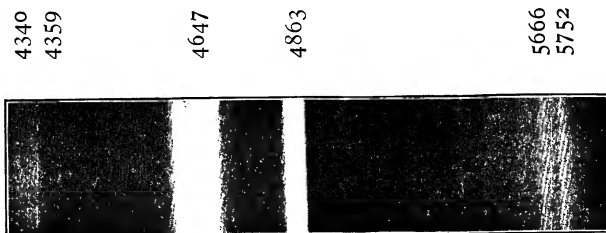


compared with $H\beta$, but in any case $H\gamma$ would appear to be distinctly fainter than $\lambda 4359$.

The spectrum of *Nova Geminorum* thus corresponds with the spectra of *Nova Persei* and *Nova Aurigae* in their later stages of development, particularly with respect to the relative intensity of the bands observed, all of which were present in both of these stars. After the transformation of the spectrum of *Nova Aurigae* into that of a nebula, in August 1892, the intensities



of $\lambda\lambda 4358, 4640, 4863,$ and 5750 were estimated by Campbell as 8, 7, 10, and 10 respectively, and were only exceeded by the chief nebular lines $\lambda 5007$ and $\lambda 4959$ with intensities of 100 and 30. On the negative of the spectrum of *Nova Geminorum* the very faint bright band in the region of the principal nebular lines is too weak for measurement.

Visual observations of the *Nova* have been made with a single ocular prism, or direct vision train, on each available night since March 27, but no changes sufficiently obvious to be noticed with such small dispersive power have been observed.

GEORGE E. HALE.

YERKES OBSERVATORY,
April 6, 1903.

NOVA GEMINORUM BEFORE ITS DISCOVERY.¹

ON March 27, 1903, a cable message was received from Professor Kreutz, of Kiel, stating that an object which was probably a new star, but was possibly a variable, had been discovered by Professor Turner. Also, that on March 16 it was of the magnitude 8.0, while on February 16 it had not been seen (presumably on a photograph). Its apparent place was R. A. $6^{\text{h}} 37^{\text{m}} 48^{\text{s}}$, Dec. $+ 30^{\circ} 4'$. The grant from the Carnegie Institution permitted an examination to be made of the early photographs of the Henry Draper Memorial, and furnished the history of this object from its first appearance to the present time. An excellent photograph of the region, taken 1903, March 1^d 15^h 3^m, G. M. T., showed stars of the magnitude 11.9, but no trace of the *Nova* was

¹ *Harvard College Observatory Circular* No. 70.

visible. A similar result was found from sixty-seven plates, the first taken March 3, 1890, the last on February 28, 1903, although nearly all of these plates showed stars fainter than the twelfth magnitude. One or more of these photographs were taken on each intermediate year. It did not therefore seem necessary to examine the other early plates of this region, a hundred or more in number. A plate taken 1903, March 2^d 13^h 19^m, showed stars of the ninth magnitude, but no trace of the *Nova*. The evenings of March 3, 4, and 5 were cloudy, but on a plate taken March 6^d 14^h 28^m, an object of the magnitude 5.08 appears in the given place. Plates taken on several later nights showed that the magnitude was gradually diminishing, as appears in Table I, which gives in successive columns the date, the Greenwich Mean Time, the photographic magnitude of the *Nova*, and the initial of the observer. F. denotes Mrs. Fleming and L. Miss Leland.

The photograph of March 6 has especial value, since, so far as is known, it contains the first photograph of the *Nova*. The image is on the very edge of the plate, and accordingly was compared with fifteen other stars at about the same distance from the center of the plate. The *Nova* was compared twice with each star by each observer. The value of the grade was much larger than usual, and equaled 0.21 and 0.33 for the two observers. The mean result for all was magnitude 5.08, with an average deviation, for the separate stars, of ± 0.26 . The magnitude on each of the other dates given in the table was found by

TABLE I.
PHOTOGRAPHIC MAGNITUDES.

Date	G. M. T.	Mag.	Obs.	Date	G. M. T.	Mag.	Obs.
	h. m.				h. m.		
1903 March 1	15 3	< 11.4	L.	1903, March 14	14 14	7.42	F.
2	14 31	< 9.5	F.	14	14 14	7.34	L.
6	14 28	4.97	F.	14	16 20	7.32	F.
6	14 28	5.20	L.	14	16 20	7.34	L.
11	15 18	6.76	F.	15	13 44	7.27	F.
12	14 25	7.06	F.	15	14 53	7.57	F.
12	15 25	7.16	F.	15	14 53	7.46	L.
13	14 52	7.12	F.	25	13 26	7.94	L.
13	14 52	7.17	F.	25	13 39	8.08	F.

comparison with six stars whose brightness was nearly equal to that of the *Nova*. These magnitudes were derived assuming that the photometric and photographic magnitudes were nearly the same for stars whose spectra were of the first type.

The evening of March 27 was cloudy and also the early part of March 28. One plate, however, taken on the latter date, gave the magnitude 8.34. Several photographs were taken on March 29, 31, and April 1, and gave the mean magnitudes 8.24, 8.24, and 8.25. These magnitudes are based upon the results given in Table II, which contains the designations, *Durchmusterung* numbers, rectangular coordinates expressed in seconds of arc with the *Nova* as an origin, and provisional photographic magnitudes of a sequence of comparison stars. It is probable that the fainter stars are really fainter than these magnitudes indicate, but the latter will serve to determine the relative changes in the *Nova* as it grows fainter, and thus render the results of different observers comparable. All the magnitudes can later be reduced to an absolute scale. They also serve to compare the faintest stars shown on early plates. Thus, the photograph taken March 1, 1903, shows star *t*, and also stars at least a tenth of a magnitude fainter. Star *u* does not appear. Hence this plate shows stars of the magnitude 11.9 and brighter.

The last plate in Table I is of interest, since it was taken with an objective prism, and accordingly shows the spectra of the *Nova* and of the adjacent stars. Six bright lines are shown in the spectrum of the *Nova*, whose designations, assumed wave-lengths, and intensities, calling the intensity of the line $H\gamma$, 10, are as follows: $H\zeta$, λ 3889, 1; $H\epsilon$, λ 3970, 3; $H\delta$, λ 4102, 8; $H\gamma$, λ 4341, 10; —, λ 4643, 11; $H\beta$, λ 4862, 9.

TABLE II.

COMPARISON STARS.

Des.	B. D.	<i>x</i>	<i>y</i>	Mag.	Des.	B. D.	<i>x</i>	<i>y</i>	Mag.
<i>a</i>	+30° 1318	+ 716	+3187	7.28	<i>p</i>	.....	+ 4	+368	11.19
<i>b</i>	+30° 1300	.....	.....	7.76	<i>q</i>	.....	+308	-132	11.41
<i>c</i>	+30° 1314	+ 274	+1949	7.98	<i>r</i>	.....	-404	-278	11.63
<i>d</i>	+30° 1320	+1021	+ 878	8.50	<i>s</i>	.....	+359	+345	11.73
<i>e</i>	+29° 1342	+1843	- 347	8.82	<i>t</i>	.....	-224	+176	11.78
<i>f</i>	+30° 1316	+ 643	+ 552	9.14	<i>u</i>	.....	+467	+145	12.08
<i>g</i>	+30° 1306	-1006	+ 142	9.36	<i>w</i>	.....	-254	+242	12.23
<i>h</i>	{	+ 504	+ 289	9.71	<i>x</i>	.....	-268	+ 92	12.45
	{	+ 504	+ 297		<i>y</i>	.....	+270	+ 16	12.70
<i>k</i>	+30° 1302	-1923	+ 231	9.93	<i>z</i>	.....	+186	- 64	12.95
<i>l</i>	+30° 1309	- 456	+ 53	10.13	<i>a</i>	.....	+ 31	+ 97	13.05
<i>m</i>	+30° 1317	+ 638	- 327	10.41	<i>β</i>	.....	- 24	- 76	13.35
<i>n</i>	... ..	- 311	- 47	10.66	<i>γ</i>	.....	+ 31	- 8	13.53
<i>o</i>	... ..	+ 544	+ 197	11.01					

From this it appears that the spectrum resembles that of *Nova Sagittarii* on April 19, 1898. No dark lines are visible, but this is perhaps owing to the small dispersion.

The same lines, and having nearly the same intensities, appeared on similar photographs taken on March 29, 31, and April 1. They also showed the additional nebula line, $\lambda 5003$, which has the intensity 2 or 3, and is certainly brighter than $H\zeta$. This line does not appear on the plate taken March 25, and indicates the first step in the change into a gaseous nebula. Three additional bright lines were detected in the later photographs, whose estimated wave-lengths are about $\lambda 4176$, 4240 , and 4462 .

In the other new stars the appearance of line 5003 was followed by the diminution in intensity of the line $H\beta$, and the appearance and rapid increase in the nebula line, near $H\zeta$, which finally became the strongest line in the spectrum.

A most important question in connection with the appearance of new stars is whether such objects can come and go without detection by astronomers. Since the Henry Draper Memorial was established, nine new stars have been discovered. Six of them, *Nova Persei* No. 1, *Nova Normae*, *Nova Carinae* No. 2, *Nova Centauri*, *Nova Sagittarii*, and *Nova Aquilae*, were found in the regular examination of the Draper Memorial photographs, and probably all of them would otherwise have escaped detection. Two, *Nova Aurigae* and *Nova Persei* No. 2, were bright, and were found visually by Dr. Anderson. The first of these might have escaped detection here, although numerous early charts were obtained which showed that it was visible to the naked eye during seven weeks before its discovery. The spectrum of Turner's *Nova* is so conspicuous on the plate taken on March 25 that when this plate was developed and examined it would doubtless have been found on it here, but for the prompt discovery and announcement by Professor Turner.

EDWARD C. PICKERING.

APRIL 3, 1903.

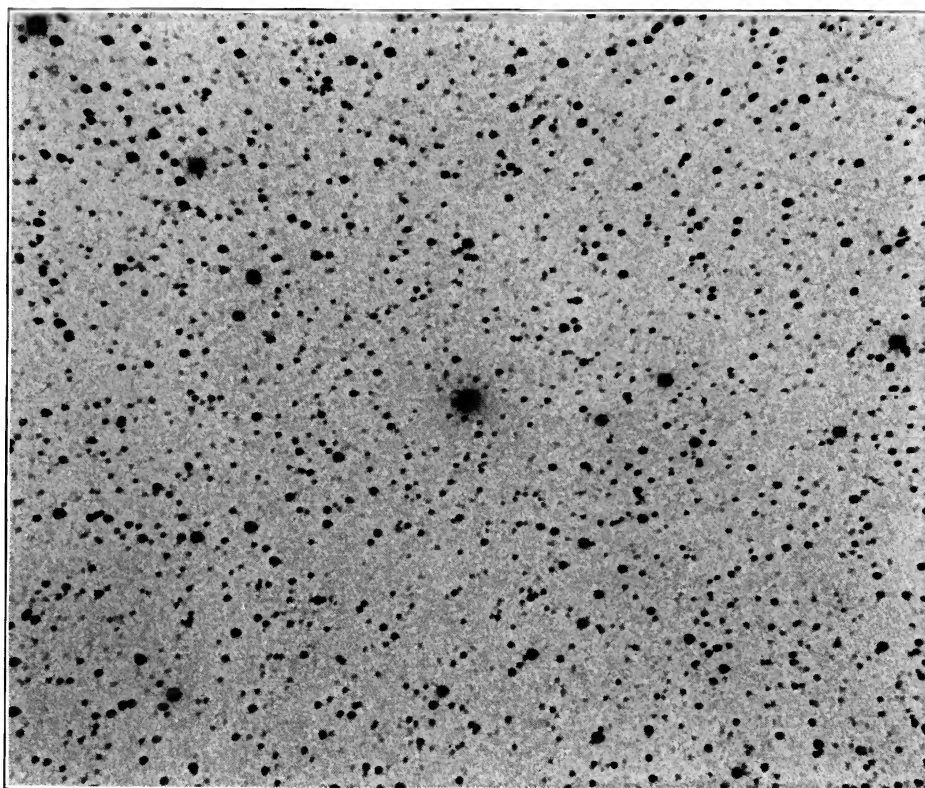
A LIST OF FOUR STARS WHOSE VELOCITIES IN THE LINE OF SIGHT ARE VARIABLE.¹

THE following four spectroscopic binaries, discovered with the Mills Spectrograph, are additional to the thirty-eight binaries already announced:

¹ *Lick Observatory Bulletin* No. 31.

PLATE XXI.

N.



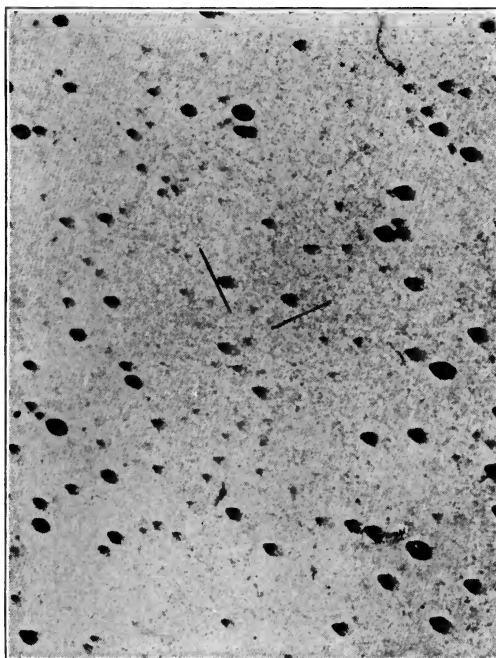
Scale : 1 mm = 20".

S.

PHOTOGRAPH OF THE REGION OF *NOVA GEMINORUM*.

PLATE XXIII.

N.



S.

Scale 1 mm = 13".

REGION OF *NOVA GEMINORUM*
February 21, 1903.