ROYAL ASTRONOMICAL SOCIETY.

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Dr. LEE in the Chair.

John Watson, Esq., Fence Houses, Durham;
Edward Tyler, Esq., Church Street, Stoke Newington;
Wm. Hislop, Esq., 108 St. John's Street Road;
Chandos Wren Hoskyns, Esq., Wroxhall Abbey, Warwickshire; and
Ch. Henry Weston, Esq., Sion Place, Bath,
were balloted for and duly elected Fellows of the Society.

The Lords Commissioners of the Admiralty have liberally placed at the disposal of the Society, for distribution among the Fellows, a limited number of copies of Hansen's Lunar Tables, which have recently been published in this country at the public expense. Any Fellow of the Society desirous of obtaining a copy of this important work should lose no time in applying for the same at the Apartments of the Society.

Abstract of Results of Measurements of Saturn's Satellites made at the Madras Observatory in 1856-7, *with the Lerebours Equatoreal. Ap.* 6·3 *in., foc.* 88·6 *in., power usually employed* 174. By Capt. W. S. Jacob, Director of the Madras Observatory.

"These observations extend over a period from 6th November to 24th March, and number as follows: of *Japetus*, 58 in angle and 41 in distance; of *Titan*, 67 and 53; of *Rhea*, 49 and 25; of *Dione*, 42 and 12; of *Tethys*, 49 and 15; from these the following elements were deduced by the method of least squares:

	Japetus.	Titan.	Rhea.	Dione.	Tethys.
	° ′	° ′	° ′	° ′	° ′
ε	78 9·0	299 42·8	288 43·5	115 30·5	281 42·8
☊	143 1·3	167 58·6	167 19·5	167 37·3	167 37·3
i	18 37·9	27 36·6	28 8·1	28 10·4	28 10·4
ϖ	349 20·0	257 6·9	185 0·0	145 4	109 7
e	0·28 443	·027937	·00080	·00310	·01086
a^o	514″·96	176″·90	76″·13	54″·85	42″·60
a^c	515 ·52	——	76 ·30	54 ·64	42 ·64
n	4°·538042	22°·577042	79°·690225	131°·534914	190°·697700

"Where ε is the epoch of mean longitude for Jan. 0·0 Green-

wich mean time; ☊, the place of the ascending node on the ecliptic; *i*, the inclination to the ecliptic; π, the place of the peri-planet; *e*, the excentricity; a^{o}, the semi-major axis at *Saturn's* mean distance, as derived from the distance measures; a^{c}, the same as deduced by Kepler's law from the value for *Titan; n*, the mean daily motion in longitude. The values of a^{o} and a^{c} agree as nearly as could be expected; even in the case of *Japetus*, the difference (0″·56) cannot be considered large, since, owing to the impossibility of obtaining measures at opposite elongations, this quantity includes the sum of the errors of distance and excentricity, as well as the effect of the different masses of the satellites; this latter will, doubtless, be quite sensible in the case of *Titan*, which is so much larger than the rest; indeed, if we subtract 0″·08 from the observed mean distance of *Titan*, the resulting mass of *Saturn* will then agree with the mean of those derived from the other satellites, and the error of *Japetus* will be reduced to 0″·32. This would indicate an excess in *Titan's* mass over the average mass of the other satellites, amounting to $\frac{1}{750}$ of that of *Saturn;* which is probably not much greater than the real quantity. The measures of the other satellites do not, therefore, suggest any sensible amount of correction to the observed mean distance of *Titan*, viz., 176″·90; and the corresponding value of the mass of *Saturn* + *Titan* is ·00028759 or $\frac{1}{3477{\cdot}3}$; the mass of the whole system will probably not differ much from $\frac{1}{3475}$ or $\frac{1}{3476}$.

"These observations do not indicate any sensible quantity for the mass of the ring; the effect of which would be to increase the apparent mass of the central body in the case of the inner satellites, or to give them a mean distance greater than that derived from Kepler's law. Now both *Rhea* and *Tethys* show a difference in the *opposite* direction; and though it is on the right side in *Dione's* case, yet little importance can be attached to this, as the observations of that satellite are fewer and of less weight than those of the others.

"Of *Enceladus* there are 27 observations, but as this satellite would rarely bear more than the very feeblest illumination of the field, the angles are mostly little better than mere estimates, and the errors in longitude range from -8° to $+6^{\circ}$; this, however, is less than half the range of Herschel's Cape Observations. No distance-measures could, of course, be attempted. All that can be deduced, therefore, is the epoch for Jan. 0, 1857, viz. 301° 55′; and the mean daily motion, 262°·73208; the latter agreeing very closely with Sir J. Herschel's determination. On 21st Jan. this satellite was seen and well measured when nearly in conjunction, opposite *Saturn's* south pole, the angle observed being 186° 8′ at $9^{h}\ 39^{m}$ Madras mean time; an event of somewhat rare occurrence, as noted by Mr. Lassell at p. 67, *Monthly Notices* for Jan. 1857.

"*Mimas* was observed 12 times, but bearing no illumination

whatever, the angles are even rougher estimates than those of *Enceladus*, the errors in longitude ranging from -23° to $+22^\circ$;* and as the previous observations of this satellite are very few, and most of them more or less doubtful, the exact periodic time is still uncertain. All the data accessible to me are, Sir W. Herschel's epoch for 1789·0 (as given by Vince); one doubtful observation by Sir J. Herschel at the Cape in 1836; and nine observations from 1846 to 1856, kindly communicated by W. Lassell, Esq. Of these last, some one or more *must* be erroneous, minute stars being probably observed by mistake: for by no conceivable rate of motion can they all be brought into agreement. If the daily motion be taken at $381^\circ{\cdot}9475$, it will agree pretty well with Herschel's Cape Observation, and will include five of Lassell's; viz. those of 21st November, 1850, 28th and 30th December, 1852, and 1st and 8th January, 1853; and for the present I think this is the most probable quantity. The epoch for Jan. 0, 1857, will be $210^\circ\ 16' - 23{\cdot}6 \times \delta n$; δn being the difference of the *true* mean motion from that given above; the uncertainty of this epoch may be as much as 2° or 3°, independent of the error of mean motion. If it be desired to include a greater number of Lassell's observations, it will be needful to reject Herschel's; but the two observations of November and December 1856, given at p. 67 *Monthly Notice* for January, can by no means be reconciled with mine.

"On *Saturn's* next appearance we may hope to settle this point; and I trust that other astronomers, having powerful telescopes at their disposal, will give their aid; in any case where the satellite may be seen or suspected, it is desirable that it should be followed up for an hour or so, in order to be sure that the object seen is not a star.

"The observations of *Mimas* are given below; those of the other satellites will be published hereafter.

Madras Mean Time.				Pos. Ang.		Wt.	Madras Mean Time.				Pos. Ang.		Wt.
d	h	m	s	°	′		d	h	m	s	°	′	
Jan. 16	8	2	17	64	9	2	Jan. 23	7	51	37	261	57	2
20	10	14	21	275	17	2	24	7	57	16	258	5	2
21	8	3	16	281	35	2	25	12	30	0	100	51	1
—	9	18	34	269	41	3	—	13	6	52	94	0	1
—		45	18	264	44	2	Feb. 8	11	51	47	249	56	1
22	7	7	29	267	35	1	14	9	27	50	85	27	1

"The alterations in the mean motions of *Dione* and *Tethys*, indicated by Herschel, in his Cape Observations, are not confirmed; my excentricities also for *Rhea*, *Dione*, and *Tethys*, are much smaller than those which he assigns. My mean motion for

* If five doubtful observations be omitted, the errors will be reduced by nearly one-half; but I have thought it best to include them all, giving double weight to the undoubted ones; a portion of the error seems due to excentricity, or to some peculiar bias.

Japetus is derived from comparison with a few of Herschel's observations near conjunction, and may be in error as much as 1′ per annum; there is, therefore, still an uncertainty about the period of this satellite amounting to nearly 1^{m} of time.

"I may mention that the light-equation has been applied throughout to the times of observation, and that the observed distances have been corrected for refraction where needful; the correction in no case exceeding 1″·0, and being in general only a few hundredths.

"*Madras*, 10 *July*, 1857."

Results of the Observations of Small Planets made at the Royal Observatory, Greenwich, since July 1857.

(*Communicated by the Astronomer Royal.*)

Astrea.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1857, Sept. 16 13 55 17·0	1 39 5·55	86 26 35·85
28 13 0 31·5	1 31 29·67	87 40 31·83
Oct. 1 12 46 27·5	1 29 13·06	88 0 16·39
8 12 13 13·9	1 23 29·86	88 46 40·30
12 11 54 (10)	.....	89 11 32·67
13 11 49 16·6	1 19 11·42	89 18 58·61
19 11 20 28·9	1 13 58·28	89 55 45·24

Phocea.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1857, July 11 11 33 47·3	18 53 3·39	68 48 42·05
14 11 19 47·2	18 50 50·58	68 40 56·38
15 11 15 9·5	18 50 8·69	.....
18 11 1 17·1	18 48 3·66	68 39 1·50
28 10 16 25·9	18 42 30·75	69 13 35·39
29 10 12 5·6	18 42 6·28	69 19 49·28
31 10 3 29·9	18 41 22·23	69 33 46·85
Aug. 5 9 42 34·9	18 40 6·63	70 16 10·66