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NEW VARIABLE STARS IN CYGNUS, LYRA AND VULPECULA

The following work is an evaluation of an area of $20^{\circ} \times 15^{\circ}$ centred at $19^{\text{h}}46^{\text{m}}+30^{\circ}$ in my series of 32 fields in the Milky Way. Two fields are previously described in IBVS (Dahlmark, 1982, 1986).

Twenty-one plate pairs (103aD +GG 11 and 103aO) exposed between 1967 and 1982 were collected and treated in the same way as described previously (Dahlmark, 1982).

In addition, 86 exposures of the field were made on Technical Pan film 4415+Schott 495 (1mm) during the period 1985-1992. Two $4'' \times 5''$ images of one hour exposure were taken immediately after each other with the Perkin-Elmer lens 65/305 mm. During 1990, 4 exposures were made on IIIaJ plates without filter and simultaneously with TP film. TP films and IIIaJ plates were always hypersensitized.

During 1987 and 1990 the area was exposed with a 200/210/300 mm Schmidt camera and a cassette with 10° field (TP film+Wr 9 filter).

16 stars were photographed twice with my Newtonian reflector (210/1660 mm) and an image intensifier camera of the micro channel type. Filter combination was Schott BG 12 (2 mm)+BG 28 (1 mm) for B magnitudes and Schott GG 495 (1 mm)+BG 38 (2 mm) for V magnitudes (T Max 400 film was used).

All magnitude estimations were made with a step scale under the films in a stereomicroscope. The scale is calibrated with the magnitudes obtained from NGC 6823, 6834, 6871 and 6882/5 in the publication of Hoag et al. (1961). Around each new variable the magnitudes of about 10 comparison stars were estimated mainly from the 103aD plates and the Schmidt exposures.

Six Schmidt negatives covering the area were enlarged (with negative images) to the scale $1''=60$ mm. A grid of epoch 1950 was drawn from the positions from SAO catalog. The coordinates of the new variables were determined from this grid. For 60 stars my coordinates were compared with those from IRAS. The average deviation in both R.A. and decl. is $\pm 13''$.

In this survey 80 stars are published. 73 of them are quite new variables. The results are based on more than 8700 magnitude estimations.

Rough B-V color estimations could be made for 44 stars. 24 stars have only a lower limit for B-V. 12 stars are without B-V estimations. The average uncertainty is estimated to be ± 0.2 . It depends mainly on the fact that the B magnitudes are very close to the plate limit.

Three different methods are used for the B-V estimations.

1. 34 stars from 103aO and 103aG +GG 11 plates
2. 21 stars from IIIaJ and TP+S 495 plates and films
3. 16 stars on T Max 400 film from the image intensifier camera

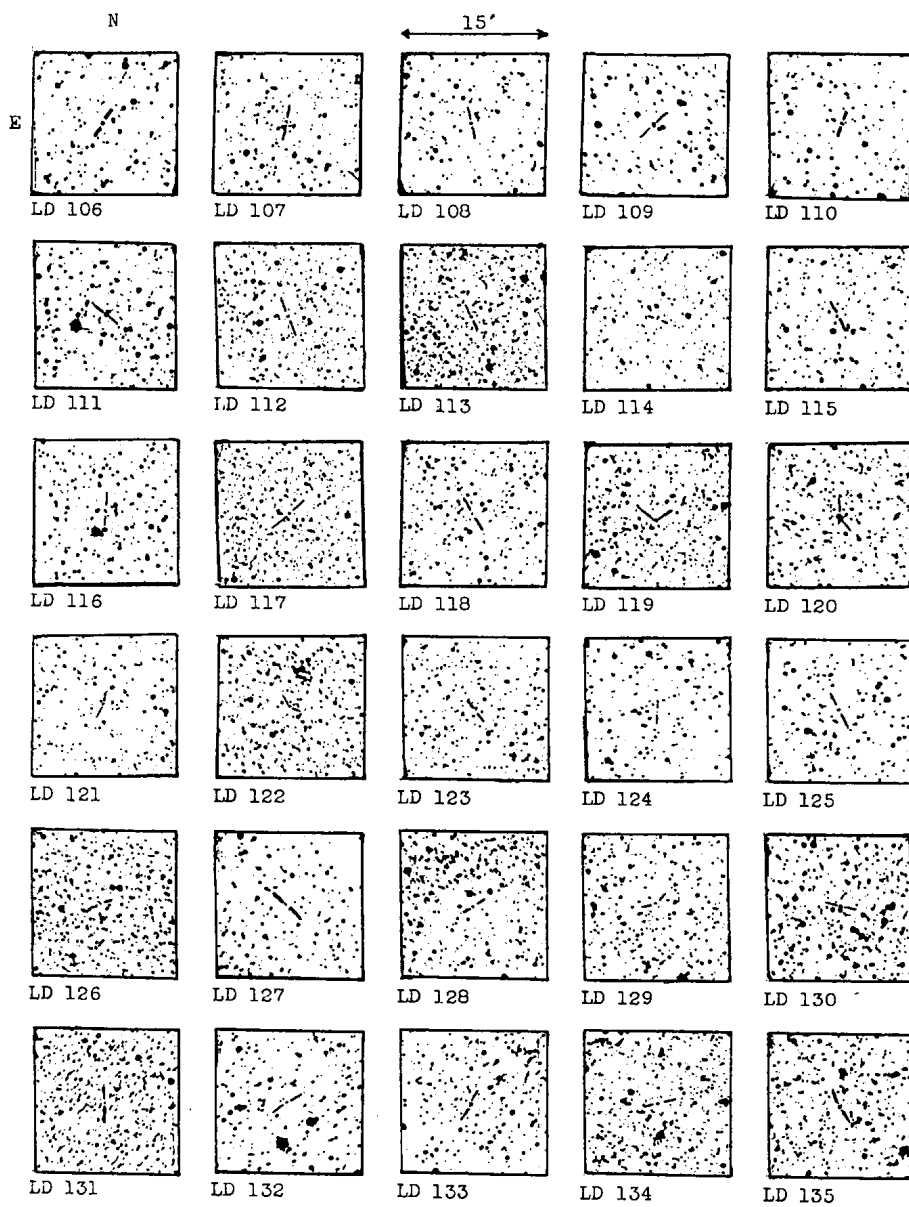
Table 1. New variables in Cyg, Lyr and Vul. Plate centre $19^{\text{h}}46^{\text{m}}+30^{\circ}$.

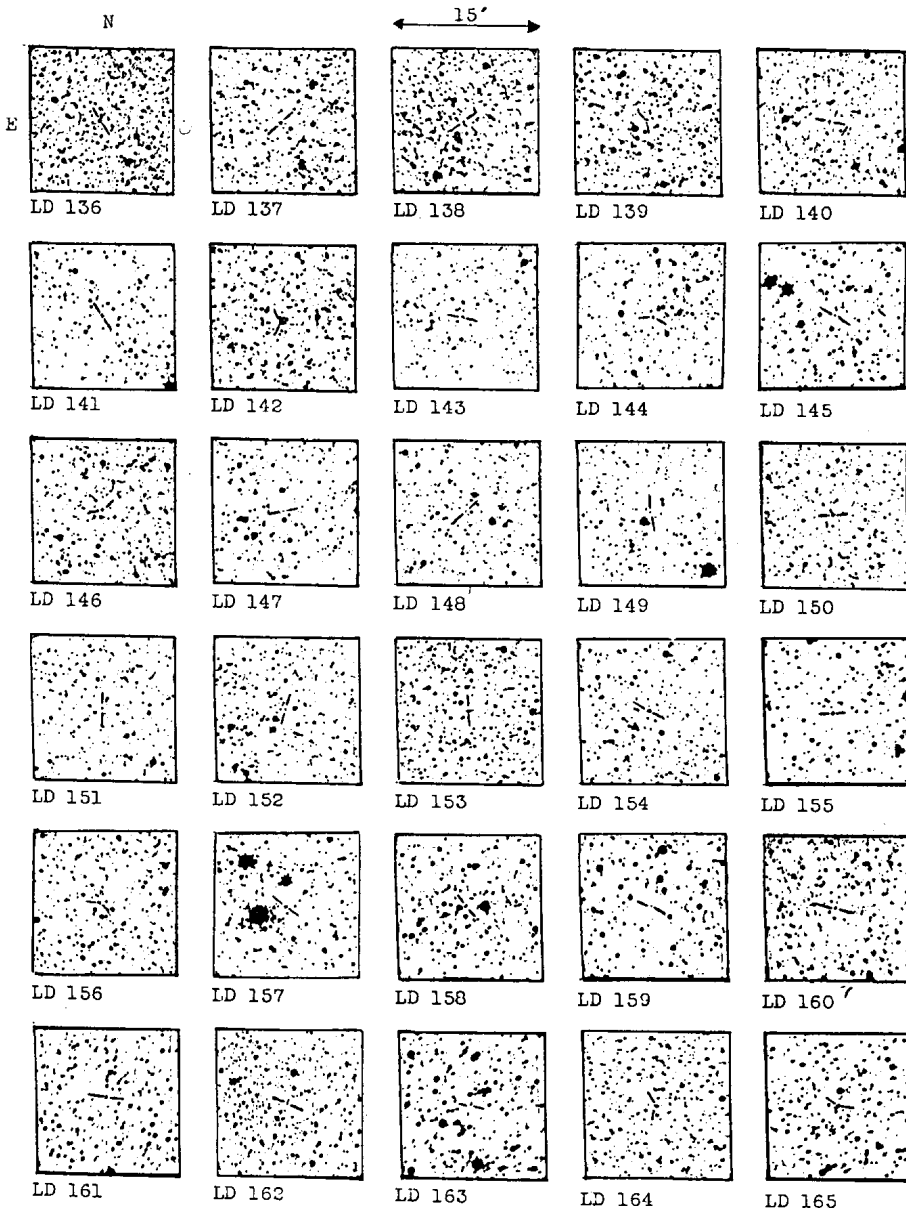
No	R.A. /1950/	Decl. /1950/	m_v		B-V	Type	Epoch 24400 00 +	P /d/	Notes
			max	min					
LD 106	19 ^h 01 ^m 22 ^s	+33°53'5	11.2	< 15.0	1.7	M	7560	459 c	
LD 107	19 04 15	+25 30.0	12.5	< 15.0	0.5	M?	6910	338 c	
LD 108	19 05 23	+31 38.0	12.6	14.4	2.0	SR	6985	308 ?	
LD 109	19 05 38	+35 41.7	12.0	13.0	1.2	IB	-	-	
LD 110	19 06 02	+36 18.3	11.9	13.5	1.6	IB	-	-	1
LD 111	19 07 10	+32 48.3	11.3	12.3	1.5	SR	6990	457	
LD 112	19 08 06	+23 15.9	13.2	< 15	0.2		7315	234 c	1
LD 113	19 09 08	+24 39.4	12.7	16.0	1.2	M	6620	302 c	
LD 114	19 10 35	+23 06.5	11.8	< 15	-	M	6620	335 c	1
LD 115	19 11 17	+26 53.6	13.8	< 15.3	-	M	7060	282 c	1
LD 116	19 12 51	+36 55.8	11.5	14.8	1.5	M	6650	290	1
LD 117	19 19 54	+23 00.8	12.2	15.2	2.3	M	6945	180 c	
LD 118	19 19 50	+26 16.7	13.4	< 16.2	-	SR	6740	395	
LD 119	19 20 37	+25 52.2	12.5	< 15.2	>0.5	M	7085	292 c	
LD 120	19 21 09	+24 21.7	10.5	13.2	3.3	M	6740	342 c	3
LD 121	19 21 46	+26 21.3	13.3	14.7	0.8	IB	-	-	1
LD 122	19 22 28	+32 13.3	11.7	< 15.2	2	SR	6620	531	3,1
LD 123	19 23 52	+26 32.3	13.2	< 15.2	1	SR	6930	407	1
LD 124	19 24 12	+34 56.9	11.6	< 15.2	1.7	M	7280	405	
LD 125	19 25 13	+35 17.3	11.6	< 15.2	1.6	M	7015	247	4
LD 126	19 25 41	+34 36.4	11.9	15.2	1.7	M	6945	132 c	1
LD 127	19 28 13	+28 03.2	12.4	< 15.3	>2	M	6950	370	2,1
LD 128	19 29 03	+23 24.0	11.4	15.2	2.4	M	6920	353	
LD 129	19 29 42	+28 44.0	12.7	14.5	1.3	SR	-	-	
LD 130	19 33 59	+34 09.2	12.3	15.2	>2	M	6700	358	1
LD 131	19 37 13	+23 37.5	11.7	< 15.0	>1.3	M	7300	292 c	1
LD 132	19 38 13	+23 26.0	14.0	15.0	-	I	-	-	
LD 133	19 38 58	+24 45.6	12.1	< 15.2	2.1	M	7300	260	
LD 134	19 40 09	+30 06.6	12.0	< 15.2	2.0	M	6700	362	11
LD 135	19 41 41	+34 21.9	10.4	13.0	3.0	SR	6750	560	5,2
LD 136	19 41 55	+32 22.2	10.2	14.7	4.0	M	6990	562 c	1,2
LD 137	19 44 27	+51 32.8	11.9	15.0	2.3	M	6700	371 c	
LD 138	19 44 46	+28 01.1	12.1	< 15.2	>1.8	M	6990	227	1,6
LD 139	19 45 27	+35 38.4	12.7	14.6	0.8	SRA?	6680	304 c	1
LD 140	19 47 12	+22 30.2	13.0	< 15.5	1.3	M	7000	470 c	1
LD 141	19 47 13	+29 24.0	10.0	12.6	2.7	M	7380	523	2
LD 142	19 47 57	+35 41.3	11.4	< 15.2	1	M?	6640	452	1
LD 143	19 47 58	+22 25.0	13.2	< 15.2	>0.7	M	7280	400	
LD 144	19 48 08	+25 13.8	13.0	15.0	>1.5	-	-	-	1,7
LD 145	19 49 10	+26 02.9	12.7	< 15.2	-	M?	7130	444	11
LD 146	19 49 33	+32 40.0	13.0	< 15.1	>0.9	M	6650	394 c	
LD 147	19 49 58	+27 01.5	12.0	15.0	1.6	SR	6650	480	8
LD 148	19 51 49	+23 00.7	13.0	15.0	1.3		6950	200	9
LD 149	19 53 03	+22 23.3	12.1	< 15.0	>1.3	M	6945	294	10,11
LD 150	19 53 47	+22 13.1	11.3	14.5	0.7	SRD?	6885	473 c	1
LD 151	19 54 19	+23 08.4	12.4	14.2	1.4	SRB	7350	404	
LD 152	19 56 07	+31 45.7	14.1	< 15.2	>0.6	M	7400	600	
LD 153	19 56 13	+29 33.1	12.6	< 15.3	1.5	M	6670	386	1
LD 154	19 57 10	+31 05.1	11.9	15.1	>2.8	M	7040	288 c	1
LD 155	20 00 29	+29 43.3	11.8	15.1	>2	M	7086	585 c	
LD 156	20 01 13	+31 15.6	12.8	13.7	1.2	I	-	-	
LD 157	20 01 23	+29 46.3	11.8	13.6	2.0	SR	-	-	
LD 158	20 04 14	+25 18.9	12.5	< 15.2	1.3	M	7005	204 c	
LD 159	20 04 20	+35 09.0	12.5	15.1	>1.3	M	7110	460	11,2

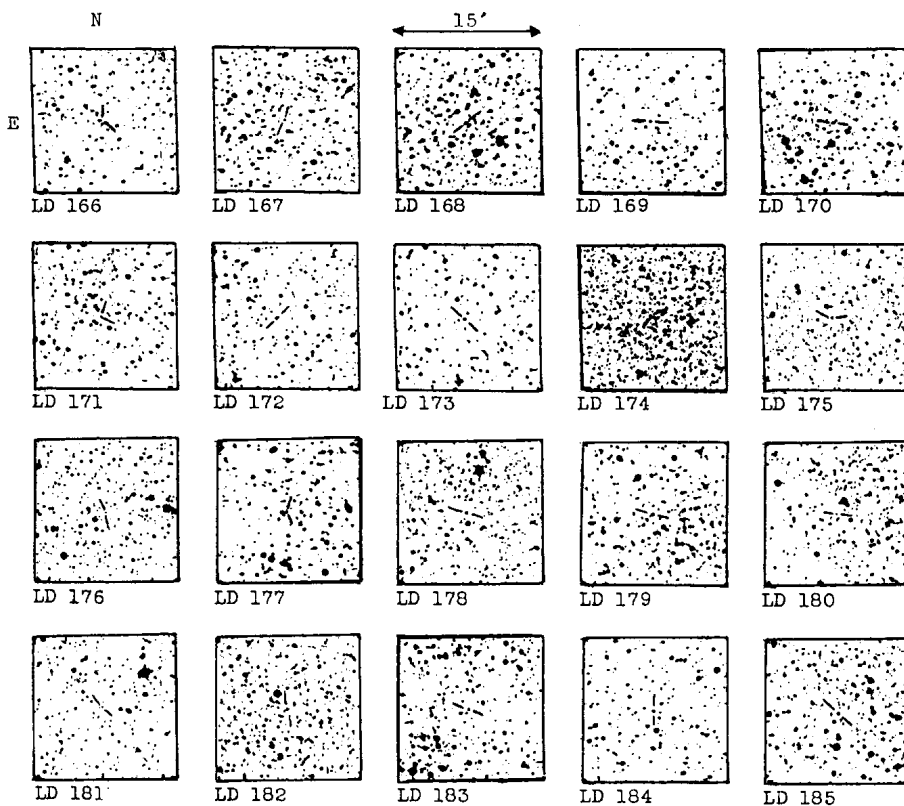
No	R.A. /1950/	Decl. /1950/	m_v		B-V	Type	Epoch 24400 00 +	P /d/	Notes
			max	min					
LD 160	20 04 43 ^s	+33° 49.4	12.5	15.1	>1.4	M	6920	355	12
LD 161	20 06 21	+25 27.3	13.8	<15.2	-	I	-	-	11
LD 162	20 07 44	+31 49.9	13.0	<15.2	>1	M	6925	437 c	1
LD 163	20 07 56	+25 29.2	11.8	15.1	1.5	M	6720	214 c	1
LD 164	20 08 51	+22 43.0	12.8	15.0	1.5	M	7355	284	1,13
LD 165	20 10 30	+24 27.8	12.4	<15.2	1.8	M	7050	263 c	
LD 166	20 13 34	+25 17.7	10.3	<15.2	2.8	M	6660	262 c	1,2
LD 167	20 13 57	+24 04.4	11.6	<15.2	>1.8	M	6720	452	
LD 168	20 19 30	+30 15.1	13.0	<15.2	>0.5	SR	6645	403	1
LD 169	20 19 31	+29 05.1	12.4	15.0	-	SR	6690	420?	
LD 170	20 19 57	+22 13.9	13.0	14.9	0.7	SRD	6640	148	1
LD 171	20 24 03	+27 59.7	12.8	<15.0	-	-	6945	430?	14
LD 172	20 25 18	+24 07.5	12.0	<16.0	1.8	M	6760	440	15
LD 173	19 15 55	+34 20.4	12.0	14.8	1.9	M	7375	269 c	
LD 174	19 19 40	+24 37.4	12.9	<15.8	-	SR	7720	323	1
LD 175	19 28 09	+24 04.0	14.2	<15.0	-	M	6980	250	
LD 176	19 46 35	+31 58.6	13.0	15.1	-	M	6650	275	
LD 177	19 43 44	+29 21.3	12.8	15.2	>1	M	6930	317 c	1
LD 178	19 50 33	+30 42.4	12.5	14.2	>1.7	M	7050	250	15
LD 179	19 52 39	+33 56.7	12.5	<15.2	1.4	M	7055	230 c	1
LD 180	19 54 17	+35 22.2	13.1	<15.0	>0.8	M	6930	382	17
LD 181	19 55 31	+30 35.0	13.9	<15.2	-	SR	6690	375	1
LD 182	19 55 53	+22 41.3	13.0	14.7	>1	I	-	-	1
LD 183	19 56 24	+35 35.1	12.3	14.8	>2	SRB	6619	103	18
LD 184	20 16 16	+26 29.8	11.8	<15.2	>1.6	M	6715	345 c	
LD 185	20 16 33	+23 25.7	13.5	15.0	>0.7	M	7715	298 c	

Notes

1. Close faint star (5" -30") may influence the magnitude estimations at minimum.
 2. Possibly carbon star.
 3. Small light variations in 1967-82.
 4. P changes ± 5 days.
 5. P changes between 450 and 560 d.
 6. P changes between 215-240 d, average 227 d. LD 138=A1 Vul.
 7. Light variations only in 1967-70, max 2440030.
 8. Long intervals constant 15.0 at min.
 9. P between 195-205 d. Fast variations of 0.3 magn in one hour.
 10. P increases from 288 to 300 d between 1986 and 1992.
 11. Not found on 103aD plates in 1967-82.
 12. P changes from 362 to 355 days between 1970 and 1990.
 13. 0.5 magn variations in one hour.
 14. Nova-like? Only one sharp max 2446945. Nothing in 1967-82.
 15. P change ± 30 d.
 16. P change (between 240-290 days).
 17. LD 180=V1460 Cyg. P increases from 367 days (1968) to 382 days (1990).
 18. LD 183=V1464 Cyg. V1460 and V1464 are given with wrong coordinates in GCVS (3' and 5').
- c means that the period P is constant between 1967 and 1992.
<15.2 means that the star is fainter than 15^m2.
LD 120=TAV 1921+24=CCS 2728. The Astronomer, Vol. 28, No. 332, 182, 1991.
LD 135=TAV 1941+34. The Astronomer, Vol. 26, No. 311, 237, 1990.
LD 142=V1000 Cyg.
LD 164=HX Vul. In GCVS given with 10' wrong coordinates.







and Newtonian telescope. I cannot find significant differences between the three methods. It is curious that IIIaJ and TP gives almost the same values as 103aO and 103aD. Perhaps the reason is that both IIIaJ and TP have their sensibility shifted about 500\AA to the red compared with 103aO and 103aD.

From 6720 magnitude estimations on TP film (1985-1992) the light curves of 80 variable stars have been drawn. From these curves the types, epoch and period (P) are estimated. The shape of these curves is correct, but the Technical Pan "V" magnitudes could be too bright, especially for red stars.

To find out the correction to be made I exposed a TP 2415 Hy film +Wr 9 with the Newtonian telescope on NGC 6866. This cluster has about 22 stars close to magn 13.5 with B-V from 0.15 to 1.85 (Hoag et al., 1961). I found a roughly linear connection between V and B-V for TP film and yellow filter

$$\text{corr.} = 0.4 (B-V).$$

This means that the carbon stars with $B-V=3$ or 4 could be 1 to 1.5 magn. too bright in the Table. For instance $V=10.2-14.7$ and $B-V=4$ is given for the star LD 136. Perhaps it is more correct with $V=11.8-16.3$. But no corrections have been made in the table nor in the graphs, while $B-V$ are rough and only known for 44 stars. The finding charts were obtained with the Schmidt camera in September 1987.

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