

## CHAPTER III.

## NEBULÆ.

THE objects selected for examination, in this series of observations, were in most cases among those named in Sir J. F. W. Herschel's General Catalogue (Phil. Trans. for 1864, Part I.). A few other nebulæ, some of which appear in Dreyer's Supplement to the General Catalogue (Trans. R. Irish Academy, Vol. XXVI.), while the rest seem not to have been noticed by other observers, were also examined. The observations may be divided into three classes; descriptions of the appearance of nebulæ in the field of the telescope, micrometric measurements of various kinds, and spectroscopic observations. In the present publication, however, it has not been thought advisable to separate these classes. Since it was often practicable to give the result of an observation in a few words, the entire material has been arranged in Table VIII., so as to give one line only to each observation. When this was insufficient, part of the record has been entered in this Table, and the rest in the notes appended to it. The successive columns of the Table contain the number of the observation, its date, the number of the object observed from the General Catalogue or from Dreyer's Supplement, the right ascension and declination of the object for 1860, the initials of the observers, and remarks. This last column contains the actual observations, or such a part of them as the space available will permit; an asterisk in the first column denotes that a continuation of the record will be found, under the corresponding number, in the notes. The place of each nebula, if practicable, is taken from the General Catalogue, and corrections to the place are given in the record, when such corrections result from the observations. For the nebulæ not found in the General Catalogue, the places are usually derived from the observations themselves, and the sources of the adopted positions are stated in the notes. The abbreviations used are, in general, such as are employed in the General Catalogue; that Catalogue itself is designated, as usual, by G. C.; the Supplement above named is denoted by Dreyer (or Dr.); the "*Siderum Nebulosorum Observationes Havnienses*," by d'Arrest (or d'A.); the "*Verzeichnisse von Nebeflecken und Sternhaufen*," mentioned in the General Catalogue, by Auwers. The references to catalogues of stars are as follows: Ll. signifies Baily's Catalogue formed from the observations of Lalande; W. (followed by the hour and number of a star), the first catalogue of Weisse formed

from Bessel's observations between the declinations  $-15^{\circ}$  and  $+15^{\circ}$ ; Oeltzen (or Oe.), the catalogue by that astronomer of stars observed by Argelander south of  $-15^{\circ}$ ; DM., the Bonner Durchmusterung.

The abbreviations *p* and *s* (in Italics) are used for position angle in degrees and distance in seconds of arc (the same letters in Roman type have their ordinary meanings of *preceding* and of *south*).  $\Delta \alpha$  and  $\Delta \delta$  stand respectively, as usual, for differences of right ascension and of declination. The symbol  $\lambda$  is used for wave-length of a line in the spectrum. The observers (whose entire names or full initials are always given) were Professors Joseph Winlock, Benjamin Peirce, and E. C. Pickering; Messrs. C. S. Peirce, G. M. Searle, Arthur Searle, E. P. Austin, O. C. Wendell, S. P. Langley, A. G. Clark, G. B. Clark, G. I. Alden, and Walter Hoxie.

Remarks in brackets [ ] have been added in the present preparation of the work for publication. The other remarks contain the substance of the original record, or immediate deductions from it; but, for the sake of brevity and distinctness, they are frequently much condensed, and occasionally rearranged. When a partial reduction of the work had already been made, it has usually been accepted as correct; but the computations have often been repeated, especially in important or doubtful cases. The details of the micrometric observations are omitted; ordinarily, each result depends upon at least two settings, and the number is sometimes as large as five. The effect of refraction has been neglected in the reduction, as the place of a nebula is usually too indeterminate to make small corrections valuable.

The telescope employed in the observations was the East Equatorial (aperture 38.1 cm., or 15 inches, and focal length 682.5 cm. or 268.7 inches). The micrometer used was that originally received with the telescope, and described in Chapter I. The spectroscope ordinarily used was that mentioned in Vol. VIII. of these Annals, p. 33. The various purposes for which the telescope was required seem to have made it impracticable to take the precautions necessary for obtaining a fully satisfactory comparison between the spectroscopic observations of each separate night and the solar spectrum. In the present reduction, the available comparisons have been selected from the record, the results charted, and the wave-lengths answering to the separate observations of nebular spectra obtained by a graphical method. At this distance of time, however, and in the absence of all the observers whose work with the spectroscope is here reduced, results of the greatest precision cannot be expected; the wave-lengths are accordingly given in round numbers, followed by the sign  $\pm$  to indicate some uncertainty. In several cases, where a coincidence was directly observed between lines in the spectrum of a nebula and that of air, no greater accuracy in the wave-length is required than will serve for the identification of the air line.

As the entire series of observed wave-lengths of nebular spectra is not a long one, it may be brought together in this place.

G. C. 116.

1869 Jan. 13. Spectrum continuous,  $\lambda 5900 \pm$  to  $\lambda 4350 \pm$ .

G. C. 385 or 386.

1869 Jan. 19. Spectrum continuous towards red; one bright line,  $\lambda 5050 \pm$ .

G. C. 826.

1868 Dec. 19. Two distinct bright lines, near each other, and coincident with air lines;  $\lambda 5020 \pm$  and  $\lambda 4990 \pm$ ; a third faint line,  $\lambda 4900 \pm$ .

G. C. 1157.

1869 Jan. 13 and 14. Probably continuous spectrum with some bright lines; the continuous spectrum from  $\lambda 6070 \pm$  to  $\lambda 4500 \pm$ . Two bright lines appear to have been observed, less refrangible than those of other nebulae; but their position is uncertain, owing to errors in the entire number of revolutions of the micrometer-screw.

G. C. 1179. Great Nebula in Orion.

1868 Nov. 15 and Dec. 8; 1869 Jan. 7 and Jan. 10. Four lines and a continuous spectrum; other lines suspected between the third and fourth (and beyond the fourth, on 1868, Dec. 19). The continuous spectrum extends to about  $\lambda 6500$  at its less refrangible end. The first line coincides with an air line;  $\lambda 5010 \pm$  to  $5920 \pm$ ; the second is at  $\lambda 4960 \pm$ ; the third at  $\lambda 4870 \pm$ ; the fourth at  $\lambda 4370 \pm$ ; not at  $\lambda 4340$ , the place of the hydrogen line near G. [But this negative determination seems to depend only on an observation of the hydrogen line eight days before, and perhaps a change in the adjustment of the spectroscope may have occurred in the interval.] No line was seen near the place of the fourth line in the spectrum of G. C. 4964.

G. C. 2038.

1869 April 28. Faint continuous spectrum, one end at  $\lambda 6100 \pm$ .

G. C. 2102.

1868 Mar. 25. One line at  $\lambda 4950 \pm$ .

G. C. 2386.

1869 April 28. Spectrum continuous, very faint; line suspected,  $\lambda 5250 \pm$ .

G. C. 3002.

1869 May 11. Spectrum continuous; middle of it at  $\lambda 5020 \pm$ .

G. C. 4355. Trifid Nebula.

1868 Sept. 18. Spectrum of the multiple star continuous, with many bright lines and some bands; one end of spectrum at  $\lambda 4280 \pm$ .

G. C. 4447. Ring Nebula.

1868 Sept. 18. One line at  $\lambda 4990 \pm$ ; the same line as in G. C. 4355 and 4532.

## G. C. 4532. Dumb-bell Nebula.

1868 Sept. 18 and Nov. 17. One line at  $\lambda 5000 \pm$ .

## G. C. 4572.

1868 Oct. 3. One line at  $\lambda 5010 \pm$ .

## G. C. 4628.

1868 Sept. 18 and Nov. 7. Three lines (a fourth line suspected Nov. 6), at  $\lambda 5000 \pm$  (coincident with an air line),  $\lambda 4970 \pm$ ,  $\lambda 4850 \pm$ .

## G. C. 4670.

1868 Oct. 3. Continuous spectrum,  $\lambda 5220 \pm$  to  $4610 \pm$ .

## G. C. 4964.

1868 Sept. 18, Oct. 3, Nov. 7. Four lines, sometimes very distinct, even bright;  $\lambda 5000 \pm$  (coincident with air line),  $4960 \pm$ ,  $4870 \pm$ ,  $4690 \pm$ ; this last line not found in the spectrum of the great nebula in Orion (G. C. 1179), where there is another considerably more refrangible.

Much additional information concerning the spectra of the nebulae will be found in the record of the observations (Table VIII. and Notes). With regard to the measures just given, it seems that the positions of the lines are probably the same in most of the nebulae observed. The only important exception is in the disagreement of the fourth lines observed in G. C. 1179 and G. C. 4964, which can scarcely be supposed identical in place, while both appear to have been well observed. The three chief lines of the ordinary gaseous spectra of the bright planetary nebulae have been carefully observed by Huggins, J. Herschel, Vogel, and Bredichin; the two last named have given the results which they obtained in wave-lengths. Vogel finds the places of the three lines at  $\lambda 5003$  to  $5008$ ,  $4956$  to  $4959$ , and  $4859$  to  $4863$  (Bothkamp Observations, Heft I. pp. 56 to 59); Bredichin, in the mean, at  $\lambda 5004$ ,  $4958$ , and  $4859$  (Memorie della Società degli Spettroscopisti Italiani, Vol. IV. p. 112). The first line is allowed by all investigators to be coincident with one of the nitrogen lines present at that part of the spectrum; the third is presumably the hydrogen line F; the second is more doubtful; and the fourth line sometimes seen, while coincident with the hydrogen line near G according to Huggins (Proc. R. Soc., Vol. XX. p. 385), does not appear to be so by the Harvard Observations even in the case of the nebula in Orion (G. C. 1179), and apparently cannot be so in the case of G. C. 4964. See "Copernicus," formerly "Urania," No. 1, p. 3, for a remark by Dr. Copeland on the difference in the respective places of the fourth line in the spectra of G. C. 1179 and G. C. 4964, as shown by his observations.

The nebulae found, and not previously mentioned by other observers so far as is

known, are those entered in Table VIII. under the numbers 25, 26, 27, 47, 177, 207, 210, 215, 257, 265, 324, 329, 331.

As a careful drawing of the Trifid Nebula (G. C. 4355) by Mr. L. Trouvelot has already appeared in Volume VIII. of this series, the opportunity has been taken to compare the relative positions of the stars in the nebula, according to older observations, as well as according to those made here in 1866, with the results obtainable from this drawing, and from Professor E. S. Holden's observations at Washington (Am. Journal of Science, Vol. CXIV. p. 444). This comparison will be found in Table IX., at the end of this chapter.

TABLE VIII.

## OBSERVATIONS OF NEBULÆ.

No.	Date.	G. C. No.	R. A., 1860.	Dec., 1860.	Obs.	Remarks.
			<i>h. m. s.</i>	<i>° ' "</i>		
1*	1868 Oct. 17	30	0 9 14.6	- 7 5 46.8	C.S.P.	cF, cS; R; psvlbM; 2 stars, 9 mag., p 6' and f 6'.
2	1869 Nov. 28	91	0 31 15	+ 2 23 54	C.S.P.	F; pS; R; psmbM. DM. +2° 83 p 4', s 5' or 6'.
3	" "	98	0 32 5.6	+ 2 17 5.2	C.S.P.	pB; pS. R; vsmbM. DM. +2° 84 p 3', n 5'.
4*	1868 Nov. 17	101	0 32 14.4	+ 2 32 55.2	J.W.	$\alpha$ 45° [? record obscure] too late.
5	1869 Nov. 28	103	0 32 22	+ 2 22 36	C.S.P.	F; S; R; gpmbM. DM. +2° 84 p 6', s 1'.
6	1866 Oct. 31	105	0 32 45.4	+ 40 55 10.2		vF and dif. No N. Seeing bad. (J.W., G.M.S.)
7	1869 Oct. 31	105	"	"		No spectrum (C.S.P., E.P.A.); some light (J.W.).
8*	1868 Oct. 12	107	0 33 32.4	- 14 38 20.1	C.S.P.	pB; pL; R; gmbM. Two p stars in line with neb.
9	1868 Oct. 3	116	0 35 3.9	+ 40 30 14.3		vF light dif. in spectr. nothing more. (J.W., C.S.P.)
10	1868 Oct. 12	116	"	"	C.S.P.	Connection with G.C. 117 not traced. Light very pe-
11*	1869 Jan. 13	116	"	"	J.W.	Spectrum continuous; b than G.C. 1157. [euliar.
12	1868 Oct. 3	117	0 35 5.3	+ 40 5 47.3		Diffused light in spectrosc. (J.W., C.S.P.)
13	1868 Oct. 12	117	"	"	C.S.P.	Connection with G.C. 116 not traced. Light very
14	1869 Jan. 13	117	"	"	J.W.	Spectrum continuous, vF. [peculiar.
15	1868 Dec. 9	138	0 40 37.6	- 26 3 40.4	J.W.	No spectrum seen.
16*	1868 Oct. 12	263	1 11 56.6	+ 2 34 43.5	C.S.P.	pF; S; star, 7 magn., f neb; p 101° 10, s 190° 03.
17	" "	264	1 12 1.0	+ 2 29 6.5	C.S.P.	cB; pS; R; gbM.
18	" "	269	1 13 21.4	+ 2 37 50.3	C.S.P.	Not found; but sky everywhere b than p B.
19*	1868 Oct. 11	307	1 17 26.8	+ 8 48 9.7	C.S.P.	vB; L; R; gmbM; middle rather spotted.
20*	" "	308	1 17 31	+ 8 58 48	C.S.P.	eF; vS; R; G.C. 307 s p; $\Delta\alpha$ about 6', $\Delta\delta$ 10' or 11'.
21*	1867 Nov. 2	5177	1 18 22.5	- 2 8 17.2	G.M.S.	Fainter than No. 22, brighter than No. 25.
22*	" "	5178	1 18 36.2	- 2 6 37.2		Bright in middle. (G.M.S., C.S.P.)
23*	" "	322	1 18 51.5	- 2 4 16.8		Stellar. }
24*	" "	323	1 18 51.5	- 2 4 16.8		Stellar. } Obsd. as one. (G.M.S., C.S.P.)
25*	" "		1 18 53.5	- 1 57 20.7	G.M.S.	eF; eS.
26*	" "		1 21 1.5	- 2 1 57.1	G.M.S.	S; E; 2 nuclei (?).
27*	1867 Oct. 31		1 21 49.7	- 1 40 32.4	G.M.S.	vF (= star 14); d 1'.5; R; N well marked.
28	1868 Oct. 11	342	1 24 18.7	- 7 35 25.6	C.S.P.	B; p L; R; gvmbM.
29	1867 Dec. 29	351	1 25 54.1	- 7 44 13.1	C.S.P.	Not visible; weather unfavorable.
30	1868 Dec. 9	352	1 25 56.3	+ 29 56 9.9	J.W.	No spectrum seen.
31	1869 Oct. 31	353	1 26 1.4	- 12 53 18.1	C.S.P.	At limit of visibility; sky bright.
32	1866 Oct. 31	385	1 33 28.5	+ 50 51 7.6		} 385 b than 386; the two in contact (J.W., G.M.S.); separated later by J.W. On Jan. 19, spectr. of 385 or 386 cont. towards red. 1 B line (17.76 by scale)
33	" "	386	1 33 37.5	+ 50 52 32.6		
34	1869 Jan. 19				C.S.P.	
35	1868 Dec. 9	428	1 44 55.9	+ 40 2 18.5	J.W.	Spectrum, nothing particular. [ $\lambda$ 5050±].



No.	Date.	G. C. No.	R. A., 1860.	Dec., 1860.	Obs.	Remarks.
			<i>h. m. s.</i>	<i>° ' "</i>		
36	1866 Oct. 6	448	1 49 2.8	+ 4 56 30.7		} Position angle of 449 from 448, 110° (J.W.), 98° (G.M.S.).
37	" "	449	1 49 3.2	+ 4 56 18.7		
38	1868 Jan. 18	510	2 8 6.4	+ 5 20 27.5	G.M.S.	eF. DM. +5° 306 s f; p 113°.21, s 45°.4.
39	1869 Jan. 19	575	2 31 38.3	+38 27 14.1	C.S.P.	Spectrum v B, continuous.
40	1867 Dec. 29	589	2 34 12.1	- 8 51 19.1	C.S.P.	Not visible; weather unfavorable.
41*	1868 Jan. 17	600	2 35 30.2	- 0 35 56.2	C.S.P.	vB; curdled; 1E s p and n f; pgbM.
42	1869 Jan. 7	600	"	"	J.W.	vB; L; 1E.
43	1868 Jan. 13	604	2 39 6.9	- 8 9 52.5	C.S.P.	1E. Just half-way between two stars p and f.
44*	1868 Jan. 18	604	"	"	C.S.P.	Not gpmbM; quite uniform, at least in this light.
45	1869 Jan. 7	604	"	"	J.W.	B; v L; E.
46	1868 Jan. 18	605	2 39 15.4	- 1 5 53.8	C.S.P.	Not mbM; not E; R; G.C. 604 smaller and mb.
47*	1869 Dec. 31	2 54 10	+26 31		C.S.P.	Comet 1869 III p neb 2 <sup>a</sup> 31 <sup>a</sup> , a little s.
48*	1868 Jan. 22	692	3 15 36.2	-15 53 51.7	C.S.P.	B; R; cL; Oe. 2223 s p neb; $\Delta\alpha \cos \delta 82''.54$ , $\Delta\delta$
49	1868 Jan. 18	709	3 20 15.0	-21 50 36.0	C.S.P.	Description in G.C. very correct. [214."36.
50	1868 Jan. 19	759	3 34 51.1	-23 0 43.7	C.S.P.	Star n p neb; $\Delta\alpha \cos \delta 65''.20$ , $\Delta\delta 150''.03$ . Measure
51*	1868 Jan. 25	768	3 37 52.3	+23 19 47.1	G.M.S.	F nebulosity like tail of a comet. [difficult, uncertain.
52*	1868 Dec. 13	768	"	"	J.W.	Not seen. Telescope carefully pointed.
53	1868 Dec. 15	778	3 39 32.4	- 4 24 37.9	C.S.P.	pB; S; R; psvmbMN.
54	" "	778	"	"	J.W.	pB; S; R; svmbM N; d'A.'s stars and 3 other nebulae
55	1869 Feb. 1	815	4 2 10.3	-21 25 36.0	A.S.	Star n f (?) neb; $\Delta\alpha 3''.2$ , $\Delta\delta 282''.52$ . [not seen.
56	" "	815	"	"	O.C.W.	$\Delta\alpha 2''.2$ , $\Delta\delta 280''.20$ .
57	1868 Jan. 13	826	4 7 50.8	-13 5 32.2	C.S.P.	Not r. Follows upper of 3 little stars.
58	1868 Dec. 12	826	"	"	J.W.	vB; S; R; smBM. Planetary nebula.
59*	1868 Dec. 15	826	"	"	C.S.P.	Planetary nebula; eB; cS; vR; vsvmbM.
60*	" "	826	"	"	J.W.	Planetary nebula; vB; S; iR; glbM; edges ragged.
61*	1868 Dec. 19	826	"	"	J.W.	Spectrum; 3 lines; 2 v distinct; 1 F; no cont. spectr.
62	1869 Feb. 13	826	"	"		2 B lines, close; 1 vF; F cont. spectr. (J.W., C.S.P.)
63	1868 Dec. 13	839	4 13 47.7	+19 11 14	J.W.	Not seen. Telescope carefully pointed.
64*	1868 Jan. 18	886	4 33 1.4	- 0 49 38.5	G.M.S.	Descr. in G.C. confirmed; r; sometimes c B; clouds
65*	1868 Jan. 24	932	4 50 1.9	- 5 5 43.5	C.S.P.	vB; R; bM. [passing.
66	1868 Dec. 12	951	4 52 39	- 8 4 0	J.W.	vF; L; m E 90°±; slbM. Large star n p; p 335°±.
67	" "	953	4 52 57.2	- 7 58 11.7	J.W.	vS; R; cF; smbM. Small star south.
68*	1868 Jan. 22	1005	4 59 55.9	- 3 32 59.7	C.S.P.	Star, 10 magn., n p neb; $\Delta\alpha \cos \delta 68''.84$ ; $\Delta\delta 174''.62$ .
69	1869 Jan. 19	1137	5 22 10.0	+34 7 56.4	C.S.P.	Spectrum vB, continuous.
70	1868 Dec. 13	1157	5 26 3.9	+21 54 49.5	J.W.	Spectrum examined; nothing seen.
71	1869 Jan. 7	1157	"	"	J.W.	vB; vL; pE; rr; glbM. [care.
72	1869 Jan. 10	1157	"	"	C.S.P.	No spectrum seen; spectroscope pointed with great
73*	1869 Jan. 13	1157	"	"	J.W.	Cont. spectr. 9.08 to 22.33 of scale [ $\lambda 6070 \pm$ to $\lambda 4570 \pm$ ].
74*	1869 Jan. 14	1157	"	"	C.S.P.	Continuous spectrum suspected; also lines.
75	1869 Jan. 16	1157	"	"	C.S.P.	Line seen in green part of spectrum.
76*	1868 Jan. 13	1179	5 28 24.0	- 5 29 10.9	C.S.P.	Nebula in Orion. Night good for nebula, not for stars.
77	1868 Jan. 17	1179	"	"	C.S.P.	Obs. of Jan. 13 mostly confirmed. 6th star not seen.
78*	1868 Jan. 19	1179	"	"	C.S.P.	Six stars visible. Whole nebula exceedingly fine.
79*	1868 Jan. 22	1179	"	"	C.S.P.	Many stars in triangular part. Nebula very fine.
80	1868 Feb. 10	1179	"	"	C.S.P.	Not dim, but very ill defined. Stars very bad.
81*	1868 Feb. 12	1179	"	"	C.S.P.	Drawing of G. P. Bond confirmed in several points.
82	1868 Feb. 16	1179	"	"	C.S.P.	Dark bands of Feb. 12 v distinct n and s. 6th star v
83	1868 Feb. 18	1179	"	"	C.S.P.	Black bands very distinct. Low power. [plain.
84	1868 Mar. 24	1179	"	"	J.W.	Spectrum of 3 or 4 lines; perhaps more; none in red.
85*	1868 Nov. 15	1179	"	"	J.W.	Hidden in finder by clouds; but line spectr. visible.
86*	1868 Dec. 8	1179	"	"	C.S.P.	Obs. of 1st line of spectrum interrupted by clouds.
87*	1868 Dec. 9	1179	"	"	J.W.	Dark streaks seen as by C.S.P. in February.
88	1868 Dec. 12	1179	"	"		6 stars in trapezium; no others. (J.W., C.S.P.)
89	1868 Dec. 15	1179	"	"	J.W.	6 stars visible, 6th not conspic. Clear, but tremulous.
90*	1868 Dec. 19	1179	"	"		4th line of spectr. cb than 3d of G.C. 926. (J.W.,
91*	1868 Dec. 22	1179	"	"		4th line of spectrum seen. (J.W., C.S.P.) [C.S.P.)
92*	1868 Dec. 26	1179	"	"		(J.W., C.S.P.)
93*	1868 Dec. 28	1179	"	"		Moon and haze; 4th line of spectrum visible. (J.W.,
94*	1869 Jan. 7	1179	"	"		4th line very bright. (J.W., C.S.P.) [C.S.P.)
95*	1869 Jan. 10	1179	"	"	J.W.	Trapezium examined for new stars; only 6 stars seen.

## MICROMETRIC MEASUREMENTS.

No.	Date.	G. C. No.	R. A., 1860.	Dec., 1860.	Obs.	Remarks.
			<i>h. m. s.</i>	<i>° ' "</i>		
96*	1869 Jan. 13	1179	5 28 24.0	- 5 29 10.9	J.W.	Many places in which 4th line cannot be seen.
97	1869 Jan. 14	1179	"	"	C.S.P.	Air rather hazy, hindering observations.
98	1869 Jan. 16	1179	"	"		4th line very brilliant; no new line. (J.W., E.C.P.)
99	1869 Apr. 10	1179	"	"		4th line thought to be visible. (J.W., C.S.P.)
100	1869 Dec. 23	1179	"	"	C.S.P.	Sixth star seen; not at its plainest.
101	1870 Jan. 3	1179	"	"	C.S.P.	Black streaks of 1868 distinct with low power.
102	1870 Jan. 28	1179	"	"	C.S.P.	Stars very tremulous, but 6th star conspicuous.
103*	1870 Feb. 20	1179	"	"	E.P.A.	Edges less sharply defined than in Bond's drawing.
104*	1868 Jan. 30	1185	5 28 38.4	- 5 21 48.7	C.S.P.	Tail mentioned in G.C. not seen.
105*	1868 Jan. 31	1191	5 29 4.0	+ 21 7 39.6	G.M.S.	Star, no neb; sky clear; moon 10° high, 50° distant.
106	1868 Jan. 24	1202	5 29 37.6	- 6 48 42.9	C.S.P.	[Sketch suggesting annular structure.]
107	1869 Jan. 7	1225	5 34 26.4	+ 9 0 56.2	J.W.	[Considered too F or too S for spectroscope.]
108*	1868 Feb. 10	1227	5 34 47.2	- 1 55 43.7	C.S.P.	Not resolved, but contains some 20 stars.
109*	1869 Jan. 7	1227	"	"	J.W.	Spectrum vB, continuous.
110	1869 Jan. 10	1351	5 58 49.3	+ 24 6 14.0	C.S.P.	Visible in finder (aperture 4½ inches).
111	1868 Jan. 16	1359	6 0 8.7	- 6 11 46.0	G.M.S.	Nebulosity scarcely noticeable.
112	1868 Jan. 16	1362	6 0 44.0	- 6 22 39.5	G.M.S.	Nebulosity well marked.
113	1868 Jan. 16	1373	6 2 41.6	- 6 18 57.6	G.M.S.	Nebulosity scarcely noticeable.
114*	1868 Feb. 10	1373	"	"	C.S.P.	Star 7 magn., vLB neb all about it, like G.C. 1227.
115	1868 Jan. 16	1375	6 4 17.9	- 6 12 6.1	G.M.S.	Nebulosity scarcely noticeable.
116	1869 Jan. 19	1401	6 16 4.8	- 27 10 38.1	C.S.P.	Not visible; moonlight.
117	1869 Mar. 1	1425	6 24 58.0	+ 10 15 16.9	C.S.P.	Just p star 7 magn., which also looks nebulous.
118*	1868 Jan. 19	1437	6 31 31.4	+ 8 51 39.5	C.S.P.	v B; com. [Sketch; E about 330° as in G.C.]
119	1869 Mar. 1	1440	6 33 16.0	+ 10 0 35.3	J.W.	[Considered too F or too S for spectroscope.]
120	1868 Jan. 30	1473	6 50 51.9	- 4 24 15.0	C.S.P.	Very wide double star; dif. neb about n comp.
121	1868 Jan. 30	1483	6 56 12.5	- 8 8 46.5	C.S.P.	No neb; brilliant Cl, ground black throughout.
122*	1868 Jan. 24	1487	6 57 33.2	- 11 6 47.8	G.M.S.	Nebulous double star; p 298°.14 (or 118°.14), s 14°.65.
123*	1868 Jan. 30	1519	7 16 42.9	+ 29 45 19.0	G.M.S.	G.C. 1519 brighter and more distinct than 1520;
124	1868 Jan. 30	1520	7 16 44.7	+ 29 45 39.0	G.M.S.	p 60°.4, s 33°.0.
125*	1868 Jan. 24	1532	7 20 54.4	+ 21 11 26.8	G.M.S.	Diameter 38" by rough setting; 34" by estimate.
126*	1869 Jan. 7	1532	"	"		Spectr. contin.; 3 bright lines. (J.W., C.S.P.)
127	1868 Jan. 24	1537	7 22 32.1	+ 0 4 10.5	G.M.S.	Only two vF triple stars; Δα 4°.5; n p star p
128	1868 Jan. 24	1538	"	"	G.M.S.	W. VII 734 by 84°. [Fig. in original.]
129*	1868 Jan. 16	1565	7 35 25.4	- 14 24 39.4	G.M.S.	d 4±; 2 stars indistinctly seen in or through it.
130	1869 Feb. 28	1565	"	"		Stars seen through it (J.W.); somewhat r. (C.S.P.).
131*	1870 Feb. 19	1565	"	"	C.S.P.	L; vB; not bM; sharply defined; a ring.
132*	1868 Jan. 16	1567	7 35 41.2	- 17 53 22.3	G.M.S.	Wisp of light on s p and n f sides.
133	1869 Feb. 28	1567	"	"	J.W.	E s p to n f; like a ring; p end of ring s.
134*	1870 Feb. 19	1567	"	"	C.S.P.	vS; mE n f and s p.
135*	1868 Jan. 22	1574	7 41 47.4	- 27 0 6.7	G.M.S.	3 vS stars near nebula.
136	1869 Feb. 28	1574	"	"	C.S.P.	Too faint for spectroscope.
137*	1868 Jan. 22	1589	7 46 40.1	- 26 2 1.1	G.M.S.	3 or 4 S stars in it, but neb irresolvable.
138	1869 Feb. 28	1594	7 48 20.5	- 15 3 19.3	C.S.P.	Only a little Cl some minutes f.
139	1870 Feb. 19	1594	"	"	C.S.P.	No neb or Cl of any account near.
140	1868 Jan. 22	1632	8 4 42.2	- 12 30 54.5	G.M.S.	Not certainly nebulous. It may be so.
141*	1870 Mar. 24	1672	8 26 57.1	- 15 39 51.8	E.P.A.	pF; S; gB n f side; somewhat brush-shaped.
142	1868 Jan. 30	1673	8 27 10.4	- 12 41 44.4	G.M.S.	2 stars 12; p 176°.36, s 71°.40; p 20°.76, s 30°.30.
143	1868 Feb. 18	1673	"	"	G.M.S.	Star s; p 175°.76; star n f; p 22°.98, s 30°.78.
144*	1869 Mar. 1	1673	"	"	C.S.P.	S; vE 285°; B; vsvmbM.
145	1869 Mar. 1	1674	8 27 14.9	- 22 29 47.4	C.S.P.	vB; L; vE.
146*	1868 Jan. 17	1696	8 38 43.9	+ 13 5 16.6	G.M.S.	vF; R; d 4° or 5°. Star 10 magn. p neb 5°, n 10°.
147	1868 Jan. 17	1698	8 39 29.7	+ 13 6 50.8	G.M.S.	Appears to consist of 4 stars 10 magn.
148	1868 Jan. 17	1699	8 40 20	+ 19 32 12	G.M.S.	A neb or perhaps eF star p G.C. 1704 54°, about 4's.
149	1868 Jan. 17	1704	8 41 23.5	+ 19 35 14.2	G.M.S.	R; a vF, S neb suspected 2' f.
150	1868 Jan. 17	1707	8 42 1.3	+ 19 31 41.0	G.M.S.	eF; perhaps several eeF stars; place agrees with G.C.
151	1869 April 8	1713	8 43 58.0	+ 33 56 21.1	C.S.P.	Too F to be easily found.
152	1870 Mar. 24	1721	8 47 20.4	- 2 32 2.2	E.P.A.	pB; vS; R; svmbMN; bet 2 stars; p star brighter.
153	1870 Mar. 24	1725	8 48 0.0	- 2 28 2.2	E.P.A.	F; S; R; glbM; f G.C. 1721 32°.55
154	1870 Mar. 24	1726	8 48 33.4	- 2 39 34.6	E.P.A.	pF; S; R; smbMN; G.C. 1721 p 63°.15; star p 13°.27.
155	1870 Mar. 24	1727	8 48 43	- 2 34 48	E.P.A.	pF; S; R; smbMN; G.C. 1721 p 81°.50.

No.	Date.	G. C. No.	R. A., 1860.	Dec., 1860.	Obs.	Remarks.
			<i>h. m. s.</i>	<i>° ' "</i>		
156	1868 Jan. 21	1730	8 48 58.2	- 2 50 24.5	G.M.S.	p B.
157	1870 Mar. 24	1730	"	"	E.P.A.	pF; pS; E s p and n f 45°; gcbM.
158	1870 Mar. 24	1740	8 52 29.4	- 3 11 6.1	E.P.A.	vF; S; R; pgcbM.
159	1868 Jan. 21	1743	8 54 2.0	- 2 50 15.1	G.M.S.	Not seen after careful search; perhaps identical with
160	1870 Mar. 24	1743	"	"	E.P.A.	Not seen; slight aurora, sky rather B. [G.C. 1730.
161	1870 Mar. 24	1744	8 55 0.5	- 3 10 51.9	E.P.A.	Consists of 3 little stars.
162*	1869 Mar. 1	1777	9 4 50.4	- 14 14 58.2	C.S.P.	Too S, but B enough for spectroscope.
163	1868 Feb. 29	1780	9 6 5.8	- 23 36 36.3	G.M.S.	Faintly E 60° ±; star 10 [Oe. 9458] s 0'.5, f 15°.
164	1869 Mar. 1	1780	"	"	C.S.P.	Visible in finder; aperture 4½ inches.
165	1868 Jan. 21	1791	9 8 54.8	+ 20 46 40.3	G.M.S.	Visible; not so faint as G.C. 1792.
166*	1868 Jan. 21	1792	9 9 5	+ 20 37 51	G.M.S.	Nearly bet. DM. +20° 2298 and 2299.
167	1868 Jan. 21	1794	9 9 12.3	+ 20 38 16.7	G.M.S.	Visible; not so faint as G.C. 1792.
168*	1869 Apr. 3	1796	9 9 37.1	- 15 43 14.6	C.S.P.	Star n p neb; Δα cos δ 94°.32, Δδ 30°.73.
169*	1868 Feb. 29	1876	9 28 32.8	- 15 46 48.4	G.M.S.	vF; S; resolvable. [23".14.
170	1868 Feb. 18	1904	9 35 27.7	- 3 4 16.5	C.S.P.	Star s p neb; p 235°.24, s 40°.58; hence Δα 2°.22, Δδ
171	1869 Apr. 10	1949	9 43 48.9	+ 69 43 50.0	J.W.	} No spectrum seen; the spectroscope was a new
172	1869 Apr. 10	1950	9 43 52.3	+ 70 25 43.7	J.W.	{ one.
173*	1868 Feb. 25	1975	9 50 39.1	+ 11 1 17.3	G.M.S.	F; r; W. ix 1096 n f neb; Δα 38°.85, Δδ 5' 55".8.
174	1866 Apr. 9	1985	9 52 37.0	- 22 7 58.4	J.W.	S star n p neb; Δα 13° ±, Δδ 157" ±.
175	1870 Mar. 24	1992	9 53 38.9	- 18 57 52.9	E.P.A.	pB; pL; R; gcbM.
176	1870 Mar. 24	1994	9 54 2.5	- 18 57 58.5	E.P.A.	Suspected.
177*	1870 Mar. 24		9 54 19.6	+ 60 47 58.2	E.P.A.	G.C. 1998 s f neb; p 45°, s 2'. [Place only approxi-
178	1870 Mar. 24	1998	9 54 36.7	+ 60 46 33.3	E.P.A.	F; S; R; mbMN. [mate.]
179*	1868 Feb. 16	2008	9 58 14.3	- 7 2 32.9	G.M.S.	A remarkable object. E 44°.44.
180*	1868 Feb. 29	2008	"	"	G.M.S.	B; vm E 44°.81.
181	1870 Mar. 24	2012	10 0 2.2	- 18 33 36.3	E.P.A.	L; iR; vgvbM; § 6' s; r. Cloud slightly susp.
182	1868 Jan. 22	2037	10 6 15.4	+ 4 3 44.3	G.M.S.	Not visible; sky perhaps somewhat hazy.
183	1868 Jan. 22	2038	10 6 29.6	+ 4 7 6.3	G.M.S.	N; b than G.C. 2041; 2038 s p 2041; p 250°.94, s
184*	1869 Apr. 28	2038	"	"		vB; S; R; vmbMN. (J.W., C.S.P.) [464".28.
185*	1869 Apr. 29	2038	"	"		vB; R; pS; svmbMN. (J.W., C.S.P.)
186*	1868 Jan. 22	2041	10 6 58.5	+ 4 9 39.7	G.M.S.	N perhaps E 50°. [See No. 183.]
187*	1869 Apr. 28	2041	"	"		vB; S; R; vmbMN. (J.W., C.S.P.)
188*	1869 Apr. 29	2041	"	"		vB; pS; R; vsvmbMN. (J.W., C.S.P.)
189	1869 Mar. 17	2083	10 14 39	+ 22 17 48	C.S.P.	[Sketch, showing middle of ray contracted.]
190*	1868 Jan. 24	2091	10 16 15.7	+ 13 15 38.6	G.M.S.	Star 14, nebulous and n of star 11.
191*	1868 Jan. 22	2102	10 18 2.2	- 17 55 50.2	G.M.S.	Not bluer than usual with planetary neb.
192	1868 Mar. 25	2102	"	"	J.W.	Line in spectrum at 15.00 of the scale [λ 4950 ±].
193*	1869 Apr. 3	2102	"	"		Oval; E 135°.85. (J.W., C.S.P.)
194*	1869 Apr. 30	2102	"	"		vvB; pS; R; psmbM. (J.W., C.S.P.)
195	1870 Mar. 24	2139	10 27 1.3	- 26 44 11.8	E.P.A.	pB; pL; E p and f; glbM.
196	1870 Mar. 24	2155	10 29 38.5	- 26 26 17.5	E.P.A.	cF; S; lE s p and n f.
197	1870 Mar. 24	2156	10 29 41.3	- 26 52 38.5	E.P.A.	Not seen.
198	1868 Jan. 31	2157	10 29 48.4	- 26 42 50.5	G.M.S.	Nearly as bright as G.C. 2159; b than G.C. 2160.
199	1870 Mar. 24	2157	"	"	E.P.A.	F; pL; iR; gvlbM.
200*	1868 Jan. 31	2159	10 30 1.1	- 26 48 5.8	G.M.S.	S star bet. this neb and G.C. 2160; others n and s.
201	1870 Mar. 24	2159	"	"	E.P.A.	pB; pL; lE s p and n f; smbM.
202*	1868 Jan. 31	2160	10 30 9.5	- 26 49 17.1	G.M.S.	Not as bright as G.C. 2157 [see No. 198].
203	1870 Mar. 24	2160	"	"	E.P.A.	pB; pL; iR; glbM.
204*	1868 Jan. 31	2161	10 30 28.7	- 26 53 42.1	G.M.S.	pB; about 1' n of G.C. 2163, not s as in G.C.
205	1870 Mar. 24	2161	"	"	E.P.A.	pF; pS; En (slightly n p); scbM.
206	1870 Mar. 24	2162	10 30 39.9	- 26 56 48.4	E.P.A.	Little nebulous.
207	1870 Mar. 24		10 30 41.2	- 27 2	E.P.A.	vF; pL; iR; gvlbM; star n p neb 1'.
208	1868 Jan. 31	2163	10 30 59.8	- 26 52 45.7	G.M.S.	[See No. 204 on decl. of G.C. 2161 and 2163.]
209	1870 Mar. 24	2163	"	"	E.P.A.	F; pS; iR; vlbM; s of G.C. 2161.
210	1870 Mar. 24		10 31	- 26 48	E.P.A.	Nebulous star 5' n of G.C. 2163.
211*	1868 Feb. 16	2170	10 32 34.7	+ 10 0 40.5	G.M.S.	Description of G.C. 2170 corresponds with this neb.
212	1869 Apr. 3	2170	"	"	C.S.P.	Not found in place of G.C.
213	1870 Mar. 24	2174	10 33 43.6	- 27 1 41.4	E.P.A.	vF; L; iR; not bM.
214*	1868 Feb. 16	2184	10 36 36.7	+ 12 25 37.9	G.M.S.	B; vmE; mbM; does not look specially r.
215	1866 Apr. 12		10 36 49	- 22 27 40	S.P.L.	Found in search for Biela's comet; place approx.



No.	Date.	G. C. No.	R. A., 1860.	Dec., 1860.	Obs.	Remarks.
			<i>h. m. s.</i>	<i>° ' "</i>		
216*	1868 Feb. 16	2194	10 39 20.4	+ 12 33 4.2	G.M.S.	E 315°; NE 350°, southern end brighter.
217	1868 Jan. 24	2203	10 40 25.7	+ 13 18 49.3	G.M.S.	vB; vmbM; lE s p to n f.
218	1868 Jan. 24	2207	10 40 52.2	+ 13 21 33.0	G.M.S.	vB; vmbM; mE s p to n f.
219	1868 Jan. 24	2211	10 41 3.8	+ 13 16 21.7	G.M.S.	pB; not mbM; oval; E p, a little n.
220*	1868 Feb. 23	2229	10 43 29.8	+ 4 9 8.6	G.M.S.	E 140° by estimate; too indefinite for measure.
221*	1868 Jan. 31	2276	10 52 56.1	+ 14 39 1.1	G.M.S.	NE 67°; brush or wisp both sides, also 67°.
222	1869 Apr. 28	2276	"	"	C.S.P.	vB; vS; R; vmbMN; spectrum continuous, vB.
223	1869 Apr. 29	2276	"	"		vB; S; R; vmbMN; pB cont. spectr. (J.W., C.S.P.)
224*	1868 Mar. 18	2301	10 58 38.7	+ 0 43 2.2	G.M.S.	E 166°; W. x 1065 s f neb; $\Delta\alpha$ 40°.53, $\Delta\delta$ 265°.16.
225*	1868 Feb. 18	2310	11 1 17.1	+ 5 35 14.4	G.M.S.	Not vS; not r; W. x 1105 n f neb; $\Delta\alpha$ 12°.5, $\Delta\delta$ 576°.80.
226	1868 Jan. 21	2319	11 3 3.7	+ 29 31 9.2	G.M.S.	mb than G.C. 2320, 2321, 2326; star f seems 10.
227*	1868 Jan. 21	2320	11 3 9.6	+ 29 26 55.9	G.M.S.	2 neb susp. s of G.C. 2319 6' and 5'.5, f 0° and 4°.
228*	1868 Jan. 21	2321	11 3 12.0	+ 29 23 38.9	G.M.S.	eF neb s f G.C. 2319; $\Delta\alpha$ about 6°, $\Delta\delta$ about 7°.
229	1868 Jan. 21	2326	11 3 36.1	+ 29 27 9.9	G.M.S.	Corresponds with description in G.C.
230	1869 Apr. 29	2341	11 6 28.1	- 25 59 51.9		B; pS; Enp; psmBM; F cont. spectr. (J.W., C.S.P.)
231	1868 May 11	2343	11 6 34.8	+ 55 46 21.8		Very spotty. (J.W., C.S.P.)
232	1869 Apr. 6	2343	"	"	C.S.P.	Not planetary.
233	1869 Apr. 10	2343	"	"		No spectrum seen; spectroscope new. (J.W., C.S.P.)
234	1868 Feb. 23	2347	11 7 16.1	+ 13 34 30.5	G.M.S.	E 83°; very doubtful and changeable.
235*	1868 Jan. 24	2355	11 9 7.9	+ 5 17 25.6	G.M.S.	Not found; region identified from DM.
236	1870 Mar. 24	2355	"	"	E.P.A.	Not found.
237	1870 Mar. 24	2361	11 10 16.1	+ 5 19 10.0	E.P.A.	Seen; R.A. right.
238*	1869 Mar. 15	2380	11 13 3.3	+ 27 43 47.5		DM. +27° 2009 f 113°.3, s 325°.4. (J.W., C.S.P.)
239*	1868 Jan. 30	2381	11 13 5.2	+ 3 43 48.5	G.M.S.	E 32°.0; wisp on both sides.
240*	1869 Apr. 28	2386	11 13 53.9	+ 4 0 6.9	C.S.P.	B; S; vLE; glbM; bluish.
241	1869 Apr. 29	2386	11 13 53.9	+ 4 0 6.9		pB; S; E; pgbM; some light in spectr. (J.W., C.S.P.)
242	1868 Jan. 30	2388	11 14 20.6	+ 3 43 9.9	G.M.S.	Not visible. [See Dreyer, p. 392.]
243	1868 Feb. 23	2396	11 15 33.5	+ 17 21 30.0	G.M.S.	Star n f neb; p 67°.14, s 147°.13.
244	1868 Feb. 25	2411	11 17 58.3	- 9 1 48.9	G.M.S.	cL; pB; lbM; E 5°±.
245	1869 Apr. 6	2413	11 18 26.4	+ 44 21 27.8	C.S.P.	Just visible in finder, aperture 4½ inches.
246	1868 Feb. 23	2419	11 19 10.3	+ 17 37 57.5	G.M.S.	Star, 10 magn., n f neb; $\Delta\alpha$ cos $\delta$ 157°.88, $\Delta\delta$ 85°.28.
247	1868 Feb. 23	2422	11 19 52.5	+ 17 37 40.2	G.M.S.	Star n f neb; $\Delta\alpha$ cos $\delta$ 68°.11, $\Delta\delta$ 169°.83.
248	1868 Feb. 23	2423	11 20 23.8	+ 17 59 32.9	G.M.S.	d 1' at least; star n p neb; p 352°.54, s 159°.93.
249	1868 Feb. 23	2427	11 20 49.6	+ 17 41 19.6	G.M.S.	F; d 0'.75±; R; not r.
250*	1868 Mar. 22	5567	11 24 29.8	+ 4 15 36.2	G.M.S.	vF; R; pS; lbM.
251*	1868 Mar. 22	5568	11 25 2.6	+ 1 35 20.4	G.M.S.	Fainter, and more uniform, than the next.
252*	1868 Mar. 22	5569	11 25 10.4	+ 1 34 30.8	G.M.S.	Rather bM; decidedly b than the last.
253	1869 Mar. 18	2487	11 32 54.5	+ 25 28 24.1	C.S.P.	Decl. +25° 18' by circle; possibly a new neb.
254	1868 Feb. 25	2499	11 33 45.7	+ 12 14 49.1	G.M.S.	pB; L; r; E 45°?; fades away vg at edges.
255*	1868 Feb. 18	2626	11 48 45.9	+ 7 31 55.8	G.M.S.	E 28°; v doubtful; seems changeable; power 316.
256	1868 Feb. 25	2626	"	"	G.M.S.	E 50° by est.; descr. of G. C. otherwise confirmed.
257	1868 Mar. 24		11 56 39.3	+ 4 19 30	G.M.S.	vF; pS; R?; bM; Ll. 22686 n f; $\Delta\alpha$ 53°.5, $\Delta\delta$ 1°.8.
258*	1868 Feb. 18	2776	12 5 42.9	+ 2 4 31.5	G.M.S.	E 145°.74; nucleus very sharp.
259*	1868 Feb. 25	2785	12 6 39.6	+ 7 58 56.8	G.M.S.	pB; S; R; bMN; star, 11 magn., n p neb.
260*	1868 Feb. 25	2805	12 8 44.8	+ 7 10 50.8	G.M.S.	E 350°?; star in neb not b than 14 magn.
261	1869 Apr. 28	2805	"	"	C.S.P.	cF; vS; E; lbM; no visible spectrum.
262*	1868 Feb. 25	2813	12 9 21.7	+ 8 14 21.1	G.M.S.	Appears bM as usual [see G.C.].
263*	1868 Feb. 25	2821	12 9 58.6	+ 7 58 19.1	G.M.S.	E 50°.94; a star n f neb; p 17°.71, s 108°.33.
264*	1868 Feb. 25	2829	12 10 17.5	+ 7 27 9.1	G.M.S.	pB; bMN; W. x 1144 s f; $\Delta\alpha$ cos $\delta$ 12°.98, $\Delta\delta$ 314°.50.
265*	1868 Feb. 25		12 10 43.6	+ 8 4	G.M.S.	F; S; R; bM; f G.C. 2821 45°, 6' n.
266*	1868 Feb. 25	2833	12 10 43.7	+ 7 53 58.1	G.M.S.	vF; L; R; f G.C. 2821 47° on same parallel.
267*	1869 Apr. 30	2834	12 10 48.8	+ 48 10 52.1		p F; vL; mE; vgcMBN; F cont. spectr. (J.W.,
268	1868 Jan. 30	2838	12 11 41.8	+ 15 11 52.4	G.M.S.	vgbM; r; no "3-branched spiral" seen. [C.S.P.]
269	1869 Apr. 8	2838	"	"	C.S.P.	Spirality suspected; also susp. by A. S.
270*	1869 Apr. 30	2838	"	"		cF; vL; R; gcbM. (J.W., C.S.P.)
271*	1868 Feb. 18	2844	12 12 13.5	+ 6 9 24	G.M.S.	F; S star close n f; 17 Virg. s f; $\Delta\alpha$ 191°.5, $\Delta\delta$ 257°.7.
272*	1868 Feb. 18	5632	12 12 38.5	+ 6 3 43	G.M.S.	pB; 17 Virg. n f; $\Delta\alpha$ 2° 46°.5, $\Delta\delta$ 83°.4.
273*	1868 Feb. 18	5070	12 12 41.0	+ 6 14 30	G.M.S.	B; 17 Virg. s f; $\Delta\alpha$ 2° 44°.0, $\Delta\delta$ 563°.7.
274*	1869 Apr. 28	5070	"	"	C.S.P.	cF; S; R; pscbM.
275*	1868 Feb. 18	2852	12 12 48.0	+ 6 7 21	G.M.S.	B; 17 Virg. s f; $\Delta\alpha$ 2° 37°.0, $\Delta\delta$ 134°.8.

No.	Date.	G. C. No.	R. A., 1860.	Dec., 1860.	Obs.	Remarks.
			<i>h. m. s.</i>	<i>° ' "</i>		
276	1869 Apr. 28	2853	12 12 48.3	+ 57 30 58.4	C.S.P.	F; S; R; glbM.
277*	1868 Feb. 18	2865	12 12 55.0	+ 6 7 1	G.M.S.	vF; G.C. 2852 n p neb; $\Delta\alpha 7^s$ , $\Delta\delta$ about $20''$ .
278*	1868 Feb. 18	2857	12 13 13.5	+ 6 9 54	G.M.S.	vB; 17 Virg. s f; $\Delta\alpha 2^m 11^s 5$ , $\Delta\delta 288'' 2$ .
279*	1869 Apr. 28	2857	"	"	C.S.P.	B; vS; mE; smbMN; spectr. continuous (doubtful).
280*	1868 Feb. 18	2876	12 14 33.0	+ 6 9 42	G.M.S.	pB; 17 Virg. s f; $\Delta\alpha 52^s 0$ , $\Delta\delta 276'' 5$ .
281*	1869 Apr. 29	2878	12 14 45.1	+ 5 15 4.7		vB; vL; R; vglbMN. (J.W., C.S.P.)
282	1869 Apr. 8	2890	12 15 50.6	+ 16 36 6.0	C.S.P.	Good nucleus and 4 or 5 bright points (power low).
283*	1868 Feb. 18	2892	12 16 2	+ 6 1 18	G.M.S.	B; 17 Virg. n p neb; $\Delta\alpha 33^s 0$ , $\Delta\delta 209'' 7$ .
284*	1868 June 14	2924?	12 17 40.3	+ 40 8 55.3		pB; 3 S stars n p; nearest $59'' 1$ n. (J.W., C.S.P.)
285*	1868 June 25	2972?	12 19 29.4	+ 32 29 40.6		B; pL; g, psymbM. (J.W., C.S.P.)
286*	1869 May 11	3002	12 21 17.5	+ 44 51 51.2		vB; L; E; cbM, or rather at p end. (J.W., C.S.P.)
287*	1868 Mar. 19	3009	12 21 50.2	+ 4 20 49.2	G.M.S.	B; pS; R; mbMN.
288	1868 Mar. 24	3009	"	"	G.M.S.	B; S; R; mbMN.
289	1868 Mar. 18	3018	12 22 15.4	+ 8 55 56.5	G.M.S.	F; S; R; star n p neb; $\Delta\alpha \cos \delta 95'' 60$ , $\Delta\delta 47'' 76$ .
290*	1868 Mar. 18	5653	12 22 22	+ 8 28 55	G.M.S.	vF; $1E 100^\circ \pm$ ; G.C. 3020 n f neb; $\Delta\alpha 8^s$ , $\Delta\delta 7'$ .
291	1868 Mar. 18	3020	12 22 30.4	+ 8 35 54.5	G.M.S.	F; pS; E $348^\circ$ ; not bM. No good comparison star.
292	1868 Mar. 18	3021	12 22 39.3	+ 8 46 15.5	G.M.S.	vB; L; mbM, not N; star f neb; $p 89^\circ 35$ , $s 51'' 21$ .
293*	1868 Mar. 18	3032	12 23 17.7	+ 5 1 16.8	G.M.S.	pF; pL; E $0^\circ \pm$ ; not bM.
294*	1868 Mar. 18	3040	12 23 53.2	+ 8 50 45.8	G.M.S.	F; R; bM.
295*	1869 May 11	3042	12 24 23.6	+ 42 20 34.1		cB; vL; E; vgmB(N?). (J.W., C.S.P.)
296*	1868 Mar. 22	3045	12 24 29.8	+ 4 42 12.1	G.M.S.	F; L; d $90''$ n to s, $45''$ p to f.
297	1869 Apr. 29	3105	12 29 21.6	+ 12 12 38.6	C.S.P.	vB; S; iR; vsvmbM; mb than G.C. 3193.
298	1869 Apr. 29	3105	"	"	J.W.	vB; S; cE; vsvmbM. B cont. spectr.
299*	1869 Apr. 29	3108	12 29 26.5	+ 12 0 33.6		B; vL; 2 heads; both psmbM. (J.W., C.S.P.)
300*	1868 Mar. 22	3125	12 31 18.5	+ 5 5 19.5	G.M.S.	pB; E $123^\circ 33$ ; W. XII 502 s p; $\Delta\alpha 36^s 20$ , $\Delta\delta 109'' 43$ .
301*	1869 Apr. 29	3132	12 32 44.2	- 10 50 14.2		vB; vL; eeEp and f; vsvmbMN. (J.W., C.S.P.)
302	1868 Mar. 24	3138	12 33 14.1	+ 3 53 26.1	G.M.S.	E $60^\circ ?$ ; descr. of G.C. otherwise confirmed.
303	1868 Feb. 16	3147	12 34 20.3	+ 8 29 8.4	G.M.S.	Not visible; region certain, from G.C. 3148 and 3157.
304	1868 Feb. 16	3148	12 34 23.9	+ 8 4 49.7	G.M.S.	DM. $+8^\circ 2629$ f neb; $p 90^\circ 34$ , $s 65'' 69$ .
305	1868 Feb. 16	3157	12 35 3.9	+ 8 26 4.7	G.M.S.	pB; E n and s; looks almost double or biN.
306	1869 Apr. 29	3170	12 35 41.9	+ 4 27 45.0	J.W.	Not found. [=G.C. 3169; see d'A. and Dr.]
307	1869 Apr. 29	3193	12 37 29.4	+ 11 57 25.9	C.S.P.	vB; S; IE; no spectrum seen.
308	1868 Mar. 24	3197	12 37 58.3	+ 3 48 45.2	G.M.S.	B; pL; E n and s; mbM.
309*	1869 Apr. 29	3225?	12 41 11.2	+ 11 45 12.4	C.S.P.	B; S; vmE; vF cont. spectr.; G.C. 3193 n p neb.
310	1869 May 12	3258	12 44 17.2	+ 41 53 28.2	C.S.P.	Not found. [Details of search not given.]
311	1868 Mar. 19	3311	12 48 53.4	+ 5 3 12.6	G.M.S.	Decidedly E $126^\circ 6$ ; considered F; clouds soon after.
312	1868 Mar. 22	3311	"	"	G.M.S.	b, more E than G.C. 3125; bM, lens-shaped; E $131^\circ 31$ .
313*	1867 Apr. 28	3321	12 49 51.8	+ 22 26 44.2	J.W.	Longer d $> 12'$ .
314*	1868 May 11	3321	"	"		Dark crescent-shaped place about N. (J.W., C.S.P.)
315*	1869 Apr. 30	3321	"	"		pB; vL; E; N. (J.W., C.S.P.)
316	1868 Mar. 22	3456	13 6 16.8	+ 6 48 26.0	G.M.S.	Rather fainter than Dr. 5726 [see No. 319]; appar-
317	1869 May 11	3474	13 9 31.9	+ 42 46 14.7	J.W.	Spectrum continuous. [ently R.
318	1869 May 12	3474	"	"	C.S.P.	vB; vL; mE; vgvmbMN; spectr. contin.; vB; long.
319	1868 Mar. 22	5726	13 10 13	+ 6 47.1	G.M.S.	F; lbM; perhaps $1E 70^\circ$ . [Place from Dreyer.]
320*	1869 May 12	3572	13 23 55.4	+ 47 54 56.0	C.S.P.	Very fine; obvious spiral.
321	1869 May 12	3574	13 24 4.4	+ 47 59 9.3	C.S.P.	Part of G.C. 3572; spectrum continuous, B.
322	1868 May 11	3606	13 29 9.0	- 29 9 31.6		No spirality seen. (J.W., C.S.P.)
323	1868 Mar. 22	3615	13 30 35.1	+ 9 36 27.9	G.M.S.	L ( $3'$ by $1'$ ); E $140^\circ \pm$ ; svmbMN; r?
324*	1868 Mar. 22		14 2 43	+ 8 43	G.M.S.	cF (clouds?); DM. $+8^\circ 2822$ n f; $\Delta\alpha 10^s$ , $\Delta\delta 4'$ .
325	1868 June 20		14 7	- 25 48	J.W.	Faint neb susp. [Place approx.; possibly G.C. 3803.]
326	1868 Mar. 18	3902	14 22 34.6	+ 3 54 1.8	G.M.S.	vF; S; star s p neb; $\Delta\delta 99'' 69$ . [See No. 327]
327*	1868 Mar. 18	3904	14 22 36.8	+ 3 51 45.8	G.M.S.	B; R; bM; star n p neb; $\Delta\alpha 14^s 27$ , $\Delta\delta 31'' 14$ .
328*	1867 July 30	4055	15 1 37.4	- 10 46 50.6	J.W.	W. xv 12 s f neb; $\Delta\alpha 68^s$ , $\Delta\delta 4'$ .
329	1867 July 30		15 3 19	- 10 56 14	J.W.	W. xv 37 f neb $25^s$ nearly on same parallel.
330*	1867 July 30	4063	15 6 3.3	- 13 44 18.9	J.W.	W. xv 91 n f neb; $\Delta\alpha 30^s$ , $\Delta\delta 3'$ .
331	1867 July 30		15 7 24	- 14 5 12	J.W.	W. xv 122 s f neb; $\Delta\alpha 36^s$ , $\Delta\delta 5'$ . [structure
332	1866 Nov. 2	4294	17 12 56.9	+ 43 16 28.8	J.W.	DN (conf. by 2 other observers); appears of spiral
333*	1866 July 31	4355	17 53 51.8	- 23 1 39.9	S.P.L.	Southern comp. of triple star seen double.
334*	1866 Aug. 2	4355	"	"	S.P.L.	Whole neb vF, brightest part invisible in moonshine.
335*	1866 Aug. 11	4355	"	"	S.P.L.	Late twilight, def. bad. Mason's meas. stars seen.

No.	Date.	G. C. No.	R. A., 1860.	Dec., 1860.	Obs.	Remarks.
336*	1866 Aug. 13	4355	<sup>h</sup> <sup>m.</sup> <sup>s.</sup> 17 53 51.8	<sup>°</sup> <sup>'</sup> <sup>"</sup> -23 1 39.9	S.P.L.	Saw a fifth component of the multiple star.
337*	1866 Sept. 10	4355	"	"	S.P.L.	Sky in the vicinity all faintly nebulous.
338*	1868 Sept. 17	4355	"	"	C.S.P.	Four components of multiple star visible.
339*	1868 Sept. 18	4355	"	"	J.W.	Spectr. of mult. star cont., many B lines, some bands.
340*	1867 Aug. 27	4390	18 5 17.8	+ 6 49 6.5		Color greenish. (J.W., G.M.S.)
341*	1867 Aug. 27	4407	18 17 13.4	-23 16 30.4	G.M.S.	mbM; almost a stellar nucleus. [4532.]
342*	1868 Sept. 18	4447	18 48 20.1	+32 51 2.8	C.S.P.	Spectrum; 1 B line; same [place] as in G.C. 4355 and
343	1868 Dec. 9	4447	"	"		Spectrum; 2 close lines, easily seen. (J.W., C.S.P.)
344*	1869 Aug. 24	4447	"	"		Spectr.; 2 lines plainly seen. (J.W., C.S.P., S.P.L.)
345	1867 Aug. 26	4473	19 4 4.8	+ 0 48 9		d 1'.5; somewhat neb stars 20" ± p. (J.W., G.M.S.)
346	1867 Aug. 26	4487	19 11 37.3	+ 6 17 13.5	J.W.	d 2' ±; F; disk def. except n p side, there fainter.
347	1867 Aug. 25	4510	19 36 3.0	-14 28 52.5	J.W.	3 satellites [small stars?]; p 79°.77, 226°.53, 308°.78.
348*	1867 Aug. 26	4510	"	"	G.M.S.	W. xix 925 s f neb; $\Delta\alpha \cos \delta$ 433''.60, $\Delta\delta$ 268''.76.
349	1868 Aug. 16	4510	"	"	J.W.	Surface uniform; edges badly defined.
350	1867 Sept. 28	4532	19 53 29.3	+22 20 17.0	J.W.	Spectrum; 1 faint broad line.
351	1868 Sept. 16	4532	"	"	J.W.	Spectrum; 1 bright line.
352	1868 Sept. 18	4532	"	"	C.S.P.	Spectrum; 1 B line, 16.77 of scale [ $\lambda$ 4990 ±].
353*	1868 Nov. 3	4532	"	"	C.S.P.	Black place at each extremity.
354	1868 Nov. 17	4532	"	"		B line on scale 16.08 (J.W.), 16.16 (C.S.P.) [ $\lambda$ 5010 ±].
355*	1866 Oct. 31	4572	20 16 7.9	+19 39 40.7	J.W.	Rather F; unequally B in different parts.
356*	1867 Aug. 27	4572	"	"	J.W.	F; unequally B; p side the fainter.
357*	1868 Oct. 3	4572	"	"		(J.W., C.S.P.)
358*	1868 Nov. 4	4572	"	"	C.S.P.	Planetary nebula; L; cB; i R.
359*	1866 Oct. 31	4627	20 56 17.5	+54 0 20.4		Wing seen; p about 260°. (J.W., G.M.S.)
360*	1867 Aug. 27	4628	20 56 31.2	-11 55 4.8	G.M.S.	E 73°.6 (approx. measure, without illumination).
361*	1868 Sept. 18	4628	"	"		Spectrum; 3 lines. (J.W., C.S.P.)
362	1868 Nov. 3	4628	"	"	C.S.P.	vB; v blue; E; horn on l end at least; looks like
363*	1868 Nov. 6	4628	"	"		Spectr.; 3 distinct lines. (J.W., C.S.P.) [Saturn.
364*	1868 Nov. 7	4628	"	"	J.W.	Spectrum; 3 lines; some appearance of cont. light.
365*	1868 Oct. 3	4670	21 23 9.9	+11 32 37.7	C.S.P.	vB globular cluster; spectrum continuous.
366*	1868 Nov. 3	4678	21 26 12.5	- 1 26 37.2	C.S.P.	Hardly r in M; looks very smooth.
367*	1868 Oct. 11	4739	21 54 51.2	-21 28 50.3	C.S.P.	pB; pL; E 57°.65; gpmbM; 2 stars p and 1 nf neb.
368	1868 Oct. 12	4761	22 2 34.9	-17 19 55.1	C.S.P.	Not found.
369	1867 Oct. 27	4775	22 10 8.7	-16 16 47.8		Descr. of G.C. confirmed. (J.W., C.S.P.)
370	1867 Oct. 27	4779	22 12 53.8	-16 28 21.5		Descr. of G.C. confirmed. (J.W., C.S.P.)
371*	1867 Sept. 27	4795	22 22 5.6	-21 32 59.8	G.M.S.	cF; R; d 10' ±; dark in M; brightest on n limb.
372*	1867 Oct. 27	4801	22 23 28.3	-14 44 11.8	C.S.P.	Apparently r; 3 B points seen in it.
373	1867 Oct. 27	4802	22 24 53.0	-14 50 30.3		Not F; cB (J.W.); p B (C.S.P.); descr. otherwise
374*	1867 Oct. 27	4807	22 26 55.7	-11 4 53.2	C.S.P.	One B point in it. [correct.]
375*	1868 Oct. 17	4810	22 28 2.3	-26 45 55.0	C.S.P.	cB; L; lEn; 2' to 3' long, 1' to 1'.5 wide.
376	1866 Oct. 31	4827	22 35 6.6	+60 32 54.6		F; R; not r (J.W.); sparkling (G.M.S.); powers 141,
377*	1868 Oct. 20	4893	22 58 40.4	+ 2 47 17.8	C.S.P.	vF; S; R; vscbM; probably a star. [206.]
378*	1868 Oct. 11	4906	23 7 28.8	+ 3 44 15.5	C.S.P.	Not vF; at least F, preferably cB; not R; lE; mbM.
379*	1868 Oct. 11	4909	23 7 37.8	+3 46 24.5	C.S.P.	B; L; E 92°.2; bM; star 10 magn. f neb; p 93°.65.
380*	1869 Oct. 31	4909	"	"		B; L; mE p and f; pgbM. (C.S.P., E.P.A.)
381*	1868 Oct. 17	4917	23 8 27.0	+ 5 56 38.4	C.S.P.	B; S; R; pgvmbM.
382*	1868 Oct. 20	4934	23 12 30	+ 7 17 36	C.S.P.	F; S; R; psmbM; 2 stars [near?]; S star n p.
383	1868 Oct. 20	4935	23 12 51.0	+ 7 38 40.5	C.S.P.	Not found; perhaps = G.C. 4936. [See also Dreyer,
384*	1868 Oct. 20	6186	23 13 3	+ 7 24	C.S.P.	vF; vS; R. [Place from Dreyer.] [p. 398.]
385	1868 Oct. 20	4936	23 13 9.5	+ 7 26 0.5	C.S.P.	cB; pL; R; vsvmbMN; G.C. 4940 f 27°.7, n 24' 1 [?].
386	1868 Oct. 20	4938	23 13 25.2	+ 7 38 10.8	C.S.P.	Star 12, with F nebulosity [neb perhaps not seen].
387	1868 Oct. 20	4940	23 13 38.0	+ 7 27 1.8	C.S.P.	B; cS; R; vsvmbMN; star 14 p 1'.
388*	1868 Oct. 20	4943	23 14 22	+ 7 26 54		vF; S; E s p and n f; 2 stars n p neb 5'. (C.S.P.,
389*	1868 Oct. 17	4946	23 14 36.4	+ 8 7 21.4	C.S.P.	pB; S; E n p and s f; 0'.5 long. [E.P.A.]
390*	1866 Oct. 6	4964	23 19 9.9	+41 46 2.5	J.W.	vB; green; elliptical.
391*	1866 Oct. 7	4964	"	"	J.W.	Darker (slightly shaded), in M; power 400.
392*	1866 Nov. 1	4964	"	"		n f side evidently the brightest. (J.W., G.M.S.)
393*	1868 Sept. 18	4964	"	"	J.W.	Spectrum; 2 or 3 lines.
394*	1868 Oct. 3	4964	"	"		(J.W., C.S.P.) [steadily.]
395*	1868 Nov. 6	4964	"	"	J.W.	Spectrum; 4 lines; two eB; 3d very distinct; 4th seen



No.	Date.	G. C. No.	R. A., 1860.	Dec., 1860.	Obs.	Remarks.
			<i>h. m. s.</i>	<i>° ' "</i>		
396*	1868 Nov. 7	4964	23 19 9.9	+ 41 46 2.5	J.W.	Four lines very distinct, even bright.
397	1867 Nov. 30	5079	23 25 33.1	- 6 22 12.0	C.S.P.	pB; S; bM; star, 9.10 magn., f neb.
398*	1868 Oct. 12	4993	23 29 2.6	+ 1 23 8.7	C.S.P.	vB; vS; star, 14 magn., s p neb; B star s f neb.
399*	1868 Oct. 12	4994	23 29 10.6	+ 1 23 8.7	C.S.P.	Identified with G.C. 4993.
400	1868 Oct. 17	4995	23 29 20.0	- 0 28 43.3	C.S.P.	F; pL; R; vgbM; star s f; $\Delta\alpha \cos \delta 6''.86$ , $\Delta\delta 123''.73$ .
401	1868 Oct. 12	5000	23 32 38.8	- 13 4 12.4	C.S.P.	Not seen.
402*	1868 Oct. 12	5005	23 37 8.5	+ 9 59 33.8	C.S.P.	F; pL; iR; svmbM; apparently BSN.

## NOTES TO TABLE VIII.

## OBSERVATIONS OF NEBULÆ.

1. Nebula n of line joining stars. A third star, 11 magn., s f neb;  $\Delta\alpha \cos \delta 21''.45$ ,  $\Delta\delta 175''.31$ .
  4. G. C. 103 verified; G. C. 98 found. [The mention of G. C. 103 and G. C. 98 seems to show that the region was fully identified; but there is some error in the record concerning G. C. 101. A recent examination of the region (Dec. 31, 1880, A. S. obs.) showed two nebulae nearly as described by d'Arrest, one n p DM. +  $2^\circ 85'$ ,  $\Delta\alpha 9'$ ,  $\Delta\delta 1'$ , the other s f the same star,  $\Delta\alpha 17'$ ,  $\Delta\delta 1'$ . For an observation of the star referred to by d'Arrest, see Astr. Nachrichten, LXII. 279 (No. 1482). The first of these two nebulae is apparently to be identified as G. C. 101, and the resulting corrections to G. C. in R.A. and N.P.D. will be  $-7'$ ,  $-0'.8$ .]
  8. Measures by E. P. A., who sees a decided nucleus. Nearest star p neb;  $p 250''.76$ ,  $s 72''.25$ ; an estimate by C. S. P. makes the distance of the other p star just three times as great [ $217''$ ]; a third star s of neb;  $p 178''.46$ .
  11. Spectrum 9.90 to 25.00 of scale [ $\lambda 5900 \pm$  to  $4350 \pm$ ].
  16. [The star seems to be W. r 176; the resulting corrections to G. C. in R.A. and N.P.D. are  $+0'.5$ ,  $+56''.7$ .]
  19. Measures by G. I. Alden; DM. +  $8^\circ 225'$  n p neb;  $\Delta\alpha \cos \delta 295''.47$ ,  $\Delta\delta 288''.36$ .
  20. Perhaps not a neb, but a star, 18 magn.; star, 11 magn., n p neb,  $2'$  to  $3'$  distant; this is followed about  $5'$  by a faint neb  $1'$  farther n; there is another ee F neb between the star and G. C. 308; but all these v F nebulae are so small that they may be stars. The star, 11 magn., f G. C. 307 nearly  $5'$  [it is doubtful whether this is an observation].
  - 21-26. [These nebulae were compared in R.A., by seven partial transits, with each other and with DM.  $-1^\circ 190'$ ; the double neb G. C. 322, 323, observed as one object, was also compared in declination with the star and with each of the nebulae Nos. 21, 22, 25, by two settings of the micrometer; No. 26 was similarly compared with the star. The places assigned to the nebulae in Table VIII. were obtained from these comparisons, and are referred to DM.  $-1^\circ 190'$ , which was observed with the Bonn meridian circle (Bonn Observations, Vol. VI.). The corrections found, and in this case applied, to the G. C. place of the double nebula G. C. 322, 323, are in R.A.  $-3'.7$ , in N.P.D.  $+22''.3$ .]
  27. G. C. 345 f near same declination. Small star s p neb;  $p 198''.4$ ; W. r 390 n f neb;  $\Delta\alpha 95''.08$ ,  $\Delta\delta 407''.45$ . [The place given in Table VIII. results from this comparison.]
  41. Seven stars in field of about  $12'$ . Nearest star s f neb;  $p 112''.80$ ;  $\Delta\alpha \cos \delta 75''.46$ ,  $\Delta\delta 31''.97$ ; nebula not resolved with power 316. [DM.  $-0^\circ 412'$  is in this neighborhood, and perhaps identical with the star mentioned in G. C.; probably not with the star observed here.]
  44. [From a sketch in the original record, the description of G. C. seems to be confirmed, except the clause gpmbM.]
  47. J. W. and C. S. P. independently think the sky generally bright f and a little n of the comet for  $14'$  or more (several fields according to C. S. P.). [The approximate place given in Table VIII. results from the comparison with the comet.]
  48. Resulting corrections to G. C. in R.A. and N.P.D.  $-2'.8$ ,  $+23''$ .
  - 51, 52. [Tempel's nebula in the Pleiades. The G. C. place is derived from that given by Auwers, p. 74, for the brightest part of the nebula; but in order to find the nebula it is better to look at some part of the border, for instance, at the star Merope (23 Tauri, DM.  $+23^\circ 522'$ ). If a telescope is directed to the place given in the catalogue, nothing perhaps will be seen, unless the magnifying power is low and the field large. This explains the failure to find the nebula on December 13, 1868, and perhaps accounts for the early supposition that this nebula was variable. The observation of January 25, 1868, is as follows:—]
- No special concentration of nebula in the place of Tempel's var neb in the Pleiades (there is a 10 magn. star, DM.  $+23^\circ 525'$ , near the place); but a little preceding it there is a broad band or fan of faint nebulosity beginning about  $1'$  south of DM.  $+23^\circ 522'$ , and  $3'$  or  $4'$  preceding, and running south and a little preceding about  $12'$ , widening from  $1'$  to  $6'$  or so, better defined on f than on p side. Much like the tail of a comet. DM.  $+23^\circ 522'$  apparently involved.



[The nebula was observed in the autumn of 1875, on October 25, November 21 and 22, and December 6; and the record of these observations is here given, although they are subsequent to the period covered by Table VIII.]

Oct. 25, 1875, 9<sup>h</sup>.5 to 10<sup>h</sup> mean time. Observers, Arthur Searle and Walter Hoxie. With the lowest power of the finder (aperture  $4\frac{1}{4}$  inches), and also with the lowest ring-micrometer eyepiece of the large telescope [power 100], A. S. saw a distinct boundary between comparatively dark and light portions of the sky along the line of the two small stars [DM. 524 and 525] bounding the nebula on the following side in Tempel's chart [see No. 5 of the Publications of the Milan Observatory]. Other shadings of the sky were suspected, in general agreement with Tempel's figure, but not satisfactorily determined. W. H. saw the boundary above mentioned, and also a somewhat bright spot on the n p side of the nebula as Tempel draws it, about two thirds of the way from Merope to the next (faint) star along that side of the nebula in Tempel's chart.

Nov. 21, 1875. A. S., obs. [power 100 as on Oct. 25], 9<sup>h</sup> mean time. Plenty of nebula, or at least of whitish light, visible near Merope; but at least as much in other parts of the group. In particular, Alcyone is surrounded by light which stretches towards the next star south of Alcyone in Tempel's drawing [a small star about 5' s p]. The nebula near Merope lies more to the preceding side than in his drawing, so that the two small stars [DM. 524, 525] which bound the nebula on the following side, according to Tempel, now have a distinct dark space between them and the nebula, while on the preceding side the star [DM. 509] which Tempel puts on the boundary of the nebula now lies well within it.

Second observation, 10<sup>h</sup>.5 mean time. Less appearance of nebula about Alcyone. Nebula near Merope as in following sketch [this sketch shows DM. 521, 524, and 525 outside of the nebula, places the southern boundary of the nebula in about the declination of DM. 521, includes DM. 506 and 509 in the nebula, placing the boundary on the s p side a little following DM. 496 and 497, and describes the nebula north of DM. 496 as having an indefinite extension on the n p side]; the three little stars preceding Merope [and north of DM. 509] in a comparatively dark space; Electra and Celæno in a very dark part of the sky. [The sketch places the northern boundary of the nebula a little south of DM. 510 and 517.]

Nov. 22, 1875, 10<sup>h</sup> mean time. Same general appearance as yesterday; boundary indefinite at top of above sketch [southern boundary indefinite].

Dec. 6, 1875, 10<sup>h</sup> mean time. Observer and instrument as on Nov. 21. Nebula visible notwithstanding moonlight; Alcyone did not appear nebulous. Observation of Nov. 21 confirmed; except that after passing the two small stars [DM. 510 and 517] between Merope and Electra, the boundary of the nebula seemed to turn towards Electra and approach it closely, but not to include it. The three small stars preceding Merope still appeared to be in a comparatively dark space; and the following boundary of the nebula appeared distinctly as on Nov. 21. [See chart of the Pleiades from Wolf's observations in the "Annales de l'Observatoire de Paris," 1874, which agrees in several points with the Harvard observations of 1868 and 1875.]

59, 60. Star following 21<sup>a</sup>. Bright spot n p. With power 316, outer edge exact ring. Separated from central body like a halo. Bright spot near centre, a little north, conspicuous. C. S. P. sees two bright spots, n f and at centre. J. W. sees but one. Ring shape of envelope quite manifest. Spectrum gaseous, brighter than yet seen with any nebula. Two lines suspected.

61. No more marked gas spectrum ever seen. Third line difficult unless slit is wide; not seen by C. S. P. The bright lines coincide with air lines at about 16.00 and 16.37 of scale [ $\lambda$  5020 $\pm$ , 4990 $\pm$ ]. The third line about 17.25 [ $\lambda$  4900 $\pm$ ]; measure rather unsatisfactory.

64. W. iv 715 n f neb;  $\Delta\alpha$  about 1<sup>s</sup>,  $\Delta\delta$  390''.28; resulting corrections to G. C. in R.A. and N.P.D. —1<sup>s</sup>.7, —11''. Star 9.5 n f neb;  $\Delta\alpha$  about 14<sup>s</sup>,  $\Delta\delta$  83''.94. Star follows W. iv 715 13<sup>s</sup>.0. [Not in DM.]

65. Star s p;  $\Delta\alpha$  cos  $\delta$  102''.61,  $\Delta\delta$  110''.79. Star n p;  $\Delta\alpha$  cos  $\delta$  177''.52,  $\Delta\delta$  302''.05.

68. W. iv 1333 s p;  $\Delta\alpha$  cos  $\delta$  350''.4,  $\Delta\delta$  184''.7; resulting corrections to G. C. in R.A. and N.P.D. —4<sup>s</sup>.3, —101''.

73. Line suspected by J. W. at 13.33 of scale [ $\lambda$  5370 $\pm$ ]; lines seen by C. S. P. at 13.66 and 13.42 (14.66 and 14.42?). [Record doubtful;  $\lambda$  5330 $\pm$  and 5350 $\pm$ , or 5180 $\pm$  and 5220 $\pm$ .]

74. Line; two readings of place on scale 15.42 and 15.53 [ $\lambda$  5100 $\pm$  and 5070 $\pm$ ]; doubtful whether there is a continuous spectrum or a second line; observations interrupted by haze.

76. (1.) The great branch s f on G. P. B.'s drawing [frontispiece of Vol. V. of these Annals] is hardly sharp enough in outline. [This branch is] more like Herschel's [representation of the nebula in the Cape Observations].

(2.) The grand triangle leaves off sharply at p side, like B.'s, not like H.'s.

(3.) Down the middle of triangle is black line, like H.'s, not B.'s.

(4.) The curl n p triangle is doubtful, though something like it is certainly there.

(5.) The spot n f [nebula surrounding a star] is hardly as threefold [radiating in three directions from the star] as B. makes it. [See also (12).]

(6.) The general tendency of the n p lines is to a convexity towards n f side [as in B.'s drawing].

(7.) The curve on the n p side with convexity facing f is well represented.

(8.) The dark spot close to triangle s p is well represented.

(9.) So is the gulf n f with bar across it.

(10.) The spokes at apex, pointing s f, are hardly as marked as represented.

(11.) I cannot see a trace of the line running from the star s f [probably s p] apex of triangle, nearly continuous with s f side.

- (12.) The spot *n f I* should represent thus: [Pencil sketch in the original. In B.'s drawing the star *n f* the nebula, mentioned under (5), besides the brighter nebula immediately about it, is surrounded by faint light somewhat in the figure of a cockle-shell, the extremity of the lip reaching to a star nearly 4' distant *n f*. The pencil sketch makes this figure more conspicuous, the body of the shell being smaller as shown by the included stars, and the lip relatively longer, but ending at the same star.] B. has something of this also, but I cannot believe that this has not become more decided since he drew it.

I might make many other observations, but give the most certain. N. B. The sixth star of the trapezium not visible to-night.

78. Many fine stars visible in triangle, and the following is a correction of my drawing of last week: [This pencil sketch does not represent the included stars, so that the dimensions of the figure are doubtful; it agrees better than the preceding drawing with B.'s figure, in showing a greater concentration of light near the middle, surrounded by a much fainter envelope.] Curl given by B. at *s p* corner of triangle perhaps seen. Streamers *s* of three stars [*s f* trapezium], and *s p* star *s p* vertex *not* seen.

79. Some of the finest points in the drawing seen; for example, the three faint stripes nearly *n* and *s*, bending towards *p* at the *p* extremity, and the very faint stripe nearly *p* and *f* at *s* part [the three stripes may be those in the *s f* part of the plate; the very faint stripe does not seem certainly recognizable]. But there is only a doubtful streamer from *p* of three stars [*s f* trapezium], and a suspicion of one from the *f* star; whence I think those streamers are too decided in the drawing.

81. Nebula about the middle one of the three stars [*s f* trapezium], and streaming from it, now seen for the first time. The streams from all three now quite plain; much more so than other points (such as the transverse stripe from the great southern wisp) which I see almost every time. Another thing seen for the first time is the black streak running off towards *s p* from the apex of the great triangle to [*s p*] star. But this is more doubtful. The bright streak beyond the star I still cannot see.

The wispy character of the nebula on both sides of the triangle is marked, that on *p* side having convexity *s f* [*n f*?], and that on *f* side having convexity *f* or *n f*.

I also notice *very plainly* what is not on Bond's drawing; there is a large black *cave* on the *n f* corner of triangle which is on all the drawings; there is also a bar across it. Now I notice, first, that this bar is broken or almost so in the middle [a figure added makes the bar taper from each side to the middle where it is broken]; and second, that from the *inner* cave thus formed the blackness extends (in a mitigated way) clear up through the triangle to the *p* side of the most *p* of those three stars [*s f* trapezium]; and third, that a less marked blackness extends southwards a little way on the *f* side of the same bar; fourth, these black bars also extend northerly, so as to be continuous with the great *n p* wisp, giving the whole nebula an entirely new aspect, so much so that it seems to me that I have just got a good idea of it. I certainly never saw it look so finely. The trapezium has always appeared to me to have a sort of glittering look, as though there were other minute stars there. It seems so now, and in particular the star *a* looks thus: [sketch of a quatrefoil shape,] as though it were composed of several. Will mark on G. P. Bond's drawing the continuous lines I notice [the copy used for this purpose is not now known]. The whole texture of the nebula seems different, I fancy. It almost sparkles. It is all but resolvable, I believe. It looks more like the elder Bond's drawing [Vol. V. of these Annals, p. 273].

85. [Afterwards clearer, apparently.] Places of lines on spectroscopic scale: 1st line coincident with air line 16.20; after adjusting focus, 16.16 [ $\lambda$  5010 $\pm$ ]; 2d line, 16.73 [ $\lambda$  4960 $\pm$ ]; 3d line, 17.48 [ $\lambda$  4870 $\pm$ ]; 4th line, (rough) 23.60; (pretty well) 24.87; other measures, 24.62, 24.36, 24.52 (this last the best measure yet), [ $\lambda$  4370 $\pm$ ]; the setting 25.17 will not answer [25.17 is the reading of a line observed in the solar spectrum 1868, Nov. 7, and presumed to be the line of hydrogen near G,  $\lambda$  4340]. Not the least light at 20.00 [which is about the place of the fourth line in the spectrum of G. C. 4964; see note on No. 396]. Continuous spectrum to 7.40 [ $\lambda$  6470 $\pm$ ].

86. First reading 16.11 (not so good); others, after closing slit, 16.07, 16.04, 16.05, 16.09 (last not so good). [ $\lambda$  5020  $\pm$ .]

87. Definition very poor; nebula very bright. Spirality seen at *n p* corner of triangle.

90. C. S. P. sees fourth line plainly; suspects another beyond it, if not two, and another still just before coming to it and very near it. J. W. does not suspect these new lines, except that when grazing  $\theta$  Orionis he thinks he sees other lines beyond the fourth, which is itself seen only in the immediate neighborhood of  $\theta$ . It is brighter and broader in the region on one side of  $\theta$  than in that on the other side.

91. Other lines suspected, but very doubtful. Lines disappeared in the order of their faintness in passing gradually towards the edge of the nebula. Mr. Van Vleck [name uncertain] also saw the fourth line. J. W. found the spectrum of  $\epsilon$  Orionis [name of star somewhat uncertain] to be continuous, with only a cluster spectrum fringing it; no gas spectrum. J. W. and C. S. P. both found stellar and gaseous spectra together from star  $\delta'$  *n* and  $\delta'$  *f* the great nebula [more nearly 7'.5 *n* and 3'.5 *f* the trapezium.]

92. Examined the spectrum in several places; found that, in passing from the brighter to the less bright parts of the nebula, the fourth or most refrangible line disappeared first; next, the middle line of the three bright lines; then, the most refrangible of these three; so that the spectrum was reduced to a single bright line. In the portion of the nebula about the star 7'.5 *n* and 3'.5 *f* the trapezium, two bright lines could be seen very near the stars, and with a very slight change of position only one line could be seen. Bright moonlight. Saw light between third and fourth lines, and before first. No fifth line after intense looking.

93. Moon at 71 Orionis. Nebulosity not well made out in spectrum of  $\epsilon$  Orionis.

94. J. W. saw light to 9.30 of the spectroscope scale [ $\lambda$  6020 $\pm$ ], also some at 6.50 [ $\lambda$  6740 $\pm$ ]. Both observers saw or suspected a line between the third and fourth. According to C. S. P., the new line was about as far to the right of the fourth as the first is from the third; the line suspected by J. W. was as much farther towards the third.

95. Fourth line brilliant. The continuous spectrum begins between 6.50 and 8.30 of the spectroscope scale [ $\lambda$  6740 $\pm$  and 6250 $\pm$ ]. To determine the relative extent of different parts of the nebula in which its spectrum shows four, three, two, or one of the observed lines, four transits were taken in the declination of the middle of the trapezium, with the following results; the last transit was considered the best.

TRANSIT 1.			TRANSIT 2.			TRANSIT 3.			TRANSIT 4.		
Time.	Spectrum.		Time.	Spectrum.		Time.	Spectrum.		Time.	Spectrum.	
<i>h. m. s.</i>			<i>h. m. s.</i>			<i>h. m. s.</i>			<i>h. m. s.</i>		
5 26 50	2 lines.		5 29 33	2 lines.		5 31 44	2 lines.		5 35 42	2 lines.	
27 4 4	"		29 40 3	"		32 28 3	"		36 7 3	"	
27 10	Star.		29 44	Star.		32 39	Star.		36 14	Star.	
27 32	2 lines.		29 55	2 lines.		32 39	2 lines.		36 24	2 lines.	
27 38	None.		30 3	None.		32 46	1 line.		36 27	1 line.	
						32 47	None.		36 36	None.	

96. The point at which the continuous spectrum seems to be best defined is  $s f$  the trapezium by a distance equal to the diagonal of the trapezium. The continuous spectrum is at least as bright as the spectrum of the nebula in Andromeda. When the slit is so narrow as to make the lines very fine and sharp, there is a black band in the continuous spectrum close to the fourth line, towards the third.

103. Nebulous place seen in belt of Orion, away from any bright star.

104. Star  $n p$  neb;  $\Delta\alpha \cos \delta 175''.53$ ;  $\Delta\delta 249''.14$ .

105. A small star,  $s p$  DM.  $+21^\circ 907$ , almost exactly in the place of this nebula, does not appear nebulous, and no nebula is visible in the field. Relative position and distance of the two stars;  $p 267^\circ.24$ ,  $s 37^\circ.06$ .

108. There are three stars of about the same magnitude and within the same degree of declination, but quite remote in R.A., which have a very similar nebulosity about them.

109. Saw nothing with spectroscope at first trial; on returning to the nebula, saw nothing except  $vB$  continuous spectrum apparently between the two stars. [A small sketch appended, if meant to represent this nebula, makes it somewhat annular, surrounding a star.]

114. Several double stars (distance  $5''$  to  $10''$ ) also seen, but no other nebulae. But the seeing is so bad that a nebula might easily be mistaken for a star.

118. DM.  $+8^\circ 1429 n f$  neb;  $\Delta\alpha \cos \delta 88''.95$ ,  $\Delta\delta 110''.39$ . [The nebula is probably DM.  $+8^\circ 1427$ ; its elongated shape may have caused an error in the DM. observation.]

122. W.  $vI$  1883  $n f$  neb;  $\Delta\alpha 2^\circ 33'$ ,  $\Delta\delta 108''$ ; corrections resulting to G. C. in R.A. and N.P.D.  $+0^\circ.5$ ,  $+10''$ . A companion  $n p$  W.  $vI$  1883;  $p 350^\circ.3$ ,  $s 17^\circ.1$  ( $s 16''\pm$  by approximate measure, 1868, Feb. 3).

123. G. C. 1519 was afterwards (1869, Jan. 19) found to be too small to be seen in the finder (aperture  $4\frac{1}{2}$  inches) during moonlight.

125. Nebula nearly circular; star perhaps a little toward  $p$  side, followed by dark space, making neb appear somewhat annular on  $f$  side. DM.  $+21^\circ 1610 n f$  neb;  $\Delta\alpha 0^\circ.29$ ,  $\Delta\delta 1' 39''.8$ . [Star observed with Bonn meridian circle; see Bonn Observations, Vol. VI.; resulting corrections to G. C. in R.A. and N.P.D.  $-0^\circ.8$ ,  $-12''.5$ .] The nebula is DM.  $+21^\circ 1609$ . The observations were hindered by wind.

126. Outside of innermost envelope dark ring;  $s f$  side darkest.

129. One star seen plainly, about one third of radius from centre to  $n p$  limb, in which direction the nebula seems a little elliptical; ratio of axes estimated 5 to 6.

131. W.  $vII$  1182  $f$  neb  $3^\circ 39'$ . The nebula is elliptical, almost planetary, in the middle of a cluster [G. C. 1564]  $vB$ ;  $Ri$ ;  $vL$ . The sky for many fields  $p$  and  $f$  is all nebulous. Two stars in the nebula.

132. Oeltzen 7260  $n f$  neb;  $\Delta\alpha \cos \delta 177''.24$ ,  $\Delta\delta 3''.52$ ; resulting corrections to G. C. in R.A. and N.P.D.  $+0^\circ.3$ ,  $-24''$ .

134. The nebula has a brighter part in the middle, which is elongated at right angles to the general elongation. This part is very bright and blue; looks like an ill-defined double star. Oeltzen 7103  $s p$  neb;  $\Delta\alpha 5^\circ 8'.5$ ,  $\Delta\delta 1^\circ 30'.5$ ; resulting corrections to G. C. in R.A. and N.P.D.  $-1^\circ.7$ ,  $-0'.5$ .

135. Position angles and distances of the three stars from the nebula: 14 magn.,  $n$  of neb,  $p 2^\circ.71$ ,  $s 85''.03$ ; 15 magn.,  $s p$  neb,  $p 235^\circ.74$ ,  $s 57''.34$ ; 15 magn.,  $s f$  neb,  $p 115^\circ.24$ ,  $s 79''.77$ .

137. Diameter about  $3'$ ; star 9 magn. very near its north limit about one tenth of diameter inside.

141. Nebula terminates at a star 9 magn. [ $n f$  ?]. Oeltzen 8686-7, estimated 6.5 magn.,  $n f$  neb;  $\Delta\alpha 9^\circ.55$ ,  $\Delta\delta 120''.79$ ; corrections resulting to G. C. in R.A. and N.P.D.  $-1^\circ.4$ ,  $+11''$ .

144. [The elongation is described as  $75^\circ n p$  and  $s f$ ; this may be either  $285^\circ$  or more probably  $345^\circ$ .] Too S, but B enough, for spectroscope.

146. W.  $vIII$  1057  $s f$  neb;  $\Delta\alpha 2^\circ 45'$ ,  $\Delta\delta 1' 3''$ ; resulting corrections to G. C. in R.A. and N.P.D.  $-2^\circ$ ,  $-2' 25''$ .

162. Large star [W. ix 54?] p neb 1<sup>m</sup> 24<sup>s</sup>.
166. Neb f line joining the two stars about 1'; about four tenths of distance from 2298 to 2299. Resulting corrections to G. C. in R.A. and N.P.D. —1<sup>s</sup>, +1'.5.
168. Another determination, by A. Searle, makes  $\Delta\alpha \cos \delta$  100''.96,  $\Delta\delta$  28''.52. [Owing to uncertainty with regard to the coincidence of the wires, the results of both observers should possibly be diminished by 9''.52.]
169. Oeltzen 9854 n p neb;  $\Delta\alpha$  32'.77,  $\Delta\delta$  77''.88; resulting corrections to G. C. in R.A. and N.P.D. —0<sup>s</sup>.2, +14''.
173. Resulting corrections to G. C. in R.A. and N.P.D. —0<sup>s</sup>.7, —15''.
177. Perhaps a nebulous star. It is half-way between G. C. 1998 and a star 11 magn.
179. Small star s p neb;  $p$  187°.57,  $s$  81''.22; larger and more distant star s p neb;  $p$  186°.21,  $s$  196''.81; small star (?) in the nebula n f;  $p$  38°.14,  $s$  18''.50.
180. Faint star s of neb;  $p$  187°.74,  $s$  81''.59; star farther s, 11 magn.;  $p$  185°.63,  $s$  196''.35.
184. Spectrum certainly continuous, eF; the spectrum has one end at 9.00 of the spectroscopic scale [ $\lambda$  6100±].
185. Spectrum continuous; one place in it brighter than the rest.
186. Star 11 magn. n f neb;  $p$  79°.30,  $s$  92''.00. The elongation of the nucleus has a direction about 20° less than this  $p$ .
187. Spectrum short, faint, continuous, with band beyond. Both observers thought they saw a line in the continuous part. Red star 7 to 8 magn. f neb.
188. A vF companion nebula (or part of the same) s p 20'±, suspected also last night. Spectrum perplexing, seems continuous. Nebula smaller and fainter than G. C. 2038.
190. Place of nebulous star with respect to the other;  $p$  9°.82,  $s$  17''.12. No third star.
191. Satellite, 13 magn., s of neb;  $p$  172°.52,  $s$  154''.64; star, 11 magn., s f neb;  $p$  112°.76,  $s$  299''.13. The nebula has the usual sparkling appearance.
193. Two bright spots in neb distinctly seen by both observers with power 400; a ring or broken ring suspected by C. S. P., not by J. W. Bright star s f neb (called  $b$  by d'A., p. 133);  $p$  113°.30,  $s$  300''.55; another star;  $p$  171°.68; a third faint star;  $p$  138°.18; the first and second were apparently measured by d'Arrest, the second and third by Herschel (Cape Observations, p. 94). Bright points seen only with high powers.
194. Spectrum of four lines, also continuous spectrum; fourth line certainly seen; it is about double [the distance] between the first and third [beyond the third?].
200. Star n f neb;  $p$  69°.84,  $s$  123''.87; star f neb;  $p$  114°.44,  $s$  35''.62; star s f neb;  $p$  163°.29,  $s$  155''.18. Hence the values of  $\Delta\alpha$  and  $\Delta\delta$  for the three stars are respectively 8°.10, 42''.7; 2°.26, 14''.7; 3°.10, 148''.6.
202. Star n f neb;  $p$  13°.99,  $s$  78''.35; star p neb;  $p$  282°.69,  $s$  62''.77; star s p neb;  $p$  201°.14,  $s$  124''.02. Hence the values of  $\Delta\alpha$  and  $\Delta\delta$  for the three stars are respectively 1°.32, 76''.0; 4°.27, 13''.8; 3°.12, 115''.7. G. C. 2160 consequently follows G. C. 2159, according to the measures of the three stars respectively, 6°.78, 6°.53, 6°.22; mean 6°.51; and is south of G. C. 2159, according to the same measures, 33''.3, 28''.5, 32''.9; mean 31''.6.
204. Star s f neb;  $p$  309°.14,  $s$  122''.75.
211. W. x 547 n p neb;  $\Delta\alpha$  2<sup>m</sup> 12'.9,  $\Delta\delta$  47''.4; resulting corrections to G. C. in R.A. and N.P.D. +32'.2, +5' 50''. No other nebula found near the place. [See Dreyer, p. 392.]
214. Apparently identical with DM. +12° 2249; DM. +12° 2248 n p;  $\Delta\alpha$  27'.4,  $\Delta\delta$  20''.8. [See next note.]
216. Identical with DM. +12° 2253; DM. +12° 2248 s p;  $\Delta\alpha$  3<sup>m</sup> 13'.8,  $\Delta\delta$  499''.9. [This looks as if the DM. declinations of Nos. 2248 and 2249 should be exchanged; see last note.]
220. An extremely faint star nearly north;  $p$  356°.52,  $s$  90''.99.
221. Star, 12 magn., p neb;  $p$  239°.84,  $s$  95''.89.
224. Resulting corrections to G. C. in R.A. and N.P.D. —0'.4, —7''.
225. Resulting corrections to G. C. in R.A. and N.P.D. +2'.3, —5''.
- 227, 228. These two (or three) nebulae are eF or eeF; they would hardly have been suspected without close attention.
235. DM. +5° 2472 n f what looks like a somewhat nebulous star, 12 magn.;  $\Delta\alpha$  14',  $\Delta\delta$  214''.4; if this star is G. C. 2355, the resulting corrections to G. C. in R.A. and N.P.D. are about +9', —4'.
238. Resulting corrections to G. C. in R.A. and N.P.D. about +1'.7, +0'.6.
239. W. xi 202 s f neb;  $\Delta\alpha$  31'.27,  $\Delta\delta$  368''.09; the R.A. of W. xi 202 (and 206) is 1<sup>m</sup> too small; resulting corrections to G. C. in R.A. and N.P.D. —0'.6, —0''.8. [See Errata, W., p. xlvii. of second catalogue.]
240. Somewhat like a planetary nebula; spectrum continuous, vF; line suspected at about 14.00 of the spectroscopic scale [ $\lambda$  5250±].
250. W. xi 442 s f neb;  $\Delta\alpha$  1<sup>m</sup> 38'.30,  $\Delta\delta$  448''.76. [The place for 1860 given in Table VIII. results from this comparison.]
- 251, 252. [The places for 1860 given in Table VIII. result from a comparison between the two nebulae, and one of the following nebula (252) with W. xi 420, which is s p the nebulae.] For the nebulae  $\Delta\alpha \cos \delta$  and  $\Delta\delta$  are respectively 117''.50 and 49''.58; for the nebula and star, 137''.38 and 299''.62.
255. With power 141, the direction of a brush on both sides of the nebula is 54°; observation very doubtful. No star conveniently placed for measurement with the nebula.
258. DM. +2° 2520 n f neb;  $p$  43°.42,  $s$  116''.12.
259. G. C. 2785 p G. C. 2821 3<sup>m</sup> 20' (by one comparison), on same parallel.



260. The whole nebula does not exceed in light a star of 11 magn.; a star, 10.5 magn., n p neb;  $\Delta\alpha \cos \delta 114''.73$ ,  $\Delta\delta 132''.15$ .
262. W. XII 130 s p neb; the  $\Delta\alpha$  and  $\Delta\delta$  are approximately  $6''.5$  and  $7''$ ; resulting correction to G. C. in R.A.  $+4''$ . [The object appears to be identified as G. C. 2813.]
263. Elongation decided. [See note on 259.]
264. Resulting corrections to G. C. in R.A. and N.P.D.  $-0''.2$ ,  $-61''$ .
- 265, 266. No nebula exactly in the place of G. C. 2833 relatively to G. C. 2821. The last of the two observed nebulae is probably identical with G. C. 2833. [The place given for the first in Table VIII. is derived from the comparison with G. C. 2821.]
267. [In the original record, the observation is entered as one of 3831; but the circle readings make it probable that 2831 was meant, and that G. C. 2834 was the nebula actually observed. The description given agrees on the whole as well with that of G. C. 2834 as with that of G. C. 2831.]
270. Spectrum continuous, faint, mottled. Small star following on the edge; spiral seen.
- 271-280. [The places given for these nebulae (except No. 276, G. C. 2853) are derived from two comparisons of the entire series with the principal component of 17 Virginis, made Feb. 18, 1868; for the numbering of the series, see Dreyer, p. 393, where, however, we should read 5632 for 5563. This nebula, No. 5632, was compared only with G. C. 2852.] A double star, both components 11 magn., distance  $10''$ , was observed with the nebulae, its resulting place for 1860 being  $12^h 13^m 16^s.5$ ,  $+6^\circ 4' 28''$ .
281. Nucleus not in middle; texture like [nebula in] Andromeda, smooth, shiny; somewhat r. Spectrum continuous, bright; C. S. P. suspects a line also, J. W. not.
283. Resulting corrections to G. C. in R.A. and N.P.D.  $-4''$ ,  $-18''$ .
- 284, 285. [Observed by mistake for a comet; identification imperfect. See Dreyer, p. 394, for correction to N.P.D. of G. C. 2972.]
286. Distinct continuous spectrum; middle of it about the reading 16.00 of the spectroscope scale [ $\lambda 5020\pm$ ].
287. W. XII 380 ( $= \Sigma 1648$ ) s f neb;  $\Delta\alpha 1^m 36^s.20$ ,  $\Delta\delta 223''.10$ ; resulting corrections to G. C. in R.A. and N.P.D.  $-0''.2$ ,  $+13''$ .
290. Is perhaps composed of several very faint stars, but hardly seems so. [The object was observed by d'Arrest as a nebula. Its place in Table VIII. depends on the comparison there given with G. C. 3020.]
293. Star n p neb;  $\Delta\alpha \cos \delta 89''.36$ ,  $\Delta\delta 87''.96$ . W. XII 378 (slightly red) n p neb;  $\Delta\alpha 5''$ ,  $\Delta\delta 11''$ ; corrections in R.A. and N.P.D. to G. C. resulting from these approximate determinations  $+0''.5$ ,  $+46''$ .
294. Star n f neb;  $\Delta\alpha \cos \delta 15''.07$ ,  $\Delta\delta 38''.47$ ; star s f neb;  $\Delta\alpha \cos \delta 75''.80$ ,  $\Delta\delta 50''.32$ ; relative places of the two stars;  $\Delta\alpha \cos \delta 56''.43$ ,  $\Delta\delta 92''.88$ .
295. No spectrum certainly visible; perhaps faint light in patches.
296. Ill defined, but perhaps broader at northern than at southern end; sometimes looks triangular. One or two small stars indistinctly seen in it (one pretty certainly toward southern end, with a brighter one s p, just outside the nebula); but they hardly look like nuclei, having no condensation about them. W. XII 413 s f neb;  $\Delta\alpha 24''.10$ ,  $\Delta\delta 175''.15$ ; resulting corrections to G. C. in R.A. and N.P.D.  $+2''.1$ ,  $-39''$ .
299. Description by C. S. P. confirmed by J. W.; very extraordinary discrepancy from description of Sir J. F. W. Herschel [a sketch in the original shows a curved connection between the two principal nebulous masses, which are presumably G. C. 3103 and 3109, both described in G. C. as very faint]. Spectrum continuous, faint, mottled.
300. Resulting corrections to G. C. in R.A. and N.P.D.  $+3''.3$ ,  $-9''$ .
301. Spectrum continuous, cB; black band in nebula, seen also by both observers in spectrum.
309. [The place of this nebula is indicated only as s f G. C. 3193. It may be a new one; G. C. 3225 is in the required direction, however. Possibly there is an error in the place of G. C. 3199 (which d'Arrest could not find), so that it may be identical with the nebula here observed.]
313. Nucleus shows appearance of a double star, but is not separable, perhaps not even stellar. Crescent-shaped blackness below it.
314. C. S. P. thought it had bright points.
315. Very peculiar dark place near nucleus; perhaps a ring. Spectrum continuous; vF (J. W.), vB (C. S. P.).
320. Spectrum of central portion continuous, vB; no spectrum obtained of ring or spiral part.
324. Clouds prevented measurement of position. [The place given in Table VIII. depends on the estimate there entered, which was made by the observer from memory.]
327. G. C. 3902 n p neb;  $p 352''.01$ ; this nebula looks perfectly simple; no appearance of any companion other than G. C. 3902. [See G. C. 3905.]
328. [If this nebula, which was found in looking for a comet, is G. C. 4055, the corrections to G. C. in R.A. and N.P.D. resulting from the observation are  $-23''$ ,  $-7''$ . The correction in N.P.D. will disappear if the nebula is south of the star instead of north of it, as stated.]
330. [Resulting corrections to G. C. in R.A. and N.P.D.  $+1''$ ,  $-21''$ ; undoubtedly within limit of error of observation.]
333. The color of the new component is blue. The estimated magnitudes of the four components are 7, 8.5, 12.5, 13, the last being the new one. J. W. suspected it independently. Measures of its place relatively to the component of 8.5 magn.; S. P. L. obs.,  $p 281^\circ 49'$ ,  $s 1''.86$ ; J. W. obs.,  $p 277^\circ 10'$ . Measures of the second and third components relatively

to the first, of 7 magn.; S. P. L. obs.,  $p\ 213^{\circ}.37', s\ 11''.20; p\ 26^{\circ}\ 39'$ . Measures of two other stars in the nebula with respect to the chief component; S. P. L. obs.,  $\Delta\alpha \cos \delta +92''.2, +119''.2; \Delta\delta +68''.2, +237''.9$ . [For identifications, see Table IX.] Seeing very good at first, becoming much worse as the nebula approached the horizon.

334. Place of fourth relatively to third component of multiple star, G. M. S. obs.;  $p\ 275^{\circ}\ 20', s\ 2''.81$ . [Description of nebula by S. P. L.; for identifications of stars, see Table IX.] The nebula is brightest at  $a$ . It passes through  $l$  and  $f$ , which are, if anything, a little outside of its confines. The prolongation below  $i$  is very faint. It diminishes from  $a$  very slightly and uniformly towards  $d$ . The prolongation in the region following  $a$  is extremely faint. It runs up to a point  $s$  and a little on the  $p$  side of  $e$ , at a distance from  $e$  about equal to that between  $a$  and  $e$ , and from its apex down to  $e$  [letter somewhat doubtful, possibly  $a$  is meant] again is better defined. The star  $a$  is involved in a faint nebulosity which bridges the dark channel. The region about  $a, k, j$ , is somewhat brighter than that in the triangle  $d, e, l$ ;  $j$  and  $g$  are a little within the nebulosity, which is lost near  $c$ . The  $s\ p$  region, devoid of stars, is perhaps the brightest part of the nebula, the dark channel over  $a$  appearing relatively well defined. The bright star  $m$  is near the extreme northerly confines of the nebula, which fades away on the  $p$  side of it. There is no approach to real definition in any part of the boundary of the nebula, and the expressions used above with regard to definition must be understood as relative to the still more confusing indistinctness of the general surface. Just north of this nebula there is another. The whole heavens in this vicinity are dubiously nebulous.

335. Observed just south of line joining  $a, e, d$ , a faint straight narrow channel nearly filled up with nebulous matter. Was less confident to-night that the nebula surrounds the quadruple star, which seemed to be in the channel, with blackness on each side, less in the  $p$  than  $f$  [the last clause no doubt referring to the place of the star, not of the blackness]. The star  $o$  has a faint but distinct companion in the  $s\ f$  quadrant. J. W. observed a similar but much fainter companion to  $n$ , only to be seen well by indirect vision and not quite as distant. [For identification of the stars observed, see Table IX. Measures of relative position of stars were made on Aug. 5 and 6, as well as on Aug. 11, and are entered together in this place.] Aug. 5, fourth relatively to second component of multiple star; J. W. obs.,  $p\ 282^{\circ}\ 9', s\ 2''.91$ ; B. Peirce obs.,  $p\ 281^{\circ}\ 40'$ ; G. M. S. obs.,  $p\ 277^{\circ}\ 36', s\ 2''.25$ ; second and third components relatively to first, G. M. S. obs.;  $p\ 214^{\circ}\ 1', 23^{\circ}\ 12'; s\ 10''\ 46, 6''\ 20$ . Aug. 6, S. P. L. obs., various stars with respect to the principal component of multiple star;  $\Delta\alpha \cos \delta$  and  $\Delta\delta$ ;  $b, -104''.8, +209''.8$ ;  $c, +118''.7, +238''.2$ ;  $i, +169''.2, +113''.0$ ;  $f, +99''.0, +66''.3$ ;  $g$  (star faint, measure uncertain),  $+50''.5, +118''.2$ ;  $h$  (star faint, measure uncertain),  $+11''.0, +176''.6$ ;  $j, +26''.1, +74''.6$ ;  $l, +84''.1, +37''.9$ ;  $e, +68''.5, -37''.8$ ;  $d, +159''.9, -76''.0$ . Aug. 11, S. P. L. obs., measures in  $\Delta\alpha \cos \delta$  and  $\Delta\delta$  as above:  $b, -101''.4, +211''.8$ ;  $c, +119''.6, +235''.8$ ;  $i, +169''.1, +115''.5$ ;  $f, +102''.9, +70''.1$ ;  $n, +345''.4, +23''.0$ ;  $o, +412''.4, -9''.2$ ;  $m, -285''.1, +253''.2$ ; bright star north of  $c, +124''.4, +449''.1$ .

336. Definition excellent just at close of twilight. The new component is south of the others. Its distance from the second component is estimated from  $\frac{1}{3}$  to  $\frac{1}{10}$  less than that from the first to the third. A very minute star also seen about  $20''$  farther south. Distance between second and fifth components measured later by J. W.; result  $5''.10$ . Measure [by S. P. L. ?] of star  $k$  in  $\Delta\alpha \cos \delta$  and  $\Delta\delta$  as on Aug. 11; result  $-66''.5, +88''.2$  (very difficult measurement). [For identifications of stars, see Table IX.]

337. The dark channel above  $a$  is not parallel to the line joining  $k$  and  $a$  as sketched on Aug. 2, but has a somewhat smaller position angle. It is not certain that there is any nebulosity about  $a$ . The little patch of darkness above  $a$  pointing in the  $s\ p$  direction is larger every way than represented on Aug. 2, and less definite. An absence of nebulosity was seen or suspected in the part of the  $s\ p$  region [about  $10^{\circ}$  to  $15^{\circ}$  preceding the multiple star, and forming a channel some  $5''$  wide, running  $n$  and  $s$  through the southern part of the nebula.] The whole nebula in this region is of the last degree of tenuity, and no specific form or outline can be assigned to it with certainty. Yet it seems probable that the nebula only fades entirely away to the preceding side of this break in its continuity. The entire region above (apparently)  $a$  [directly south of the multiple star, and following the portion last described] is judged as before to be the brightest part of the nebula, or nearly so. North of the star  $c$  it is as certain as anything about the nebula that there is a uniform blackness separating the upper and lower divisions entirely. The whole northern part of the nebula as figured by Mason (the part north of the Trifid proper) has hardly any more separate existence as a nebula than any other equal portion of space in the vicinity, which is all faintly nebulous. This northern part, involving the conspicuous star [Herschel's  $\beta$ , Mason's No. 22], is very faint and very widely diffused. It is diffuse and formless even by comparison with the rest of the Trifid, and the drawing by Mason bears no resemblance to what is seen this evening. The channel above  $a, e, d$ , is rather suspected than seen. The conspicuous star to the north [Herschel's  $\beta$ , Mason's No. 22] has a dark channel above and below it with thicker nebulous matter on either side. This last observation confirmed by J. W. [For identification of stars, see Table IX.]

338. Position angle of fourth from second component of multiple star  $274^{\circ}.7$  (single setting, without illumination; seeing bad).

339. Same thing seen (with some little doubt) by C. S. P. Yet he was certain of seeing a bright place move when the field was illuminated. The spectrum extended to 27.00 of the spectroscopic scale (J. W.), to 26.67 (C. S. P.);  $\lambda\ 4280 \pm (W.)$ ,  $4290 \pm (P.)$ .] Another nebula close to large cluster [probably an adjacent part of G.C. 4355]; one bright line seen by C. S. P. at 16.92 [ $\lambda\ 4980 \pm$ ].

340. Nebula identified with W. XVIII 85; W. XVIII 92 n f neb;  $\Delta\alpha \cos \delta\ 213^{\circ}.31, \Delta\delta\ 33''.26$ ; resulting  $\Delta\alpha\ 14''.32$ ;  $\Delta\alpha$  from Weisse  $14''.36, \Delta\delta$  (for 1860)  $30''.3$ ; mean resulting corrections to G. C. in R.A. and N.P.D.  $+0''.7, -18''$ . Telescope unsteady in  $a$ .

341. Oeltzen 18197 s f neb;  $\Delta\alpha \cos \delta\ 71''.79, \Delta\delta\ 98''.16$ ; resulting corrections to G. C. in R.A. and N.P.D.  $-1''.1, +5''$ . Telescope unsteady in  $a$ , owing to wind.

342. Reading of spectroscope scale  $16.69 [\lambda 4990 \pm]$ .
344. [The second line] slightly more refrangible than the other [principal] line, and perfectly unmistakable. The two lines were also seen by A. G. Clark and A. Searle.
348. Resulting corrections to G. C. in R.A. and N.P.D.  $+1^{\circ}.3, -0^{\circ}.2$ .
353. Blotchy and curdled; occasional appearances of resolution.
355. Edges not very well defined; n f part the brightest. Power 141.
356. Place compared by G. M. S. with that of a star, 10 magn., close by; star n p neb;  $\Delta\alpha \cos \delta 3''.97, \Delta\delta 46''.33$ ; resulting  $\Delta\alpha 0^{\circ}.28$ . [DM.  $+19^{\circ} 4387$  is in the immediate neighborhood, and may be identical with the brightest of the stars mentioned in the note on No. 358; probably not with this star or with the nebula itself.]
357. Spectrum; 1 line at 16.09 of scale (C. S. P.)  $[\lambda 5010 \pm]$ ; faint in moonlight.
358. Nebula in cluster of small stars; four stars about it; the brightest is the most preceding, and farthest north but one; nebula s f this star and nearly in the same R.A. as the star s f this star; nebula in same declination as the most following of the four stars;  $\Delta\alpha \cos \delta 7''.35, \Delta\delta 10''.29$ ; nebula s of star. [It is not stated to which of the four stars this measurement applies.]
359. Observations by J. W.; double star seen; also a single star in the middle; another afterwards seen; both imbedded in the nebula, which appears hollowed out on the side towards the double star. Of the two stars in the nebula, the fainter precedes;  $p 247^{\circ} 42'$ ; the fainter component of the double star is south of the other;  $p 186^{\circ}$ ; distance of the stars in the nebula from the bright component of the double star  $54''.3$ ; [possibly a measure of  $\Delta\alpha \cos \delta$  or of  $\Delta\delta$  instead of distance;] power 316. Observations by G. M. S.; nebula appears oval; the two bright points in it may perhaps be concentrated nebula instead of stars.
360. Observations by J. W.; nebula examined with powers 141, 206, 316, 401; projection on each side in nearly an equatorial direction; preceding limb highest. The projections or wings are very light nebulous matter; the ellipticity very decided. These features are much more distinct with the high power. Observations by G. M. S.; power 401; appearance of globe with brighter elliptic nebulous matter placed upon it, and a ring besides, seen nearly edgewise. The major axis of the ellipse is about equal to the diameter of the globe. A very faint satellite on the following side a little above the ring.
361. Finest nebula spectrum ever seen here. Observations by J. W.; two lines on right of unequal brilliancy, and a fine one to left. Observations by C. S. P.; places of lines on spectroscope scale: brightest line twice measured, 16.71, 16.73; middle line 17.17; faintest line 18.40  $[\lambda 4990 \pm, 4970 \pm, 4820 \pm]$ .
363. Fourth line suspected farther to the right; distance from third line estimated by J. W. and by G. B. Clark equal to that from first to third line; by C. S. P., somewhat greater.
364. Fourth line not seen, after very careful examination with both powers. Places of lines on spectroscope scale; third line 17.50  $[\lambda 4870 \pm]$  (wires may be a little to the left; clouds interfere); first line corresponds exactly with air line at 16.00  $[\lambda 5020 \pm]$ ; second line could not be measured on account of clouds.
365. Diffused but moderately bright light from 12.23 to 20.92 of the spectroscope scale  $[\lambda 5520 \pm \text{ to } 4610 \pm]$ .
366. All the stars green, yellowish.
367. Star n f neb;  $p 56^{\circ}.67, s 148^{\circ}.47$ .
371. An approximate comparison of the nebula with  $\nu$  Aquarii, made the next day (Sept. 28, 1867), makes its place for  $1860 22^{\circ} 21' 56'', -21^{\circ} 33' 22''$  [the G. C. place, resulting from a heliometer observation a few years earlier, is doubtless more accurate; the differences,  $10''$  and  $22''$ , are not larger than would be expected].
372. This is the nebula observed by Rosse (G. C. 4799) [see also Dreyer, p. 398]. J. W. and C. S. P. confirm Rosse's description "E n p to s f."
374. A little E, principally p to f, a little s to n (C. S. P. obs.); in the direction of a long line of stars at the end of which is the nebula (J. W. obs.).
375. Diffuse, somewhat mottled; nebulous star  $6' n f$  neb; star, 9 to 10 magn., p neb about  $2'$ , in the same declination with the northern part of the nebula. Nebula too vague for measurement. [Sky] looks nebulous s of nebula. Nucleus seen by E. P. A.
377. E. P. A. thinks it certainly a star.
378. Difference of declination between this and G. C. 4909,  $100''.7$ .
379. Minute object s p neb about  $3'$ , suspected to be a double star; not resolved; identified with G. C. 4906 [see last note].
380. An e S neb  $3' \pm s p$  [G. C. 4906]. The small neb resembles the large one [in elongation?]. No spectrum visible.
381. Small star n f neb;  $\Delta\alpha \cos \delta 111''.69, \Delta\delta 11''.46$ .
382. [Object] s p G. C. 4934  $2'$ ; eeF; perhaps a star. G. C. 4934 and 4940;  $\Delta\delta 403''.7$  [record somewhat doubtful].
384. G. C. 4936 n f;  $\Delta\alpha 5^{\circ}.7, \Delta\delta$  about  $3'$ .
388. G. C. 4940 p in same declination;  $\Delta\alpha 44^{\circ}.0$ . G. C. 4942 is probably identical with this nebula. [See d'Arrest, p 370.] Measures of one of the 3 stars n p neb;  $\Delta\alpha \cos \delta 271''.2, \Delta\delta 75''.7$ .
389. Star s p neb about  $1'.5$ ; n p this star about  $1'.5$  is a nebulous object; with power 206 it seems to be a nebulous double star.
390. Edges about as definite as Jupiter's. Two other observers also considered the color to be green, much deeper under illumination than without; they thought that there was a shadow or a darker shade of color on the n f side. Direc-



tion of major axis;  $p\ 57^\circ$  (J. W. obs.),  $p\ 45^\circ$  (G. M. S. obs.). Major and minor axes  $31''.0$ ,  $25''.5$  (J. W. obs.),  $26''.8$ ,  $21''.8$  (G. M. S. obs.). Power 141 used by both observers.

391. Two edges seen by J. W. and G. M. S., as of a brighter nebula placed over a dimmer one. The brighter and fainter ellipses have major axes slightly differing in direction; the brighter having the position angle of its major axis  $10^\circ$  to  $15^\circ$  the larger (J. W. obs.);  $20^\circ$  to  $30^\circ$  according to a less careful estimate by G. M. S., to whom the northern side appears brighter; appearance to J. W. that of a hollow cylinder with one end turned nearly towards the observer. Small star n f neb;  $p\ 62^\circ 2'$ ,  $s\ 52''.63$  (G. M. S. obs.); position measured with wires tangent to nebula, distance from centre of nebula. Direction of major axis (power 141, no illumination),  $p\ 45^\circ 56'$  (J. W. obs.),  $34^\circ 26'$  (G. M. S. obs.); major and minor axes  $24''.40$ ,  $22''.54$  (G. M. S. obs.); not so trustworthy as the measures of the previous night, owing to variable haze; an earlier measure of the minor axis this night was  $25''.28$ .

392. Not so well defined at the edges as before; less bright in the centre than at the edges (J. W. obs.). Direction of major axis (power 316, no illumination),  $p\ 31^\circ 39'$  (J. W. obs.),  $37^\circ 49'$ ,  $47^\circ 24'$  (two observations by G. M. S.),  $16^\circ 24'$  (W. M. Davis obs.). Satellite [small star n f neb?];  $p\ 63^\circ 24'$  (J. W. obs.),  $s\ 51''.65$  (G. M. S. obs.). Major and minor axes (G. M. S. obs., taking  $35^\circ$  as the position angle of the major axis),  $27''.44$ ,  $27''.05$ ; nebula much fainter during measure of major axis.

393. A still finer object than G. C. 4628. Places of lines on spectroscope scale; brightest  $16.86\ [\lambda\ 4900\pm]$ ; middle  $17.18\ [\lambda\ 4960\pm]$ ; faint line  $17.84\ [\lambda\ 4890\pm]$ ; this may be another setting on the middle line; the record is somewhat doubtful.

394. Places of lines on spectroscope scale; brightest line  $16.07$ ,  $16.01$  (C. S. P. obs.),  $16.05$  (E. P. A. obs.); second line  $16.47$  (C. S. P. obs.)  $[\lambda\ 5020\pm, 4990\pm]$ . The brightest line corresponds pretty nearly with the bright line next towards the violet from  $b$ , except one rather faint line near it. This is a little nearer  $b$  than the nebula line. On the whole C. S. P. thinks the lines coincide, and J. W. can see no difference between them.

395. Fourth line  $\frac{1}{4}$  to  $\frac{1}{2}$  more to right of third than third from first; seen also by glimpses by C. S. P. and by G. B. Clark. J. W. also saw diffused light from third to fourth line. The spectroscope was then put on the finder, without cylindrical lens, and three lines seen, very bright, short, and small.

396. Places of lines on spectroscope scale; 1st,  $16.12$ ,  $16.04$  (improved very decidedly at second measure)  $[\lambda\ 5020\pm]$ ; coincides with air line; 2d,  $16.62\ [\lambda\ 4960\pm]$ ; 3d,  $17.53\ [\lambda\ 4870\pm]$ ; plainer than in G. C. 4628; wires and line seen at the same time; 4th,  $19.95$ ,  $19.94\ [\lambda\ 4690\pm]$ ; further observations prevented by clouds.

398. B star s f neb;  $\Delta\alpha\ 10^\circ 90$ ;  $\Delta\delta\ 203''.60$ . [This star is presumably W. xxiii 599; in that case, the corrections to G. C. in R.A. and N.P.D. resulting from the comparison are  $+1^\circ 6$ ,  $+15''$ .]

399. [But Rosse says (Phil. Trans. 1861, p. 736), with regard to G. C. 4993, or h 2257, "Nucleus; a F neb f about  $2''$ "; hence two distinct nebulae were apparently observed in this place.]

402. Smaller nucleus n f principal one; star involved in nebula, s f principal nucleus, with which it was compared as follows:  $p\ 104^\circ 82$ ,  $s\ 71''.76$ .

#### NOTE ON THE TRIFID NEBULA.

The drawing of the Trifid Nebula by Mr. L. Trouvelot, already published in these Annals (Vol. VIII. Plate X. and Part II. Plate 32) represents one hundred and four of the stars in and about the nebula, laid down carefully by means of a glass plate ruled in squares and inserted in the eyepiece. The relative places of these stars may be presumed to be much more correctly given in this figure than they would be in a mere sketch made without other lines of reference than such as might be afforded by the stars themselves. It has therefore been thought worth while to form a catalogue of the stars observed in this region by Mr. Trouvelot, and to compare with his results those obtained by other observers, either with or without the aid of micrometric measures. The comparison is given in Table IX.

The material available for the purpose is as follows:—

1. Sir J. F. W. Herschel's list of stars (Cape of Good Hope Observations, p. 11). Twenty-one of the positions are derived only from a drawing, and there is an uncer-



tainty about the measures of the star  $\kappa$ ; perhaps the measured star was Lassell's No. 10 and the charted one Lassell's No. 33 (Nos. 56 and 67 of Table IX.). Only four other stars were referred by actual measurement to the chief star of the nebula; these are  $\epsilon$ ,  $\theta$ ,  $\beta$ , and  $\eta$  (Nos. 31, 69, 73, and 78 of Table IX.). The date of the observations is 1835.

2. Mason's list of twenty-nine stars, including the chief star of the nebula and a distant reference star (Mem. Am. Phil. Soc., VII. pp. 185–194). The places determined by measurement with respect to the distant star are those of Nos. 2, 8, 9, 19, 21, 22, 25, 28 of this list (Nos. 31, 43, 45, 69, 70, 73, 78, 90 of Table IX.); the remaining places were obtained from a drawing. These observations were made in 1839.

3. Lassell's list (Mem. R. A. S., XXXVI. p. 49) of nine stars referred to the chief star of the nebula by measurement. The chart of the nebula also given by Lassell enumerates many additional stars, the places of which might, if desirable, be measured from the chart, but are not otherwise given. Some of these stars do not occur in Mr. Trouvelot's chart. Mr. Lassell observed the nebula in 1862.

4. The Harvard College observations, mostly by Mr. S. P. Langley, already given in Table VIII. and the notes connected with it, and made in 1866.

5. Professor E. S. Holden's measurements of nine stars (Am. Journal of Science, Vol. CXIV. p. 444), made in 1877.

The first columns of Table IX. contain a number for reference, and the designations of the various stars by Herschel, Mason, Lassell, and Langley, in the works above mentioned. The identifications of the stars merely charted by the older observers are not always satisfactory, and notes of interrogation are attached to the designations in some of the most doubtful cases. It cannot, perhaps, be decided whether Herschel's  $\phi$  is No. 92 or No. 95 of Table IX. The next two columns contain the results of the measurements in right ascension and in declination made upon a copy of Plate X. (Vol. VIII. of these Annals) by means of a scale of seconds of arc. Each position is referred to the chief star of the nebula, No. 45, the place of which is entered as 1000" in each of the two columns, in order to avoid the necessity of positive and negative signs, and to facilitate the application of the residuals in the following columns of the table. The numbers increase, as usual in measurements of right ascension and declination, from preceding to following, and from south to north. The remaining columns contain residuals formed by subtracting the values just given from corresponding values obtained respectively from the lists of Herschel, Mason, Lassell, Langley, and Holden, already cited. In reducing the differences of right ascension given by Herschel and Mason to the required form ( $\Delta\alpha \cos \delta$  in

seconds of arc) it has been thought unnecessary to pay regard to the differences of declination among the stars, and the cosine of  $23^\circ$  has been used throughout in the reductions. Lassell's observations of position angle and distance have been reduced merely by the multiplication of the distance by the sine and by the cosine of the angle. The mean value of the Harvard College observations has been adopted when more than one measurement of the same interval was made. The results found by Holden are often means derived from several observations, and, in a comparison with other measurements of the same kind, would be expressed in fractions of a second of arc; but for the present purpose the nearest whole second has been adopted.

It seems from Table IX. that the chart of Mr. Trouvelot ordinarily approaches the micrometric measurements of the other observers in precision, and that it may fairly be regarded as on the whole correct to about  $5''$ .

It may be well to collect, in this place, the various measures of the multiple star given in Table VIII. and its notes. The components will be designated by their numbers in Table IX.

Date.	Obs.	Position angle of No. 39 from No. 43.		Distance of Nos. 39 and 43.
1866 July 31.	S. P. L.	281	49 (3 settings).	1.86 (2 settings).
	J. W.	277	10 (5 " ).	
Aug. 2.	G. M. S.	275	20 (4 " ).	2.81 (3 " ).
Aug. 5.	J. W.	282	9 (3 " ).	2.91 (3 " ).
	B. Peirce.	281	46 (3 " ).	
	G. M. S.	277	36 (3 " ).	2.25 (3 " ).
1868 Sept. 16.	C. S. P.	274	42 (1 setting; no illumination).	
		Position angle of No. 43 from No. 45.		Distance of Nos. 43 and 45.
1866 July 31.	S. P. L.	213	37 (3 settings).	11.20 (3 settings).
Aug. 5.	G. M. S.	214	1 (3 " ).	10.46 (3 " ).
		Position angle of No. 48 from No. 45.		Distance of Nos. 48 and 45.
1866 July 31.	S. P. L.	26	39 (3 settings).	
Aug. 5.	G. M. S.	23	12 (3 " ).	6.20 (3 settings).

The distance of No. 42 from No. 43 was measured by J. W., 1866, Aug. 13, as  $5''.10$ ; there is no measure of position angle.

The position angle and distance of No. 43 from No. 45 were measured by South in 1823, with the results  $208^\circ 15'$ ,  $10''.95$  (Phil. Trans., 1824, Part III., p. 412); and the position angle by Herschel in 1835 (Cape of Good Hope Observations, pp. 228, 130), with the result  $211^\circ.3$ ; the accompanying distance ( $15''$ ) is estimated, not measured. At the same time the position angle of No. 48 from No. 45 was found to be  $21^\circ.1$ , with the estimated distance  $5''$ . There appears to be an increase of the position angle of No. 43 from No. 45 (1823,  $208^\circ$ ; 1835,  $211^\circ$ ; 1866,  $214^\circ$ ); but as the early

measures depend only on single settings, the increase may not be real. The Cincinnati Observations of 1877 (Publication No. 4 of the Cincinnati Observatory, pp. 40, 41) give  $213^{\circ}.2$  for this position angle; and  $21^{\circ}.1$  for that of No. 48 from No. 45, agreeing with Herschel's measure of 1835, but not with the Harvard College observations of 1866. For the position angle of No. 39 from No. 43, the Cincinnati result is  $276^{\circ}.2$ . The three corresponding distances are  $10''.60$ ,  $5''.08$ ,  $2''.23$ .

TABLE IX.

COMPARISON OF OBSERVED PLACES OF STARS IN THE TRIFID NEBULA (G. C. 4355).

No.	Designation by				$\Delta\alpha \cos \delta$ Trouv.	$\Delta\delta$ Trouv.	Residuals from Trouvelot's $\Delta\alpha \cos \delta$ .					Residuals from Trouvelot's $\Delta\delta$ .				
	h.	Mn.	Ls.	Ly.			h.	Mn.	Ls.	Ly.	Hn.	h.	Mn.	Ls.	Ly.	Hn.
1	..	..	..	..	519	1153	..	..	..	..	..	..	..	..	..	..
2	..	..	..	..	541	782	..	..	..	..	..	..	..	..	..	..
3	..	..	..	..	571	1204	..	..	..	..	..	..	..	..	..	..
4	..	..	..	..	582	1214	..	..	..	..	..	..	..	..	..	..
5	..	..	..	..	583	1011	..	..	..	..	..	..	..	..	..	..
6	..	..	..	..	601	1278	..	..	..	..	..	..	..	..	..	..
7	..	..	..	..	610	1317	..	..	..	..	..	..	..	..	..	..
8	..	..	..	..	612	1548	..	..	..	..	..	..	..	..	..	..
9	..	..	..	..	623	1118	..	..	..	..	..	..	..	..	..	..
10	..	..	..	..	627	1192	..	..	..	..	..	..	..	..	..	..
11	..	..	..	..	640	622	..	..	..	..	..	..	..	..	..	..
12	..	..	..	..	668	1284	..	..	..	..	..	..	..	..	..	..
13	..	..	..	..	686	864	..	..	..	..	..	..	..	..	..	..
14	..	..	8	m	705	1270	..	..	+ 1	+ 10	..	..	..	- 11	- 17	..
15	..	..	..	..	713	1798	..	..	..	..	..	..	..	..	..	..
16	..	..	..	..	734	616	..	..	..	..	..	..	..	..	..	..
17	..	..	..	..	735	799	..	..	..	..	..	..	..	..	..	..
18	..	..	47	..	752	1228	..	..	..	..	..	..	..	..	..	..
19	..	..	41?	..	755	1078	..	..	..	..	..	..	..	..	..	..
20	..	..	..	..	763	612	..	..	..	..	..	..	..	..	..	..
21	..	..	..	..	789	1758	..	..	..	..	..	..	..	..	..	..
22	..	..	..	..	805	1310	..	..	..	..	..	..	..	..	..	..
23	..	..	..	..	806	1776	..	..	..	..	..	..	..	..	..	..
24	..	..	..	..	814	1664	..	..	..	..	..	..	..	..	..	..
25	..	..	44?	..	819	1084	..	..	..	..	..	..	..	..	..	..
26	..	..	..	..	832	1672	..	..	..	..	..	..	..	..	..	..
27	..	..	..	..	840	602	..	..	..	..	..	..	..	..	..	..
28	..	..	..	..	842	1464	..	..	..	..	..	..	..	..	..	..
29	..	..	51	..	854	1270	..	..	..	..	..	..	..	..	..	..
30	..	..	50	..	858	1240	..	..	..	..	..	..	..	..	..	..
31	$\epsilon$	2	4	b	899	1213	- 9	- 2	- 9	- 2	..	- 3	+ 3	+ 4	- 2	0
32	a?	4	21	..	901	949	+ 42	+ 22	- 8	..	..	- 21	+ 12	- 22	..	..
33	c	5	18	k	931	1087	- 26	+ 4	..	+ 3	0	+ 7	- 6	..	+ 1	+ 1
34	..	3	40	..	940	1050	..	- 31	..	..	..	..	- 21	..	..	..
35	..	..	..	..	950	658	..	..	..	..	..	..	..	..	..	..
36	..	..	..	..	961	1147	..	..	..	..	..	..	..	..	..	..
37	..	6	20	..	967	959	..	- 6	..	..	+ 10	..	- 23	..	..	+ 7
38	$\rho$ ?	7	..	..	973	1535	- 62	+ 17	..	..	..	+ 1	- 10	..	..	..
39	..	..	..	$\delta$	987	984	..	..	..	+ 5	..	..	..	..	+ 7	..
40	$\chi$ ?	..	..	..	991	1579	- 48	..	..	..	..	+ 12	..	..	..	..
41	..	..	..	..	992	1696	..	..	..	..	..	..	..	..	..	..
42	..	..	..	$\epsilon$	992	974	..	..	..	..	..	..	..	..	..	..
43	$\gamma$	8	2	$\beta$	994	983	0	- 1	..	0	..	+ 5	+ 8	..	+ 8	..
44	..	..	..	..	998	610	..	..	..	..	..	..	..	..	..	..

No.	Designation by				$\Delta\alpha \cos \delta$ Trouv.	$\Delta\delta$ Trouv.	Residuals from Trouvelot's $\Delta\alpha \cos \delta$ .					Residuals from Trouvelot's $\Delta\delta$ .				
	h.	Mn.	Ls.	Ly.			h.	Mn.	Ls.	Ly.	Hn.	h.	Mn.	Ls.	Ly.	Hn.
45	$\alpha$	9	1	$\alpha, \alpha$	1000	1000	0	0	0	0	0	0	0	0	0	0
46	..	..	..	..	1001	592	...	...	...	...	...	...	...	...	...	...
47	..	..	..	..	1003	996	...	...	...	...	...	...	...	...	...	...
48	$\delta$	10	19	$\gamma$	1004	1007	-3	-4	...	-1	...	-1	-2	...	-1	...
49	b	..	14	$h$	1010	1169	-14	...	+1	+1	+2	+31	...	+8	+8	+5
50	..	..	..	..	1022	1755	...	...	...	...	...	...	...	...	...	...
51	..	..	..	..	1029	1478	...	...	...	...	...	...	...	...	...	...
52	$\nu$	11	12	$j$	1032	1081	-7	-9	...	-6	-6	+5	-9	...	-6	-3
53	..	12	16?	..	1037	770	...	-7	...	...	...	+43	...	...	...	...
54	$\psi$	13	13	$g$	1070	1123	-30	-24	...	-20	-18	+6	-13	...	-5	-3
55	..	..	..	..	1072	647	...	...	...	...	...	...	...	...	...	...
56	$\xi$	16	10	$e$	1073	965	...	-12	+4	-5	...	+1	-12	...	-3	...
57	$\xi$	14	..	..	1074	1361	-15	-16	...	...	...	+2	-12	...	...	...
58	..	..	..	..	1085	1656	...	...	...	...	...	...	...	...	...	...
59	..	..	..	..	1086	561	...	...	...	...	...	...	...	...	...	...
60	..	15?	..	..	1087	1608	...	-26	...	...	...	+3	...	...	...	...
61	$\mu$	17	11	$l$	1087	1038	+4	-14	...	-3	-3	-10	+1	...	0	+1
62	$i$	20	..	..	1088	1708	+12	+13	...	...	...	+8	+1	...	...	...
63	..	..	..	..	1089	1280	...	...	...	...	...	...	...	...	...	...
64	..	..	15?	..	1091	788	...	...	-39	...	...	...	...	-32	...	...
65	$\sigma$	..	..	..	1092	1805	+32	...	...	...	...	-41	...	...	...	...
66	$o$	18	..	..	1093	1347	+12	-10	...	...	...	+11	0	...	...	...
67	$\kappa$	..	33	..	1105	950	0	...	...	...	...	-17	...	...	...	...
68	$\omega$	..	9	..	1106	722	-10	...	...	...	...	-18	...	...	...	...
69	$\theta$	19	6	$f$	1107	1075	-9	-19	...	-9	-6	-5	-10	...	-7	-8
70	$\zeta$	21	3	$c$	1108	1237	-3	+1	+9	+11	...	+3	+3	+6	0	...
71	..	..	55	..	1109	771	...	...	...	...	...	...	...	...	...	...
72	..	..	23	..	1113	891	...	...	...	...	...	...	...	...	...	...
73	$\beta$	22	..	..	1117	1453	+4	+4	...	+7	...	-11	-1	...	-4	...
74	$\pi$	23	..	..	1141	1342	-17	-10	...	...	...	+2	-3	...	...	...
75	..	..	..	..	1145	637	...	...	...	...	...	...	...	...	...	...
76	..	..	17	..	1147	1219	...	...	...	...	...	...	...	...	...	...
77	..	..	26	..	1154	1069	...	...	...	...	...	...	...	...	...	...
78	$\eta$	25	5	$i$	1159	1124	+5	+4	+16	+10	+8	-16	-11	+1	-10	-10
79	$\lambda?$	24	7	$d$	1161	925	+38	-6	+1	-1	...	-55	-5	-7	-1	...
80	..	..	..	..	1163	1542	...	...	...	...	...	...	...	...	...	...
81	..	..	..	..	1165	1736	...	...	...	...	...	...	...	...	...	...
82	..	..	27	..	1179	1151	...	...	...	...	...	...	...	...	...	...
83	..	..	..	..	1185	660	...	...	...	...	...	...	...	...	...	...
84	..	..	..	..	1201	650	...	...	...	...	...	...	...	...	...	...
85	$\tau?$	..	..	..	1202	1804	-41	...	...	...	...	-1	...	...	...	...
86	..	..	28	..	1210	1180	...	...	...	...	...	...	...	...	...	...
87	..	26	..	..	1226	1515	...	+3	...	...	...	...	+44	...	...	...
88	..	..	..	..	1239	1333	...	...	...	...	...	...	...	...	...	...
89	$v$	27	..	..	1255	1606	+42	-26	...	...	...	-29	+43	...	...	...
90	..	28	..	..	1260	718	...	-11	...	...	...	...	+11	...	...	...
91	..	..	..	..	1282	1277	...	...	...	...	...	...	...	...	...	...
92	$\varphi?$	..	..	..	1294	1692	+21	...	...	...	...	+22	...	...	...	...
93	..	..	..	..	1301	762	...	...	...	...	...	...	...	...	...	...
94	..	..	..	..	1320	1241	...	...	...	...	...	...	...	...	...	...
95	$\varphi?$	..	..	..	1336	1762	-21	...	...	...	...	-48	...	...	...	...
96	..	..	..	..	1347	797	...	...	...	...	...	...	...	...	...	...
97	..	29	..	..	1354	1478	...	-31	...	...	...	...	+59	...	...	...
98	..	..	..	$n$	1357	1030	...	...	...	-12	...	...	...	...	-7	...
99	..	..	..	..	1367	1018	...	...	...	...	...	...	...	...	...	...
100	..	..	..	..	1387	1778	...	...	...	...	...	...	...	...	...	...
101	..	..	..	$o$	1432	982	...	...	...	-19	...	...	...	...	+9	...
102	..	..	..	..	1453	1292	...	...	...	...	...	...	...	...	...	...
103	..	..	..	..	1454	964	...	...	...	...	...	...	...	...	...	...
104	..	..	..	..	1508	785	...	...	...	...	...	...	...	...	...	...