The ellipticity and Surface-markings of Uranus.

Observations at Princeton New Jersey (U. S. A.), by Prof. *C. A. Young*.

Professor Safarik's note upon Uranus (Astr. N. 2505) called my attention to the present favorable opportunity for determining the ellipticity of the planet and led me to make the following observations.

The series is not so extensive or complete as could be wished, having been begun too late to secure the desirable symmetry in respect to the vertical, and having been interrupted by bad weather, and by an accident to the micrometer wires. The results however are fairly in accordance with those of Professor Schiaparelli (Astr. Nachr. 2526), and make it quite certain that Uranus, like Jupiter and Saturn, has a rapid rotation nearly in the plane of its satellite-orbits.

The measures were made by myself at the Halsted Observatory (not the School of Science Obs.) with the great Equatorial, which has an aperture of 23 inches (584^{mm}) and a focal length of 30 feet. The filar-micrometer employed is provided with Burnham's illumination, giving bright wires upon a dark field: five of the fourteen sets of measures were however made in the twilight without any artificial illumination, and are marked with asterisks in the table.

The value of one revolution of the screw is $9''.469$, determined by about 100 star transits over wires at a distance of 25 revolutions, observed with the chronograph. This value is only provisional, but is quite precise enough for the purpose as the probable error does not exceed $\pm 0''.005$.

Two achromatic eyepieces of Steinheil's form were used, giving powers of 480 and 720.

Each measure presented in the table depends upon ten readings; five with the movable wire on one side of the fixed wire, and five with it on the other, thus giving a double distance free from zero-error. The thickness of the wires was separately determined for each measure, with unchanged illumination.

In setting the position angle of the wires, it was assumed that the planet's equator must sensibly coincide with the plane of the satellite-orbits, the researches of Tisserand having shown that this coincidence is forced whenever the planet's ellipticity is sufficient to give it dominance.

In the table most of the columns explain themselves. The Hour Angle applies to the moment midway between the two measures of Polar and Equatorial diameters to which it is attached. It was always West, the observations not having been begun early enough to permit any measures East of the meridian.

The columns marked P and E contain the values of the Polar and Equatorial diameters, deduced from the measures, and reduced to the distance 19.1826 (log. 1.28291). The corrections for phase and differential refraction were neglected, never reaching $\pm 0''.004$ in any case. The columns headed w give the weight assigned to the measures with which they are connected. There may be some question as to the propriety of weighting such observations at all: in this case however it makes practically no difference, for by taking indiscriminate means we get the same results, within the limits of probable error, as from the weighted data.

Measures of the Polar and Equatorial diameters of Uranus.

Nr.	1883	H. Angle	Mag.	P	w_p	E	w_e	Remarks.
1	May 18	$1^h\ 5^m$	480	$3''.96$	8	$4''.46$	8	Bright wires. Image steady.
2	18	1 40	480	4.06	7	4.43	7	Bright wires. Image not so good.
3	24	1 15	480	*4.04	6	*4.37	6	Twilight. Air unsteady.
4	24	1 45	480	4.13	7	4.42	8	Bright wires. Image better.
5	25	1 0	480	*3.78	4	*4.31	6	Twilight. Image very bad at first.
6	25	1 40	720	4.07	8	4.06	9	Bright wires. Image now good.
7	June 1	1 15	480	*3.62	4	*4.24	6	Twilight. Image execrable at first.
8	1	1 45	720	4.12	7	4.21	7	Bright wires. Image moderately good.
9	11	2 10	720	3.97	8	4.19	8	Bright wires. Image moderately good.
10	12	2 30	720	3.95	9	4.39	9	Bright wires. Image excellent.
11	15	2 15	720	*3.82	8	*4.25	9	Twilight. Image steady, but pale.
12	15	2 50	720	4.06	8	4.52	5	Bright wires. Air became unsteady at last.
13	19	2 20	480	*3.51	4	*3.80	4	Twilight. Image unsteady and very faint. Haze.
14	19	3 0	720	4.15	6	4.17	8	Bright wires. Image now fairly good.

Weighted means $3''.974 \ldots 4''.280$; giving Ellipticity $= \frac{1}{13.99}$

(Indiscriminate means $3.946 \ldots 4.273$; giving Ellipticity $= \frac{1}{13.07}$)

It will be noticed that my values of the Polar and Equatorial diameters exceed those of Schiaparelli, by 0".42 and 0".37 respectively; and my value of the ellipticity is less than his; $\frac{1}{14}$ as against $\frac{1}{11}$.

I am disposed to think my own diameters are too large, as I have repeatedly found that my filar-micrometer measures of discs exceed those of most other observers, and are much larger than the results obtained with double-image micrometers. This constant error would not however seriously affect the deduced ellipticity.

It is otherwise with a different error, with which my own measures (as well as those of other observers) are very likely to be affected. In investigating the ellipticity of Mars (Am. Journal Science and Art, March 1880) I found in my measures a distinct tendency to exaggerate all vertical dimensions as compared with horizontal. To eliminate this error enough observations ought to have been obtained East of the meridian to make the average position-angles of the two diameters under investigation symmetrical with respect to the vertical, a condition not at all met by the present series. The effect of the correction would be to diminish the deduced value of the Equatorial diameter (which was always nearly vertical during my observations), and so to reduce the ellipticity still more. It is strongly my impression that the real value is less than $^1/_{15}$. I hope next year to obtain a more satisfactory series of measures.

Surface-Markings.

In the course of the observations, markings resembling the belts of Jupiter and Saturn were seen upon the planet's disc whenever vision was good, and the image bright and steady. They were of course very faint, but they were repeatedly seen not only by myself, but by my Assistant Mr. Mc Neill, and by Professor Brackett.

I first perceived them on May 25, and on asking Mr. Mc Neill to look and tell me what he saw, without telling him of my own impression, he at once saw them also in the same way that I did.

On May 25 the Western Pole was notably brighter than the Eastern; and the Western belt showed a little spur running out toward the pole: this marking unfortunately never recurred. On June 1, Mr. Mc Neill suspected two very faint polar belts in addition to the equatorial. One June 11 the equatorial space between the belts seemed to be unusually wide.

On several occasions the trend of the belts appeared to make a considerable angle with the line of the satellites: a very puzzling circumstance in view of Tisserand's results, if it is really a fact. During the whole series of observations the position angle of the major axis of the satellite-orbits varied only a few minutes from 15°.

On June 1 I measured the position angle of the belts as 36°, and a few minutes later Mr. Mc Neill made it 43°. Still later in the evening however Prof. Brackett set the wire at 15°. But at that time, although it was darker, the seeing was worse, and the image unsteady, so that the belts were difficult to make out.

On June 11 the belts were rather suspected than fairly seen, vision being only indifferent. On June 12 (8^h45^m Wash. Time) the belts seemed to Mr. Mc Neill darker on the East side of the planet than on the West.

On June 15 the belts were again seen inclined to the line of the satellites, two of which, Oberon and Titania, were conspicuously visible at position-angles of 14° and 15°, and at distances of about 40" and 30" respectively. My own measurement of the position angle of the belts at this time (8^h45^m W.m.T.) was 32°, and Mr. Mc Neill made it 37° a few minutes after. Of course no great weight is to be assigned to this angle, but the six different settings by Mr. Mc Neill and Myself all ranged within 10° of each other. On the 19th the seeing was not good enough to permit the belts to be visible.

It does not seem to be possible to deduce any reliable rotation-period from the data so far collected, but there is certainly reason to hope that another year something more definite may be made out by some of the great telescopes.

It may not even be necessary to depend solely upon the great telescopes. From the final sentence of Professor Schiaparelli's paper, it appears that, with his instrument of only 8 inches aperture, he also has caught glimpses of these same markings: a fact which speaks volumes for the Italian observer, instrument and sky, since at Princeton, with 23 inches, they could only be made out in a very vague, faint, and far from satisfactory manner.

Princeton 1883 Sept. 11.

C. A. Young.

Beobachtung von Sternbedeckungen

auf der Privatsternwarte des Hrn. A. Auerbach in Gohlis bei Leipzig.

[Lage der Sternwarte: Breite +51°21′43".3, Länge $0^h49^m28^s.6$ östl. v. Greenwich.]

Ich beobachtete an dem in Nr. 2466 der A. N. beschriebenen Refractor dieser Sternwarte und wandte am 17. Mai und 14. Juni 216fache Vergrösserung, am 14. Sept. wegen ungünstiger Luftbeschaffenheit nur 72fache Vergrösserung an. Die Zeitbestimmungen geschahen im unmittelbaren Anschlusse an die Bedeckungsbeobachtungen.

1883	Bedeckung	Gr.	Eintritt (dunkl. Rand)	Austritt (hell. Rand)	
Mai 17	χ Virginis	5	$10^h35^m31^s.9$ gut	$11^h51^m7^s.8$ unsicher	M. Z. Gohlis
Juni 14	50 Virginis	6	10 1 15.4 gut	— Wolken	
Sept. 14	c^1 Capricorni	$4^1/_2$	9 38 17.9 leidlich	— Wolken	