Photovisual and Photographic Magnitudes of Nova (CP) Lacertae 1936

by

E. Rybka and J. Mergentaler.

1. Observations.

Nova (CP) Lacertae 1936 was observed in the Astronomical Observatory of Lwów University photographically from 1936 June 28 till 1937 March 12. Observations were executed by the aid of the Zeiss triplet with the 10 cm aperture and 50 cm focal length. Observations were discontinued after Nova Lacertae had reached 11^m photovisually.

The aim of the observations was a derivation of photographic and photovisual magnitudes of the star in the international photometric scale. Photographic magnitudes were derived from focal exposures on plates Ilford Zenith (before 1936.IX.18. incl.) and Eastman 40 (after 1936.IX.19. incl.). Exposure-times were increased gradually from 20^s to 12^m 0^s according as the brightness of the star decreased. Photovisual magnitudes were derived from the focal exposures taken on Eisenberger Ultrarapid plates (before 1936.IX.19 incl.) and Eastman Spectroscopic Plates type I G (after 1936.X.24 incl.) by putting the yellow Wratten K 3 filter (Nr. 9) in front of the objective. The filter, which is used in the Astronomical Observatory of Lwów University for the fundamental photovisual photometry, is cemented in optical circular flats of the highest quality (glass "A"). Star-images on plates, obtained through the filter, are perfectly regular without any distortion. Eastman Spectroscopic Plates surpass the Eisenberger Ultrarapid plates in quality, but they could not be used till October 1936,

as they were not delivered before that date to the Observatory. Exposure-times on Eastman Spectroscopic plates I G were increased from 10^m to 34^m during the observational period.

The spectral sensitivity of all brands of plates, used in the photometric investigations in Lwów, was checked in the Photographic Institute of the Lwów Politechnic by Dr. W. R o m e r, Director of the Institute, to whom we express our best thanks for his courtesy. It was estimated provisionally from spectrograms that effective wave-lengths of four optical systems composed of the objective and a plate of the objective, the filter and a plate, are as follows:

Eastman 40 (without filter) circa 4210 A
Ilford Zenith „ „ „ 4350 „
Eisenberger Ultrarapid (with K3 filter) 5300 A
Eastman Spectr. I G „ „ „ 5480 „

The detailed results of the investigations of spectral sensitivity of the plates will be published elsewhere.

2. Comparison Stars.

The list of comparison stars is given in Table I. Magnitudes were derived from exposures taken with and without the coarse grating put in front of the objective. The grating is composed of parallel wires 0.45 mm thick spaced by intervals equal to that thickness. The grating was executed by Mr. J. T o m a s i k, the intrumentmaker of the Physical Institute of Lwów University, by the kind permission of Prof. S. L o r i a, director of the Institute. The condition of the equality of the widths of the wires and the spaces between them was fulfilled with great precision thus enabling theoretical grating constant $0^m.981$ to be adopted. More detailed investigations will be published elsewhere.

The comparison stars were chosen in such a manner that their spectral classes are of A or B type (except ε Cep, *a* and *m*). As the differences in the spectral sensitivity between Eastman 40 and Ilford Zenith plates as well as between Eis. Ultr. and East. Spectr. I G. plates are small, the magnitudes of comparison stars were derived from exposures on Eastman 40 and Eastman Spectr. Plates I G only and they were applied to the derivation of magnitudes of Nova on Ilford Zenith and Eisenberger Ultrarapid plates. Zero points of photometric magnitudes were derived from plates containing the exposures of North Polar Sequence. Each of such plates contained four exposures taken in the following order: pole, field, field, pole. The surroundings of Nova Lacertae were photographed on these plates in the zenith-distances near that of the pole. Photographic and photo-

Table I. Comparison stars.

Des.	Star's name	H. A. 99			Upsala Med. 58			Wilno Bull. 19	A. N. 6249	Lwów			
		mg pg	mg pm	Sp.	mg pg	C. I.	Sp.	mg pg	mg ptm	mg pg	n	mg pv	C. I.
		m 4.51	m 4.23					m 4.69		m 4.53		m (4.23)	
ε Cep	B.D. + 56° 2741 (5.1)	5.92	5.42	F_0	—	—	—	5.95	—	5.62	4	5.08	+ .54
a	56 2727 (6.0)	6.49	6.54	F_8	—	—	—	—	—	6.29	4	6.27	+ .02
b	56 2545 (6.7)	6.14	6.19	B_8	6.1	— .09	σ +	—	—	5.84	5	5.99	— .15
c	56 2765 (6.7)	6.54	6.87	B_8	5.9	— .11	$B_8\tau$ —	6.02	—	6.83	5	6.64	+ .19
d	55 2695 (7.3)	6.75	6.87	B_8	6.8	— .03	$B_8\tau$ —	6.92	—	7.54	4	7.35	+ .19
e	54 2708 (8.0)	8.0	8.0	B_9	7.4	— .05	$B_8\sigma$ +	7.50	—	8.14	4	8.12	+ .02
f	54 2740 (7.3)	8.14	8.16	B_9	7.9	— .02	$B_8\sigma$ +	7.96	—	8.76	4	8.56	+ .20
g	54 2742 (8.5)	8.7	8.6	A_3	—	—	—	8.70	—	8.97	2	8.90	+ .07
h	54 2732 (8.8)	8.9	8.9	A_0	8.9	+ .04	$B_0\sigma$	8.89	—	9.62	2	9,22	+ .40
i	54 2726 (9.1)	—	—	—	9.5	+ .01	B τ	—	—	9.83	2	9.64	+ .19
k	54 2724 (9.2)	—	—	—	9.8	— .14	$A_0\sigma$	—	—	10.33	2	10.14	+ .19
l	C. A. 61341 *)	—	—	—	—	—	—	—	10 17	10.40	1	9.99	+ .78
m	61489+61490 *)	—	—	—	—	—	—	—	10.40	10.77	2	11.43	+ .37
n	61350 *)	—	—	—	—	—	—	—	11.29	11.80	2		

*) Cat. Astr. Vatican. Vol. X. + 55°. Lastra 112. 61489 d = 12, 61490 d = 10, 61341 d = 18, 61350 d = 12, l = $10^m.3$, m = $10^m.6$, n = $11^m.3$.

visual magnitudes of comparison stars with their colour-indices found in Lwów, are given in columns 11 — 15 of Table I where *n* denotes the number of plates on which the magnitudes in the next preceding column are based. Table I contains also magnitudes and colours of some comparison stars, which are given in the Henry Draper Catalogue (H.A. 99) Meddelanden Upsala Nr. 58 [1]) Wilno Bull. Nr. 19 [2]) and M. Beyer's list (A.N. 6249). Lwów colour-indices differ systematically from those of Upsala derived spectrophotometrically, differences being caused probably by different methods which were used for a derivation of colour-indices in both observatories. Three faintest comparison stars are not contained in B.D. They were found in the Astrographic Catalogue Vatican Vol. X. Zone + 55° Lastra 112. The star *m* was seen on Lwów plates as a single one, though its images are a product of the overlapping of two near stars, measured in the Astrographic Catalogue separately.

Magnitudes of comparison stars were derived from 11 plates taken in 1936. IX.17, IX.18, IX.19 and 1937.III.17, V.17, V.30, VI.3, VII.1, VII.5.

3. Magnitudes of Nova Lacertae.

All plates were measured in the Schilt photometer of the Astronomical Observatory of Lwów University. Only two comparison stars (except one case) were measured on each plate and a magnitude of Nova was interpolated between them. Comparison stars were always chosen in such a manner, that the brightness of Nova was intermediate between the magnitudes of comparison stars. Photographic and photovisual magnitudes are given in Table II and are represented graphically on diagrams (fig. 1 and fig. 2). It is at once evident from the diagrams that the decline of the brightness of Nova was continuous without any conspicuous oscillations. The fall seems to be more steady than that of Nova Aquilae 1918.

4. Colour-indices of Nova.

Colour-indices, derived from Lwów observations, are given in Table II and are represented graphically on fig. 3. The colour index rose from $-0^m.1$ on July 1936 to about $+0^m.7$ in the winter 1936/7. The diagram seems to indicate that the colour index reached its minimum on 1936 July 10.

[1]) Carl Schalén: „Untersuchungen über Dunkelnebel".

[2]) W. Zonn: „Photographic and ultra-violet magnitudes of Nova CP Lacertae".

Table II. Observations.

Nr. of plate	Data	T. U. h	T. U. m	J. D.	Exposure time m	Exposure time s	mg pg m	mg pv m	C. I. m	Number of expos.	Brand of plates	Comparison stars	Obs.
A 58	1936 VI.28	21	48.2	2428348.4084	1	50	4.63	4.56	+.07	3	E. U.	ε Cep, a	E. R.
A 59		22	11.0	.4243	0	20				3	I. Z.	ε Cep, a	E. R.
A 62	VII. 2	23	37.3	8352.4842	3	30	5.07	5.06	−.01	3	E. U.	ε Cep, a	E. R.
A 63	3	0	0.6	.5004	0	40				3	I. Z.	ε Cep, a	E. R.
A 64	VII.10	21	55.7	8360.4137	4	0	5.90	6.00	−.10	3	E. U.	b, c	E. R.
A 65		22	24.1	.4334	0	30				3	I. Z.	b, c	E. R.
A 66	VII.17	21	42.3	8367.4044	5	0	6.20	6.16	+.04	3	E. U.	b, c	E. R.
A 67		22	10.4	.4239	0	40				3	I. Z.	b, c	E. R.
A 68	VII.18	21	35.4	8368.3996	5	0	6.37	6.20	+.17	3	E. U.	b, d	E. R.
A 69		22	3.7	.4192	0	40				2	I. Z.	b, d	E. R.
A 74	VII.19	23	51.1	8369.4939	5	0	6.35	6.20	+.15	3	E. U.	b, c	E. R.
A 75	20	0	18.8	.5131	0	40				2	I. Z.	b, d	E. R.
A 76	VII.20	23	31.0	8370.4799	5	0	6.35	6.24	+.11	3	E. U.	b, c	E. R.
A 77	21	0	2.8	.5020	0	40				3	I. Z.	b, d	E. R.
A 78	VII.24	21	45.9	8374.4068	5	0		6.31	—	3	E. U.	b, d	E. R.
A 79	VII.25	21	56.8	8375.4145	5	0	6.52	6.37	+.15	3	E. U.	b, d	J. M.
A 80		22	33.2	.4397	0	40				3	I. Z.	b, d	J. M.

Table II. Observations.

Nr. of plate	Data	T. U.	J. D.	Exposure time	mg pg	mg pv	C. I.	Number of expos.	Brand of plates	Comparison stars	Obs.
		h m		m s	m	m	m				
A 81	1936 VII.26	21 53.9	8376.4124	5 0		6.36	+.28	3	E. U.	b, d	E. R.
A 82		22 21.8	.4318	0 40	6.64			3	I. Z.	b, d	E. R.
A 84	VII.27	21 45.5	8377.4066	5 0		6.39	+.29	3	E. U.	b, d	J. M.
A 85		22 24.4	.4336	0 40	6.68			2	I. Z.	b, d	J. M.
A 88	VII.28	22 16.6	8378.4282	8 0		6.46	+.29	3	E. U.	b, d	J. M.
A 89	29	0 22.4	.5156	1 18	6.75			3	I. Z.	b, d	J. M.
A 90	VIII.19	22 15.2	8400.4272	2 0	7.85		+.51	3	I. Z.	e, f	J. M.
A 91		23 4.4	.4614	10 0		7.34		3	E. U.	e, f	J. M.
A 92	IX. 8	20 52.8	8420.3700	3 0	8.36		—	3	I. Z.	f, g	E. R.
A 95	IX.17	19 48.9	8429.3256	2 10	8.75		+.67	3	I. Z.	f, g	E. R.
A 96		20 21.2	.3480	20 0		8.08		1	E. U.	e, f, g	E. R.
A 101	IX.18	19 59.0	8430.3326	2 10	8.73		+.63	3	I. Z.	f, g	E. R.
A 102		20 26.4	.3517	20 0		8.10		1	E. U.	f, g	E. R.
A 108	IX.19	19 55.8	8431.3305	2 10	8.75		+.75	3	E. 40	f, g	E. R.
A 109		20 38.7	.3602	20 0		8.00		2	E. U.	e, f	E. R.
A 120	X.24	22 22.8	8466.4325	12 0		9.03	—	3	E.S.I G.	h, i	E. R.
A 123	X.25	22 50.9	8467.4520	13 0		9.05	+.62	3	E.S.I.G.	h, i	E. R.
A 124		23 40.5	.4864	4 0	9.67			3	E. 40	h, i	E. R.

A 136	1936 XI.12	20 50.5	8485.3684	3 10	9.82	9.21	+.61	1	E. 40	i, k	E. R.
A 137		21 15.0	.3854	10 0				1	E.S.I.G.	i, k	E. R.
A 143	XII. 2	20 9.3	8505.3398	3 10	10.19	9.58	+.61	1	E. 40	k, l	E. R.
A 144		20 29.4	.3538	10 0				1	E.S.I.G.	i, k	E. R.
A 146	XII. 6	20 7.2	8509.3383	3 10	10.32	9.58	+.74	1	E. 40	k, l	E. R.
A 147		20 32.1	.3557	10 0				1	E.S.I.G.	i, k	E. R.
A 150	XII.12	20 31.9	8515.3555	8 0	10.23	9.77	+.46	1	E. 40	k, l	E. R.
A 151		21 6.0	.3792	23 0				1	E.S.I.G.	k, l	E. R.
A 153	XII.14	20 49.6	8517.3678	8 0	10.38	9.84	+.54	1	E. 40	l, m	E. R.
A 154		21 20.1	.3890	23 0				1	E.S.I.G.	k, l	E. R.
A 156	XII.20	18 32.0	8523.2722	8 0	10.29	9.74	+.55	1	E. 40	k, l	E. R.
A 157		19 3.7	.2942	23 0				1	E.S.I.G.	k, m	E. R.
A 158	XII.21	21 12.2	8524.3834	8 0	10.31	9.92	+.39	1	E. 40	k, l	E. R.
A 159		21 40.9	.4034	23 0				1	E.S.I.G.	k, m	E. R.
A 161	XII.22	21 54.0	8525.4125	8 0	10.29	9.84	+.45	1	E. 40	k, l	E. R.
A 162		22 25.7	.4345	23 20				1	E.S.I.G.	k. m	E. R.
A 166	1937 I. 5	20 48.4	8539.3670	9 0	10.66		—	1	E. 40	l, m	E. R.
A 168	I.14	17 53.9	8548.2457	9 0	10.87		—	1	E. 40	l, m	E. R.
A 183	II. 4	18 4.7	8569.2533	12 0	11.16		—	1	E. 40	m, n	E. R.
A 191	III.12	2 0.0	8604.5833	34 0		10.74	+.74	1	E.S.I.G.	l, n	E. R.
A 192		2 36.0	.6083	12 0	11.48			1	E. 40	m, n	E. R.

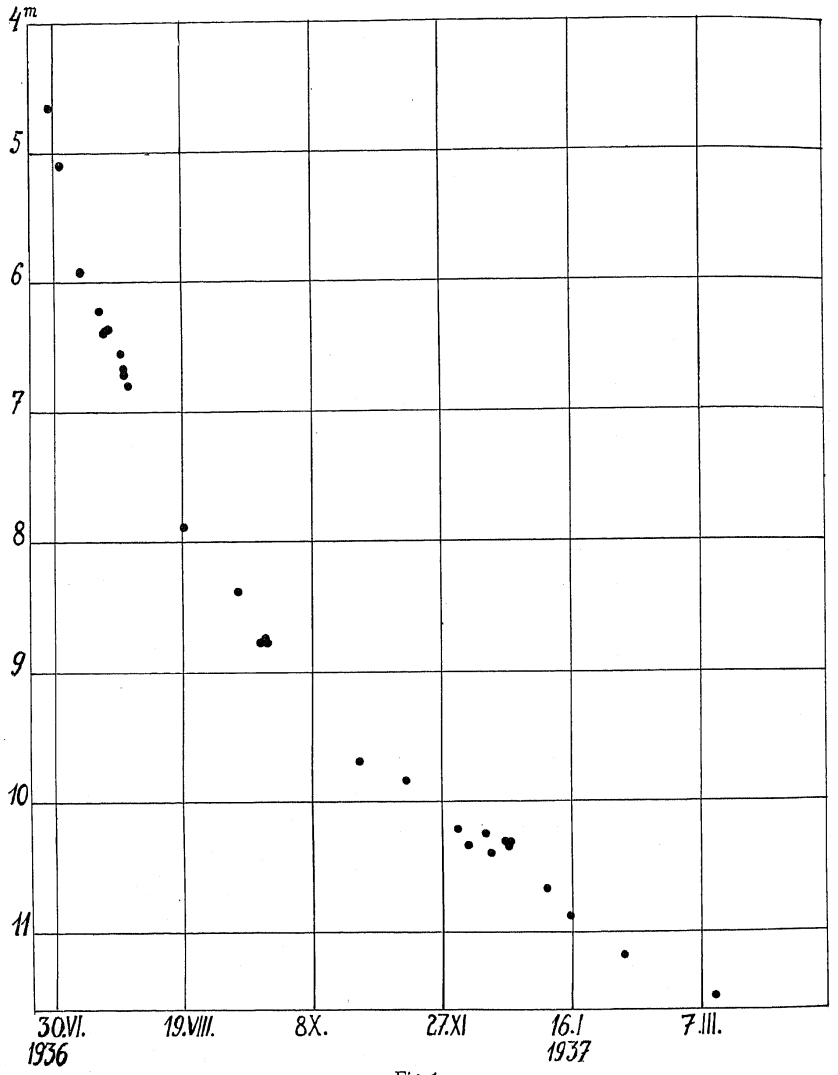

Fig. 1.
Photographic magnitudes of Nova CP Lacertae.

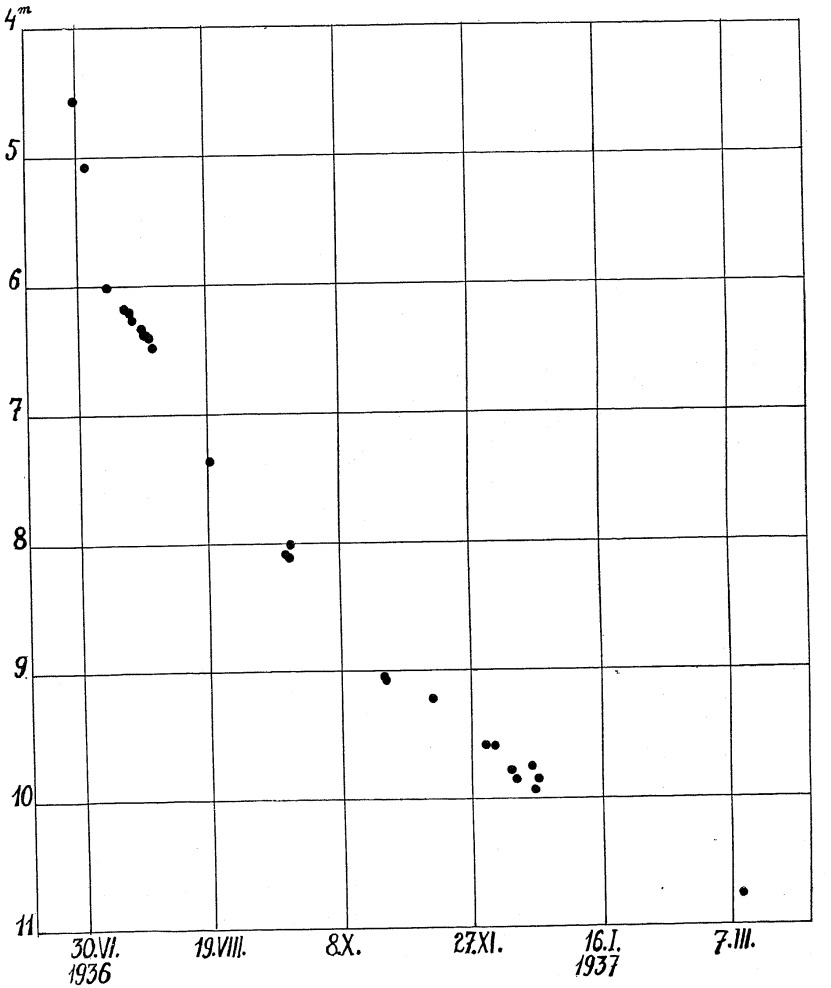

Fig. 2.
Photovisual magnitudes of Nova CP Lacertae.

D. L. Edwards and D. R. Barber[3]) report that on 1936 July 7 two emission bands λ 4534 and λ 4640 widened and became prominent. Such spectral changes strengthened the radiation on which photographic magnitudes are based, and contributed to a diminution of the colour-index.

The changes of the colour-index, found by the authors agree generally with those published by Zonn [2]) derived from photographic and U-V magnitudes.

All measurements and calculations were executed by the second-named writer of this paper.

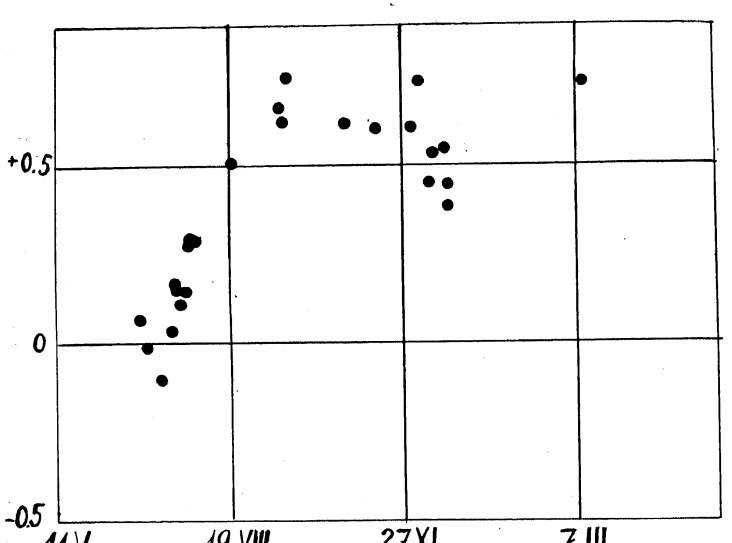

Fig. 3.
Colour-Indices of Nova CP Lacertae

Lwów
Astronomical Observatory
of the University
January 1938.

[3]) M. N. Vol. 98 page 42-52.

Fotowizualne i fotograficzne wielkości gwiazdy Nowa (CP) Lacertae 1936.

(Streszczenie).

Nova Lacertae 1936 była obserwowana w Obserwatorjum U. J. K. we Lwowie od 28 czerwca 1936 do 12 marca 1937 r. Ogółem sfotografowano Nową na 56 płytach. Wielkości gwiazd porównania otrzymano ze zdjęć przy użyciu siatki dyfrakcyjnej przed objektywem. Wielkości te nawiązano do międzynarodowego punktu zerowego przez sfotografowanie na niektórych kliszach bieguna północnego. Wielkości gwiazd porównania zostały podane w tabl. I, zaś wielkości fotograficzne i fotowizualne Nowej wraz z jej wskaźnikami barwy zawarte są w tabl. II. Przebieg zmian w jasności i barwie uwidaczniają wykresy.