	4.9	F, spindle, 20''×4'', <i>p</i> 32°, BM.	
<i>d</i> ,	31	8.2	F, sliver, 10''×2'', <i>p</i> 15°.	
<i>e</i> ,	35	6.9	MF, spindle, 12''×3'', <i>p</i> 115°, gbM.	
<i>f</i> ,	162	13.6	MF, spindle, 20''×6'', <i>p</i> 44'', gbM, Nu.	
<i>g</i> ,	156	16.0	MF, spindle, 5'' diameter, gbM, Nu.	
<i>h</i> ,	59	7.9	F, sliver, uniform, 15''×3'', <i>p</i> 30°.	
<i>i</i> ,	88	8.5	MF, uniform 12'' diameter, with Nu. 2'' diameter elongated 143°.	
<i>j</i> ,	146	14.3	F, uniform, 6'' diameter.	
<i>k</i> ,	146	20.0	MF, 8'' diameter, gbM.	
<i>l</i> ,	84	16.5	MF, spindle, 10''×4'', <i>p</i> 63°, gbM, Nu.	
<i>m</i> ,	61	20.5	MB, spindle, 13''×6'', <i>p</i> 40°, gbM, Nu. (edge of plate).	
<i>n</i> ,	94	17.8	F, 8'' diameter gbM (edge of plate).	
<i>o</i> ,	98	19.2	MF, 10'' diameter gbM (edge of plate).	

N.G.C. 1186,* Perseus

$$\alpha = 3^{\text{h}}0^{\text{m}}16^{\text{s}}, \quad \delta = +42^{\circ}30'9'' (1920); \quad \lambda = 115^{\circ}, \quad \beta = -13^{\circ}$$

Plate No. 310, 1917, November 16, 220^m. S 27.

Images large. Illustrated Plate XVd

This photograph was made for comparison with No. 245, taken in 1914. This supposedly variable nebula has undergone no relative change since 1914. The longer exposure brings out, however, the spiral structure more clearly and shows the nebulosity extending to 2'.5×0'.8. The arrangement of the arm is not regular.

Many small nebulae are on the plate, among them the following. The measures refer to the nucleus of N.G.C. 1186, and not to the star.

<i>a</i> , <i>p</i>	233°	<i>d</i>	18.8	MF, 9" diameter, nebulous spot, fades at edges.
<i>b</i> ,	326		19.9	MF, 8" diameter, nebulous spot, fades at edges.
<i>c</i> ,	229		13.7	MF, 10" diameter, nebulous spot, gbM.
<i>d</i> ,	229		12.2	MF, 6" diameter, nebulous spot, gbM.
<i>e</i> ,	312		11.1	F, 7"×2", <i>p</i> 135°, nebulous patch.
<i>f</i> ,	262		8.0	MF, 7"×2", <i>p</i> 50°, nebulous spot.
<i>g</i> ,	331		15.8	MF, 5" diameter, nebulous spot, gbM.
<i>h</i> ,	346		12.5	F, 4" diameter, nebulous spot, gbM.
<i>i</i> ,	349		13.3	F, 4" diameter, nebulous spot, gbM.
<i>j</i> ,	190		10.6	MF, 5" diameter, nebulous spot, gbM.
<i>k</i> ,	350		7.3	F, 5" diameter, nebulous spot, gbM.
<i>l</i> ,	353		11.2	MF, 11" diameter, nebulous spot, gbM.
<i>m</i> ,	357		9.5	MF, 3" diameter, nebulous spot, gbM.
<i>n</i> ,	178		5.3	MB, 35"×6", <i>p</i> 65°, spindle, stellar Nu.
<i>o</i> ,	87		1.8	F, 10"×2", <i>p</i> 23°, thread.
<i>p</i> ,	55		2.5	MF, 10"×8", <i>p</i> 9°, nebulous spot, gbM.
<i>q</i> ,	141		7.6	MB, 8" diameter, almost a nebulous star.
<i>r</i> ,	73		7.0	F, 5" diameter, nebulous spot, gbM.
<i>s</i> ,	90		13.6	B, 9" diameter, nebulous star.
<i>t</i> ,	55		17.4	MB, 7" diameter, nebulous spot.

N.G.C. 1491, Perseus

$$\alpha = 3^{\text{h}}57^{\text{m}}21^{\text{s}}, \quad \delta = +51^{\circ}5'6'' (1920); \quad \lambda = 118^{\circ}, \quad \beta = -1^{\circ}$$

Plate No. 308, 1917, October 20, 45^m. Cramer Crown.

Images small and round

Plate No. 355, 1919, December 22, 160^m. S 23. Images small and round. Illustrated Plate XVc

A tuft of wispy nebulosity, roughly triangular in shape, about 3' on a side. The effect is produced by three principal V-shaped streamers or filaments, included angle 80°–90°, pointing *p* 225°. They are displaced with respect to one another and thus cross. A star of magnitude 10–11 lies in the fainter nebulosity filling the V.

N.G.C. 1555, Taurus

$$\alpha = 4^{\text{h}}17^{\text{m}}17^{\text{s}}, \quad \delta = +19^{\circ}20'1'' (1920); \quad \lambda = 144^{\circ}, \quad \beta = -20^{\circ}$$

Plate No. 312, 1917, November 17, 195^m. S 27. Images small and elongated

Plate No. 322, 1918, February 11, 110^m; 12, 100^m; 13, 110^m. Total 320^m. S 27.

Images medium and round

Plate No. 326, 1919, March 1, 90^m. S 30. Images small and round

For previous descriptions and chart see *Mount Wilson Contribution*, No. 127; *Astrophysical Journal*, 45, 89, 1917. All three plates show nebulosity *A* remaining about the same, nebulosity *C* extending farther to the W and N. Traces of *G* show as before, while dark regions not sketched show S and E of *K* and *H*.

N.G.C. 1699, 1700, Eridanus

N.G.C. 1699, $\alpha = 4^{\text{h}}53^{\text{m}}3^{\text{s}}$, $\delta = -4^{\circ}52'8''$ } (1920); $\lambda = 172^{\circ}$, $\beta = -26^{\circ}$
 N.G.C. 1700, $\alpha = 4^{\text{h}}53^{\text{m}}0^{\text{s}}$, $\delta = -4^{\circ}59'3''$ }

Plate No. 314, 1917, November 18, 120^m. S 27. Large images, fairly round
 Plate No. 3 (Hoge), 1919, December 24, 110^m. S 30. Small round images

N.G.C. 1700 has a very bright center fading away in several gradual steps and forming an ellipse $50'' \times 30''$, $p\ 92^{\circ}$. The entire mass is soft, having no detail or structure other than the changes in intensity between center and edge. A 23-hour exposure made with the focal-plane spectrograph on the 60-inch reflector gave a spectrum of sufficient strength to show that the type is Go or later, and that the nebula has large positive radial velocity.

There are two other nebulae on the plate whose positions are given with respect to the nucleus of N.G.C. 1700.

a, N.G.C. 1699, $p\ 6^{\circ}$, $d\ 6'6''$, MB, $30'' \times 17''$, $p\ 161^{\circ}$. Almost uniform left-handed spiral, vs B Nu. Position given in N.G.C. is incorrect.

b, 129, 13.6 MF, $15'' \times 10''$, $p\ 9^{\circ}$ lbM, vs B Nu.

N.G.C. 2024, Auriga

$\alpha = 5^{\text{h}}37^{\text{m}}49^{\text{s}}$, $\delta = +51^{\circ}5'6''$ (1920); $\lambda = 174^{\circ}$, $\beta = -15^{\circ}$

Plate No. 316, 1917, November 19, 30^m. Cramer Crown.

Images large and round

Comparison of this plate with Keeler's photograph, taken June 28, 1902, shows no apparent change in the nebula (*Lick Observatory Publications*, 8, Plate 13).

N.G.C. 2146, Camelopard

$\alpha = 6^{\text{h}}5^{\text{m}}53^{\text{s}}$, $\delta = +78^{\circ}23'$ (1920); $\lambda = 102^{\circ}$, $\beta = +25^{\circ}$

Plate No. 358, 1919, December 23, 258^m. S 23. Images medium and a little elongated. Illustrated Plate XVf

A most remarkable nebula, best described in parts, although actually all blended together. (1) An irregular mass of nebulosity $3'5'' \times 1'$, $p\ 150^{\circ}$ greatly differing in intensity, with dark

markings in the direction of its elongation. The nucleus lies a little S of the center of this mass; the nebulosity is brightest around the nucleus. Superimposed on this bright mass is a dark marking in the form of a hand, with four talon-like fingers stretching Sp and with three stars standing out upon it. (2) A lobe in the form of an elongated ellipse $3'.3 \times 1'$, $p\ 125^\circ$, with greatest density along the periphery. This extends about $1'.4$ beyond the S end of (1) and its axis produced would intersect (1) at its N end. The interior is filled with soft nebulosity, has a line of bright knots toward its N end, and some tufts projecting over its *f* side. (3) A spiral arm leaving the Np point of (1) and sweeping to the S in such a way as to give the effect of a left-handed spiral. It ends $p\ 200^\circ$, $d\ 2'$, with respect to the nucleus.

One might describe the system as a spiral with abnormal center, attached to a single arm or to double arms in the latter case, the lobe forming one of the arms. In the former case a single arm emerges from the S corner of (1), sweeping around the *f* side and under the N end of (1), and emerging on the *p* side as (3). In either case the major axis of the arm or arms would be $5'.2$ long and lie in $p\ 120^\circ$. At the extremities there is the effect of a turn in the arm, but there is no increase in density where the single arm and element (1) are superimposed.

A medium-bright right-handed spiral, $8' \times 2'$, $p\ 30^\circ$ lies $p\ 54^\circ$, $d\ 19'$ with respect to nucleus of N.G.C. 2146. The plate shows many small nebulae.

N.G.C. 2245, Monoceros

$\alpha = 6^h 28^m 17^s$, $\delta = +10^\circ 13' 2''$ (1920); $\lambda = 169^\circ$, $\beta = +2^\circ$

Plate No. 323, 1918, February 14, 60^m. S 27. Poor seeing.

Large round images

Plate No. 329, 1919, March 28, 95^m. S 30. Excellent seeing.

Small round images. Illustrated Plate XVIa

A fan-shaped nebula fading away irregularly from an almost stellar point toward the circumference, beyond which extends, torch fashion, nebulosity similar to that of the Orion nebula. A few seconds from its apex and almost at right angles to its axis is a line of nebulosity $30''$ – $40''$ long. Alongside this line, away

from the nebula, is a fan-shaped dark area, appearing to be a shadow cast by an opaque portion of the line, the light source being the fan itself. Evidently the whole region is nebulous, as detail can be seen in the shadow, particularly a looped thread formation. The two photographs appear to show a striking difference about the head, but this may be due to the differences in the plates. The 1918 plate shows a round stellar nucleus standing out from the nebulosity, while the 1919 plate shows an almost solid mass completely covering the nucleus. Further observations will be made.

N.G.C. 2247, Monoceros

$\alpha = 6^{\text{h}}28^{\text{m}}45^{\text{s}}$, $\delta = +10^{\circ}22'8''$ (1920); $\lambda = 169^{\circ}$, $\beta = +2^{\circ}$

Plate No. 323, 1918, February 14, 60^m. S 27. Poor seeing.

Large round images

Plate No. 329, 1919, March 28, 95^m. S 30. Excellent seeing. Small round images. Illustrated Plate XVIa

This nebula lies 9'.9 N of and 5'.7 f N.G.C. 2245 involving centrally the star B.D. +10° 1172. It surrounds the star irregularly, streamers radiating 2' to 3' from the center. In addition to the streamers there is a small patch 1' N and a line about 1' S. Both N.G.C. 2245 and N.G.C. 2247 lie in a dark lane. While Hubble's variable N.G.C. 2261 is related to a variable star, neither of these stars has been mentioned as variable.

The position given in the N.G.C. is not correct. Swift's original description is so exactly like that surrounding B.D. +10° 1172 that there is no question of this being the object. The position given is that of the B.D. star.

N.G.C. 2274, 2275, Gemini

N.G.C. 2274, $\alpha = 6^{\text{h}}42^{\text{m}}28^{\text{s}}$, $\delta = +33^{\circ}39'0''$
 N.G.C. 2275, $\alpha = 6^{\text{h}}42^{\text{m}}3^{\text{s}}$, $\delta = +33^{\circ}41'0''$ } (1920); $\lambda = 149^{\circ}$, $\beta = +15^{\circ}$

Plate No. 313, 1917, November 17, 20^m. Cramer Crown. Poor seeing.

Images medium and elongated

Plates Nos. 100-137, 1919, December 19, 30^m. S 23. Images small and comate

N.G.C. 2274. Nebulosity 7'' diameter, gradually brighter toward the middle, with bright almost stellar nucleus. There is trace of a wing Np.

N.G.C. 2275. Nebulosity 10'' diameter, gradually brighter toward the middle, with bright stellar nucleus. There are traces of faint surrounding nebulosity 30'' in diameter.

N.G.C. 2288, 2289, 2290, 2291, and 2294, Gemini

N.G.C. 2288,	$\alpha=6^h45^m28^s$,	$\delta=+33^\circ29'.1$	} (1920); $\lambda=149^\circ$, $\beta=+15^\circ$
N.C.C. 2289,	$\alpha=6\ 45\ 29$,	$\delta=+33\ 30.9$	
N.G.C. 2290,	$\alpha=6\ 45\ 33$,	$\delta=+33\ 27.7$	
N.G.C. 2291,	$\alpha=6\ 45\ 35$,	$\delta=+33\ 33.0$	
N.G.C. 2294,	$\alpha=6\ 45\ 47$,	$\delta=+33\ 33.2$	

Plate No. 311, 1917, November 16, 90^m. Cramer Crown. Good plate.
Small images

Plate No. 315, 1917, November 18, 70^m; 19, 140^m. Total 210^m. S 27. Poor seeing. Large images. Illustrated Plate XVa

This group is mentioned by Lord Rosse in his *Observations* and is shown by the photographs to be composed of spirals with a background of ill-defined nebulae of similar character.

The following is a brief description of all the nebulae on the plates. The positions are referred to the nucleus of N.G.C. 2290.

N.G.C. 2288, $p\ 325^\circ$, $d\ 1'.8$, MB nebulosity, 7'' diameter. B Nu. almost stellar.

N.G.C. 2289, $p\ 343$, $d\ 2'.6$, $15''\times10''$, $p\ 100^\circ$. gbM, B almost stellar Nu.

N.G.C. 2290, MF ring 5'' to 15'' wide, broken in places, outside diameter $1'.10\times0'.54$ and mean diameter $0'.9\times0'.45$. B stellar Nu. in MB nebulosity 10'' diameter connecting with outer ring. Almost certainly a left-handed spiral.

N.G.C. 2291, $p\ 3^\circ$, $d\ 5'.3$, B almost stellar Nu. in F, R, nebulosity 35'' diameter showing traces of rings, almost certainly spiral.

N.G.C. 2294, $p\ 28^\circ$, $d\ 6'.2$, B almost uniform spindle $27''\times9''$, $p\ 7'.5$. Surrounded by faint nebulosity $40''\times10''$ and having a vs B diffuse elongated Nu.

a, $p\ 263^\circ$, $d\ 16'.2$ F Patch, 8'' diameter.

b, 285 11.9 F 3'' diameter, gbM, Nu.

c, 220 11.7 MB 10'' diameter, gbM, Nu.

d, 349 11.0 Semicircular, 10'' radius, MB on curve, fades back of Nu. From vertex to central Nu. is a bright line 2'' wide, $p\ 137^\circ$.

e, 96 5.2 F Sliver, $10''\times5''$, $p\ 130^\circ$.

f, 95 5.4 F Spot, 3'' diameter.

g, 108 6.0 F Diffuse spot, 8'' diameter.

<i>h</i> ,	130	8.7	F	20"×5", <i>p</i> 116", MB Nu. near <i>f</i> end.
<i>i</i> ,	146	12.9	MB	Nebulous star.
<i>j</i> ,	96	7.5	F	15"×10", <i>p</i> 85° elongated diffuse spot.
<i>k</i> ,	127	9.4		15"×8", <i>p</i> 32° gbM Nu., looks S-shaped.
<i>l</i> ,	67	13.5	F	Diffuse patch, 15" diameter.

N.G.C. 2359, Canis Major

$$\alpha = 7^{\text{h}}13^{\text{m}}50^{\text{s}}, \quad \delta = -13^{\circ}4'1'' (1920); \quad \lambda = 197^{\circ}, \quad \beta = 0^{\circ}$$

Plate No. 320, 1917, December 17, 60^m; 18, 150^m. Total 210^m. S 23.

Images large and round. Illustrated Plate XVIb

The brighter parts of the nebula agree closely with the drawings by the earlier observers. Sir John Herschel pictured it as resembling a bust, while Lassell drew it as like a balloon, with a long neck twisted in the *Sp* direction. The balloon or head is approximately 5' in diameter; the neck is to the S, with nebulosity about 1' wide extending 8' *p*, concave on the N and gradually narrowing and fading out. From the top (N) of the head a symmetrical streamer concave to S extends in *p* direction. The radius of curvature of the two streamers is roughly 15' and their ends are about 8' apart. A second streamer about 1' wide extends *f* from the top of the head to a distance of 9'.

N.G.C. 2403,* Camelopard

$$\alpha = 7^{\text{h}}29^{\text{m}}7^{\text{s}}, \quad \delta = +65^{\circ}46'5'' (1920); \quad \lambda = 118^{\circ}, \quad \beta = +30^{\circ}$$

Plate No. 307, 1917, October 19, 100^m. Cramer Crown.

Images small and round

The illustration of N.G.C. 2403 (*Mount Wilson Contribution*, No. 132, Plate Xc; *Astrophysical Journal*, 46, 35, 1917, Plate V) was made from Plate No. 307, and not from No. 169 as there stated.

The nebulous spot *p* 50°, *d* 3'4, with respect to the center of the nebula is probably a flaw, as there is a difference in character between it and the rest of the nebulosity on the plate.

N.G.C. 2537, Lynx

$$\alpha = 8^{\text{h}}7^{\text{m}}35^{\text{s}}, \quad \delta = +46^{\circ}14' (1920); \quad \lambda = 141^{\circ}, \quad \beta = +33^{\circ}$$

Plate No. 2968 (Shapley), 1916, March 27, 30^m. S 27

Plate No. 359, 1919, December 23, 60^m. S 30. Images small and elongated

Nebulosity of the form of a horseshoe or a semi-elliptical line, major axis N-S, concave to the S, together with a line of

nebulosity $30''$ long lying in the center of the ellipse on the major axis. Two faint lines of nebulosity extend from the N end of this line to the outer nebulosity, the included angle being about 150° . The axes of the complete ellipse would measure $75'' \times 45''$. The nebulosity is of the mixed type, there being a number of well-defined knots in it.

I.C.II 2233 falls near the edge of the plates and appears to be a faint edge-on spiral $4' \times 10''$, $p \ 170^\circ \pm$, with faint stellar nucleus. A faint patch $20''$ diameter lies $4'.6$ f N.G.C. 2357.

N.G.C. 2964, Leo Minor

$$\alpha = 9^h 38^m 11^s, \quad \delta = +32^\circ 12.8 \ (1920); \quad \lambda = 162^\circ, \quad \beta = +50^\circ$$

Plate No. 321, 1917, December 18, 60^m . Cramer Crown. Images small and round

Plate No. 324, 1919, February 28, 210^m . S 30. Images small and round

A right-handed spiral, with bright inner arms extending to $75'' \times 45''$, $p \ 90^\circ$, and exterior arms to $2'.5 \times 1'.2$. The inner arms are dotted with bright condensations, the outer are faint and soft. Several peculiar details suggest a drift of the component parts relative to each other; among these may be noted the winged knots on the p side, the disjunction of the nucleus and the f arm, and a left-handed wisp crossing the p arm N of the nucleus.

N.G.C. 2968, Leo Minor

$$\alpha = 9^h 38^m 28^s, \quad \delta = +32^\circ 17'.7 \ (1920); \quad \lambda = 162^\circ, \quad \beta = +50^\circ$$

Plate No. 321, 1917, December 18, 60^m . Cramer Crown. Images small and round

Plate No. 324, 1919, February 28, 210^m . S 30. Images small and round

Probably an edge-on spiral, since it shows an irregular ellipse of nebulosity $1'.2 \times 7'$, $p \ 31^\circ$, gradually increasing in brightness toward the central nucleus $2''$ diameter, and has an absorption streak running irregularly along the major axis.

The plate shows many small nebulae; measures were made of 15 with the nucleus of N.G.C. 2968 as a center.

a , $p \ 305^\circ$, $d \ 13'.4$ MB, uniform ellipse, $7'' \times 3''$, $p \ 142^\circ$.

b , $247 \ 11.3$ MB, uniform ellipse, $8'' \times 4''$, $p \ 140^\circ$, sbM.

c , $282 \ 10.0$ MF, uniform, $3''$ diameter.

<i>d</i> ,	196	9.2	F,	spindle, 20"×6", <i>p</i> 129°, F Nu.
<i>e</i> ,	329	2.7	MF,	uniform patch, 9"×4", <i>p</i> 48°.
<i>f</i> ,	242	0.8	MB,	10"×2", <i>p</i> 179°, gbM.
<i>g</i> ,	4	14.1	MB,	10" diameter, gbM.
<i>h</i> ,	166	6.5	MB,	10" diameter, <i>f</i> side stronger.
<i>i</i> ,	168	13.6	MB,	gbM, 11"×8", <i>p</i> 60°.
<i>j</i> ,	154	7.7	F,	uniform, 12"×3", <i>p</i> 132°.
<i>k</i> ,	61	4.9	MB,	sbM, 12"×6", <i>p</i> 75°.
<i>l</i> ,	19	13.0	MF,	spindle, gbM, 10"×4", <i>p</i> 23°.
<i>m</i> ,	124	13.7	MF,	nebulous star, 4" diameter.
<i>n</i> ,	56	14.0	F,	uniform, lbM, 10"×3", <i>p</i> 23°.
<i>o</i> ,	47	15.9	MF,	gbM, Nu, 10"×3", <i>p</i> 29°.

N.G.C. 2970, Leo Minor

$\alpha = 9^{\text{h}}38^{\text{m}}48^{\text{s}}$, $\delta = +32^{\circ}20'7''$ (1929); $\lambda = 162^{\circ}$, $\beta = +50^{\circ}$

Plate No. 321, 1917, December 18, 60^m. Cramer Crown. Images small and elongated

Plate No. 324, 1919, February 28, 210^m. S 30. Images small and round

Bright nebulosity gradually fading away, 15"×10", *p* 80°, with a bright stellar nucleus about 5" diameter centrally located.

N.G.C. 3310, Ursa Major

$\alpha = 10^{\text{h}}33^{\text{m}}48^{\text{s}}$, $\delta = +53^{\circ}55'1''$ (1920); $\lambda = 124^{\circ}$, $\beta = +55^{\circ}$

Plate No. 356, 1919, December 22, 12^m and 90^m. Exp. on same plate. S 30. Images small and round

A left-handed spiral, 90"×50", *p* 170°. The short exposure shows a bright nucleus surrounded by a bright elliptical ring, 22"×15", *p* 140°, from which springs an arm of much smaller density in *p* 130°, bending to the north and running for a length of about 25". A faint star with faint surrounding nebulosity lies just adjoining the ring at *p* 230°, *d* 14", from the center. The long exposure shows a mass 30"×25", *p* 130°, with the arm emerging as above and ending at *p* 20°, *d* 25". The nucleus, ring, and two stars show plainly. There are traces of other arms lying around the bright mass, particularly one emerging opposite the strong arm running southward and ending at *p* 165°, *d* 30". The ring is strongest in its N and S sections.

N.G.C. 3367, Leo Major

$$\alpha = 10^{\text{h}}42^{\text{m}}21^{\text{s}}, \delta = +14^{\circ}10'.2 \text{ (1920)}; \lambda = 200^{\circ}, \beta = +59^{\circ}$$

Plate No. 289, 1917, April 22, 70^m. S 23. Images small and comate

Plate No. 327, 1919, March 1, 150^m. S 30. Small round images.
Illustrated Plate XVe

A left-handed spiral about 1'.8 diameter, almost circular, with a bright sharp stellar nucleus. The periphery is well defined on the *p* side but lacking on the *f*. It is similar in type to N.G.C. 5921¹ in that an almost straight bar crosses the center *p* 70°, from the ends of which emerge arms almost at right angles to the bar, a single arm at one end, a double one at the other. The bar is slightly concave on the N side and its *f* end continues in a series of condensations across the arm to the periphery. The arm emerges from the bar 14'' from the nucleus and turns to the N. The *p* end of the bar spreads into soft nebulosity and just touches the arm from the *f* end; the arm on the *p* end leaves at about 16'' from the nucleus, turns to the south, and at about 10'' spreads into two parallel arms with nebulosity between them, which run parallel for about 90°; the outer one then fades away into the rim, while the inner one continues and is merged in the *p* rim. There are a number of branching and crossing threads, and a bright knot *p* 267°, *d* 47'', from the nucleus lying in the periphery. The greatest extent of the nebulosity is 60'', *p* 40°. The double arm brightens at a point just *f* the nucleus. The plate shows a number of nebulous spots, the more prominent of which are as follows, the measures referring to the nucleus of 3367.

<i>a</i> ,	<i>p</i> 269°, <i>d</i> 14'.4	5'' diameter, uniform.
<i>b</i> ,	193	11.0 3'' diameter, gbM, B, stellar Nu.
<i>c</i> ,	151	4.9 3'' diameter, stellar Nu.
<i>d</i> ,	149	13.0 11''×5'', <i>p</i> 126°, gbM.
<i>e</i> ,	150	15.0 10''×4'', <i>p</i> 145°, lbM.
<i>f</i> ,	25	18.1 5'' diameter, gbM.
<i>g</i> ,	34	14.3 5'' diameter, lbM.
<i>h</i> ,	45	17.7 4'' diameter, lbM.
<i>i</i> ,	57	15.3 5'' diameter, gbM.
N.G.C. 3377	49	21.8

¹ *Publications of the Astronomical Society of the Pacific*, 24, 227, 1912.

- N.G.C. 3371 Should lie about one-third the distance from
3367 to 3377, but there is nothing on the plate.
- N.G.C. 3373 Should lie in the region *f* 3367 and a little S,
but there is nothing on the plate.

N.G.C. 3377, Leo Major

$$\alpha = 10^{\text{h}}43^{\text{m}}28^{\text{s}}; \quad \delta = 14^{\circ}24'.4 \quad (1920); \quad \lambda = 201^{\circ}, \quad \beta = +60^{\circ}$$

Plate No. 289, 1917, April 22, 70^m. S 23. Small astigmatic images

Plate 327, 1919, March 1, 150^m. S 30. Small comate images

A diffuse ellipse $90'' \times 30''$, $p \ 40^{\circ}$, gradually increasing in brightness toward the center, where there is a great increase in brightness in an elongated nucleus $20'' \times 13''$. A number of faint nebulae not listed under N.G.C. 3367 appear in the field. The measures refer to the nucleus of N.G.C. 3377.

<i>a</i> ,	<i>p</i>	315°	<i>d</i>	9'.1	Very faint, 1' diameter.
<i>b</i> ,		60		8.2	MF, uniform, 10'' diameter.
<i>c</i> ,		110		12.9	MF, uniform, 12'' \times 4'', $p \ 129^{\circ}$.
<i>d</i> ,		64		19.4	MF, lbM, 8'' diameter.
N.G.C. 3391	52	22.9			(10 ^h 44 ^m 45 ^s , +14° 38'.6) (1920); appears on the corner of plate 289. The image is bright, 20'' \times 11'', $p \ 26^{\circ}$, and suggestive of spiral formation, but the image is too comate to say for certain.

N.G.C. 3379, Leo Major

$$\alpha = 10^{\text{h}}43^{\text{m}}37^{\text{s}}, \quad \delta = +13^{\circ}0'.2 \quad (1920); \quad \lambda = 203^{\circ}, \quad \beta = +59^{\circ}$$

Plate No. 290, 1917, April 23, 75^m. S 23. Small, slightly elongated image

Plate No. 334, 1919, March 30, 120^m. S 23. Small, slightly elongated image.

Illustrated Plate XVIIa

A nebula which long since attracted attention, owing to its resemblance to an unresolved star cluster. It has a very bright nucleus 10''-12'' diameter, surrounded by a bright atmosphere, 30'' diameter, which gradually fades away at 90'' diameter. The nebula differs from many others, such as N.G.C. 4374 (M 84) and N.G.C. 4402, in having a planet-like nucleus, whereas usually the nebulosity gradually increases toward the center, with a possible sudden increase in brightness to form a semi-diffuse nucleus. A spectrogram[†] made with the focal-plane spectrograph at the

[†] *Publications of the Astronomical Society of the Pacific*, 30, 255, 1918.

Newtonian focus of the 60-inch reflector shows the nucleus to be G5 or later, and to have a radial velocity of about +850 km/sec. Slipher obtained a value of 780 km/sec. Faint traces of the outer nebulosity show a maximum of continuous spectrum corresponding to the nucleus.

N.G.C. 3384, Leo Major

$$\alpha = 10^{\text{h}}44^{\text{m}}4^{\text{s}}, \quad \delta = +13^{\circ}3'1'' (1920); \quad \lambda = 203^{\circ}, \quad \beta = +59^{\circ}$$

Plate 290, 1917, April 23, 75^m. S 23. Small, slightly comate images

Plate 334, 1919, March 30, 120^m. S 23. Small, lightly comate images.

Illustrated plate XVIIa

An astonishing nebula consisting of a bright center 40'' diameter, on which are superimposed a very bright elongated nucleus 19'' \times 10'', p 45°, crossed by a second bright nucleus 40'' \times 5'', p 130°, presenting a Saturn-like appearance. Finally, from this mass wings or branches extend in p 53° on either side, to a distance of 1'.5 The wings gradually broaden to a width of 1' at 1' from the center, where they are rounded off.

The three nebulae, N.G.C. 3379, 3384, 3389, appearing on the same plate present very different features. N.G.C. 3389 is a well-defined spiral, N.G.C. 3384 presents spiral and planetary characteristics, while N.G.C. 3379 leads one to believe it a very distant, unresolved cluster or group of spirals.

N.G.C. 3389, Leo Major

$$\alpha = 10^{\text{h}}44^{\text{m}}14^{\text{s}}, \quad \delta = +12^{\circ}57'0'' (1920); \quad \lambda = 204, \quad \beta = +60^{\circ}.$$

Plate No. 290, 1917, April 23, 75^m. S 23. Small slightly comate images

Plate No. 334, 1919, March 30, 120^m. S 23. Small slightly elongated images. Illustrated Plate XVIIa

A medium-bright right-handed spiral 110'' \times 52'', p 107°, having a very small stellar nucleus. The arms are fairly dense, with condensations along them, but are not strictly regular in form.

N.G.C. 3395-3396, Leo Minor

$$\left. \begin{array}{l} \text{N.G.C. 3395, } \alpha = 10^{\text{h}}45^{\text{m}}23^{\text{s}}, \quad \delta = +33^{\circ}24'4'' \\ \text{N.G.C. 3396, } \alpha = 10^{\text{h}}45^{\text{m}}28^{\text{s}}, \quad \delta = +33^{\circ}24'9'' \end{array} \right\} (1920); \quad \lambda = 160^{\circ}, \quad \beta = +64^{\circ}$$

Plate No. 286, 1917, March 26, 120^m. S 23. Small round images.

Illustrated Plate XVIIIa

Plate No. 332, 1919, March 29, 110^m. S 30. Small round images

N.G.C. 3395 is a right-handed spiral with its major axis in $p\ 32^\circ$. Its Sp portion is well defined and extends about $52''$ along the major axis from the nucleus. The Nf portion is markedly deficient in size and in density of material. N.G.C. 3396 lies $p\ 66^\circ$, $d\ 73''$ Nf with respect to the nucleus of 3395. It is composed of a bright elongated nucleus $10'' \times 5''$, $p\ 97^\circ$, with which is blended a knot about $3''$ diameter $9''$ f and a short line diagonally opposite. Surrounding this is a mass whose general axis is in $p\ 94^\circ$ and which extends $42''$ f the nucleus. Between the two nebulae is evidence of a great disturbance, since material which would ordinarily belong to the Nf arm of 3395 is absent, while stream lines indicate its presence about 3396. It remains to be ascertained whether the formation is the result of two separate centers or whether 3395 has separated from 3396, or, finally, whether 3396 has wrenched material away from 3395. The stream line of 3395 suggests a right-hand twist. There is more than enough material in 3396 to make up for that lost in the arm of 3395; in fact, it is just about equal to the complete arm of 3395.

There are many small nebulae on the plates, the more prominent of which are the following, the measures referring to the nucleus of N.G.C. 3395:

I.C.II 2603			Not on plates.
a ,	$p\ 278^\circ$, $d\ 15.9$	$10'' \times 4''$, $p\ 56^\circ$, bM.	
Big. 270		Not on plates.	
b ,	280	11.1	MF, $5''$ diameter, bM.
c ,	210	15.2	MF, $10'' \times 5''$, $p\ 99^\circ$, lbM.
I.C.II 2604	203	13.8	MB, Irr. R, $50''$ diameter, RH spiral.
d ,	339	11.9	MF, $6''$ diameter, lbM.
e ,	330	4.3	MF, $6''$ diameter, lbM.
f ,	342	5.4	MB, $2''$ diameter, stellar.
I.C.II 2605 } Big. 402 }			Part of arm of N.G.C. 3395.
I.C.II 2608	157	14.1	MB, $45'' \times 6''$, $p\ 118^\circ$, B Nu., spindle.
g ,	40	13.0	MB, $10''$ diameter, lbM.
h ,	98	9.2	MF, $3''$ diameter, lbM.
i ,	46	17.4	MF, $4''$ diameter, lbM.
j ,	80	12.7	F, $9'' \times 5''$, $p\ 116^\circ$, lbM.
k ,	124	23.2	MB, $60'' \times 10''$, $p\ 170^\circ$, B Nu., spindle.

N.G.C. 3786, 3788, Ursa Major

N.G.C. 3786, $\alpha = 11^h 35^m 29^s$, $\delta = +32^\circ 21' 3''$ } (1920); $\lambda = 159^\circ$, $\beta = +75^\circ$
 N.G.C. 3788, $\alpha = 11^h 35^m 32^s$, $\delta = +32^\circ 22' 8''$ }

Plate No. 337, 1919, April 29, 30^m. S 23. Images small
and slightly elongated

Plate No. 338, 1919, April 29, 135^m. S 27. Images large
and fairly round. Illustrated Plate XVb

N.G.C. 3786 is a right-handed spiral with a bright nucleus, a fairly bright central part $60'' \times 30''$, p 67° , and a faint interrupted ring, not strictly elliptical, $2' \times 1'$, p 75° , which is probably an extended arm. The central part is weaker on the N side, which shows an irregular dark marking. The outer ring just touches a faint prolongation from the S end of N.G.C. 3788.

N.G.C. 3788 is a right-handed elliptical spiral $92'' \times 20''$, p 179° , very similar to N.G.C. 5545 lying p 18° , d $1'.4$ N of N.G.C. 3788. The nebulosity on and between the arms is soft, with traces of condensation near the center. The brightest spot is a knot p 40° , d $10''$. The center and the N end of the major axis in the curve of the arm are bright.

N.G.C. 3791 and 3793 do not appear on the plates. Plate No. 338 is literally covered with small nebulae, some of them spindles, and many of them merely rounded masses with relatively bright ill-defined centers. Presumably these are related to the spiral family. The measures of some of them, referred to the nucleus of N.G.C. 3786, are as follows:

<i>a</i> , p 314° , d $22'.4$	MF, R, $7''$, lbM.
<i>b</i> , 311 16.6	F, $9'' \times 4''$, p 135° .
<i>c</i> , 285 12.4	F, Irr. R, $6''$.
<i>d</i> , 273 11.0	MF, R, $7''$, lbM.
<i>e</i> , 330 17.4	MF, R, $4''$, lbM.
<i>f</i> , 325 14.4	MB, R, $5''$, BM.
<i>g</i> , 331 16.7	F, Irr. R, $8''$.
<i>h</i> , 336 18.5	MB, R, $7''$, BM.
<i>i</i> , 331 14.9	F, Irr. R, $6''$, lbM.
<i>j</i> , 322 11.4	MF, R, $5''$, bM.
<i>k</i> , 238 6.1	MF, Irr. R, $9''$, lb near end.
<i>l</i> , 226 4.8	MF, $20'' \times 4''$, p 132° , knots at middle and ends.
<i>l'</i> , 225 4.7	MB, $8'' \times 3''$, p 87° , other F nebulosity <i>f</i> .

<i>m</i> ,	285	2.9	F, Irr. R, 6'', uniform.
<i>n</i> ,	351	16.0	MF, R, 5'', bM.
<i>o</i> ,	210	1.4	MB, 10''×3'', <i>p</i> 139°, BM.
<i>p</i> ,	181	10.5	MF, R, 6'', lbM.
<i>q</i> ,	6	8.4	MB, R, 6'', bM.
<i>r</i> ,	167	8.5	MF, R, 5'', lbM.
<i>s</i> ,	10	11.4	MF, R, 4'', bM.
<i>t</i> ,	70	4.6	MF, 14''×4'', <i>p</i> 3°, bM, spindle.
<i>u</i> ,	44	10.7	MF, R, 4'', lbM.
<i>v</i> ,	115	8.6	F, Irr. R, 4'', lbM.
<i>w</i> ,	34	15.0	MF, 10''×2'', <i>p</i> 135°, lbM.
<i>x</i> ,	115	11.4	F, In R, 6'', lbM.
<i>y</i> ,	60	12.4	F, R, 2''.
<i>z</i> ,	112	15.3	MF, Irr. R, 10'', uniform.

N.G.C. 4395, 4399, 4400, 4401, Canes Venatici

N.G.C. 4395,	$\alpha = 12^h 21^m 51^s$,	$\delta = +33^\circ 59' 4''$	} (1920); $\lambda = 121^\circ$, $\beta = +82^\circ$
N.G.C. 4399,	$\alpha = 12 \ 22 \ =$	$\delta = +34 \ 0 \ =$	
N.G.C. 4400,	$\alpha = 12 \ 22 \ =$	$\delta = +34 \ 0 \ =$	
N.G.C. 4401,	$\alpha = 12 \ 22 \ 1$	$\delta = +33 \ 57.5$	

Plate No. 330, 1919, March 28, 270^m. S 23. Images small and elongated

Plate No. 331, 1919, March 28, 20^m. S 30. Images small and round

Plate No. 333, 1919, March 29, 30, 450^m. S 30. Images small and slightly elongated. Illustrated Plate XVIIb

These four nebulae, together with a large amount of fainter nebulosity, form a remarkable spiral. The configuration is approximately circular in outline, with indications of a three-armed spiral or pinwheel and a two-armed spiral with one detached arm (similar to N.G.C. 3395-3396), all of which are blended and not simply superimposed. The brightest nebulosity is not at the center of either, but lies in the *Sf* portion of the whole. Aside from these predominating features, large faint whorls are also seen which indicate that the nebula is roughly spherical in form. N.G.C. 4395 is the two-armed portion, N.G.C. 4399 the *Sf* arm of the pinwheel, and N.G.C. 4401 the brightest knot of the whole. The nebula as a whole is roughly 12'×10', elongated in *p* 128°, with N.G.C. 4395 as center; beyond this, and in fact scattered over the plate, are many small nebulous stars or spots similar to those within the

nebula. The plates are not strong enough to show definitely the relation of the component parts, and further descriptions will be reserved for a longer exposure.

N.G.C. 4656-4657, Canes Venatici

N.G.C. 4656, $\alpha = 12^h 40^m 5^s$, $\delta = +32^\circ 36'.2$ } (1920); $\lambda = 90^\circ$, $\beta = +86^\circ$
 N.G.C. 4657, $\alpha = 12 40 14$, $\delta = +32 39.4$ }

Plate No. 336, 1919, April 28, 20^m. S 27. Images comate

Plate No. 339, 1919, April 29, 140^m. S 27. Images medium and elongated

Plates Nos. 100-145, 1920, February 16, 240^m. S 30. Images small and round. Illustrated Plate XVIIIb .

The objects listed as N.G.C. 4656 and 4657 constitute a most interesting single right-handed spiral. It appears as though a section were scaling off from a streamer of nebulosity which extends across the plate for a distance of 20'. The nebulosity strongly resembles that of N.G.C. 4449. There is no well-defined center or nucleus, but the inner end of the stronger arm is relatively bright, and this is taken as the center in the discussion. The strong Nf arm consists of well-defined soft nebulosity dotted with about 50 condensations and having much fainter material lying on its concave side. The position angle at the center is about 26°, but the direction changes rapidly, the arm becomes concave on the f side and turns south at $p\ 50^\circ$, $d\ 3'.6$ from the center, and after a return of 25'' stops. The width is from 20'' to 30''. The Sp arm is not as well defined and the material is distributed in several bands. It consists of a p member emerging from the center in $p\ 220^\circ$ to a distance of 3'.4, which then branches, one branch continuing straight on, the other curving slightly concave N for a distance of 5'. The second member starts in $p\ 185^\circ$, runs straight for 2', then gradually curves for about 5', ending in $p\ 223^\circ$. There are traces of other lines of material extending to a distance of 8'.

In addition to a number of very small nebulae on the plate there is a well-defined two-armed right-handed spiral $p\ 260^\circ$, $d\ 3'.4$ with respect to the center of 4656-7; it is 30'' \times 20'', $p\ 10^\circ$.

N.G.C. 5257, 5258, Virgo

N.G.C. 5257, $\alpha = 13^h 35^m 49^s$, $\delta = +1^\circ 14' 7''$ } (1920); $\lambda = 298^\circ$, $\beta = +61^\circ$
 N.G.C. 5258, $\alpha = 13 \ 35 \ 53$, $\delta = +1 \ 14.3$ }

Plate No. 345, 1919, June 27, 50^m. S 30. Images small and elongated. Illustrated Plate XIX*b*

N.G.C. 5257 is a left-handed spiral with two principal arms, each making a complete revolution before fading out. It forms an irregular ellipse $80'' \times 40''$, $p \ 120^\circ$ (no trail). For a length of $20''$, beginning a half-turn from the center, there are several bright knots in line in each arm. Beyond this the nebulosity is soft and spreads into brushes at the ends. The curvature at the ends is very small, and there is indication that the f one extends to N.G.C. 5258.

N.G.C. 5258 is a left-handed spiral whose brighter parts lie within an ellipse $60'' \times 18''$, $p \ 30^\circ$ (no trail), from the extremities of which spring the two main opposite arms forming a letter S, the arms themselves being opposite arcs of a circle of $30''$ radius. The central nucleus is brighter than that of N.G.C. 5257, and two knots as bright as the nucleus lie one to the N end and one to the S. The arms are soft and brushy, as in N.G.C. 5257.

N.G.C. 5278-5279, Ursa Major

N.G.C. 5278, $\alpha = 13^h 38^m 40^s$, $\delta = +56^\circ 4' 3''$ } (1920); $\lambda = 74^\circ$, $\beta = +60^\circ$
 N.G.C. 5279, $\alpha = 13 \ 38 \ 45$, $\delta = +56 \ 4.5$ }

Plate No. 341, 1919, May 28, 30^m. S 30. Fair images

Plate No. 342, 1919, June 25, 160^m. S 30. Fair images. Illustrated Plate XIX*a*

These separately listed objects are parts of the same nebula, consisting of a stellar center and a ribbon of nebulosity which encircles the nucleus for a little more than one turn, then abruptly decreases in intensity and widens out, and continuing in a curve, concave to the S, ends abruptly in a bright twist or hook, at about $p \ 70^\circ$, $d \ 40''$. The first coil is roughly $30'' \times 20''$, $p \ 60^\circ$, and the whole lies within an ellipse $65'' \times 30''$, $p \ 60^\circ$. The curl on the end forms a semicircle of about $7''$ radius and points $p \ 320^\circ$.

This nebula appears on the same plates as the group of objects listed by Barnard under I.C. 917 to 928; the illustration is from Plate No. 342 where it appears near the edge.

N.G.C. 5544,* 5545,* 5557, Boötes

N.G.C. 5544, $\alpha = 14^h 13^m 40^s$, $\delta = +36^\circ 56'.5$
 N.G.C. 5545, $\alpha = 14 \ 13 \ 41$, $\delta = +36 \ 56.8$
 N.G.C. 5557, $\alpha = 14 \ 15 \ 5$, $\delta = +36 \ 51.6$

(1920); $\lambda = 32^\circ$, $\beta = +68^\circ$

Plate No. 127, 1912, June 13, 180^m. S 23

Plate No. 260, 1916, April 30, 50^m. S 23. Images small and round

Plate No. 261, 1916, May 1, 2, 3, 4, 5, 360^m. S 27. Images small. Illustrated Plate XXb

In *Mount Wilson Contribution*, No. 132, the orientation of these plates is in error 180°, consequently the descriptions of N.G.C. 5544 and 5545 are interchanged and Plate XIIIc is shown S at top and *f* at right. The positions in N.G.C. are incorrect, as that of 5545 is S of 5544, while actually it is to the N. Bigourdan's value (*Annales Observatoire de Paris, Observations*, 1899) for N.G.C. 5544 is $\alpha = 14^h 12^m 50^s.62$, $\delta = +37^\circ 2' 7''.2$ (1900), the relative position of the nebulae $p \ 244^\circ \pm$, $d \ 37''$, but he states that the measures are uncertain and difficult. The corrected description is as follows:

N.G.C. 5544 and 5545 are two overlapping spirals, the former in plan, the latter very much inclined to the line of sight.

N.G.C. 5544 consists of a bright stellar nucleus, a nebular ring about 5'' wide and 28'' outside diameter, a fainter diametral streak crossing the nucleus in $p \ 130^\circ$ and an outer ring of about the same intensity as the inner one, irregularly round, 8'' wide and 45'' outside diameter; both rings are slightly elongated in $p \ 115^\circ$. The nebulosity is entirely soft.

N.G.C. 5545 is a left-handed spiral $70'' \times 15''$, $p \ 60^\circ$, its p end just tangent to the *f* point of the nucleus of N.G.C. 5544. The nucleus is faint and stellar. The arms are about equal in intensity where they start from the nucleus, but that on the p side continues bright for a much greater distance, being interrupted, however, at several points. Several knots and condensations

appear. Its extremely small, bright nucleus lies in $p\ 68^\circ$, $d\ 36''$, with respect to nucleus of N.G.C. 5544.

N.G.C. 5557 appears at the f side of the plates; it is so distorted that one cannot more than suspect it to be a spiral. Its position with respect to N.G.C. 5544 is $p\ 105^\circ$, $d\ 17.4$ and, allowing for distortion, seems to be a bright mass $18'' \times 14''$ surrounded with fainter nebulosity $40''$ diameter.

The plates are covered with a multitude of faint nebulae, a number of which are as follows, their positions being given with respect to the nucleus of N.G.C. 5544:

a ,	$p\ 235^\circ$,	$d\ 20.7$	MB, Irr. R, $12''$ diameter BM (edge of plate).
b ,	216	21.3	F, nebulous spot, $5''$ diameter (edge of plate).
c ,	329	9.8	F, uniform sliver, $20'' \times 2''$, $p\ 24^\circ$.
d ,	205	7.5	MB, elongated Nu., $4'' \times 2''$, $p\ 4^\circ$, in MF nebulosity, $11''$ diameter.
e ,	228	3.8	F, $5''$ diameter, gbM.
f ,	356	6.6	Faint, MF at center, $10'' \times 3''$, $p\ 42^\circ$.
g ,	179	4.8	Bright Nu., $2''$ to $3''$ diameter, surrounded by F nebulosity, $13''$ diameter, $p\ 79$.
h ,	173	16.1	MF center, $10'' \times 2''$, $p\ 145^\circ$, in F nebulosity $15'' \times 5''$.
i ,	23	7.8	Two F slivers each $11''$ long lying $p\ 37^\circ$ and 52° intersecting to form a ∇ on Sp end.
j ,	139	18.5	F, $8''$ diameter, gbM.
k ,	97	13.0	F, $10'' \times 2''$, $p\ 130^\circ$.
l ,	124	16.0	F, Wisp, $13'' \times 3''$, $p\ 76^\circ$.
m ,	130	23.1	Nebulous spot, $10'' \times 5''$, $p\ 51^\circ$ (edge of plate).

N.G.C. 5868, 5869, Serpens

N.G.C. 5868, $\alpha = 15^h 5^m 44^s$, $\delta = +0^\circ 50' 2''$ } (1920); $\lambda = 328^\circ$, $\beta = +47^\circ$
 N.G.C. 5869, $\alpha = 15\ 5\ 45$, $\delta = +0\ 46.6$ }

Plate No. 328, 1919, March 1, 50^m , S 23. Images small and almost round

Plate No. 335, 1919, March 30, 30^m , S 30. Images small and elongated

N.G.C. 5868 is a medium bright, semi-diffuse stellar nucleus $2''$ - $3''$ diameter with a faint halo $5''$ diameter.

N.G.C. 5869 is a medium bright, diffuse stellar nucleus $5'' \times 4''$, $p\ 133^\circ$, surrounded with nebulosity gradually fading away at $10'' \times 7''$.

N.G.C. 5865 and N.G.C. 5871, for which positions are given in this vicinity, do not appear on the plates.

There is a very faint diffuse spot roughly 7'' diameter, $p\ 116^\circ$, $d\ 1'9$, with respect to the nucleus of 5868.

N.G.C. 6014, 6017, Serpens

N.G.C. 6014, $a=15^h52^m\ 1^s$, $\delta=+6^\circ\ 9'7''$ } (1920); $\lambda=341^\circ$, $\beta=+39^\circ$
 N.G.C. 6017, $a=15\ 53\ 19$, $\delta=+6\ 13.6$ }

Plate No. 325, 1919, February, 28, 30^m. S 30. Images small and slightly elongated

N.G.C. 6014. Medium bright stellar nucleus lying centrally in faint nebulosity 30'' diameter, showing traces of rings. It is probably a spiral. There is a faint nebula of the same character, 15'' diameter, at $p\ 51^\circ$, $d\ 11'0$, with respect to N.G.C. 6014.

N.G.C. 6017. A faint elliptical nebula $18''\times6''$, $p\ 133^\circ$, with bright nucleus $7''\times5''$.

N.G.C. 6703,* Lyra

$a=18^h45^m0^s$, $\delta=+45^\circ27'7''$ (1920); $\lambda=42^\circ$, $\beta=+18^\circ$

Plate No. 344 (Duncan and Hoge), 1919, June 26, 315^m. S 30.
 Images medium and elongated

This plate was taken for classification, but the results are not conclusive and the type must be settled spectroscopically. The nucleus is lost in the very strong central part, 30'' in diameter. The ring, 80'' diameter, shows more plainly, and there is nebulosity between the ring and the central mass; but it is not clear whether the nebula is a planetary or a spiral in plan. Ten small faint nebulae, in addition to the six mentioned previously, are shown on the plate.

N.G.C. 6820, Vulpes

$a=19^h39^m3^s$, $\delta=+22^\circ53'3''$ (1920); $\lambda=27^\circ$, $\beta=-1^\circ$

Plate No. 298, 1917, July 23, 90^m. S 23. Images small and nearly round

The nebula lies in a rich region of the Milky Way. It has a stellar nucleus lying eccentrically to the south in a mass of soft, irregular, patchy nebulosity, roughly 30'' in diameter.

N.G.C. 6823, an open cluster, appears on the Nf corner of the plate.

N.G.C. 6846, Cygnus

$$\alpha = 19^{\text{h}}53^{\text{m}}22^{\text{s}}, \quad \delta = +32^{\circ}8'.4 \text{ (1920)}; \quad \lambda = 37^{\circ}, \quad \beta = +1^{\circ}$$

Plate No. 295, 1917, July 20, 150^m. S 23. Images small and elongated

A small group of twelve stars, approximate magnitude 17, in a very rich region of the Milky Way, clustered about three stars of magnitude 15.

N.G.C. 6888, Cygnus

$$\alpha = 20^{\text{h}}9^{\text{m}}33^{\text{s}}, \quad \delta = +38^{\circ}9'.1 \text{ (1920)}; \quad \lambda = 43^{\circ}, \quad \beta = +1^{\circ}$$

Plate No. 299, 1917, August 21, 60^m. S 23. Images small and slightly elongated

Plate No. 301, 1917, August 22, 60^m. S 27. Images small and slightly elongated

Plate No. 348, 1919, July 25, 300^m. S 30. Images medium. Illustrated Plate XXc

A network nebula in the heart of the Milky Way, about 13° Np N.G.C. 6960 and 6992, which it resembles in shape and character of nebulosity. It is roughly elliptical, 18' × 9', p 42°. The N, Np, and Sp edges include the bulk of the nebulosity, which gives it a crescent form, the bowl of which is filled with faint and scattered nebulosity.

N.G.C. 6906, Sagitta

$$\alpha = 20^{\text{h}}19^{\text{m}}36^{\text{s}}, \quad \delta = +6^{\circ}12'.3 \text{ (1920)}; \quad \lambda = 18^{\circ}, \quad \beta = -18^{\circ}$$

Plate No. 352 (Benioff), 1919, August 27, 120^m. Images small and nearly round

A right-handed spiral lying at the edge of the Milky Way where the star density, for this plate, is five to six stars per square minute of arc. The nebula measures 90'' × 35'', p 35°, the arms are soft and delicate, though increased exposure may show parts to be granular. A short line 12'' long projects equally beyond the nucleus in p 165° and 345°.

N.G.C. 6927, 6928, 6930, Delphin

$$\left. \begin{array}{l} \text{N.G.C. 6927, } \alpha = 20^{\text{h}}28^{\text{m}}46^{\text{s}}, \quad \delta = +9^{\circ}38'.6 \\ \text{N.G.C. 6928, } \alpha = 20 \ 28 \ 58, \quad \delta = +9 \ 39.2 \\ \text{N.G.C. 6930, } \alpha = 20 \ 29 \ 7, \quad \delta = +9 \ 34.6 \end{array} \right\} \text{ (1920)}; \quad \lambda = 22^{\circ}, \quad \beta = -18^{\circ}$$

Plate No. 347 (Duncan and Hoge), 1919, June 27, 60^m. Images small and elongated

Plate No. 350, 1919, August 21, 140^m. S 23. Images small and elongated

These plates show three N.G.C. nebulae in addition to the several small nebulae given below. The foregoing positions have been corrected from Bigourdan's observations.

The following measures refer to the brightest spot of N.G.C. 6928.

<i>a</i> ,	<i>p</i> 231°, <i>d</i> 4.2	10"×5", <i>p</i> 20°, gbM, BM.
N.G.C. 6927	257	3.0 18"×8", <i>p</i> 10°, gbM, BM.
N.G.C. 6928		100"×28", <i>p</i> 110°, left-handed spiral, two arms making about three-fourths of a turn each. Brightest in the middle where the two arms join with a slight offset, forming a bent line 35" long.
<i>b</i> ,	161	1.6 MF, nebulous spot, 4" diameter.
N.G.C. 6930	146	3.9 30"×12", <i>p</i> 9°, left-handed spiral nebula with slight traces of outside arms at end of major axis.
<i>c</i> ,	139	5.6 Nebulous spot, 3" diameter.
<i>d</i> ,	126	13.2 20"×6", <i>p</i> 70°, lbM.

N.G.C. 7023, Draco

$$\alpha = 21^{\text{h}}0^{\text{m}}37^{\text{s}}, \delta = +67^{\circ}51' (1920); \lambda = 72^{\circ}, \beta = +14^{\circ}$$

Plate No. 343, 1919, June 25, 160^m. S 23. Images small and slightly elongated

Comparison of this plate with No. 12 (1911, July 23, 149^m, S 23) in the stereocomparator gave no indication of change.

N.G.C. 7048, Cygnus

$$\alpha = 21^{\text{h}}11^{\text{m}}23^{\text{s}}, \delta = +45^{\circ}57'4 (1920); \lambda = 57^{\circ}, \beta = -2^{\circ}$$

Plate No. 296, 1917, July 20, 60^m. S 23. Images round and large

A planetary resembling the Dumb-bell nebula, about 1' diameter, weak axis in *p* 170°. The central star is very faint. A longer exposure is necessary to bring out the detail.

N.G.C. 7240, 7242, Lacerta

$$\left. \begin{array}{l} \text{N.G.C. 7240, } \alpha = 22^{\text{h}}11^{\text{m}}53^{\text{s}}, \delta = +36^{\circ}52'7 \\ \text{N.G.C. 7242, } \alpha = 22^{\text{h}}12^{\text{m}}10^{\text{s}}, \delta = +36^{\circ}53'7 \end{array} \right\} (1920); \lambda = 59^{\circ}, \beta = -17^{\circ}$$

Plate No. 292, 1917, June 21, 22, 195^m. S 23. Images round and medium

Plate No. 354, 1919, December 22, 50^m. S 23. Images round and small

Plate No. 357, 1919, December 23, 145^m. S 23. Images small and elongated

A group including twenty in addition to the six nebulae described by Barnard in *A.N.*, 137, 717, 1906. The measures refer to the nucleus of N.G.C. 7242.

N.G.C. 7240 <i>p</i>	$0^{\circ}d$	$0'$	$18'' \times 5''$, p 108° , gbM, B stellar Nu., Barnard <i>c</i> .
N.G.C. 7242	73	3.6	$12'' \times 6''$, p 33° , gbM, B stellar Nu., Barnard <i>a</i> .
<i>a</i> ,	217	8.7	MB, $9'' \times 1''.5$, p 178° , gbM.
<i>b</i> , I.C.II 5191?	287	4.1	Spindle, $45'' \times 6''$, p 66° , BNu., Barnard <i>f</i> .
<i>c</i> ,	214	6.0	F, $3''$ diameter
<i>d</i> ,	203	8.2	F, $8'' \times 2''$, p 170° .
<i>e</i> ,	217	3.6	B, $3''$ diameter, almost stellar, F wings p 58° .
<i>f</i> , I.C.II 5192?	251	1.8	$12'' \times 6''$, p 160° , gbM, Barnard <i>d</i> .
<i>g</i> ,	193	6.5	F, $2''$ diameter, bM.
<i>h</i> , I.C.I 1441	332	1.4	Spiral, $30'' \times 15''$, p 40° , Barnard <i>e</i> , Bigourdan 233.
<i>i</i> ,	171	4.6	F, $4'' \times 2''$, p 140° .
<i>j</i> ,	4	9.7	F, $10'' \times 2''$, p 143° .
<i>k</i> ,	15	4.1	MB, $4''$ diameter, stellar.
<i>l</i> ,	175	14.0	MB, $3''$ diameter.
<i>m</i> ,	95	2.3	F, $2''$ diameter.
<i>n</i> ,	157	6.2	Spindle, $20'' \times 6''$, p 120° , B stellar Nu.
<i>o</i> ,	141	4.1	F, $6'' \times 3''$, p 100° .
<i>p</i> , I.C.II 5195	71	4.0	B, $4''$ diameter, gbM, almost stellar.
<i>q</i> ,	140	5.7	F, $3''$ diameter, Nu.
<i>r</i> , I.C.II 5194?	119	4.8	$10''$ diameter, gbM, B stellar Nu., Barnard <i>b</i> .
<i>s</i> ,	41	6.3	F, $3''$ diameter.
<i>t</i> ,	68	7.3	B, $3''$ diameter, almost stellar.
<i>u</i> ,	40	15.4	F, $20'' \times 6''$, p 124° , B stellar Nu.
<i>v</i> ,	51	12.5	F, $2''$ diameter.
<i>w</i> ,	83	10.0	F, $2''$ diameter.
<i>x</i> ,	117	13.6	$18'' \times 5''$, p 118° , stellar Nu.

N.G.C. 7435, 7436, Pegasus

N.G.C. 7435, $a = 22^{\text{h}}54^{\text{m}}6^{\text{s}}$, $\delta = +25^{\circ}42'.2$ }
 N.G.C. 7436, $a = 22^{\text{h}}54^{\text{m}}6^{\text{s}}$, $\delta = +25^{\circ}43'.3$ } (1920); $\lambda = 62^{\circ}$, $\beta = -31^{\circ}$

Plate No. 293, 1917, June 23, 120^m. S 23. Images small and round

The plate shows a rich field of small nebulae consisting of elongated masses with bright almost stellar nuclei. They are probably spiral.

N.G.C. 7431, $a = 22^{\text{h}}53^{\text{m}}47^{\text{s}}$, $\delta = +25^{\circ}44'.2$ (1920), is a star with faint companion *f*.

N.G.C. 7433, $a = 22^{\text{h}}54^{\text{m}}2^{\text{s}}$, $\delta = +25^{\circ}43'.2$ (1920), does not appear on the plate.

N.G.C. 7436 has a bright stellar nucleus surrounded by faint nebulosity, 7" diameter.

The positions of the following nebulae are referred to N.G.C. 7436.

<i>a</i> , <i>p</i>	239°, <i>d</i>	14'9	MB, 20"×8", <i>p</i> 40°, lbM.
<i>b</i> ,	273	7.9	F, 15"×5", <i>p</i> 150, lbM.
<i>c</i> ,	249	7.2	MB, 30"×8", <i>p</i> 140, spindle, bM.
<i>d</i> ,	332	12.6	F, 15"×10", <i>p</i> 30, lbM.
<i>e</i> ,	238	5.7	F, 20"×10", <i>p</i> 150, lbM.
<i>f</i> ,	334	5.8	MF, 10"×5", <i>p</i> 150, spindle, stellar Nu.
<i>g</i> ,	313	3.5	MF, 5" diameter, stellar Nu.
<i>h</i> ,	300	1.6	MB, 30"×10", <i>p</i> 45, ellipse, stellar Nu.
<i>i</i> ,	232	1.0	MB, 30"×10", <i>p</i> 160, spiral, stellar Nu.
<i>j</i> ,	187	2.4	MB, 5" diameter.
<i>k</i> ,	270	0.4	B, 20"×6", <i>p</i> 95, spindle, stellar Nu.
<i>l</i> ,	168	1.1	MF, 4" diameter stellar nucleus, N.G.C. 7435.
<i>m</i> ,	136	7.3	MB, 20"×10", <i>p</i> 130.
<i>n</i> ,	141	9.4	F, 30"×8", <i>p</i> 40, uniform.
<i>o</i> ,	47	8.9	MF, 6" diameter, bM.

N.G.C. 7611, 7615, 7617, 7619, 7621, 7623, 7626, 7631, Pegasus

N.G.C. 7611,	$\alpha = 23^{\text{h}}15^{\text{m}}33^{\text{s}}$,	$\delta = +7^{\circ}22'5''$	} (1920); $\lambda = 56^{\circ}$, $\beta = -51^{\circ}$
N.G.C. 7615,	$\alpha = 23\ 15\ 53$,	$\delta = +7\ 58.5$	
N.G.C. 7617,	$\alpha = 23\ 16\ 2$,	$\delta = +7\ 43.7$	
N.G.C. 7619,	$\alpha = 23\ 16\ 12$,	$\delta = +7\ 46.0$	
N.G.C. 7621,	$\alpha = 23\ 16\ 20$,	$\delta = +7\ 55.7$	
N.G.C. 7623,	$\alpha = 23\ 16\ 27$,	$\delta = +7\ 57.5$	
N.G.C. 7626,	$\alpha = 23\ 16\ 39$,	$\delta = +7\ 46.7$	
N.G.C. 7631,	$\alpha = 23\ 17\ 24$,	$\delta = +7\ 46.7$	

Plate No. 351, 1919, August 21, 130^m. S 23. Images small and round

N.G.C. 7611, B, stellar Nu., 10" diameter in F nebulosity. 60"×15", *p* 140°, edge of plate.

N.G.C. 7615, MF, uniform, 40"×20", *p* 140°.

N.G.C. 7617, B, stellar Nu., 8"×5", *p* 32°.

N.G.C. 7619, B, Nu., 12"×10", *p* 32°, in F nebulosity.

N.G.C. 7621, Stellar Nu., 3" diameter in nebulosity 20"×5", *p* 170°.

N.G.C. 7623, B, stellar Nu., 8"×6", *p* 170°, in F nebulosity 15" diameter.

N.G.C. 7626, B, stellar Nu., 8" diameter, in F nebulosity 40" diameter.

N.G.C. 7631, MF, stellar Nu., 3" diameter, in F nebulosity 90"×30", *p* 80°.

There are many other small nebulae on the plate, which will be listed when a duplicate plate has been made.

N.G.C. 7722, Pegasus

$$\alpha = 23^{\text{h}}34^{\text{m}}41^{\text{s}}, \quad \delta = +15^{\circ}31'0'' (1920); \quad \lambda = 68^{\circ}, \quad \beta = -44^{\circ}$$

Plate No. 353, 1919, August 27, 27^m. S 23. Images small, almost round

The exposure is sufficient to show a spiral with bright nucleus and strong absorption streak *f* the nucleus. The portion shown on the plate covers $45'' \times 30''$, $p \ 150^{\circ}$ (no trail).

I.C.I 922, 928, 931, Ursa Major, and a Group of 72 Others

$$\left. \begin{array}{l} \text{I.C.I 922, } \alpha = 13^{\text{h}}40^{\text{m}}17^{\text{s}}, \delta = +56^{\circ}0'4'' \\ \text{I.C.I 928, } \alpha = 13 \ 40 \ 43, \delta = +56 \ 1.2 \\ \text{I.C.I 931, } \alpha = 13 \ 40 \ 49, \delta = +56 \ 1.3 \end{array} \right\} (1920); \quad \lambda = 73^{\circ}, \quad \beta = +59^{\circ}$$

Plate No. 341, 1919, May 28, 30^m. S 30. Fair images

Plate No. 342, 1919, June 25, 160^m. S 30. Fair images

Barnard originally called attention to this group in *A.N.*, 125, 379, 1890, and numbers from 917 to 938 (with a few exceptions) were assigned to it in the *Index Catalogue*. Of the seventy-five nebulae shown on the plates only three (not including N.G.C. 5278-5279, which appear among them) have been identified, namely, I.C.I 922, 928, 913. Many of the objects are almost stellar, but they have been listed because of some peculiarity of appearance which distinguishes them from the neighboring star images. Measurements were made on the plate relative to B.D. +56° 1677, for which the reduced co-ordinates are $\alpha = 13^{\text{h}}37^{\text{m}}19^{\text{s}}.6$, $\delta = +56^{\circ}25'2''$ (1860). Positions are given for right ascension and declination 1860. Hubble's paper¹ on this field which has just been published identifies twenty-five of the objects given here; they are indicated as H22, etc.

¹ E. P. Hubble, "Photographic Investigations of Faint Nebulae," *Publications of the Yerkes Observatory*, 4, Part II, 1919.

Description		α 1860	δ 1860
MB, Spindle, 30"×9", p 10°, lbM.....		13 ^h 36 ^m 7 ^s .0	+56°22'.4
MF, 7", gbM.....	H22	9.1	15.9
B, 14"×8", p 70°.....		11.6	20.4
MB, 7", gbM.....		19.6	25.5
B, Nucleus, N.G.C. 5278.....		27.2	22.0
B, Tail, N.G.C. 5279.....		31.5	22.2
MF, 10", patch.....	H31	47.3	28.8
MB, 5".....		52.5	36.3
MF, 5", lbM.....		56.7	36.0
F, 10", patch.....		37 4.6	8.9
MF, 5", lbM.....		5.6	19.9
MF, 12" diameter, patch.....		13.0	40.6
MB, 12"×8", p 135°, spindle, gbM.....		13.7	31.1
F, 6", lbM.....		14.1	14.7
MB, 10", gbM.....	H34	14.1	8.9
MF, 20"×5", p 170°, uniform.....		16.7	31.2
B, B.D.+56° 1677.....		19.6	25.2
MF, 12"×8", p 100°, lbM.....	H35	21.9	14.0
MF, 12"×8", p 70°, lbM.....		23.2	10.2
MB, 4".....		23.5	15.9
B, 20"×8", p 100°, gbM.....	H36	26.1	13.8
MB, 12"×8", p 135°, gbM.....	H37	34.3	12.6
MF, 4".....		38.7	24.8
B, 6", stellar.....	H40	45.1	17.8
F, 8", patch.....		46.9	10.2
MF, 10", lbM.....		47.1	40.1
MB, 10", patch.....		48.2	35.1
MB, 12"×4", p 60°, uniform.....		48.5	33.0
MB, 8"×4", p 135°, lbM.....	H41	52.0	22.0
MF, 5", lbM.....		53.7	26.8
MB, 5", lbM.....		54.6	17.4
MB, 8", I.C.I 922, gbM.....	H42	38 02.7	18.6
B, 5", gbM.....	H43	3.4	17.7
MB, 20"×5", p 100°, spindle, gbM.....	H44	5.4	18.5
F, 5", patch.....		7.5	13.7
MF, 5", lbM.....		8.9	17.4
B.D.+56° 1679.....		14.8	19.7
B, 5", stellar.....		16.0	28.1
F, Patch 8".....		16.0	14.7
MF, Patch 8".....		19.0	14.6
MB, 10"×4", p 90°, patch.....		26.1	16.7
MB, 3".....		28.0	20.4
B, 8"×4", p 120°, gbM, I.C.I 928.....		29.2	19.4
MF, 6", gbM.....		32.0	24.8
MF, 8", patch.....		32.7	16.7
MB, 10"×8", p 90°, lbM.....		33.0	25.3
B, 5", I.C.I 931, stellar.....	H48	34.8	19.5
MB, 7"×3", p 30°, lbM.....		35.2	30.4
B, 4", almost stellar.....	H49	35.5	20.3
B, Star?.....		36.6	15.8
B, Star? 4".....	H51	37.3	15.6
MF, 10"×4", p 140°, lbM.....		38.9	24.3
B, 5", almost stellar.....		39.4	18.9
B, 6", almost stellar.....	H53	41.4	20.3
MB, 4", almost stellar.....		42.7	20.9
F, 7", lbM.....		43.1	15.0

Description		α 1860	δ 1860
F, 8"×4", p 95°		13 ^h 38 ^m 47 ^s .2	+56°19'.4
F, 10"×5", p 135°	H56	51.0	15.5
B.D. +56° 1684		56.4	19.6
B, 8"×5", p 40°, gbM		58.9	25.4
B, 15"×6", p 90°, gbM	H59	59.2	23.8
MF, 7", patch, lbM		39 0.0	28.3
B, 30"×6", p 80°, BNu., spindle	H60	12.7	32.8
F, 6", patch		13.6	11.4
B, 30"×6", p 30°, gbM	H61	13.7	38.9
F, 5", patch		14.0	12.1
B, 8"×5", p 135°		19.6	19.3
B, 10"×6", p 150°	H62	25.5	19.1
MB, 25", patch, gbM	H63	31.6	41.2
B, 15"×10", p 40°, patch	H64	33.5	34.8
F, 30"×4", p 10°, sliver		33.5	34.1
MB, 4", almost stellar		36.1	22.4
MB, 4", almost stellar		37.3	23.1
F, 5"		40.8	28.7
MF, 3"		41.5	19.7
F, 11"×6", p 135°		47.5	11.1
MF, 8", patch, lbM		51.6	24.5
MF, 8"×4", p 40°, patch		53.6	24.3
MB, 10"×4", p 130°, spindle, bM	H66	55.0	16.1

I.C.I 1470, Cassiopeia

$$\alpha = 23^{\text{h}}1^{\text{m}}51^{\text{s}}, \quad \delta = +59^{\circ}48'9'' (1920); \quad \lambda = 78^{\circ}, \quad \beta = -1^{\circ}$$

Plate No. 297, 1917, July, 21, 190^m. S 23. Images intermediate and fairly round. Illustrated Plate XXa

A gaseous nebula lying in a rich region of the Milky Way. Its prominent feature is a bright thread of nebulosity irregularly triangular in shape, superimposed on the fainter nebulosity. The sides of the triangle are roughly 30" long; the north side lies in p 88° and is straight, except for an abrupt bend to the N around a star directly in its middle; the f side in p 60° is shaped like an integral sign, while the p side, p 140°, is V-shaped, points inward, and has a faint star at its apex. The N and p sides do not quite join. The faint nebulosity is roughly 70"×45" and is quite full of markings, which a longer exposure will show to advantage. A dark marking cuts across the nebula north of the triangle.

Three nebulous stars appear in the plate:

a ,	314°	14.8	Three stars involved in F nebulosity.
b ,	197	10.7	Bright star in group of 5, involved in nebulosity.
c ,	84	6.2	Two stars involved in nebulosity.

I.C.II 2233, Lynx

$\alpha = 8^{\text{h}} 8^{\text{m}} 19^{\text{s}}$, $\delta = +45^{\circ} 59' 5$ (1920); $\lambda = 141^{\circ}$, $\beta = +35^{\circ}$
 Plate No. 2968 (Shapley), 1916, March 27, 30^m. S 27
 Plate No. 359, 1919, December 23, 60^m. S 30. Images elliptical

The nebula falls near the edge of the plates of N.G.C. 2537 and appears to be a faint edge-on spiral $240'' \times 10''$, p 170° (no trail), with a faint stellar nucleus.

I.C.II 5146, Cygnus

$\alpha = 21^{\text{h}} 50^{\text{m}} 25^{\text{s}}$, $\delta = +46^{\circ} 53' 2$ (1920); $\lambda = 62^{\circ}$, $\beta = -7^{\circ}$
 Plate No. 276, 1916, August 4, 60^m. S 23. Images small and round.
 Plate No. 349, 1919, July 26, 300^m. S 23. Images small and elongated.
 Illustrated Plate XIXc

This well-known nebula lies at the end of a dark lane which is well shown on Plate No. 349 and on the various published photographs of Barnard, Curtis, Franks, and Wolf. It surrounds the star B.D. $+46^{\circ}$ 3474 9^M5, and its strong parts are 12' in diameter, while extensions run to the boundaries of the dark region in which it lies. Two of these extensions end at stars involved in nebulosity, a , p 257, d 9'7, which is preceded by a bright patch, and b , p 156^o, d 9'8, where the nebulosity brightens on the preceding side of the star. The nebula is a wonderful array of dark and light markings and cannot be likened to any other object, although counterparts of certain configurations may be found in some of the other large gaseous nebulae. For example, the dark birdlike or torchlike dark markings in the Sp section, of which there are two, are similar to a marking in the p section of M 16; two dark indentations on the Np side resemble some of the indentations about the rim of M 8; and some of the canopied structure resembles the outlying parts of the Orion nebula.

MOUNT WILSON OBSERVATORY

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ERRATA in *Mount Wilson Contr.*, No. 132,

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Page 35: N.G.C. 2403, Plate Vc was made from negative No. 307 (of the present series) instead of No. 169.

Page 41: N.G.C. 4594, the equation should read $V = -2.78x + 1180$.

Plate VIIIc: N.G.C. 5544-5545, orientation of the plate is S at top, f at right; identification of nebulae in text is not correct; true description is found in the present series.

Page 42: N.G.C. 4900, $\alpha = 12^{\text{h}} 56^{\text{m}} 28^{\text{s}}$.