

ART. LV.—*Notes on the Satellites of Saturn*; by MARIA MITCHELL.

THE object glass of the telescope used in the observations which follow is of twelve and one-third inches diameter. Its definition is good.

The telescope is used in such observations as its very imperfect mechanism will allow; these are observations of the conjunctions of the satellites with the edge of Saturn's ring, of size and color, and of differences of right ascension.

The last are made by connecting with the chronograph, and recording the time of passage of the satellites over a fixed wire.

In the course of these observations such different relative magnitudes have been given to the small satellites, on different evenings, as to lead to the suspicion that some of them are variable.

The sparkle of Tethys and the grayish blue color of Rhea make it seem unlikely that small stars can have been taken for these two satellites; in the case of Enceladus and Dione mistakes are more easily made; but the rapid motion of Enceladus soon establishes its identity. The most noticeable changes are in Rhea.

In 1877, Rhea is recorded as small on Nov. 30th; as dull on Dec. 3d; as blurry and large, Dec. 14th; and as ruddy, Dec. 18th. In 1878 Rhea is recorded as faint Oct. 3d and Oct. 16th; as bright on Oct. 25th, and on Dec. 3d it is called nearly as bright as Titan.

1877, Oct. 5.—Rhea was in conjunction with the preceding edge of the ring at 8^h 58^m 29^s P. M. Two small satellites following the planet were in conjunction at the same time; the smaller one moved rapidly toward the ball.

1877, Oct. 6.—Two small satellites were nearly in conjunction with the edge of the preceding ring at 9^h 28^m P. M. The smaller of these was probably Dione; the larger may have been a star.

1877, Oct. 9.—10^h 8^m P. M. Tethys is moving away from the ball and has passed conjunction with the ring. Another satellite, probably Enceladus, is coming in, and is nearly up to conjunction with the following edge of the ring.

1877, Oct. 13.—At 10 P. M., two small satellites were seen to be nearly together following Saturn, the space between them being 1''·5. At 10^h 53^m 31^s, the two satellites could not be separated with a power of 400. The two were of the same size. At 11^h 20^m 31^s, the satellites could be seen separated. These may be Tethys near greatest elongation, and Enceladus approaching the planet.

1877, Oct. 14.—Rhea was in conjunction with the preceding edge of the ring and above the ring at 9^h 9^m 30^s.

1877, Oct. 23.—Rhea was again in conjunction with the preceding edge of the ring and above it, at 10^h 29^m 22^s.

1877, Nov. 6.—Tethys was in conjunction with the preceding edge of the ring at $9^{\text{h}} 31^{\text{m}} 30^{\text{s}}$.

1877, Nov. 7.—Tethys was in conjunction with the following edge of the ring and above the ring at $9^{\text{h}} 22^{\text{m}} 50^{\text{s}}$.

1877, Nov. 13.—Dione was in conjunction with the following edge of the ring at $8^{\text{h}} 44^{\text{m}} 6^{\text{s}}$.

1877, Nov. 14.—Titan was in conjunction with the preceding edge of the ring at $8^{\text{h}} 7^{\text{m}} 6^{\text{s}}$.

1877, Nov. 16.—Enceladus was in conjunction with the following edge of ring and beneath it at $9^{\text{h}} 51^{\text{m}} 6^{\text{s}}$.

1877, Nov. 17.—The seeing was excellent. Two satellites, probably Tethys and Enceladus, were seen as one at $6^{\text{h}} 29^{\text{m}} 24^{\text{s}}$. In twenty minutes they had separated $3''$. Rhea was in conjunction with the following edge of ring at $6^{\text{h}} 45^{\text{m}} 21^{\text{s}}$ and $3''$ below the ring. Dione was nearly at conjunction with the preceding edge of ring at 7 P. M.

1877, Nov. 30.—Titan was in conjunction with the preceding edge of the ring at $7^{\text{h}} 17^{\text{m}} 1^{\text{s}}$. A small satellite (Tethys?) a little past conjunction and above the ring at $8^{\text{h}} 10^{\text{m}}$.

1877, Dec. 12.—Tethys was in conjunction with the preceding edge of the ring and below it at $6^{\text{h}} 48^{\text{m}} 49^{\text{s}}$.

1877, Dec. 14.—A small satellite preceded the ring by one and three-fifths the measurement of the preceding ansa. Was this Mimas? The time was $7^{\text{h}} 34^{\text{m}}$.

1877, Dec. 16.—Titan was in conjunction with the preceding edge of the ring at $6^{\text{h}} 19^{\text{m}} 36^{\text{s}}$.

1878, Jan. 12.— $5^{\text{h}} 50^{\text{m}}$ to 6 P. M. The ring of Saturn appeared as a line. Titan preceded the planet and three small satellites followed, two of them estimated to be a second of arc only asunder. The distance from the following edge of the ring to the two satellites so closely together was nearly twice that from the ball to the edge of the ring.

1878, Jan. 16.—Observations began at $4^{\text{h}} 50^{\text{m}}$ P. M. The ring was seen as a line at $5^{\text{h}} 12^{\text{m}}$, its following portion being seen first. A bright spot was seen on this portion of the ring.

1878, Jan. 18.—The night was very fine, and at 6 P. M. the ring could be seen as a ring. The preceding portion of the ring was sharper than that following. On the following portion a bright spot was seen.

1878, Jan. 29.—At $5^{\text{h}} 25^{\text{m}}$ P. M. the ring could be seen as a bright line across the planet. Titan preceded the planet and four satellites followed. At $6^{\text{h}} 40^{\text{m}}$ a very faint satellite was seen (Tethys?) nearly up to conjunction with the ring and moving toward the ball.

1878, Feb. 7.— $6^{\text{h}} 30^{\text{m}}$ P. M. Points of light could be seen preceding Saturn, but the continuity of the ring could not be kept. A small point of light, possibly a satellite preceded the ring. Rhea and Titan followed the planet.

1878, Oct. 3.— $8^{\text{h}} 40^{\text{m}}$ P. M. Two satellites, supposed to be Rhea and Dione, are nearly in conjunction and preceding the planet. Two others follow, Tethys moving out and Enceladus (?) nearly

at conjunction with the ring. Of the four satellites, Tethys is the brightest.

1878, Oct. 16.—Titan was in conjunction with the edge of the following ring at 7^h 38^m; above the ring.

1878, Oct. 24.—Titan was seen emerging from the ball of Saturn at 9^h 16^m 30^s. 7^h P. M.—A very faint satellite was seen by glimpses, following, nearly in conjunction with the ring.

1878, Oct. 25, 7 P. M.—Titan and another satellite supposed to be Rhea were nearly in conjunction separated by 7". A very small satellite precedes the tip of the ring.

1878, Oct. 28.—Tethys was in conjunction with the edge of the following ring and below at 7^h 37^m P. M.

1878, Oct. 29.—Tethys was nearly at conjunction with the preceding ring and above at 7 P. M.

1878, Nov. 9.—At 8^h 18^m 3^s Titan was seen to emerge from the planet. It was wholly detached from the planet in twenty minutes. At 9^h 25^m P. M., a small satellite was seen, nearly at conjunction with the following ring.

1878, Nov. 13.—Six small bodies preceded Saturn. Of these, Titan, Rhea, Tethys and Dione could be identified. At 7^h 48^m P. M. the satellite supposed to be Rhea is distant from the preceding ring 6", Tethys is distant 1".

1878, Nov. 14.—7^h 30^m P. M. A very small satellite follows Saturn, distant about 3".

1878, Nov. 26.—Titan and a satellite supposed to be Rhea were asunder 6" 3' at 7^h 22^m. If this satellite was Rhea, it was unusually bright. Tethys and a very faint satellite precede Saturn, the latter is probably Enceladus.

1878, Nov. 29.—At 6^h 15^m P. M. a small satellite preceded Saturn and three others followed. Of those following, that which was nearest to Saturn could not be found at 9 P. M., and the second in distance from Saturn had moved in; the latter was probably Tethys.

1878, Dec. 3.—Dione was in conjunction with the following edge and above the ring at 7^h 46^m 34^s P. M. A small satellite was seen by glimpses, following at a distance of 6" from the ring.

1878, Dec. 6.—At 6^h 25^m a small satellite followed Saturn distant 7" from the edge of the ring. This satellite could not be found at 7^h 55^m although the seeing was much better. At 7^h 55^m a small satellite having the peculiar sparkle of Tethys, was seen a little beyond the following edge of the ring, and moving away from the ball.

1878, Dec. 13.—Titan and three small satellites precede the planet, probably Rhea, Tethys and Dione. Of the three, Tethys is the brightest at 6^h 57^m. It moves away from the ball. At 8^h 57^m two of these satellites could not be separated with a power of 230. I suppose them to be Tethys and Rhea.

1878, Dec. 16.—9^h 5^m P. M. Tethys was nearly up to conjunction with the ring; moving toward the ball. Rhea was large and dull in color.

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Longitude from Greenwich, 4^h 55^m 33.9^s. }