The Parallax of Nova Geminorum (2), 1912.
By Frederick Slocum.

Nova Geminorum (2) was discovered by Enebo March 12, 1912. It was then nearly 90° east of the sun, and a series of observations with the 40-inch refractor of the Yerkes Observatory for the investigation of its parallax was immediately begun.

Fifteen plates were secured at three parallactic epochs as shown by Table I.

TABLE I.

Plates of Nova Geminorum (2). *Taken with the* 40-*Inch Refractor of the Yerkes Observatory.*

Number.	Date.	Hour Angle. h	Observers.	Quality of Images.
702	1912 Mar. 18	−0·2	Sl., Sl.	Fair
703	Mar. 18	+ ·2	Sl., Sl.	Good
704	Mar. 19	− ·2	Sl., Sl.	Good
705	Mar. 19	+ ·2	Sl., Sl.	Good
920	Sept. 22	−1·8	Su., M.	Good
937	Oct. 5	− ·7	Su., Sl.	Good
947	Oct. 13	− ·3	Su., M.	Fair
955	Oct. 19	− ·5	Su., Sl.	Good
971	Oct. 27	− ·9	Su., Sl.	Fair
978	Nov. 2	− ·4	Su., Sl.	Good
1135	1913 Feb. 12	− ·2	Su., M.	Good
1146	Mar. 6	− ·5	M., Sl.	Poor
1155	Mar. 8	− ·4	M., Su.	Poor
1156	Mar. 8	·0	M., Su.	Good
1164	Mar. 9	− ·3	Sl., Su.	Good

The first four were taken when the star was east of the sun, the next six about six months later, when it was west of the sun, and the last five again to the east.

The third column gives the hour angle of the star at the time the plate was exposed, plus indicating west of the meridian, and minus east. So far as possible, all observations for parallax are made near the meridian with the telescope west of the pier. In this series one plate has an hour angle greater than one hour, and three, only, greater than half an hour.

Two exposures were made upon each plate, the exposure time varying from 6 to 15 minutes according to the transparency of the atmosphere and the sensitiveness of the plate emulsion. The guiding was done by the observers indicated in column 4: Sl = Slocum, Su = Sullivan, and M = Professor S. A. Mitchell of Columbia University. The plates were measured by the writer, and the computations made by Miss Magill.

Six comparison stars were selected, as symmetrically situated as possible, and as near as possible to the mean brightness of the *Nova*. Table II. gives additional data pertaining to the comparison stars.

TABLE II.

No.	B.D.	X (R.A.)	Y (Dec.)	Dependence.	Diameter.	Approximate Magnitudes. Photographic.	Visual.
					mm		
1	+32° 1431	−257·6	+106·8	+·151	0·21	10·4	9·1
2	+32° 1432	−254·0	− 21·9	·144	·22	9·4	9·2
3		−194·0	−127·7	·144	·16	10 0	9·7
4	+32° 1434	−161·0	+244·7	·166	·26	8·7	8·6
5	+32° 1441	+402·8	−323·9	·183	·28	9·5	8·7
6		+463·8	+122·0	·212	·19	10·5	9·4
Nova		+ 41·88	+ 1·66		·22		5·5 to 9

The third and fourth columns show the co-ordinates of the comparison stars and the *Nova* in units of the scale of the measuring machine. One division of this scale equals $2''\cdot66$ approximately. The fifth column gives what Professor Schlesinger calls the "Dependence" of each comparison star.* The figures indicate the relative influence of each star upon the parallax to be found, and they are used to derive from the measures of a plate the residual for the parallax star on that plate. This residual is called the "Solution" (m) in Table III. Column 6 contains the diameters of the star images in fractions of a millimetre. Isochromatic plates were used in connection with a yellow-colour filter, so these diameters will correspond more nearly with the visual than with the photographic magnitudes. Between the first and last observations the *Nova* diminished in light by about 3·5 magnitudes, but the size of its image on the plates was kept practically constant by the use of the rotating disc with adjustable sector. When the star was brightest the sector was opened 10°, thus reducing the star about four magnitudes. For the last plate the occulting disc was removed entirely, for the magnitude of the *Nova* then was very nearly equal to the mean of the magnitudes of the comparison stars.

The last two columns give the approximate magnitudes. For the photographic magnitudes I am indebted to Professor Parkhurst. The visual magnitudes were taken from the B.D. for the four B. D. stars and estimated from the plates for the other two.

The usual method of reduction was followed. One plate was selected as a standard, in this case No. 920, and all of the others were referred to this standard by a linear relation of the form

$$-ax+by+c=x-x_0.$$

A least square reduction gives the residual for the parallax star on each plate. These residuals involve the displacements due to

* *Astrophysical Journal*, xxxiii. p. 161.

parallax and proper motion, plus a constant. Each plate then gives an equation of the form

$$c + T\mu + P\pi = m,$$

from which the parallax and proper motion may be found. Table III. contains the data for the fifteen equations of this form. The unit of T is 100 days, and P is the parallax factor parallel to the equator. All quantities are expressed in terms of scale divisions except where otherwise indicated.

TABLE III.

Reductions for Nova Geminorum (2).

Plate.	Solution (m).	Weight (p).	Parallax Factor (P).	Time in Days (t).	Residual (v).	$\sqrt{p} \cdot v$ in Arc.
702	−0·024	0·7	−·966	−188	+·005	+0″·01
703	−·059	1·0	−·966	−188	−·030	−·08
704	−·025	1·0	−·970	−187	+·004	+·01
705	−·007	1·0	−·970	−187	+·022	+·06
920	−·029	1·0	+·980	0	−·003	−·01
937	−·018	1·0	+·995	+13	+·008	+·02
947	−·022	0·7	+·980	+21	+·004	+·01
955	−·033	1·0	+·956	+27	−·007	−·02
971	−·029	0·7	+·909	+35	−·003	−·01
978	−·022	1·0	+·862	+41	+·004	+·01
1135	−·042	1·0	−·665	+143	−·012	−·03
1146	·000	0·4	−·893	+165	+·031	+·05
1155	−·031	0·4	−·908	+167	·000	·00
1156	−·028	1·0	−·908	+167	+·003	+·01
1164	−·037	1·0	−·915	+168	−·006	−·02

Normal Equations.

$$12{\cdot}9\,c + 0{\cdot}374\,\mu - 1{\cdot}675\,\pi = -0{\cdot}3649$$
$$23{\cdot}238\,\mu + 2{\cdot}622\,\pi = -0{\cdot}0180$$
$$+11{\cdot}079\,\pi = +0{\cdot}c723$$

From which

$$c = -0{\cdot}0280$$
$$\mu = -0{\cdot}0006 \quad = -0''{\cdot}0016 \quad \pm 0''{\cdot}005$$
$$\pi = +0{\cdot}0024 \quad = +0''{\cdot}006 \quad \pm 0''{\cdot}007$$

Probable error corresponding to unit weight, $\pm 0{\cdot}009 = \pm 0''{\cdot}024$.

The relative parallax comes out $+0''{\cdot}006$ with a probable error of $\pm 0''{\cdot}007$. According to Kapteyn's table of average parallaxes, that of the comparison stars may be taken as $0''{\cdot}005$, which would make the absolute parallax of the *Nova* $+0''{\cdot}011$, corresponding to 296 light years.

The proper motion also appears to be very small. The solution of the equations of Table III. gives $-0''{\cdot}0016$ for 100 days, which is equal to $\mu_a = -0^s{\cdot}0003 \pm 0^s{\cdot}001$ per year.

For the proper motion in declination seven plates only were used, three in March 1912, three in March 1913, and the standard plate. The parallax in declination was neglected, as it would enter the value of the proper motion by only about two one-hundredths of its value. From these seven plates I find $\mu_\delta = +0''\cdot036 \pm 0''\cdot016$ per year.

Both of these values are, of course, relative to the weighted mean of the proper motions of the comparison stars.

Yerkes Observatory:
1913 *March* 29.

On the Short Period Variable SW Draconis.
By C. Martin and H. C. Plummer. (Plate 17.)

1. The star SW Draconis, like the neighbouring variable of similar type SU Draconis, was among those found to be variable by Miss Leavitt * from an examination of plates of the Harvard map of the sky. It received the provisional number 45·1907, and its position is

$$1900\cdot0 \quad 12^h\ 13^m\ 4^s, \quad +70^\circ\ 4'\cdot0.$$

Photographic observations were made with the 15-inch reflector of the Dunsink Observatory between 1912 December 31 and 1913 March 25, during which time sixty-three measurable exposures were secured. The whole of the observations and reductions were made by Mr. Martin.

2. The method adopted at this observatory in order to obtain differential estimates of stellar magnitudes has been fully described,† and the details need not be repeated. Only on one point some comment may be added. It has been stated that the diameters of the images are measured with a micrometer instead of measuring the density with a photometer (p. 166). This is true. But the element of photometric estimation is not altogether absent. The measurer makes a preliminary inspection of the images to be measured, and decides mentally on the degree of density within the image where the settings may be most advantageously and consistently made. He thus measures the diameter of a nucleus at the boundary of which a standard photographic density is judged to obtain. It will be readily understood that the faculty of maintaining such a standard needs experience on the part of the observer, and uniform illumination of the plate during measurement. As daylight is found preferable to an artificial source, certain consequences follow. In order to secure steady conditions of light, the measures must be effected within a reasonably short time. This limits the number of comparison stars which can be profitably employed. And further, if for any reason it is desired to include

* *Harvard Circ.*, 127; *A.N.*, 4181.
† *M.N.*, lxxi. p. 511, lxxiii. p. 166.