

# MEASURES OF PLANETARY NEBULÆ.



## MEASURES OF PLANETARY NEBULÆ WITH THE 36-INCH EQUATORIAL OF THE LICK OBSERVATORY.

BY S. W. BURNHAM.

During the progress of my regular double star work with the 36-inch equatorial, I have occasionally examined some of the more interesting nebulae, and incidentally a few of the HERSCHEL planetary nebulae. It occurred to me that objects of the latter class would be specially suitable for careful micrometrical measures for the purpose of determining, now or hereafter, whether they have any proper motion in space. I assumed that some of the many observers of nebulae had already done this for at least the brighter nebulae of this class, or those where the central stars were bright enough to bring them within the reach of ordinary instruments. I was surprised to find, upon looking over many of the works of the leading observers, that very little, almost nothing, had been done in this field; and I determined, therefore, to measure all the objects of this class when it could be done without seriously interfering with the regular micrometer work on double stars. In the selection of objects classed as planetary nebulae, I have relied, of course, upon DREYER'S General Catalogue. After an examination of a few of the prominent examples, it is not difficult to say whether or not a doubtful object belongs to the planetary class, since it is entirely a matter of appearance in the telescope, and has nothing to do with the nature of the nebulae as shown by the spectroscope or otherwise. A central star is usually found in these nebulae. This is so generally the case as to suggest that as the criterion for classification. Some of these stars are very faint, and can only be seen with a large aperture, and, in a few instances, the large object-glass furnishes none too much light for their accurate measurement with the micrometer. As will be seen from the observations, I have found but two or three nebulae, which could be otherwise described as of the planetary class, where the central star is wanting. From the wide range of these stars in magnitude, it is fair to infer that the missing stars might be seen with a telescope of still greater light-power. One of these is very far south, and too low in this latitude for any very faint star to be seen.

I have also examined Nos. 934, 2440, 2452, 4107, 5144, and 6210 of DREYER'S General Catalogue, and found them more or less lacking in the characteristics of planetary nebulae. They belong to a much larger and less interesting class of

objects, which would be briefly described as small circular patches of nebulosity. Many of the more recently discovered nebulae, though very much fainter, and usually smaller, are similar in a general way. I have also looked at a number of the so-called "stellar" nebulae, discovered by PICKERING, SWIFT, and others. These are all, so far as I have examined them, very small, bright, round nebulae, which in a small instrument would resemble stars slightly out of focus, but do not appear to come within the planetary class.

Various powers have been used in studying these central stars, and particularly the brighter ones. In no instance has any one of these stars presented under any power any peculiar appearance. So far as it can be determined in this way, they all appear to be true stars, differing in no sense from the comparison stars. Many of the nights on which these measures were made were of the best quality, and any nebulous or other unusual appearance should have been apparent if it really exists.

I have not attempted to give any detailed description of these objects, in the first place because it was foreign to the special purpose in view, and secondly, because verbal descriptions, like most of the drawings, have, at this time, little scientific value, and particularly so far as the question of change or motion is concerned. Certainly no one would predicate any change upon evidence of this kind. Skilled observers, even with instruments of about the same power, differ greatly, and it is impossible to eliminate the real from the imaginary. I have therefore limited my observations to actual measures with the micrometer, the accuracy of which can be tested at any time.

I think there can be no doubt that these central stars are in some way associated with the nebulae themselves, and that any change in the positions of these stars will be accompanied by a corresponding drift in space of the nebulae. Of the thousands of nebulae now known, these examples in the planetary class, with a few exceptions, possibly among very minute nebulae, are the only ones where any proper motion could be detected within any reasonable time. For this reason there is no reliable evidence yet of the change in position of any nebula in the heavens. There is no apparent reason why the nebulae should not be distributed in space in the same manner as the stars, and with the same varying distances from our system. If this is so, the nebulae should be drifting in space with proper motions analogous to those of the stars. A re-measurement of these objects a few years from now will detect at once even a small annual variation. Some of them can be measured with much smaller instruments than the one now used. In some instances the comparison star is very faint, but I have endeavored to select the best star, taking the magnitude and distance both into account. Should any relative change be shown hereafter, it will be easy to determine to which of the stars it belongs.

In the observations which follow, I have used DREYER'S number and place. In nearly every instance the measures were made with a power of 350, the higher

eye-pieces having too small a field for many of the distances. The measures are made by double distances, except in the single instance noted, and, of course, with a bright-wire illumination, which interferes in no way with the visibility of the faintest object.

### Barnard.

R. A.  $3^h 38^m 34^s$  }  
Decl.  $+ 34^\circ 37'.6$  }

This planetary nebula was discovered by BARNARD in December last while observing ZONA'S Comet (*Ast. Nach.*, 3017). It is a fine object in the telescope, and perfectly planetary in general appearance. On one occasion I suspected a central star, or a very small nucleus, but this has not been verified. It is slightly elliptical in a north and south direction. A rough setting of the wires on two nights gave, with a power of 1000,  $10''.0$  as the diameter of the nebula in this direction. BARNARD remeasured the diameter December 10, 1890, and obtained  $8''.5$ .

The nearest catalogue star is D.M.  $+ 34^\circ$ , 732, called 9.0-m by ARGELANDER:

Nebula and D.M.  $+ 34^\circ$ , 732.

1891.689	119.6	204.50	8.0
.692	119.5	203.74	8.3
1891.69	119.5	204.12	

These are single distances. The measures give for the difference in R. A.  $14''.4$ , and for the difference in Decl.  $100''.7$ . In December, 1890, BARNARD observed these differences directly, using the 12-inch refractor, and obtained  $14''.4$  and  $102''.0$  for the corresponding values.

I have also measured the nearest of the two faint stars referred to in *Ast. Nach.*, 3017, from the center of the nebula, with the following result:

Nebula and 13-m star preceding.

1891.689	288.4	21.79	13.0
.692	287.8	21.78	13.0
1891.69	288.1	21.78	13.0

The other star 14-m, is  $33''$  from the nebula, in the direction of  $347^\circ$ . The magnitude of the nebula was estimated by BARNARD as 10-m. It is easily found from the sketch of the field given in *Ast. Nach.*, 3017.

Applying the differences obtained above to the D.M. place of the comparison star, we have for the nebula (1860) the place given above.

### No. 1501.

R. A.  $3^h 54^m 59^s$  }  
Decl.  $+ 60^\circ 32'$  }

1890.775	193.8	90.97	12.5 .. 12.7
.777	193.8	91.03	13.5 .. 13.7
1890.77	193.8	91.00	13.0 .. 13.2

This is one of the HERSCHEL planetary nebulae. The central star is brighter than the nearest available comparison star.

There are two observations of these stars with the ROSSE reflector, the second of which is probably by COPELAND.

1867.961	195.7	91.5
1873.870	192.9	89.9

### No. 1514.

R. A.  $4^h 0^m 30^s$  }  
Decl.  $+ 30^\circ 24'$  }

1891.657	357.4	69.94	8.6 .. 14.0
.689	357.9	70.11	8.6 .. 14.0
.692	357.2	70.18	8.6 .. 14.0
1891.68	357.5	70.08	8.6 .. 14.0

The small star used for comparison is in, or near, the edge of the nebula. The diameter of the nebula is about  $126''$ . The small star does not appear to have been noticed before. HERSCHEL speaks of a "faint star following," and in another observation, "star suspected n. p." but no distance is given. In the drawing by ROSSE (*Phil. Trans.*, 1861), a small star is shown in the direction of  $60^\circ$  or  $70^\circ$ , and distant about one diameter of the nebula from its edge. This nebula is not described as planetary in DREYER. Mr. BARNARD called my attention to it as probably belonging to the planetary class; and it certainly possesses the general characteristics. The surface, however, is not uniform, but broken and mottled.

No. 1535.

R. A.  $4^h 7^m 44^s$   
Decl.  $- 13^\circ 6'$

1890.760	257.3	119.42	11.5 .. 12.0
.775	257.0	120.21	11.0 .. 11.5
.785	257.1	119.69	11.0 .. 12.0
1890.77	257.1	119.77	11.2 .. 11.8

Besides the central star, there are other fainter stars within the nebula. The most prominent of these is near the northern edge of the circular disc. I have measured this from the central star as follows:

1890.760	323.1	16.47	15.0
.775	324.6	16.26	14.5
.785	324.7	15.79	14.0
1890.77	324.1	16.17	14.5

This nebula is H IV. 26. It has been drawn by D'ARREST (*Instrumentum Magnum Aequatoreum*, 1861); and by LASSELL (*Memoirs R. A. S.*, vols. xxiii. and xxxvi.). The 14.5-m star does not seem to have been seen by these observers.

There are two measures of the distant star by COPELAND at Parsonstown:

1873.003	256.7	122.9	14-m
1873.041	256.7	121.2	13-m

No. 2022.

R. A.  $5^h 34^m 26^s$   
Decl.  $+ 9^\circ 1'$

1890.802	192.6	95.60	14.5 .. 13.5
.840	192.2	95.34	15.0 .. 14.0
1890.82	192.4	95.47	14.7 .. 13.7

There is no star in the middle of this nebula, but there is a very faint one on the s. p. edge, and that is the one measured. The nearest outside star is n. f., and about one diameter of the nebula distant. With reference to the nebulous disc LASSELL says: "Some bright patches or nodules seem to exist in it, but nothing more can be made out." There are drawings by D'ARREST and LASSELL in the volumes last cited, and also by SECCHI (*Mem. Coll. Rom.*, 1852-5).

No. 2392.

R. A.  $7^h 20^m 53^s$   
Decl.  $+ 21^\circ 12'$

1890.879	3.0	99.62	9.0 ... 8.2
.882	2.9	99.74	8.7 ... 8.2
1890.88	3.0	99.68	8.9 ... 8.2

One of the most beautiful objects of the kind in the heavens. The central star is round and sharp with all powers. A measure of the diameter of the bright inner disc in the direction of the outside comparison star gave  $19''.0$ ; and for the diameter of the whole disc in the same direction  $44''.7$  (1890.88). There are drawings of this nebula by LASSELL (*Mems. R. A. S.*, xxiii. and xxxvi.); D'ARREST (*Observations of Nebulae*, 1867); ROSSE (*Phil. Trans.*, 1850); and SECCHI (*Mem. Coll. Rom.*, 1852-55). LASSELL speaks of the comparison star as being nebulous. I did not notice any peculiarity in the appearance of this star. SCHÖNFELD (in 1862.19) made the difference in R. A.  $0''.20$  and in Decl.  $100''.4$ . These stars have been measured directly as follows:

1853.20	2.6	100.12	OΣ	4 n
1864.98	2.4	100.16	Knott	4 n
1873.70	2.9	98.00	Copeland	3 n

It is evident no change has taken place in the last forty years.

No. 2438.

R. A.  $7^h 35^m 26^s$   
Decl.  $- 14^\circ 25'$

Central Star and Star s. f.

1890.939	127.1	49.88	12.0 .. 11.5
1891.151	127.6	49.56	12.0 .. 10.7
1891.04	127.3	49.72	12.0 .. 11.1

These stars were measured at Parsonstown:

1873.006	128.6	48.7	...	Copeland	1 n
1876.123	129.6	50.0	16.0	Dreyer	1 n

Central Star and Star in Nebula.

1890.939	209.0	15.10	14.5
1891.151	210.7	15.27	13.5
1891.04	209.8	15.18	14.0

The last measures connect the central star with a faint star in the s. p. side of the ring. This is probably the star shown in ROSSE's drawing, and

must be the one shown in LASSELL's drawing, although the position-angle is erroneous if the drawing is to be looked at in the usual way. The outside diameter of the nebula is 63".9. There are drawings by ROSSE (*Phil. Trans.*, 1850); LASSELL (*Mems. R. A. S.*, xxiii.); and SECCHI (*Mem. Coll. Rom.*, 1852-5). COPELAND has a single measure of the last-named star:

1873.063    210.8    17.4    13-14 .. 16.0

## No. 2452.

R. A.  $7^h 41^m 47^s$  }  
Decl.  $-27^\circ 0'$  }

Not planetary. There are two nuclei, giving it a sort of dumb-bell appearance.

## No. 3242.

R. A.  $10^h 18^m 2^s$  }  
Decl.  $-17^\circ 56'$  }

1891.241	173.1	155.11	12.0 .. 10.5
.244	173.0	155.47	11.0 .. 10.5
.246	173.2	155.98	11.0 .. 10.5
1891.24	173.1	155.52	11.3 .. 10.5

I have made the following measures of this interesting object:

Direction of the longer axis of the ellipse ..  $324^\circ.8$   
Longer diameter of the whole ellipse ....  $42''.4$   
Shorter diameter of the whole ellipse .....  $38.3$   
Longer diameter of inside ring .....  $23.2$   
Shorter diameter of inside ring .....  $17.0$

This nebula has been drawn by HERSCHEL (*Cape Observations*); LASSELL (*Mems. R. A. S.*, xxiii. and xxxvi.); SECCHI (*Mem. Coll. Rom.*, 1852-5); and ROSSE (*Trans. R. Dublin Soc.*, II.). There is a single observation of these stars by SEARLE (*Annals Harvard Obs.*, xiii.) giving  $172^\circ.5 : 154''.64$  (1868.06). The comparison star is called 13-m. There is also a single measure of COPELAND,  $173^\circ.9 : 155''.2$  (1874.18).

## No. 3587.

R. A.  $11^h 6^m 40^s$  }  
Decl.  $+55^\circ 47'$  }

1891.239	25.3	156.15	13.5 .. 10.0
.241	24.5	156.49	14.5 .. 10.5
.244	24.6	156.79	14.5 .. 11.0
1891.24	24.8	156.48	14.2 .. 10.5

This has been drawn by ROSSE (*Phil. Trans.*, 1833, 1850).

## No. 4107.

R. A.  $11^h 59^m 35^s$  }  
Decl.  $+11^\circ 23'$  }

Not planetary, but it is brighter in the middle, and extended in the direction of  $115^\circ$ . In DREYER it is described as having a star 10-11-m south following. There is nothing in that place, but there is a star of that magnitude north preceding.

## No. 6369.

R. A.  $17^h 20^m 49^s$  }  
Decl.  $-23^\circ 38'$  }

1891.594	58.8	90.52	14.0 .. 13.5
.597	56.7	90.30	15.0 .. 13.8
1891.59	57.7	90.41	14.5 .. 13.7

This is an annular nebula, and very much like the well-known example in *Lyra*, except in brightness. The longer axis is in the direction of  $33^\circ$ , and the extreme diameter on that line is  $31''$ . HERSCHEL has a drawing in *Cape Observations*. I am not aware of the central star having been seen before.

## No. 6543.

R. A.  $17^h 58^m 36^s$  }  
Decl.  $+66^\circ 38''$  }

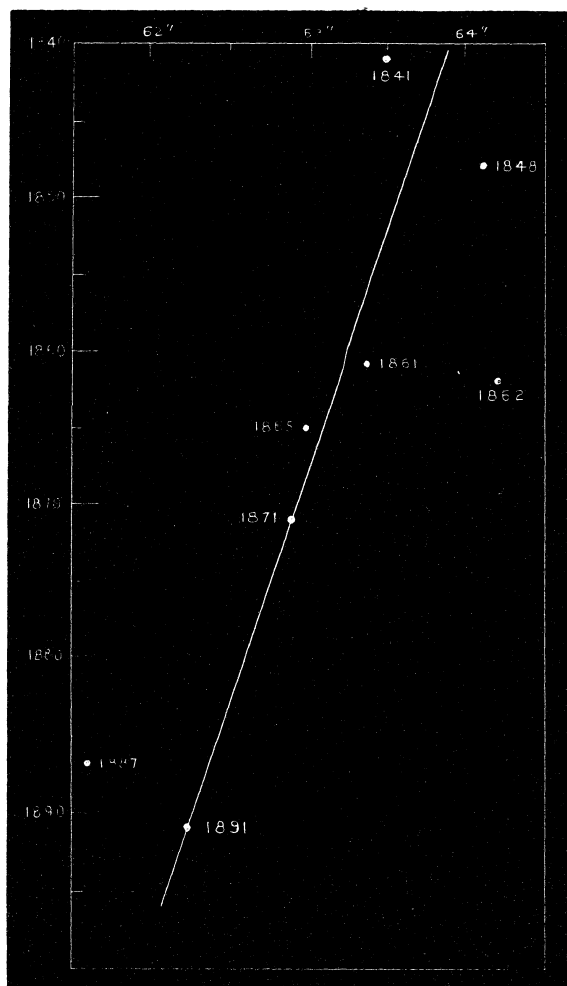
1891.392	292.3	163.34	...
.395	292.4	163.14	9.5 ... 9.0
.397	292.4	163.18	9.7 ... 8.8
.416	292.4	163.28	9.5 ... 8.7
1891.40	292.4	163.24	9.6 ... 8.8

This is the well-known planetary nebula in *Draco*. It has been more frequently observed than any other object of this class, with the exception of the ring nebula in *Lyra*. The comparison star is D. M.  $+66^\circ, 1065$ . The only direct measures of these stars which I have found are two single observations with the ROSSE reflector by DREYER, as follows:

1873.709	290.1	161.6
1873.711	291.2	162.8

In 1871-2 BRUNNOW used the same stars in an attempt to measure the parallax of the nebula, but measured the difference of declination only (*Dunsink Observations*, III.). From a large number of measures he found this difference to





DREYER 6543.

Observed Differences of Declination.

be  $62''.90$ . Later, BREDICHIN, in a similar work, used the same stars and method of observation (*Annals Obs. Moscow*, III.), but I have not seen this volume, and do not know what result he obtained. SCHÖNFELD (1861.64) obtained  $63''.4$ ; and SCHULTZ in 1865, as a mean of five rather discordant measures,  $63''.0$ . These different results apparently indicate a movement on the part of one or the other of the stars, or that at least some of the observations are of very doubtful value; but the important fact must be considered that the central star was not really seen at all by most of the observers, and that the measures were made from the estimated center of the nebula. SCHULTZ used the "geometrical center" of the nebula, and SCHÖNFELD evidently did not

see the star. At Parsonstown, where the direct measures were made, it was noted "no certain indication of a central star"; and, therefore, these observations, like those giving the difference in declination, cannot be compared with the late measures for the purpose of determining whether or not there has been any relative change. The DUNSINK measures, however, seem to be on different footing in this respect, for BRUNNOW says that the nebula "has in the center a well-defined point resembling a star of the eleventh magnitude. I have compared this point in declination with a star to the north of the tenth magnitude," etc. Evidently the star was not very conspicuous with the DUNSINK equatorial, or it would not have been referred to as a "point resembling a star," but it was undoubtedly well enough seen to make a definite point for placing the wires.

O. STRUVE from a single night found  $293''.0$ :  $164''.40$  (1848.73), and by two measures of the difference in declination in 1841 and 1848,  $63''.5$  and  $64''.1$ .

The difference of the declination of the two stars, computed from my measures of the position-angle and distance, is  $62''.20$ . This is  $0''.7$  less than BRUNNOW's value, and should be much too large for the ordinary errors of observation, particularly in measures of this kind, where the telescope is stationary, and the bisection of the stars is so easily and certainly made. After learning of this difference I determined to see whether the value derived from the angle and distance would be confirmed by observing the difference of declination with the same instrument used in the direct measures. By this method I obtained the following:

1891.652	Dif. Decl. = $62''.42$
.655	$62''.31$
.666	$62''.25$
.671	$62''.34$
1891.66	$62''.33$

The difference between this result and that derived from the first series of measures is only  $0''.13$ , a quantity which is insensible in direct measures of that distance, and within the limits of error in careful observations.

The various results found for the difference in



the declination of these two stars, arranged in chronological order, are as follows:

1841	Dif. Decl.	63.5	$O\Sigma$
1848		64.1	$O\Sigma$
1861		63.4	Schönfeld
1862		64.2	Argelander
1865		63.0	Schultz
1871		62.90	Brunnow
1887		61.6	Engelhardt
1891		62.26	$\beta$

All of these measures appear to have been made with the micrometer, with the exception of ARGELANDER'S, which were with the meridian circle. (*Bonn Observations*, VI.)

These observations are laid off to scale on the accompanying diagram. It is apparent that there is a slow change in the declination of one of these stars, and that the difference is steadily decreasing. An examination of these positions, and omitting for this purpose those of 1862 and 1887, shows that the annual change in declination amounts to  $0''.033$ . It is probably impossible to determine at this time to which star, if only one, this motion belongs.

There are drawings of this nebula by VOGEL (*Bothkamp Observations*, IV.), and by HOLDEN and SCHAEBERLE (*Mon. Not.*, xlviii., 390).

#### No. 6563.

R. A.  $18^h 2^m 48^s$  }  
Decl.  $- 33^\circ 53'$  }

This nebula is fairly planetary in appearance, and there seem to be some faint stars in it, but the central star is wanting. No drawings cited in DREYER.

#### No. 6572.

R. A.  $18^h 5^m 18^s$  }  
Decl.  $+ 6^\circ 50'$  }

1891.575	77.0	33.02	10.5 . . 14.5
.578	75.5	32.82	11.0 . . 15.5
.597	76.6	33.08	11.0 . . 15.0
1891.58	76.4	32.97	10.8 . . 15.0

This is one of the brightest of the planetary nebulae. It is sometimes spoken of as  $\Sigma 6$ , which is an unfortunate as well as an improper method of referring to the list of nebulae observed by STRUVE, since the symbol  $\Sigma$  preceding a numeral has been universally used to designate

the double stars comprised in the great catalogue of double stars, *Mensurae Micrometricae*.

There are drawings of this nebula by SECCHI (*Mem. Coll. Rom.*, 1852-5), and by VOGEL (*Pub. Potsdam Obs.*, IV.). I have not seen these illustrations.

#### No. 6720.

R. A.  $18^h 48^m 23^s$  }  
Decl.  $+ 32^\circ 51'$  }

1891.326	88.2	61.64	15.5 . . 12.0
.416	87.8	61.44	15.5 . . 13.5
.419	86.5	61.56	15.5 . . 12.0
.518	88.4	62.28	15.0 . . 13.0
.559	88.0	61.56	15.5 . . 11.5
1891.45	87.8	61.69	15.4 . . 12.4

This is the well-known annular nebula in *Lyra*. All the measures were made under very favorable conditions, and the central star well seen. When the seeing was the best, and perfect for all practical purposes, the ring and the darker interior were carefully examined with various powers, but without detecting any other stellar point. In various places there are minute areas of slightly brighter nebulosity, but none of them appear to be stars. There are many drawings of this nebula. The comparison star in the foregoing measures is the familiar one near the following edge of the nebula.

#### No. 6781.

R. A.  $19^h 11^m 38^s$  }  
Decl.  $+ 6^\circ 17'$  }

1891.562	72.1	49.22	15.0 . . 12.0
.575	74.5	49.50	15.0 . . 13.0
1891.57	73.3	49.36	15.0 . . 12.5

The primary star is not central, but is north of the middle. Drawings have been made by LAMONT and LASSELL.

#### No. 6818.

R. A.  $19^h 36^m 4^s$  }  
Decl.  $- 14^\circ 29'$  }

This seems to present a true planetary appearance, but there is no central star. There appear to be two or three slight condensations of nebulous matter, which at first glance might be taken for faint stars, but I do not think they are real stellar points. There are drawings by ROSSE, LAMONT, D'ARREST, and SECCHI.

## No. 6826.

R. A.  $19^h 41^m 2^s$  }  
Decl.  $+ 50^\circ 11'.2$  }

1891.747	194.1	96.15	9.0 .. 10.0
.750	194.4	96.17	8.7 .. 9.0
1891.75	194.2	96.16	8.8 .. 9.5

This beautiful object is almost an exact duplicate of the planetary nebula in *Draco*. It is slightly elliptical, with the longer axis in the direction of  $295^\circ$ . A setting of the wires gave for the longer diameter  $26''.6$ , and for the shorter  $24''.3$ . There are a number of stars nearer than the one measured. The nearest, about 14-m, is  $27''.0$  from the central star, in the direction of  $283^\circ.1$ . Drawings have been made by HERSCHEL and SECCHI.

ENGELHARDT (*Observations Astron.*, II.) by three measures made the difference of declination between the two stars,  $93''.5$  (1887.79). Computed from my angle and distance it is  $93''.2$ .

## No. 6891.

R. A.  $20^h 8^m 32^s$  }  
Decl.  $+ 12^\circ 19'$  }

Central Star and  $p$  Star ( $a$ ).

1890.785	242.3	42.67	11.0 .. 12.0
.840	242.5	43.20	12.0 .. 13.0
1890.81	242.4	42.93	11.5 .. 12.5

Central Star and  $p$  Star ( $b$ ).

1890.802	289.0	57.15	12.5 .. 11.5
.840	289.4	57.40	12.0 .. 10.5
1890.82	289.2	57.27	12.2 .. 11.0

In making the second measure a different comparison star was used, and therefore both were subsequently measured. This nebula was discovered by COPELAND.

## No. 6894.

R. A.  $20^h 10^m 45^s$  }  
Decl.  $+ 30^\circ 8'$  }

1891.594	186.7	119.65	15.0 .. 11.5
.610	185.3	119.92	15.0 .. 10.8
1891.60	186.0	119.78	15.0 .. 11.1

Considerably darker in the middle, and apparently belongs to the annular class. The faint star

within is not central, but is near the preceding side. There are many stars nearer the nebula than the 11-m comparison star. This nebula has been figured by ROSSE (*Phil. Trans.*, 1833). (*Trans. R. Dublin Soc.*, II.)

## No. 6905.

R. A.  $20^h 16^m 9^s$  }  
Decl.  $+ 19^\circ 40'$  }

1891.594	358.0	46.76	14.0 .. 10.0
.610	357.2	46.61	14.0 .. 10.0
1891.60	357.6	46.68	14.0 .. 10.0

A measure of the diameter of this nebula in the direction of the 10-m star gave  $39''.1$ . There are many drawings by the principal observers. SEARLE gives difference of declination between nebula and star (central star not mentioned) as  $46''.33$  (1867.65). (*Annals Harvard Coll. Obs.*, XIII.)

## No. 7009.

R. A.  $20^h 56^m 33^s$  }  
Decl.  $- 11^\circ 55'$  }

1890.709	343.3	96.45	12.5 .. 13.0
.725	343.7	96.55	11.5 .. 12.0
.777	343.4	96.13	12.0 .. 13.0
1890.74	343.5	96.38	12.0 .. 12.7

There are many drawings of this object, sometimes called the "*Saturn* nebula," references to which will be found in DREYER.

The following single measures are from the ROSSE observations:

1873.655	343.3	99.0
1874.695	343.3	101.2

## No. 7026.

R. A.  $21^h 1^m 33^s$  }  
Decl.  $+ 47^\circ 17'$  }

1891.562	271.7	6.21
.575	272.6	6.40
.578	274.5	6.74
1891.57	272.9	6.45

This nebula was discovered by me in 1873 with the 6-inch refractor, with which it was also seen double or elongated. One of the nuclei is brighter than the other. The measures given above are of the angle and distance between

these nuclei. They are not stars, but small enough for fairly accurate bisection. This object does not properly belong to the planetary class of nebulae. Some rough measures were made a few years ago, which differ much from the results given here, but it is not probable that any change has occurred in the nebula.

## No. 7027.

R. A.  $21^{\text{h}} 1^{\text{m}} 48^{\text{s}}$  }  
Decl.  $+ 41^{\circ} 40'$  }

1891.575                      131.0  
.578                          135.1

Discovered by WEBB. It has two nuclei, the following one of which is fairly well defined, but the brighter is too large and diffused for reliable measures of distance. There is nothing planetary about the appearance of this nebula. The nearest star is 15-m, and is about  $14''$  from the bright condensation, in the direction of  $96^{\circ}$ .

## No. 7208.

R. A.  $21^{\text{h}} 59^{\text{m}} 25^{\text{s}}$  }  
Decl.  $- 29^{\circ} 44'$  }

This is a faint circular nebula, but not specially planetary in appearance. HERSCHEL's description is "almost planetary."

## No. 7354.

R. A.  $22^{\text{h}} 35^{\text{m}} 8^{\text{s}}$  }  
Decl.  $+ 60^{\circ} 33'$  }

There seems to be a faint condensation near the margin of the nebula on the preceding side, but there is no central star; otherwise it presents the true planetary appearance. DREYER has no reference to any drawings.

## No. 7662.

R. A.  $23^{\text{h}} 19^{\text{m}} 11^{\text{s}}$  }  
Decl.  $+ 41^{\circ} 46'$  }

1890.782	62.4	51.82	15.0 .. 13.0
.785	63.4	51.87	15.0 .. 13.0
1890.78	62.9	51.84	15.0 .. 13.0

A number of drawings have been made of this nebula, references to which will be found in DREYER. SEARLE (*Annals Harvard Coll. Obs.*, XIII.) measured the outer star from the center of the nebula (the central star not seen), and from two observations gives  $62^{\circ}.7:52''.14$  (1866.80). O. STRUVE, from four nights, found  $61^{\circ}.3:51''.85$  (1847.86). He states that the central star, which has been noted with the ROSSE reflector, was not seen. (*Mélanges Math. et Ast.*, III.)