

P A P E R S.

I. *Observations of Planets and Nebulæ at Malta.* By WILLIAM LASSELL, F.R.S.

Read November 9, 1866.

THE Telescope with which the following observations were made was constructed by me, principally in the years 1859 and 1860, at my former residence of Bradstones, near Liverpool. It is a Newtonian Reflector equatoreally mounted, on generally the same principle as the 2-foot Equatoreal, of which some account has been given in the *Memoirs* of this Society. The first Plate gives a very correct notion of its general appearance and construction. There are two large specula, of exactly 4 feet clear aperture, and respectively of the foci of 441·8 and 448·1 inches. The length of the tube is 37 feet, and its diameter 4 feet 3 inches, of the lattice or skeleton form, flat bars of iron being joined (with spaces between, nearly equal to the breadth of the bars) by flanchrings at convenient distances. The object of making the tube of this form was to prevent the possibility of any currents of differently heated air in the tube; or of any inequality of the internal and external temperatures—it appeared to answer this end perfectly.

The principle of mounting, even when carried out on this large scale, I consider successful; and I have not been annoyed by any sensible amount of flexure in the frame-work, in the course of its use. Up to the latitude

of Malta, $35^{\circ} 55'$, it answers well; but I should hesitate to erect it in a much lower latitude without some modification. There is no roof or covering over the telescope; but the observer or observers are protected by being placed in one or other of the storeys (according to the altitude of the object to be viewed) of a Tower, which affords a means of getting conveniently at the eye-piece, which, when the telescope points to the zenith, is about 39 feet from the ground.

A staircase within the tower leads to the different storeys, which are about 4 feet 6 inches square, and afford abundant room for papers, micro-meters, eye-pieces, lamps, and any other small apparatus required; beside furnishing to the observer a most grateful shelter from the dew, and occasionally from an inclement wind. During observation, however, the size of the storey in use becomes practically much larger, by the opening of the folding-doors and letting down of the platform, as shown in the engraving; the available space being then about 6 feet 9 by 4 feet 6 inches. The tower is carried round on a circular railway, and has besides, a revolution on its axis, and a radial motion to and from the telescope: so that at most altitudes and hour-angles the eye-piece is easily accessible. It has been usual, however, for the most obvious reasons, to observe within three hours of the meridian, east or west.

I have not attempted to carry on the telescope by a driving clock, properly so called; as the great weight, amounting to many tons on the bearings, makes it a difficult problem. I have, however, a system of wheel-work, terminating in a fly-wheel and winch-handle, which I might almost say answers equally well. The train is so regulated that to give the telescope a sidereal motion it is only necessary to turn this winch-handle once, accurately, in every second. A sort of skeleton-clock giving motion to a loud-beating pendulum, is placed adjacent to the handle; and it is the duty of an assistant (he may be merely a peasant) to take his place at this winch, giving it one revolution for every vibration of the pendulum. The fly-wheel generally insures the uniformity of each revolution, and a very short initial training is generally sufficient to enable the workman to make the revolutions perfectly coincident with the beats of the pendulum. In some respects this mode of driving is superior to the ordinary mode; for it can be instantly interrupted, or accelerated, or retarded at pleasure, when required for any special purpose. The amount

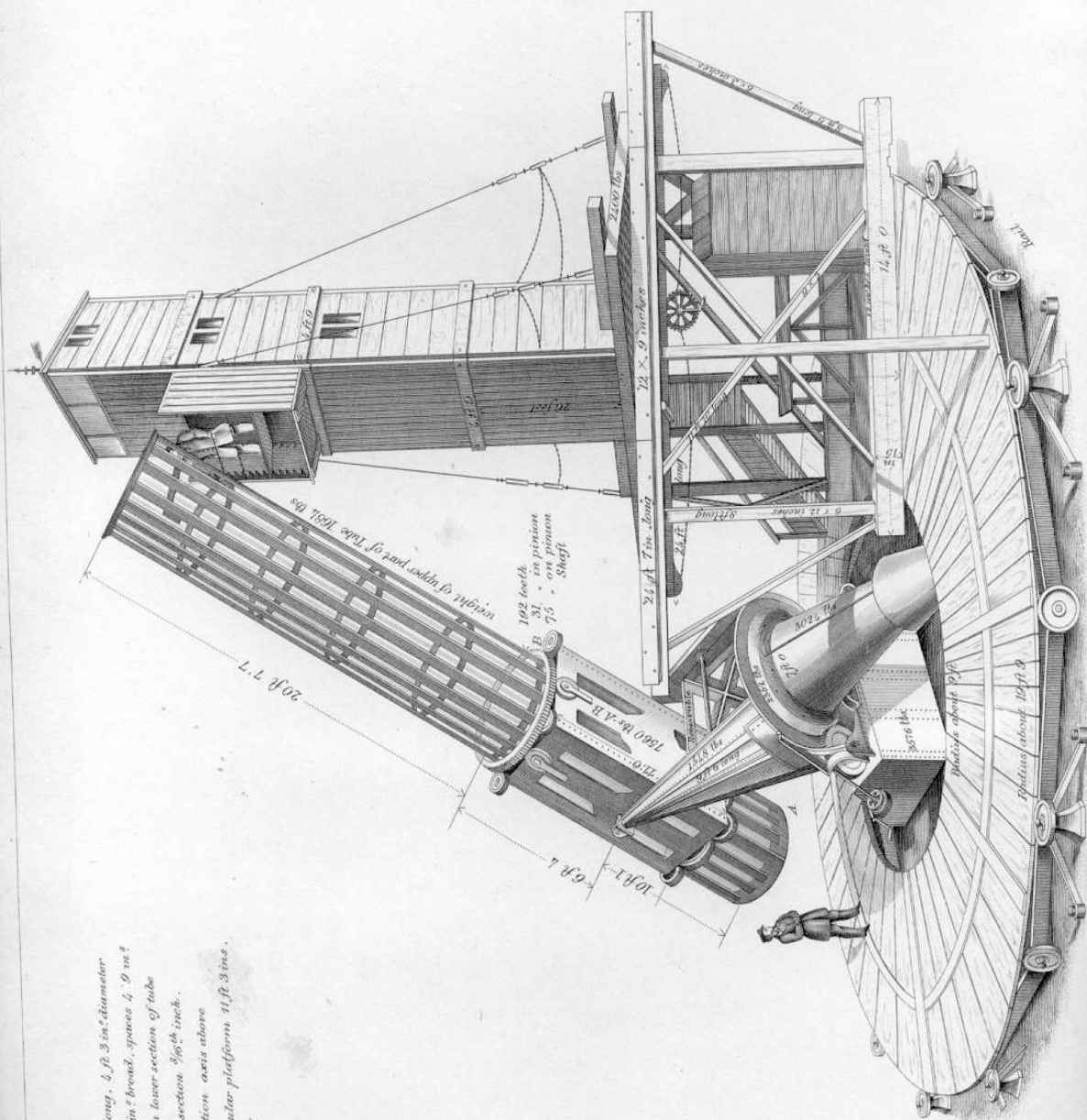
of labour is not great, as it may be continued for hours without being oppressive.

Attached to this regulating-clock are two dials, the finger or index of one of them having a retrograde motion and the dial figured accordingly; while the other is direct. The first, of course, belongs to the eastern hour-angle which is constantly diminishing—the second to the western. Being set to the present hour-angle at the commencement by the observer—if from clouds or any other cause the observation is interrupted—when the sky clears, the assistant can by mere inspection of the dial, bring up the telescope to correspond with it, by another winch, having a quick motion; without the observer having to descend from the tower, or interfere in any way.

Two assistants are all the observer requires, and they are far from being constantly engaged. One or other of them (and they generally interchange during a long night's observation) is occupied pretty constantly in driving the telescope—the other fitfully, in carrying on the tower, as the telescope retreats from it. I may remark that I have often been struck with the convenience—I had almost said luxury—of observing which has been made compatible with so large a telescope. Almost all altitudes are equally convenient, by the adaptation of the several attitudes of kneeling, sitting, or standing, none of them irksome when not continued too long; and the head is always in a comfortable position, which I am persuaded influences not merely the convenience, but the accuracy of observation. The observer is also sheltered from the dew, with all the apparatus of drawing materials, &c., almost within arm's length.

The adjustments of the instrument did not materially vary from the time of its first erection—*i.e.* there were no changes which could be traced to any alteration of either polar or declination axis. I do not, however, mean to say that the telescope could be used otherwise than differentially for giving any accurate places; nor that it was not liable to a change of three or four minutes of arc, at widely different hour-angles: but these errors seemed to arise mainly from minute changes in the position of the great speculum (which it is well known cannot be constrained), as it necessarily rolls over somewhat in changing from east to west. The errors, however, were generally so moderate in amount as to give no trouble in the kind of work we pursued, and so nearly constant at the

Tube 32 ft 0 in long, 4 ft 3 in diameter
10 ribs in tube 5 in broad, spaces 4 9 in.
thickness of ribs in lower section of tube
1/4 inch in upper section 5/16 inch.
Height of declination axis above
circular platform 4 ft 3 ins.
Latitude 33° 55'.



M^{RS} LASSELL'S NEWTONIAN REFLECTING TELESCOPE.

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same hour-angles, as to make it unnecessary to spend time in investigating which of the many minute disturbing causes had the greatest share in the effect. During the three years of my sojourn, the large mirrors were repeatedly polished and interchanged, involving a complete re-adjustment of both large and small specula; but the corrections generally remained within such narrow limits as to present no difficulty or inconvenience.

The telescope being entirely in the open air, and exposed to every change of weather and temperature, the specula, both large and small, were necessarily subject to more exposure than if they had been in a closed building, especially the plane specula, placed high in the air at the upper end of the tube. Yet the only two planes which were in use, have never been repolished, and I am not certain that there is a sensible or obvious deterioration of lustre in either of them. It is, however, practically of much more importance that the surface of the plane should be purely brilliant than that that of the concave should be so. In case of any injury to the lustre of the latter, the means were at hand in the polishing machine, and by the occupation of a single day, of renewing the surface without risk of spoiling it. It is scarcely necessary to remark that in saying that the telescope was exposed to every change of weather, I do not mean that the surfaces of both the mirrors were not reasonably well defended by close-fitting covers.

The two systems of levers for zenithal and horizontal support of the great speculum, which I first applied to the 2-foot telescope, and which have been described in the Report of the Meeting of the British Association at Edinburgh, in 1850, have, with slight modification, been applied to these large specula with equal success. I find these levers quite essential to eliminate inevitable flexure, and give round images of the stars.

Observations of Remarkable Nebulæ.

The Plates which accompany this Paper are copies of Drawings carefully made, generally during or after several surveys. It will be remarked that Fig. 7 is omitted; in fact, it refers to a rather elaborate drawing of the Nebula of *Orion*, which, being on a scale of $100'' = 1.194$ inches, is too large for engraving conveniently.

Explanation of the Plates of Figured Nebulæ.

PLATE I. *Fig. 1.*—No. in HERSCHEL'S General Catalogue 138, h. 61;
R.A. $0^h 40^m.6$; N.P.D. $116^\circ 4'$ (1860).

A large elliptic Nebula with dark spaces. It is too large to be included in the eye-piece, power 231, which has a field of $15' 33''$. It is more clearly shown with 474, which, however, does not include half of it. Viewed 1862, Oct. 18th, and re-examined and drawn 1863, Nov. 14.

Power used 231, the inscribing circle representing the boundary of the apparent field.

Fig. 2.—G. C. 600, h. 262; M. 77; R.A. $2^h 35^m.5$; N.P.D. $90^\circ 36'$.

1862, Nov. 17. A spiral Nebula. The neighbouring star seems also nebulous. Atmosphere not favourable.

Power 760; field $4'.0$ in diameter, which on the scale of the engraving would represent a circle 3.85 inches in diameter.

Fig. 3.—G. C. 604, h. 264; R.A. $2^h 39^m.1$; N.P.D. $98^\circ 10'$.

1862, Nov. 17. A very obscure faint spiral Nebula of apparently this form with power 760 drawn on the same scale as figure 2.

Fig. 4.—G. C. 826, h. 2618; R.A. $4^h 7^m.8$; N.P.D. $103^\circ 6'$.

An extraordinary and beautiful Planetary Nebula. Viewed 1862, Nov. 22, and re-examined 9th and 14th January, 1863; powers 760 and 1060. The circumferential nebula fades away at its upper margin; and the lower and opposite part of the circumference is less strongly defined than the preceding and following sides. Moreover, the nucleus does not seem stellar, but a small patch of bright light.

G. C. 1112; M. 79; R.A. $5^{\text{h}} 18^{\text{m}}.4$; N.P.D. $114^{\circ} 40'$.

1862, Jan. 22. Power 474, having a field of $5'.6$ diameter. A remote cluster somewhat of the character of that in *Hercules*, yet immensely more distant or smaller, since it is shown nearly as that cluster appears in a 12-in. reflector. It is not quite resolved to the centre, but probably there is no nebulous matter, only the stars are too close for identification. It occupies about one-fifth, or less than a fourth, of the field. Some stragglers lying off; no spiral character traceable. Re-examined 1863, Jan. 9.

No figure of this cluster is attempted.

PLATE II. *Fig. 6.*—G. C. 1157, h. 357; R.A. $5^{\text{h}} 26^{\text{m}}.1$; N.P.D. $68^{\circ} 5'$.

A very amorphous and indistinct Nebula viewed 1864, Jan. 1, with power 474, of which the circle represents the limit of the field of 5.6 minutes in diameter.

PLATE I. *Fig. 8.*—G. C. 1225 h. 365; R.A. $5^{\text{h}} 34^{\text{m}}.4$; N.P.D. $80^{\circ} 59'$.

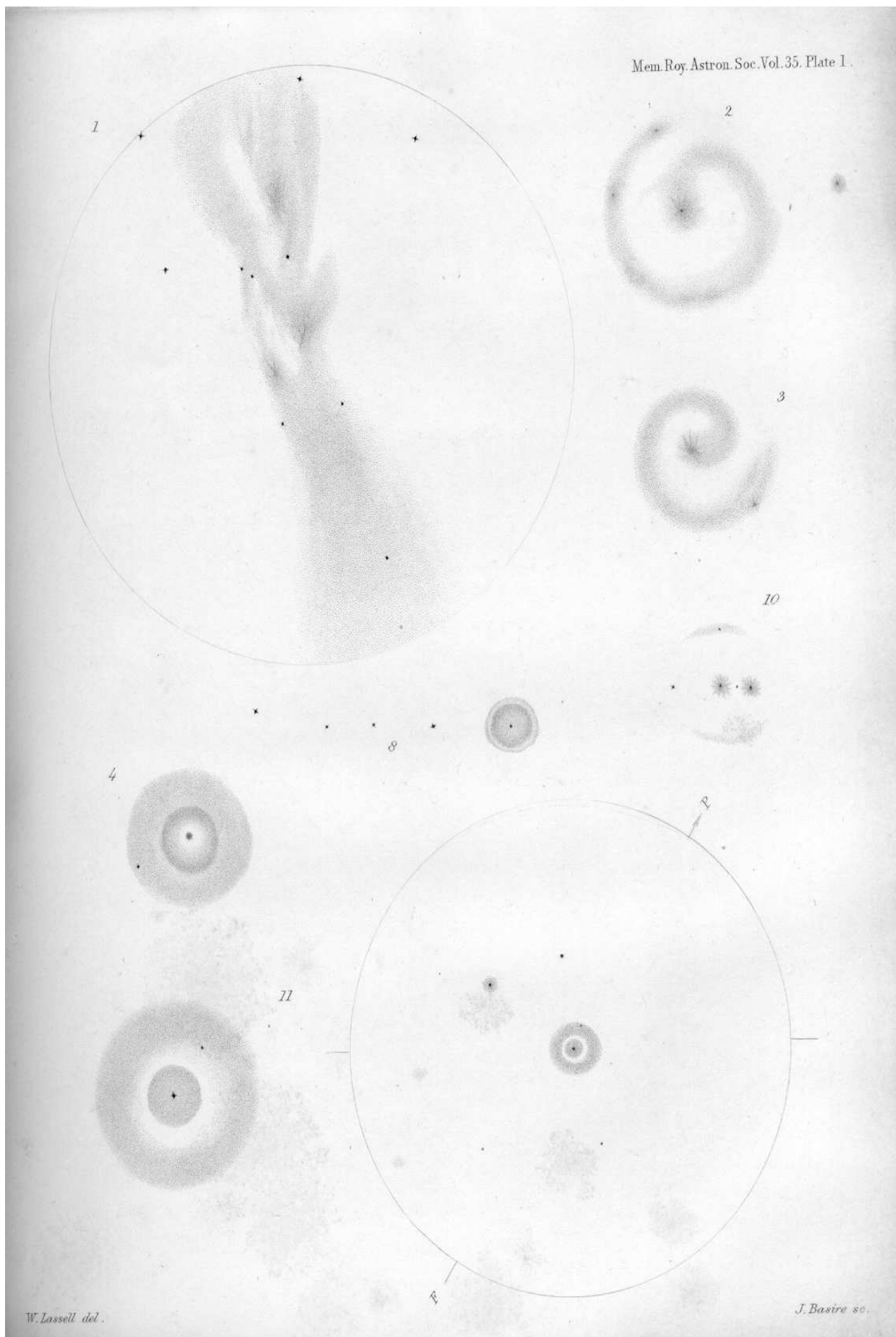
A Planetary Nebula, diameter about $30''$, viewed 1862, Feb. 3, and re-examined 24 Jan., 1863. With 1060 some bright patches or nodules seem to exist in it, but nothing more can be made out. The disposition of the neighbouring stars is remarkable.

PLATE II. *Fig. 9.*—G. C. 1511, h. 3075; R.A. $7^{\text{h}} 11^{\text{m}}.1$; N.P.D. $102^{\circ} 58'$.

Viewed in March 1864. A singular object. Many bright stars are in the field; power 210. Indeed it may be said to be almost filled with a cluster of bright stars. I do not pretend to put them down with any *precision* in either position or magnitude, or even in number.

PLATE I. *Fig. 10.*—G.C. 1519, h. 444; R.A. $7^{\text{h}} 16^{\text{m}}.7$; N.P.D. $60^{\circ} 15'$.

1862, March 24. A very remarkable small double Nebula or Planetary Nebula and stars; view with power 285.



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PLATE I. *Fig. 11.*—G. C. 1532, h. 450; R.A. $7^h 20^m.9$; N.P.D. $68^\circ 49'$.

A very remarkable Planetary Nebula. Viewed and re-examined on different days in March 1862. Powers used 231, 539, and 760; diameter about $53''$. The view inscribed in the circle is that obtained with power 231. The distance of the nebulous star is about $105''$. No other stars beside the two depicted are visible within the distance of the nebulous star. The central point is very bright and undoubtedly stellar. It seems to consist of only one bright star. The larger drawing is a very careful copy of the view with 760 (a very excellent eye-piece), which however does not seem to reveal more than power 539, with which the drawing was originally made. The nebulous star is reddish. There seems to be a number of minute points not steadily seen, about the nebulous star.

A re-examination in more than average circumstances introduces no modification of the drawing, which I consider very trustworthy. I can see no trace of the dark patch in Lord Rosse's drawing, near the bright centre.

PLATE II. *Fig. 12.*—G. C. 1861, h. 604; R.A. $9^h 24^m.2$; N.P.D. $67^\circ 54'$.

1862, Feb. 25. A very faint and difficult Nebula, about 4 minutes in length. Viewed with power 231, it appears to me more wavy than spiral. There appear to be three very faint stars (*c*) *fig. 12*.

(*b*) *Fig. 12.*—Drawn under much more favourable circumstances, and when the object was on the meridian; power 285. It is better seen with this power.

Re-examined March 4 (*a*).—The centre is not at all like a nucleus, but like an exceedingly remote cluster of bright and equal stars. Power used 285. In this diagram I have inserted all the stars I can see.

PLATE III. *Fig. 13.*—G.C. 2017, h. 3228; R.A. $10^h 1^m$; N.P.D. $129^\circ 45'$.

A faint elliptic Planetary Nebula; transverse diameter about $67''$; (*a*) represents the view with 760.

1862, April 16 (*b*) represents the view with the smaller power 285;

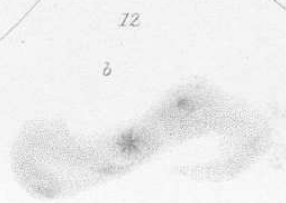
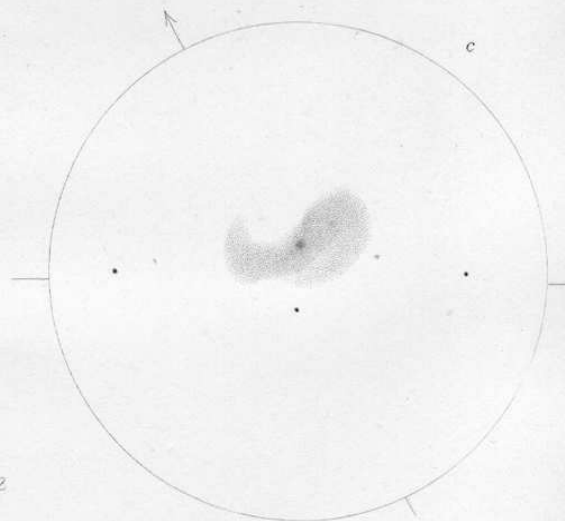
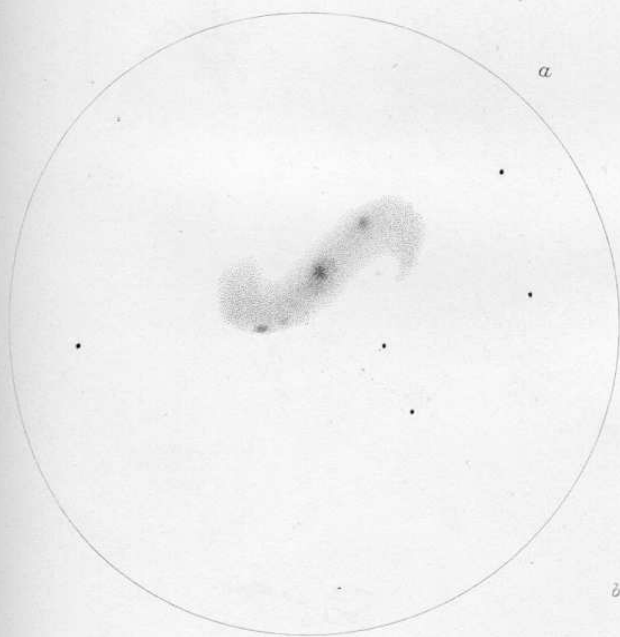
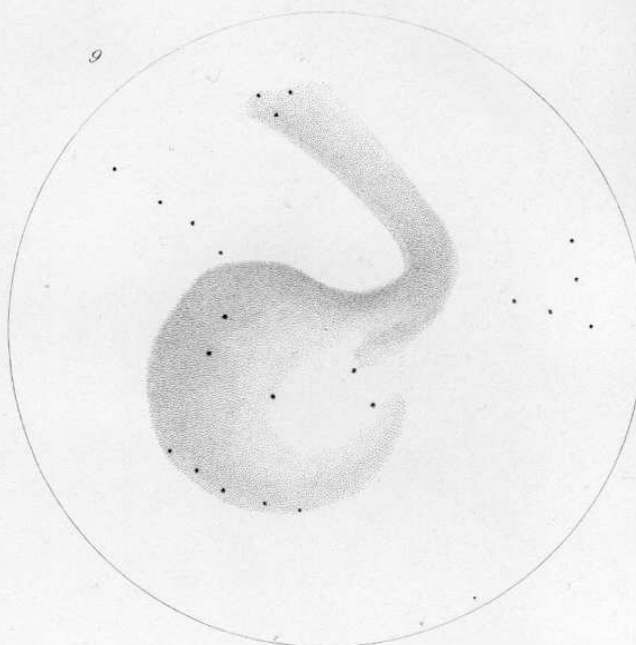
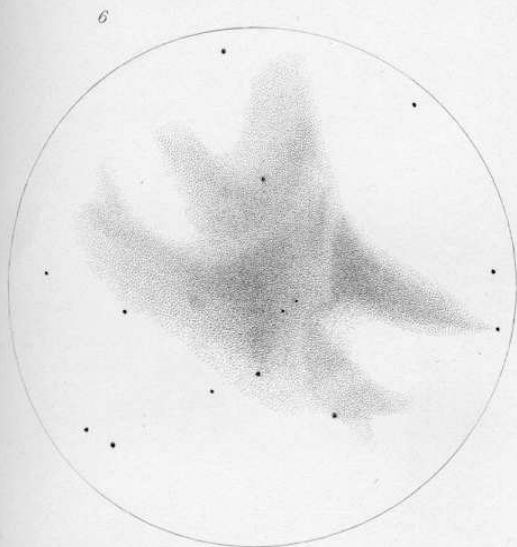
many stars are in the field, more than are here drawn; they are generally, however, very faint. There is a considerable similarity in this object to the annular nebula in *Lyra*, only it is incomparably fainter. The centre is bright, and evidently stellar. There is a minute star touching the south preceding side of the nebula. The sides of the nebula are flattened and better defined than the ends. I think the nebula in *Lyra* if removed very much further off would present a similar aspect. The stars marked *a*, *b*, *c*, in the margin of (*b*) are very faint.

PLATE III. *Fig. 14.*—G. C. 2102, h. 3248; R.A. $10^{\text{h}} 18^{\text{m}}$; N.P.D. $107^{\circ} 56'$.

A most extraordinary Planetary Nebula.—1862, March 24. The colour of this object is, at first sight, its most striking characteristic. It is of a brilliant sky-blue with a tinge of pale green. It was viewed with various powers up to 1060, which was rather too high. The form is but slightly elliptical and appears even less so with the lower powers. The interior brighter and more oval ring has nothing stellar about it; but is very bright and well defined; as is the case with the central spot, which conveys the idea of a bright nebulous disk not stellar. The north-following end of the exterior part of the nebula fades away a little, also towards the bright ellipse, so as to envelope it in a darkish border. The two stars in the drawing are very faint. Re-examined April 17th, and the drawing generally confirmed. The central spot is perhaps proportionally a little bright and the exterior margin of the nebula a *little* too oval.

Fig. 15.—G. C. 2373, h. 854; R.A. $11^{\text{h}} 11^{\text{m}}.6$; N.P.D. $76^{\circ} 9'$.

A faint, irregular, and formless Nebula. Viewed 1862, April 21; power 285. There are several excessively minute stars striking the eye occasionally in and around the nebula. The two I have drawn, following, are accompanied, I believe, by one or two others which I can not be certain of. The sky is clear and the object within 30^{m} of the meridian. The third star I have drawn, following, I am persuaded I see with 474, with which the nebula of course appears larger, but I cannot by it improve my drawing. The other stars are rather suspected than verified.



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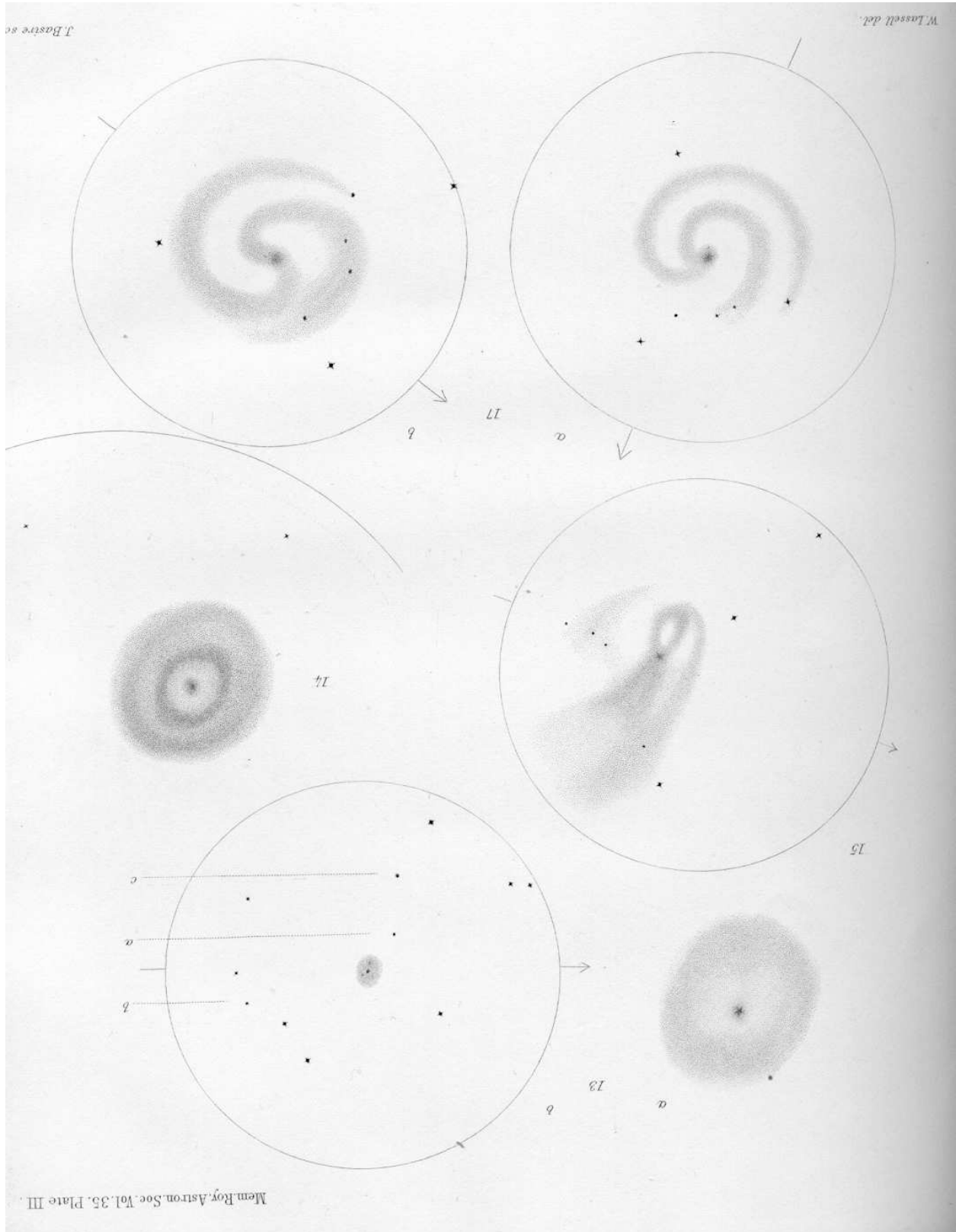


PLATE IV. *Fig. 19.*—G.C. 3025 ; R.A. $12^{\text{h}} 22^{\text{m}}.7$; N.P.D. $75^{\circ} 36'$.

May 19. A small double Nebula. The central one is bright and has a resolvable character. The smaller one is much less bright—it has a nucleus, but does not seem stellar. Difference of R.A. $14^{\text{s}}.4$, of P.D. $3' 34''$. They are distant from each other about $5' 22''$.

Fig. 20.—G.C. 3049, h. 1312 ; R.A. $12^{\text{h}} 24^{\text{m}}.9$; N.P.D. $74^{\circ} 48'$.

1862, May 21. This Nebula is of a somewhat convoluted form ; it may be a spiral, but I cannot make it out. Power 285. With 466 I am unable to add any details to the drawing.

PLATE V. *Fig. 21.*—G.C. 3106, h. 1357 ; R.A. $12^{\text{h}} 29^{\text{m}}.4$; N.P.D. $63^{\circ} 15'$.

1862, April 29. A very remarkable Nebula. Examined with great care, and for a long time, with powers 474 and 1060. I can see no convolutions. I consider the drawing good. There are three minute stars in the nebula. The circle represents the field of the 474 eye-piece.

Fig. 22.—G.C. 3132, h. 1376 ; R.A. $12^{\text{h}} 32^{\text{m}}.7$; N.P.D. $100^{\circ} 50'$.

1862, April 28. A very long spindle-shaped Nebula ; its axis almost exactly parallel to the Equator. It has a dark band through its entire length, which extends to $7' 5''$. There are four stars in the field.

Fig. 23.—G.C. 3155, h. 1386 ; R.A. $12^{\text{h}} 34^{\text{m}}.9$; N.P.D. $77^{\circ} 34'$.

1862, April 29. A double Nebula or Nebula and cluster. With power 285 I cannot individualize any stars in the principal nebula, yet I have an impression that it is no nebula at all, but a *very remote* globular cluster, such as that in *Hercules*, yet incomparably more distant. Power 474 does not bring me to any other conclusion.

PLATE V. *Fig. 24.*—G.C. 3167, h. 1397; R.A. $12^{\text{h}} 35^{\text{m}}.4$; N.P.D. $56^{\circ} 41'$.

1862, May 27. A narrow Nebula $15'$ in length, with a star on its border, and internal bright patches, almost stellar. A very small nebula is adjacent, to the north. Power, 231.

Fig. 25.—G.C. 3258, h. 1456; R.A. $12^{\text{h}} 44^{\text{m}}.3$; N.P.D. $48^{\circ} 7'$.

1862, May 20. A bright round Nebula, increasing in brightness gradually to the centre, with a remarkable dark annulus. Power, 285.

PLATE VI. *Fig. 26.*—G.C. 3321, h. 1486; R.A. $12^{\text{h}} 49^{\text{m}}.9$; N.P.D. $67^{\circ} 33'$.

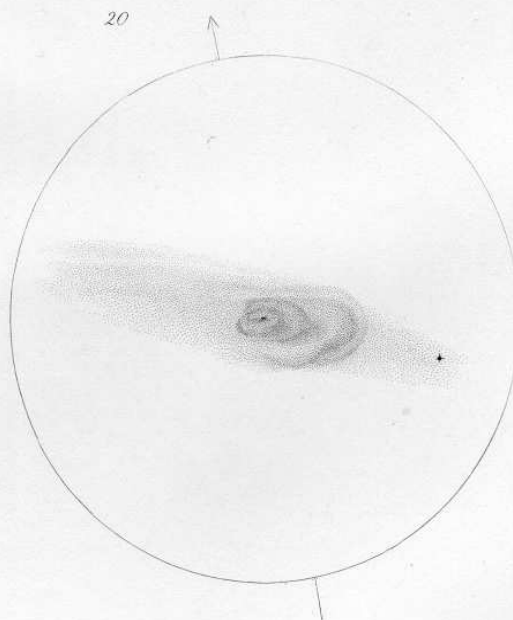
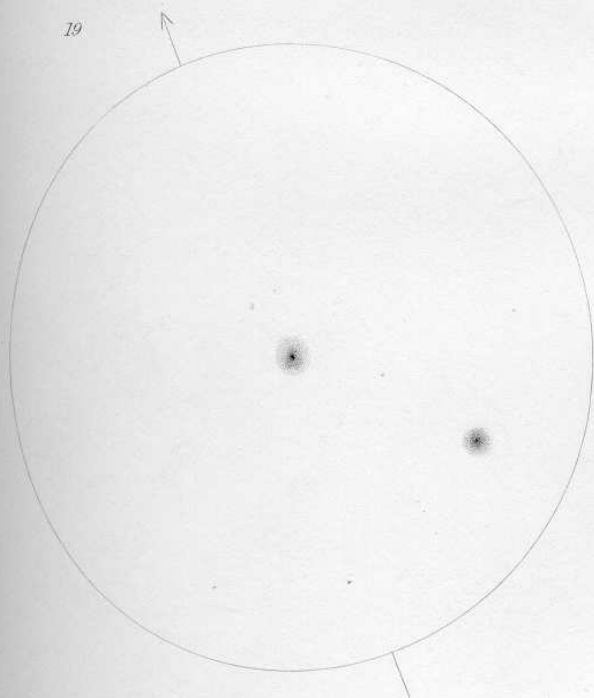
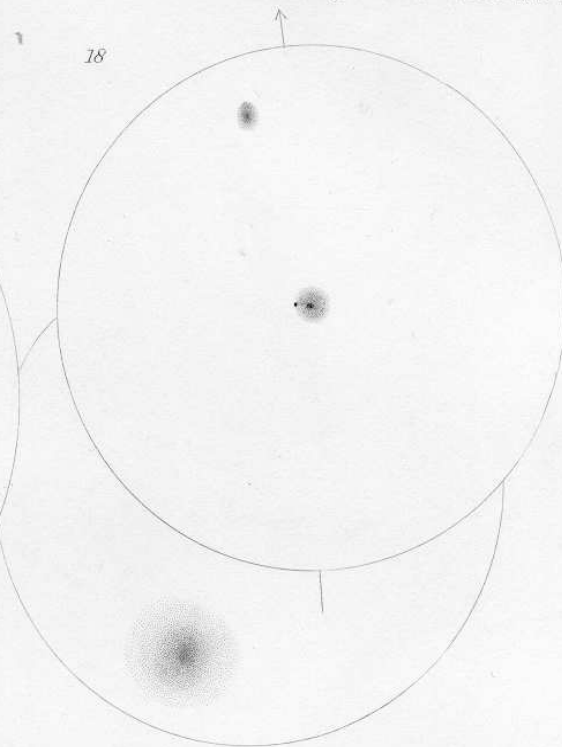
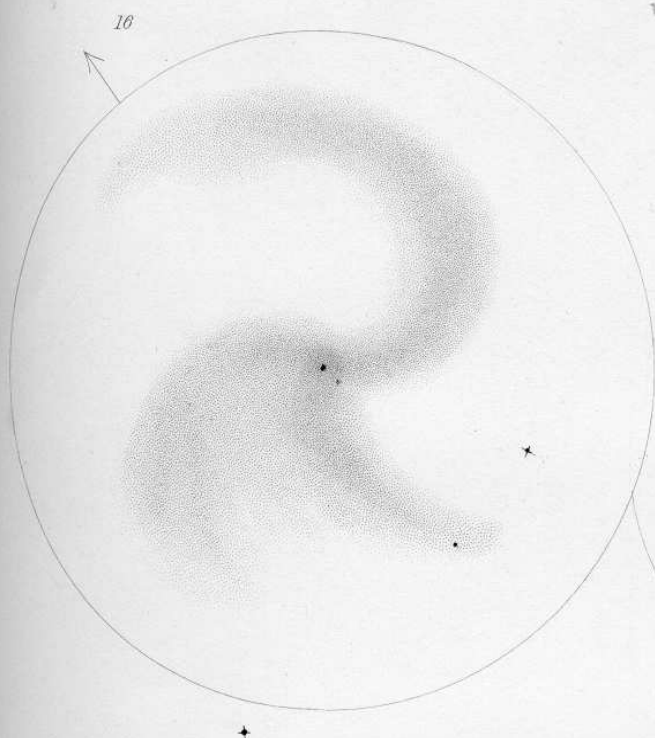
1862, April 22. The principal part of the drawing was made with power 285 and 39 inches aperture. With full aperture the Nebula was certainly brighter altogether, and seemed to extend further, but the boundary of the remarkable dark space was not quite so precise, nor of so deep a colour. In fact, I believe there is no nebula there; it is as dark as any part of the surrounding sky. Some little addition to the drawing was made with 474 and full aperture, with which the most minute details were best seen. I consider the drawing good. The nucleus is bright, apparently stellar, yet I cannot individualize any distinct star.

Re-examined 29th April with 285 and 474, confirming the above observations.

Fig. 27.—G.C. 3572, h. 1622; R.A. $13^{\text{h}} 23^{\text{m}}.9$; N.P.D. $42^{\circ} 5'$.

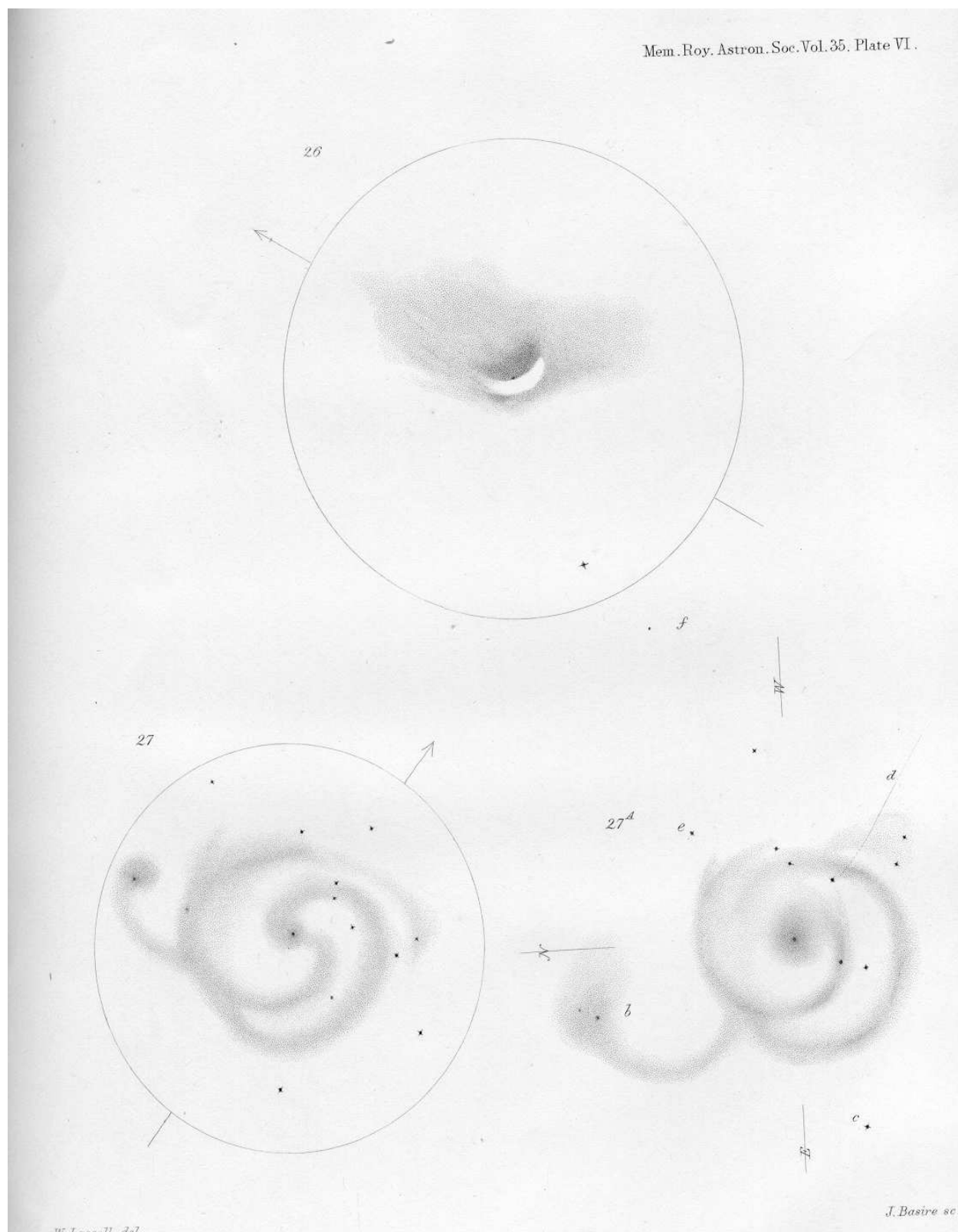
Chief spiral Nebula, M. 51. Surveyed generally, with 285, and the stars carefully placed by estimation in position and magnitude, 1862, June 27. Afterwards verified with 466, the faint stars being more plainly seen with that power. Viewed also 23rd June with 474, but the field of view was rather too small for the whole nebula.

Re-examined 2nd July, and the following positions and distances were



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taken of the stars designated by letters in *fig. 27 A*. The measured stars are inserted in their true positions approximately, and the smaller ones filled in by alignment :—

(b)	Position	$17^{\circ}6$	Distance	$274''.2$
(c)		$110^{\circ}4$		246.6
(d)		232		91.5
(e)		309.8		191.0
(f)		293.3		428.4

PLATE VII. *Fig. 28*.—G. C. 3606, h. 3523; R.A. $13^{\text{h}} 29^{\text{m}}.2$; N. P. D. $119^{\circ} 10'$.

A faint Nebula with bright nucleus, observed 1862, May 20. A singular object, the nucleus obviously stellar. One star is certainly outside the nucleus, north preceding. Re-examined 22d May. The nucleus seems quite disconnected from the nebula, conveying the idea of a small bright compressed cluster; whilst the nebula is very faint. There are several minute stars south-preceding, where I have marked some; but they are not so constantly visible as to enable me to assign precisely their number or places.

Fig. 29.—G. C. 3614, h. 1649; R.A. $13^{\text{h}} 30^{\text{m}}.5$; N.P.D. $107^{\circ} 10'$.

1862, May 20. A very faint spiral Nebula. The inscribing circle represents the size of the field with power 285. The nucleus bears 474, and seems better shown and brighter, but the nebula fades much with increase of power, and is indeed a very faint one. Re-observed 23d and 27th of May.

Fig. 30.—G. C. 4290, h. 3680; R.A. $17^{\text{h}} 12^{\text{m}}.7$; N.P.D. $128^{\circ} 20'$.

1862, June 21. A singular and apparently very remote object. Diameter of the ring about $66''$. Whether to call it a planetary or ordinary nebula I scarce can tell. The star is perhaps $10\frac{1}{2}$ or 11th magnitude. It is a faint object. Uncertain whether the point on the edge of the ring be stellar or nebulous.

PLATE VII. *Fig. 31.*—G. C. 4343, h. 1989; R.A. $17^{\text{h}} 46^{\text{m}}.0$; N.P.D. $66^{\circ} 53'$.

1862, June 27. In my list this object is called a Planetary Nebula; but I should rather call it a double star in a nebula. Power 466. The smaller star distant about $10''$ or $11''$.

PLATE VIII. *Fig. 32.*—G. C. 4355, h. 1991; M. 20; R.A. $17^{\text{h}} 53^{\text{m}}.9$; N.P.D. $113^{\circ} 2'$.

A most remarkable object, consisting of several bright nebulous patches, sprinkled over with many stars of various magnitudes, distinguished by the brightest two forming a conspicuous and unequal double star in the centre of the brightest part of the nebula. Surveyed 1862, June 27, and on this and many other nights re-examined, several of the stars measured and the nebula carefully drawn. The scale of the drawing is 1 inch = $166''.4$. The observed stars are also laid down in duplicate on a skeleton drawing (fig. 32 A), and the stars numbered for identification and to prevent mistake. No. 1 is the central star, from which the others are measured. Nos. 3, 4, 5, 7, 8, 10, 14, 15, and 21, are measured in position and distance; the others are placed by careful estimation by the eye. The principal star I judged to be of the $8\frac{1}{2}$ magnitude, and the others follow in numbers nearly in order of magnitude. To convey a notion of the scale by which they descend, I have grouped them arbitrarily in classes, from A to G, thus,—No. 1 = A, 2 = B, 3 to 9 = D (passing over C, which indicates a great falling-off of magnitude from 2 to 3), 10 to 16 = E, 17 to 28 = F, and 29 to 55 = G, including the smallest stars I have been able to detect. No. 40 is indistinct and may be double.

The places of the principal stars having been laid down on a sheet of paper, the nebula was filled in amongst them at the telescope's side, the utmost care and attention being given in the delineation to make the drawing both in respect of outline and variation of intensity as perfect a copy of the object as possible; and I believe it conveys an accurate and not exaggerated picture of this very remarkable nebula. The places of the measured stars are,—

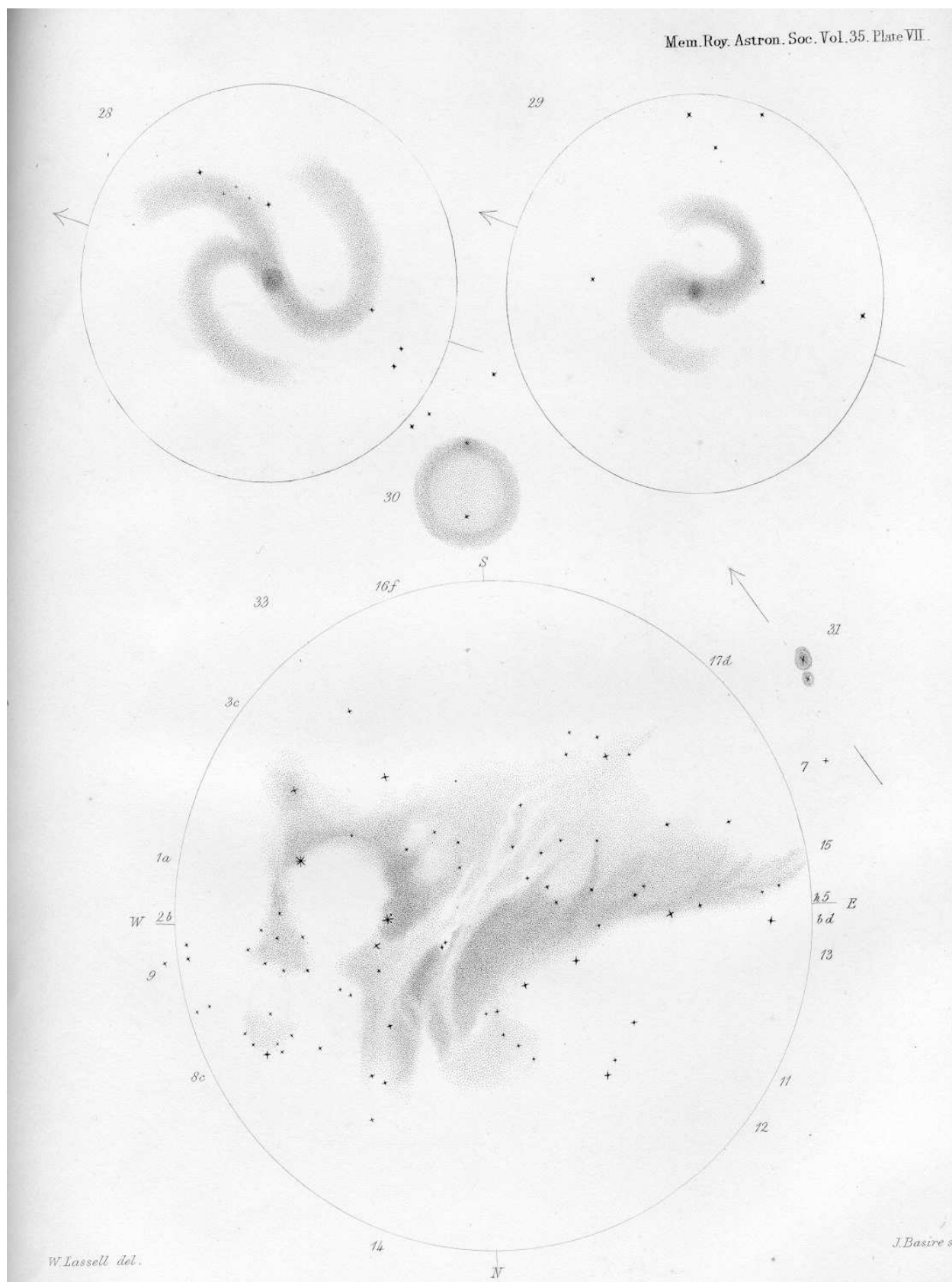
No. 3	Position $25^{\circ} 46'$	Distance $270'' 15$
4	333 4	243'20
5	54 31	215'37
7	116 49	181'21
8	311 24	391'68
10	121 30	90'39
14	3 43	177'17
15	167 52	249'25
21	235 40	129'17

PLATE VII. *Fig. 33.*—G.C. 4403, h. 2008; M. 17; R.A. $18^{\text{h}} 12^{\text{m}} 6$; N.P.D. $106^{\circ} 14'$.

A very remarkable Nebula in which there is much detail and many stars. Eleven of the principal stars (74 in all) were measured, and the remainder laid down by careful estimation, while some approximation at least to their proportionate magnitudes is preserved in the drawing. More precision, however, in this respect is obtained by reference to the Index-Map (Plate VIII., fig. 33 A), in which the magnitudes of the stars No. 1 to 12 are in some degree indicated by the letters affixed, *a, c, d, e*; the omission of the letter *b* being intended to show that there is a considerable falling-off in magnitude from the two principal stars to the next smaller. The numbers are generally, but not uniformly, in the descending order of magnitude. Magnifying powers used 285 and 228. Scale $166'' 4 = 1$ inch. The circle represents the field of the 228 eye-piece, $13' 7$ in diameter.

Co-ordinates of the Principal Stars measured from No. 2.

No. 1	West $114'' 2$	South $68'' 3$
3	„ $162 9$	North $160 3$
4	East $492 6$	„ $18 6$
5	„ $284 3$	South $196 8$
6	West $120 7$	„ $158 2$
7	„ $12 3$	North $38 8$
8	„ $5 9$	„ $137 8$
9	East $4 6$	South $177 5$
10	West $189 8$	North $32 7$
11	„ $113 3$	„ $63 0$
12	East $365 9$	„ $12 8$



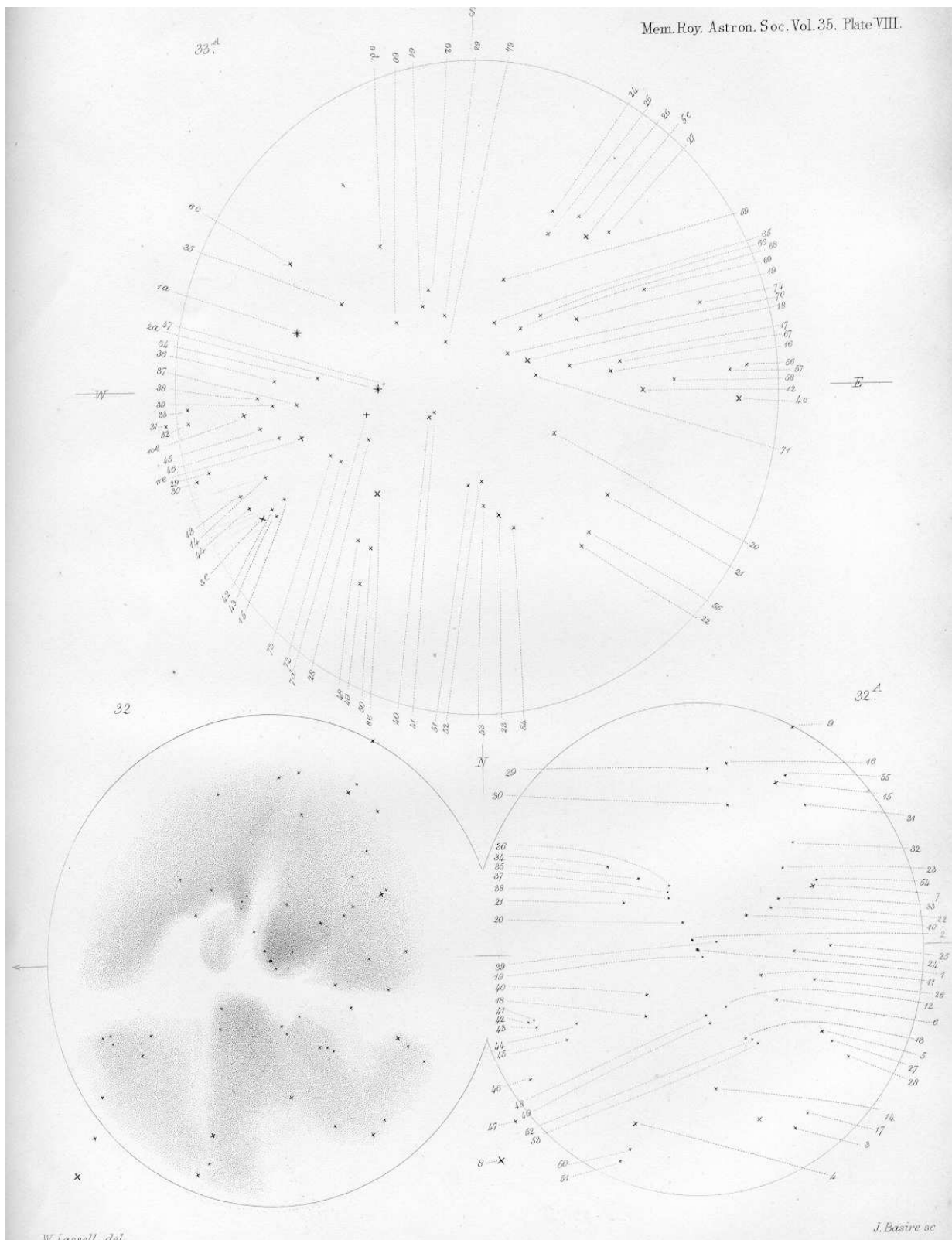


PLATE IX. *Fig. 34.*—G. C. 4487, h. 2037; R. A. $19^{\text{h}} 11^{\text{m}} 6$; N. P. D. $83^{\circ} 43'$.

1862, August 29. Planetary Nebula. A pale round ball, about $116''$ in diameter. Pretty uniform in light, except a want of definition on the north side. With 760 the nebula fades away in the centre, but the object is too faint for this power; 474 suits it better. There are more stars within its area than I have inserted in the drawing, but they are so minute and appear so fitfully, that I cannot mark their places. I may probably have seen four or five more than I have marked down. The letters are in order of brightness, but the largest is very faint, and they are scarcely visible with this power.

Fig. 35.—G. C. 4532, h. 2060; R. A. $19^{\text{h}} 53^{\text{m}} 5$; N. P. D. $67^{\circ} 40'$.

The "Dumb-Bell" Nebula. The annexed drawing is the most faithful picture I have been able to produce as the result of a great number of observations with a great variety of magnifying powers, and under the best circumstances which offered. To secure identification of the stars without disfiguring the drawing, I have added an Index-Map, Plate X., fig. 35 A, in which the stars with letters attached are placed according to the measurements of M. OTTO STRUVE, from the star *a*. Scale $100'' =$ one inch. The other stars are added by alignment with these.

Fig. 36.—G. C. 4572, h. 2075; R. A. $20^{\text{h}} 16^{\text{m}} 1$; N. P. D. $70^{\circ} 20'$.

A small planetary Nebula, examined 1862, August 19th, with powers 474 and 760. The distance between the bounding stars is about $85''$, but there are other stars at right angles and more distant. The central point of the nebula is apparently a pretty bright star. The stars at the preceding edge of the nebula are not constantly seen, but they strike the eye by glimpses. The nebula is not uniformly bright all over, and suggests a very distant view of the "Dumb-Bell" Nebula. It is a little elongated nearly at right angles to the parallel.

PLATE X. *Fig. 37.*—G. C. 4628, h. 2098 ; R.A. $20^{\text{h}} 56^{\text{m}}.5$; N.P.D. $101^{\circ} 55'$.

1862, August 23. My first impression of this Nebula was that it was a sky-blue likeness of *Saturn*. Viewed with higher powers, the brilliancy and peculiarity of the colour are less striking, but the conformation of this truly wonderful object attracts the attention even more strongly. Under the most favourable circumstances, and after patient attention with lower powers, I thought that I employed even 1480 with advantage. The annexed drawing gives the best impression I could obtain from repeated examinations of the nebula under various circumstances and magnifying powers. The transverse axis of the ellipse is inclined to the parallel about 13° and the length and breadth of the ellipse are respectively about $26''$ and $16\frac{1}{2}''$.

Fig. 38.—G. C. 4964, h. 2241 ; R.A. $23^{\text{h}} 19^{\text{m}}.2$; N.P.D. $48^{\circ} 14'$.

1862, Oct. 23. A very remarkable Planetary Nebula. Examined with various powers up to 1480, and at various times. The accompanying drawing will convey, I think, very fairly the impression remaining on my mind from all the observations. Position of the *n. f.* star from the centre of the nebula = 62° . Major axis of outer ellipse $32''.32$; minor axis $27''.97$. Central point not stellar, but apparently a *very minute* planetary disk of a bluish colour. This nebula is remarkable for the symmetry of its exterior boundary, and for the sharpness of its outline. The nebula diminishes in brightness towards the internal bright ring, which is not quite so well formed as the margin of the envelope ; and its transverse axis is a little less inclined to the parallel than is the transverse axis of the envelope,—viz. about ten degrees. The part of the inner ring near the end of the minor axis southward, seems flatter than it ought to be for a true ellipse. Perhaps this may occasion the central star or disk to appear rather nearer that end of the minor axis than the other. Of the boundary of the envelope, that part of its circumference which is near the southern end of its minor axis is its brightest part. The central point is bright and conspicuous, not to be overlooked even in a cursory examination.

