*New Planetary Nebulæ**.

Measurements of the light of the planetary nebulæ have been made during the past year with the fifteen-inch telescope of the Harvard College Observatory. In connection with these observations the spectrum of each nebula has also been examined. A spectroscope of the usual form would be open to many objections for this work, especially as it must be frequently removed and replaced by the photometer. Accordingly a direct-vision prism was placed between the eyepiece and objective of the telescope, thus forming a spectroscope without a slit. When a star was brought into any part of the field it was spread out into a coloured line of light, the rays of each wave-length forming an image of the star in a different place. A nebula, on the other hand, being mainly monochromatic, would form a point or small disk of light, while a minute cluster would give a spectrum like that of a star. The difference in these appearances is so marked that the idea suggests itself that this device might serve to detect any minute planetary nebulæ, which could not otherwise be distinguished from stars. Accordingly a systematic search for such bodies was undertaken. A power of about 140 is employed with a field 12′ in diameter. The telescope is clamped in right ascension and moved through 5° in declination. This is repeated so frequently that the successive sweeps shall overlap, the region continually varying by the diurnal motion. Great numbers of stars pass through the field and are spread out into lines. The position of any object presenting a different appearance is at once determined by observing the declination and time. The positions of bright stars are also observed to furnish corrections for the limits of the zone. Various precautions must be taken; for instance, if the spectra run north and south, the lines cannot be distinguished from points, when the telescope is moved, owing to the persistence of vision. The prism is therefore always turned so that the direction of the spectra shall be perpendicular to the line of motion. Even then the eye is constantly deceived and an object thought to be a nebula is seen to be a star when the telescope is stopped. The retina appears to be especially sensitive to rays of particular wave-lengths. The strain upon the eye and mind in examining so many objects, several a second, renders this work very fatiguing, and I have found it best not to continue it for more than half an hour without an intermission. A count of the number of stars to be seen at a time in fields taken at random shows that the spectra of over ten thousand stars are often examined in this time.

The first sweep was made on July 13, and revealed in a few minutes a bright point of light wholly unlike the lines formed by the stars. This proved to be a new planetary nebula having the position for 1880 R.A. $18^h\ 25^m{\cdot}2$ and Dec. $-25°\ 13'$. Its disk is

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so small that it can scarcely be distinguished from a star and would not probably have been detected with an ordinary eyepiece even if brought into the field of view. Measures of its light show that it is about eight magnitudes fainter than λ *Sagittarii*, or of about the eleventh magnitude on the scale of Pogson. The next evening another new nebula was found somewhat fainter than this, but with a larger disk. Its position for 1880 is R.A. $18^h\ 4^m{\cdot}3$ and Dec. $-28°\ 12'$. This region was selected since it contains four of the fifty previously known planetary nebulæ. Sweeps on several subsequent evenings in this vicinity and elsewhere revealed nothing new.

On August 28 an object entered the field having a very singular spectrum. Two bright bands were seen near the ends of a faint continuous spectrum. The position of this object for 1880 was found to be R.A. $18^h\ 1^m\ 17^s$, Dec. $-21°\ 16'$. It therefore is identical with the star Oeltz. Arg. No. 17681. Its position was observed once by Argelander and twice in the Washington zones. It must therefore have had nearly its present position and brightness over thirty years ago. It appears to be slightly fainter than Oeltz. Arg. No. 17648, which precedes it about a minute and is 4′ north, so that even a small change in its light can be easily detected hereafter. A careful examination of the spectrum shows that the bright portions are longer than they are wide, and accordingly that they are bands and not lines. This view was confirmed by attaching a spectroscope of the usual form to the telescope. The less refrangible band extends from the wave-length 5800 to 5850, the other from 4670 to 4730. A third band was suspected at about 5400. All these measures are only approximate, and should be repeated at some observatory where spectroscopy is made a special study. A large telescope is needed, since at best the spectrum of so faint a star will not be easily measured. It will be noticed that the first of these bands is in the yellow not far from the D line, but of somewhat less wave-length. The other band is in the blue between the F and G lines. This spectrum is unlike that of any other source of light so far as is yet known. It is difficult to know in what class to place this body. From its spectrum of bright bands on a faint continuous background, we might place it with the nebulæ, since most of the planetary nebulæ seem to have a faint, continuous spectrum not due to the presence of stars in their vicinity. The material of which this object is composed must, however, be different. On the other hand, it resembles a star in other respects, showing no disk and having a much greater intrinsic brightness than other nebulæ.

The fourth new object was discovered on September 2 and consists of a very minute nebula in R.A. $18^h\ 14^m{\cdot}3$ and Dec. $-26°\ 53'$. This is the smallest planetary nebula known and could not be distinguished from a thirteenth-magnitude star in an ordinary telescope. The difference between it and a star is, however, very marked in the prism, and had it been a magnitude fainter its peculiar character would probably have been detected.

It is estimated that the spectra of about a hundred thousand stars have so far been examined, although only about one hundredth part of the heavens has as yet been explored. A more rapid survey of the whole heavens is also being made with a comet-seeker of about four inches aperture, to show the presence or absence of peculiarities in the spectra of the brightest stars.

Cambridge, U. S., Sept. 7, 1880. EDWARD C. PICKERING.

Observations of Jupiter.

THE times of transit of the red spot have been noted here on 34 nights since Sept. 27. A few of the more recent observations are given below :—

1880.	*p.* end. h m	middle. h m	*f.* end. h m
Dec. 15.....	10 30	10 56	11 22
20.....	9 38	10 4	10 33
25.....	8 40	9 12	9 39
28.....	6 15	6 40	7 7
30.....	7 50	8 21	8 50
31.....	..	4 11	4 39
1881.			
Jan. 6.....	8 40	9 7	9 33
7.....	4 31	4 57	5 25
12.....	..	4 5	4 32
13.....	9 27	..	..
14.....	5 17	5 44	6 13
16.....	6 54	7 23	7 52

In Mr. Marth's ephemeris ('English Mechanic,' Dec. 17, 1880) the assumed first meridian passed the middle of the illuminated disk on Jan. 16 at $7^h\ 32^m{\cdot}2$, so that the middle of the spot only preceded it by $9^m{\cdot}2$ on that date. There is a dark shading at the interior *f.* end of the spot, which I first noted on Sept. 27, and have frequently seen since. Mr. Calver has confirmed this since November 17.

There is a dusky streak or elliptical spot of very distinct aspect *s. p.* the red spot, which has remained visible since it was detected by Mr. Barnard on July 25 last, when it occupied a position S. of the preceding end of the red spot. The distance between the two objects is gradually widening, for I found that the interval had increased from $1^h\ 38^m$ on November 2 to $2^h\ 31^m$ on Jan. 16, in fact the smaller spot has a rotation period of about $17\frac{1}{2}$ seconds less than the red spot, for during the 75 days embraced by the observations the latter has lost 53^m; and, 181 rotations having been performed in the interval, the difference has amounted to $42^s{\cdot}4$ daily. There is another marking in the southern hemisphere, smaller but of similar type, which now precedes the red spot about 4 hours. This also was detected by Mr. Barnard on July 25, and he has deduced its rotation period as $9^h\ 55^m\ 16^s{\cdot}176$.