LICK OBSERVATORY

UNIVERSITY OF CALIFORNIA

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OBSERVATIONS OF THE SATELLITES OF URANUS IN 1900 AND 1901

The present great south declination of the planet Uranus makes observations of its faint satellites at northern observatories of little value, unless the observing conditions are good. This will account for the small number of observations, especially of Ariel and Umbriel, contained in the present paper; for of the nights when the 36-inch telescope was available to me, I used for this work only those on which the satellites measured could be seen continuously during the time of observation, and on which the image of the planet was sufficiently steady and well defined to permit accurate bisections to be made with the micrometer wire.

A complete observation consists of four micrometer settings for position angle, four measures of double distance, and four more settings for position angle. A 520-power eyepiece was generally used. The times are given in Pacific Standard Time. I have recorded in the "Notes" some data upon the relative brightness of the satellites. Umbriel in general was the most difficult one to see, and Titania the easiest. But on several nights Ariel could not be seen steadily, though Umbriel was measured satisfactorily.

The columns (O-C) in the tabulation give the residuals derived by comparing the observations with NEWCOMB'S Tables (Washington Observations for

1873—Appendix I). The residuals indicate that the satellites are slightly in advance of their predicted places, and that their orbits are a little smaller than those given by Newcomb.

The average residuals are as follows:

Ariel	+2.2	—0.29
Umbriel	+1.2	—0.16
Titania	+1.45	—0.18
Oberon	+0.7	—0.13

Assuming these quantities to show the actual error of the Tables, I applied them to the residuals, and then computed the probable error of a single observation of each satellite, with the following results:

Ariel	±1.2	±0.16
Umbriel	±1.1	±0.18
Titania	±0.6	±0.20
Oberon	±0.3	±0.18

NEWCOMB'S Tables are based upon observations made with the 26-inch refractor of the Naval Observatory in 1874 and 1875. That they represent observations made a quarter of a century later as closely as is indicated by the residuals here given is sufficient commentary upon their accuracy.

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July 29, 1901.

ARIEL.				O.—C.		NOTES.
1900	P. S. T.			<i>p.</i>	<i>s.</i>	
May 19	12 ^h 12	1 ^m 3	28 ^s 1	321.8		
					13.81	+2.1 —0.85
25	11 11	43 43	15 26	98.0	14.47	+2.5 —0.14
27	11 11	38 38	50 59	22.4	14.21	+2.3 —0.29
June 22	11 11	26 33	30 51	134.4*	14.39	+1.2 —0.24
24	9 9	58 58	59 41	54.3	14.22	+4.7 +0.03
1901						
April 11	16 16	5 4	52 45	251.4	13.63	+2.3 —0.65
19	15 15	6 4	00 58	305.1	14.19	—0.5 —0.16
May 10	14 14	53 53	24 44	69.5	14.37	+4.8 —0.14
June 6	11 11	27 27	10 18	300.1	14.45	—0.8 —0.18
14	11 11	50 50	7 22	9.8	14.20	+3.8 —0.28
July 5	10 10	45 45	37 33	122.5	14.11	+3.1 —0.42
14	9 9	49 49	42 42	320.0	14.29	+0.8 —0.15

*One-half weight.

				UMBRIEL.			
1900							
May	25	12	1 49	18.8		+2.5	
		12	1 57		20.17	—0.03	
June	15	11	10 54	39.6		+1.6	Umbriel very faint. Ariel too faint to measure.
		11	11 59		20.10	—0.02	
	22	10	50 18	286.0		+0.6	Sky hazy. Measure very difficult.
		10	50 6		20.47	+0.18	
	24	10	21 9	100.6		+3.1	Sky very clear, but seeing poor. Umbriel nearly as bright as Ariel.
		10	21 22		19.93	—0.30	
July	22	9	27 19	8.1		+2.4	Good conditions.
		9	27 3		19.56	—0.31	
1901							
April	18	15	8 19	77.8		—1.0	Umbriel very faint. Measures difficult.
		15	6 57		19.48	—0.54	
	19	15	32 32	165.7		—1.2	Umbriel estimated = 15 $\frac{1}{4}$ mag.
		15	33 54		19.71	—0.16	
May	10	14	38 51	188.9		+0.6	Good seeing. Umbriel = 15 mag.
		14	39 00		20.19	+0.11	
June	6	11	48 10	6.6		+2.8	Fairly good. Umbriel = 15 mag.
		11	47 00		19.80	—0.40	
	13	11	17 20	250.2		—0.3	Good conditions. Ariel too faint to measure.
		11	17 34		20.34	+0.04	
	14	11	30 3	339.5		+1.9	Good seeing. Umbriel seems a little brighter than Ariel.
		11	30 11		19.75	—0.50	
July	5	11	1 40	2.4		+2.0	
		11	1 37		19.83	—0.24	
	17	10	0 19	319.4		+0.2	Good seeing. Umbriel = 16 mag. Ariel $\frac{1}{4}$ mag. brighter.
		10	0 55		20.16	+0.07	

TITANIA.

	1900	P. S. T.			<i>p.</i>	<i>s.</i>	O.—C.		NOTES.
							Δp	Δs	
	April 27	13 ^h 13	54 ^m 54	24 ^s 57	225.5	32.80	+1.6	—0.14	Sky hazy.
	May 18	12 12	36 36	41 45	11.5	32.40	+1.6	—0.83	
	19	12 12	42 43	36 17	54.6	32.69	+2.7	—0.45	
	25	12 12	18 18	14 21	299.6	33.65	+0.2	+0.08	
	27	11 11	56 56	8 7	22.2	32.82	+0.8	—0.38	
	June 15	10 10	50 50	14 25	87.6	33.30	+1.8	+0.06	
	July 22	9 9	47 48	48 37	174.2	32.62	+0.8	—0.11	
	1901								
	Mar. 28	15 15	42 42	8 20	40.7	32.53	+2.8	+0.35	Satellites very faint. Measures difficult.
	April 11	15 15	20 20	41 39	256.8	32.42	+0.6	—0.30	
	12	14 14	43 43	54 58	296.4	32.38	+0.2	—0.33	Sky hazy.
	13	14 14	49 49	21 35	339.9	32.12	+2.1	—0.52	Sky hazy.
	18	15 15	30 31	48 10	187.1	32.62	+1.2	+0.03	
	19	15 15	57 58	14 17	230.5	33.02	+2.2	+0.25	
	May 10	15 15	21 21	9 20	17.6	32.61	+1.9	—0.39	Titania estimated = 13 mag.
	June 6	12 12	7 7	23 19	49.2	33.30	+2.0	+0.05	Titania estimated = 13 mag.
	8	11 11	24 24	42 47	129.1	33.39	+0.8	—0.06	Sky hazy, seeing poor.
	22	10 10	48 48	29 21	348.1	33.12	+1.9	—0.08	Seeing very poor. Inner satellites visible only by glimpses.
	July 5	11 11	15 15	7 12	165.6	32.67	+1.0	—0.38	
	6	10 10	37 37	3 23	207.2	32.55	+2.0	—0.34	Poor seeing.
	14	10 10	10 10	43 19	176.2	32.80	+1.1	—0.04	

				OBERON.		O.—C.		NOTES.
	1900	P. S. T.			<i>p.</i>	<i>s.</i>	Δp Δs	
April 27		13 ^h 13	29 ^m 29	21 ^s 34	195.2	43".87	+0.8 —0".15	
May 18		12 12	54 54	30 13	36.4	43.42	+0.8 —0.80	Poor seeing.
19		13 13	4 5	2 2	64.3	43.88	+0.5 —0.44	Oberon $\frac{1}{2}$ mag. fainter than Titania.
25		12 12	30 30	36 42	222.7	44.32	+0.2 +0.08	
June 2		10 10	46 47	55 26	75.0	44.26	+0.1 —0.14	Good seeing, but sky hazy.
16		10 10	45 45	11 30	90.7	43.88	+1.2 —0.52	Poor conditions.
22		11 11	9 9	37 11	251.0	43.98	+0.6 —0.12	
1901								
Mar. 28		16 16	11 11	28 38	154.1	42.75	+0.9 —0.13	
April 11		15 15	39 39	3 30	168.3	43.21	+1.2 —0.10	
12		15 15	6 7	33 8	194.4	43.63	+0.9 +0.30	
13		15 15	7 7	37 51	221.8	43.18	+1.4 —0.33	
18		15 15	46 46	51 54	355.3	43.41	+0.8 —0.11	
May 10		15 15	9 9	30 37	223.8	44.39	+1.1 +0.20	Oberon = 13 $\frac{1}{2}$ mag.
June 6		12 12	24 24	12 9	222.7	44.48	+0.8 +0.11	Oberon = 13 $\frac{1}{2}$ mag.
8		10 10	54 54	11 48	274.0	44.94	+0.3 +0.25	
22		10 10	28 30	52 5	287.3	44.57	—0.4 —0.05	
July 6		10 10	21 21	39 51	302.1	44.11	+0.2 —0.26	