T ANDROMEDÆ.

By EDWARD C. PICKERING.

ON learning of the discovery by Mr. Anderson of the variable star T Andromedæ, an examination was made of the Henry Draper Memorial photographs of this object. The results were communicated to the *Astronomische Nachrichten* (**134**, 347), and, as there stated, indicate a photographic magnitude of 9.0 at maximum, and a very uniform increase and diminution in the light at the rate of one magnitude in twenty-six and twenty-five days respectively during the three months preceding and following the maxima. This form of light curve is confirmed by the photographs taken since then which are enumerated below. They also indicate a change in the period, the value 281 days, which satisfies the observations during 1891 to 1894, giving a maximum later than that which actually occurred in 1895. These results are represented in the following table, which gives in successive lines all the photographs so far obtained here of this star. Photographs of the region taken when the star was too faint to appear are not included. The dates and observed photographic magnitudes are followed by the maximum computed by the law given above. Thus the first plate was taken on the Julian Day 2,412,039. The magnitude 10.4 indicates that it was 1.4 magnitudes fainter than the maximum, and multiplying 1.4 by 26 gives 36, the time in which the maximum would be attained. Adding 36 to 2,412,039 gives 2,412,075, or 2,075 if we omit the constant 2,410,000. This quantity is entered in the third column. The mean of the individual values of each time of maximum is given in the next column, followed by the residuals found by subtracting it from the individual values. The residuals have the average value of $\pm$ 2.9 days, corresponding to a deviation of the observed magnitudes of $\pm$ 0.11. These values would be reduced one-quarter if we could reject the last three results. The latter are not due to errors of observation,

since a second independent measurement gave the same result in each case within 0.05 of a magnitude, corresponding to a change of two days in the time of maximum. While these photographs fail to show whether the light curve is pointed or rounded at the exact time of maximum, they indicate that the curvature, if any, is inappreciable except within a few days of the maximum.

Date	Obs. Mag.	Max.	Mean	Resid.
1891 Nov. 2	10.4	2075	2074	+ 1
" " 27	9.3	2072		— 2
" Dec. 13	9.2	2075		+ 1
1892 Oct. 24	10.6	2356	2356	0
" Nov. 6	11.1	2357		+ 1
" " 13	11.4	2356		0
1893 Sept. 13	12.3	2638	2638	0
1894 Jan. 2	12.3	2917	2916	+ 1
" " 7	12.0	2914		— 2
" " 7	12.0	2914		— 2
" " 19	11.5	2913		— 3
" " 25	11.5	2919		+ 3
" Feb. 2	11.1	2917		+ 1
" Sept. 28	11.6	3168	3173	— 5
" Oct. 11	11.4	3175		+ 2
" " 18	11.1	3175		+ 2
" " 19	11.0	3173		0
" " 20	10.8	3169		— 4
" Nov. 6	10.2	3170		— 3
" Dec. 5	9.0	3168		— 5
" " 6	8.8	3169		— 4
" " 13	9.0	3176		+ 3
" " 20	9.6	3168		— 5
1895 Jan. 2	9.6	3181		+ 8
" Feb. 5	10.8	3185		+ 12

The form of light curve is shown in Plate XIV, Fig. 1, in which abscissas represent the times in days preceding or following the observed maxima, and ordinates the corresponding magnitudes. The assumed law is represented by the heavy line. The observations from which the form of light curve was inferred are represented by crosses, the later observations by circles.

If we take first differences of the times of maxima found above we find the intervals 282, 282, 278 and 257. The observations during 1891 to 1894 are therefore very well satisfied by the period 281 days. The observations of 1894 indicate a change

in the period which cannot be accounted for by errors of observation. Rejecting the last two observations changes the mean time of maximum from 3173 to 3171.

The magnitudes given above are found by comparing the photographic images of the variable with adjacent comparison stars of nearly equal brightness and estimating the difference in magnitude. The comparison stars when the variable is bright are BD. + 26° 40, + 26° 47, + 25° 42 and + 25° 40. Their photographic magnitudes are 8.7, 9.2, 9.8 and 10.3. The positions and magnitudes of the fainter stars will be given elsewhere.

In a recent article in the *Astronomical Journal* (**14,** 183) Mr. P. S. Yendell describes his observations of this star and concludes that the period is 265.35 days. Since the photographic magnitudes do not accord with this theory, he derives the singular conclusion that they must be wrong, maintaining that some of them are in error by two or three magnitudes. He states that the light curve described above has a form which "is not only inherently improbable, but which actually proves to be incorrect." Inherently improbable does not seem to be a strong argument in view of the variety in form of light curves of variable stars, especially as the linear form is strikingly confirmed by Nova Aurigæ and other variables (*A. N.* **134,** 138). It also represents one of the simplest theoretical laws, the variation in the energy being proportional to the energy itself. Furthermore it coincides with Newton's law of cooling. Whether the light curve is actually incorrect cannot be proved by observations made at a different time and on a different portion of the light of the star. As Mr. Yendell does not give the light curve he has himself deduced or even the names and magnitudes of his comparison stars, it is difficult to discuss it. It may be noted, however, that unless he measured the variable photometrically or used magnitudes photometrically determined for his comparison stars, it would be impossible for him to tell whether his light curve was linear or not, when represented on the scale of Pogson used here. The error in his assumed scale of magnitudes might easily introduce a marked deviation from a straight line in his

curve. Mr. Yendell's table of observed maxima appears to me illusory. Two of these maxima are derived from the Harvard photographic magnitudes by a process which he does not describe, and give results which differ widely from those found here. It is surely impossible to infer from maxima thus obtained that the observations on which they depend are themselves sometimes in error by more than two magnitudes. If such errors exist, this determination of the maxima should have been rejected.

The photograph of this star taken on November 27, 1891, is represented in Fig. 2. The variable, A, is distinctly brighter than the two stars below and to the right, which are of about the tenth magnitude. The upper of these stars is BD. + 25° 40. A defect in the original negative to the left of this star has been removed in the print without affecting the image of the star itself. The magnitude of the variable on this day according to the above table is 9.3. The photograph taken October 24, 1892, is represented in Fig. 3. The variable, B, is here fainter than the stars below. Its magnitude is given above as 10.6, or 1.3 magnitudes fainter than A. According to Mr. Yendell's theory on the first date the photographic magnitude 9.3 is too bright by 2.1 magnitudes, and its magnitude should have been 11.4. B similarly should have been 10.5, or 0.9 magnitudes brighter than A. An inspection of the plate will enable the reader to decide whether to believe that Mr. Yendell's theory or the photographic magnitudes are in error.

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PLATE XIV

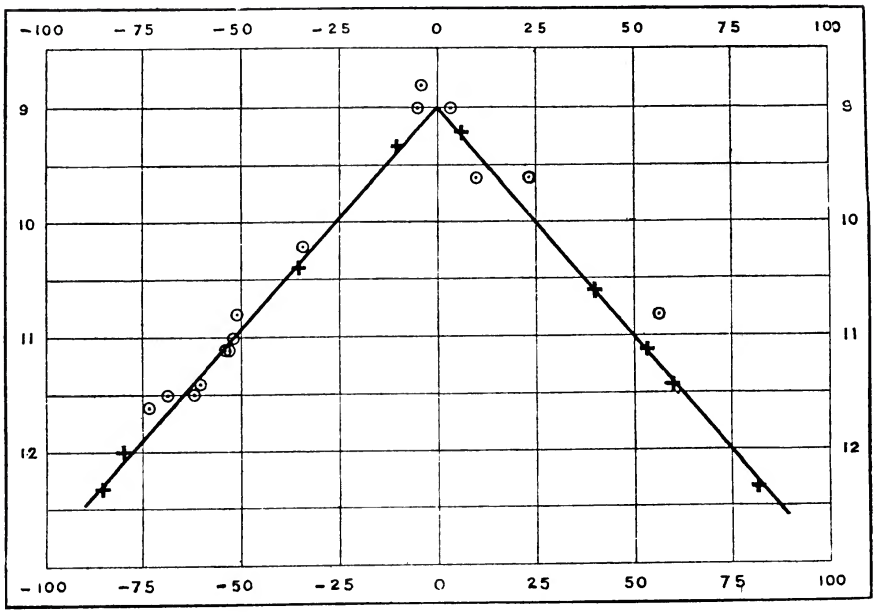

FIG. 1

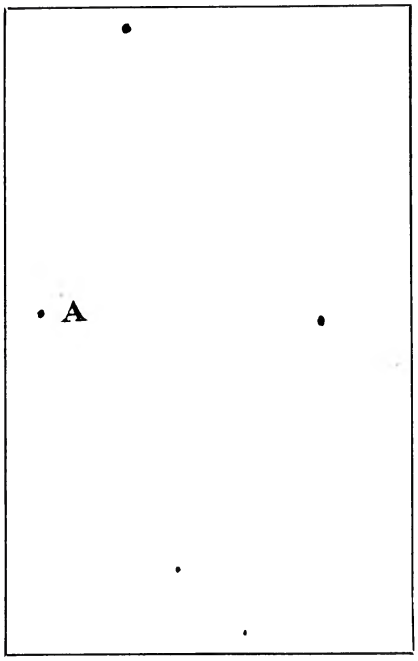

FIG. 2

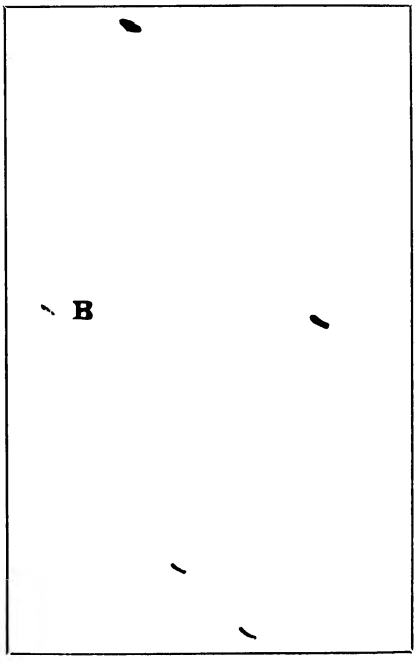

FIG. 3