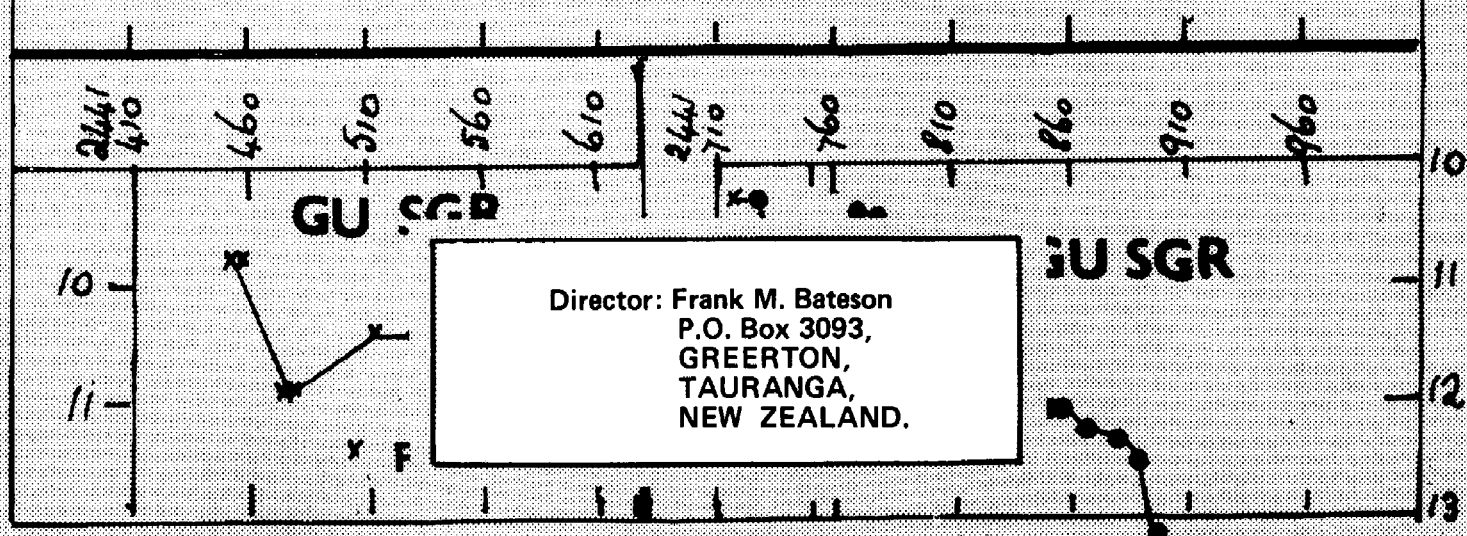


FIGURE 5

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THE LIGHT CURVE OF THE DWARF NOVA WX HYDRI.

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SUMMARY: A light curve of WX Hyi from J.D. 2,442,744 to 2,446,540 is presented. The 313 observed outbursts are listed and light curves on an enlarged scale reproduced for many of these. WX Hyi is a member of the SU UMa sub-class of dwarf nova. The mean super cycle is $187^d.1$ and that for the normal, short maxima $10^d.99$. The results are discussed.

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1. INTRODUCTION

The light curve of WX Hyi from J.D. 2,441,066 to 2,442,743 was published by Bateson(1) and 77 outbursts listed. Hereafter that publication is referred to as Paper 1. The present paper continues the light curve to J.D. 2,446,540. All observations were made visually by members of the Variable Star Section, R.A.S.N.Z.

The aim of the present paper is to provide the basic details. An analysis will then be carried out at the N. Copernicus Astronomical Center by A.Kozłowska in her search for relationships using better facilities than are available to us.

2. OBSERVED OUTBURSTS

Observed outbursts are listed in Table 1, continuing those given in Paper 1. A running number assigned to each outburst appears in the first column. The second column gives the type of outburst--N for normal, short outbursts and S for superoutbursts. The Julian Date for each maximum is next given followed by a question mark if the date is uncertain for any reason. The fourth column gives the visual maximum magnitude. A minus sign after the magnitude indicates that this was probably brighter than shown but could not be determined with certainty owing either to lack of observations or because the maximum occurred in daylight.

The fifth column gives the interval, in days, between successive maxima, irrespective of type. Brackets indicate that the outbursts were not consecutive. The width of the outburst, in days, appears in the next column and is the time that WX Hyi was brighter than magnitude 13.0. It was often not possible to determine this value, either because the star did not reach that magnitude or because the duration was too short. The column headed "Wt" indicates the degree of accuracy of the data given in the preceding columns. This is on the scale of 5 to 1, when 5 represents well determined data and 1, poor.

Remarks are given in the final column. Here any gaps in the observations either immediately before or after the date of maximum is mentioned. A few observations were rejected, although plotted on the light curves, because they appear to be in error and are in conflict with other estimates. The reasons for the remaining remarks will be obvious.

Table 1 has been compiled from both the computer light curves and by using the individual observations. This enabled greater weight to be given to the estimates from the most experienced observers.

3. LIGHT CURVES

Figures 1 to 13 show the light curve on a small scale with each figure covering 300 days. These give an overview of the star's variations as well as showing the intervals in which the star was closely monitored. It will be seen that, at first, it did not receive the attention it deserved. This improved after the publication of Paper 1, which showed observers the importance of following WX Hyi closely.

Figures 14 to 34 show a number of individual outbursts on an extended scale when there are sufficient observations to justify this. The captions give the number of the outburst from Table 1.

In all light curves the sign "v" indicates that the variable was invisible and fainter than the magnitude shown.

4. NORMAL OUTBURSTS

Normal outbursts occur frequently and are of short duration. There are 159 listed in Table 1 to which a weight of 4 or 5 have been assigned. These have a mean maximum magnitude of 12.68, but ranging from 11.6 to 13.5. Their mean cycle is 10.99 days with an extreme range of 5.3 to 23.9 days. The mean widths at magnitude 13.0 between the rise and fall could only be determined for 100 normal outbursts with weights of 4 or 5. The mean duration for these is 1.20 days and an extreme range of 0.2 to 2.7 days.

5. SUPER OUTBURSTS

Thirty super outbursts have been observed, including those listed in Paper 1. These have a mean maximum magnitude of 11.44, ranging from 11.1 to 11.7 with a mean deviation of $\pm 0^m.13$. The intervals between successive super outbursts varies widely from 124.0 to 304.0 days. The mean super cycle is 187.1 days.

The number of normal outbursts between successive super outbursts varies widely from 1 to 30. This is partly an observational effect, when the variable was not closely monitored and partly due to the length of the super cycle. The shorter the super cycle the fewer the number of normal outbursts in it. This number, on the average, increases steadily from the shortest super cycle to those with a length of around 160 days. Then the number of normal outbursts levels off at around 18 until super cycles with lengths of 260 days after which the number increases sharply. The mean number of normal outbursts in a super cycle is 12.

Normal outbursts which immediately precede a super outburst tend to occur at a shorter interval than those that immediately follow a super outburst. The respective mean intervals are 14.2 days (4.0 to 37.2 days) and 20.3 days (12.5 to 46.0 days). The shortest intervals before a super outburst occur when a normal outburst is almost superimposed on it as is also seen with VW Hyi.

6. MINIMA

WX Hyi at minimum is below the threshold of most of the instruments used. However, a number of positive observations have been recorded by those with larger apertures and dark observing sites. These observations are scattered in time, but do indicate that at minimum WX Hyi varies in the range of $14^m.2$ to $15^m.0$.

7. DISCUSSION

It is well known that WX Hyi belongs to the SU UMa sub-type of dwarf nova and has a short orbital period. Superhumps appear during super outbursts. The light curves reproduced in this paper are all from individual estimates. The best observed outbursts clearly show the foregoing features of this star. No attempt has been made to determine the orbital period from these observations since this can be more precisely done photoelectrically.

The objective of this paper is to present the results of continuous monitoring over an interval of 3,797 days. These, when combined with the observations in Paper 1, cover a period of 5,475 days. Such coverage is only possible through the observations of members of the VSS,RASNZ, widely scattered in latitude and longitude. A total of over 10,500 observations were made. Careful visual monitoring is the only method by which a continuous record of the variations of such stars can be obtained.

We have made every effort to eliminate doubtful observations, or have indicated them in the remarks to Table 1. It is obvious from the data that WX Hyi has a very short mean cycle, despite the fact that some outbursts passed unobserved. There is considerable theoretical interest in any relationships that may exist between different parameters. We are pleased to cooperate with the N.Copernicus Astronomical Centre in determining these since they have more adequate facilities than are available to us.

8. CONCLUSIONS

WX Hyi has two types of outbursts, viz normal or short and superoutbursts. Their mean magnitudes at maximum are respectively 12.68 and 11.44. The mean cycle between successive normal outbursts is 10.99 days. The mean length of super cycles is 187.1 days but varies within wide limits

ACKNOWLEDGMENTS

We thank all observers for their very careful monitoring of WX Hyi. We trust that this paper will show them the value of their observations and encourage them to continue following this star closely. The computer light curves have been produced by Ranauld McIntosh, whilst the rest of the paper is the responsibility of Frank Bateson and any shortcomings in it are his.

REFERENCE

- (1) Bateson, F.M. 1976. Publ. 4 Var. Star Section, Royal astr. Soc. of N.Z.
pp. 5 - 14.

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TABLE No.1.

WX HYDRI - OBSERVED OUTBURSTS.

No.	TYPE	J.D. MAX. 2,442,000+	MAX. M _v	INT. d	WIDTH 13 ^m .0 d	AT	Wt	REMARKS
78	S	756.0	12.3?	24.7	14.4		4	
79	N	802.0	13.0?	46.0	....		1	Gap 3 days after.
80	N	812?	13.4-	10.0	....		1	Gap 6 days after.
81	N	829?	13.5-	17	....		1	Gap 2 days before & after
82	N	850.9?	12.7	21.9	....		1	Single observation.
83	N	874?	13.2?	23.1	....		1	Single observation
84	N	890?	13.2?	16	....		1	Single observation
85	N	900	13.0	10	....		3	
86	S	913?	11.5	13	9.5?		3	Gap 4 days before
87	N	948.8?	13.2-	35.8	....		1	Gap 5 days before
88	N	961.9	12.9	13.1	....		2	Gap 2 days before
89	N	969?	13.2-	7.1	....		1	Gap 2 days before & 4 days after
90	N	977.9	13.2	8.9	....		3	
91	N	988.5?	13.2-	10.6	....		1	Gap 7 days before
92	N	2,443,000+ 022	(13.2)	(33.5)	....		2	Possibly max. around 013
93	S	042.9	11.7	20.9	13.5		5	
94	N	065.0	12.1	22.1	1.9		5	
95	N	083.0	(13.0)	18.0	....		4	
96	N	090.0	(13.0)	7.0	....		3	
97	N	098.0	12.9	8.0	....		4	
98	N	105.9	12.9	7.9	....		2	
99	N	115.5	12.9	9.6	....		3	
100	N	125.0	13.0	9.5	....		3	
101	N	131.9	13.2	6.9	....		2	
102	N	141.0	13.0	9.1	....		4	
103	N	150.0	13.0	9.0	....		3	
104	N	158.9?	13.2	8.9	....		3	
105	S	174.0	11.2	15.1	14.9		5	
106	N	197.5	13.1	(23.5)	....		4	Possibly Max. around 188
107	N	205.9?	(13.5)	8.4	....		1	Gap 3 days after. Moonlight makes date doubtful
108	N	215.9	13.2	10.0	....		5	
109	N	224.9	13.3	9.0	....		5	
110	N	234.0?	13.2	9.1	....		2	Gap 3 days before
111	N	243.0	13.3	9.0	....		3	
112	N	252.0	13.4	9.0	....		2	
113	N	269.8	12.8	17.8	....		5	
114	N	283.7	13.3	13.9	....		3	
115	N	298.9	13.2	15.2	....		1	Single observation
116	N	307.8?	12.9	8.9	....		2	Gap 2 days before
117	S	345.0	11.2	37.2	9.2?		4	Gap of 10 days after 12 ^m 0 on decline
118	N	367.8?	13.3	22.8	....		3	Gap 2 days before
119	N	376.5	13.2-	8.7	....		4	
120	N	394.0	13.4	17.5	....		5	Confirmed by p.e. obs.

TABLE No. 1 (cont)

5.

<u>No.</u>	<u>TYPE</u>	<u>J.D. MAX.</u> 2,443,000+	<u>MAX</u> <u>M_v</u>	<u>INT.</u> <u>d</u>	<u>WIDTH AT</u> <u>13^m0</u> <u>d</u>	<u>Wt</u>	<u>REMARKS</u>
121	N	405.9	12.9	11.9		5	Slow rise of 4 ^d 8 from 14 ^m 2
122	N	425.8	12.6	19.9	0.8	5	
123	N	432.9	12.6	7.1	1.7	5	
124	N	443.0	12.9	10.1		2	Obs. of 10 ^m 4 on 471.1 rejected.
125	N	450.9	13.0	7.9	....	5	
126	N	462.1	13.1	11.2	....	5	
127	N	470.1	13.0	8.0	....	5	
128	S	484.0	11.3	13.9	13.7	5	
129	N	507.9	12.9	23.9		5	Gap 3 days before
130	N	515.0	13.2	7.1	....	5	
131	N	523.9	13.1	8.9	....	5	
132	N	531.9	13.5	8.0	....	1	
133	N	542.0	13.0	10.1	....	4	
134	N	549.9	13.5	7.9	....	5	
135	N	559.9	13.2	10.0	....	1	
136	N	569.5	13.0-	9.6	....	5	
137	N	580.4	13.4	10.9	....	5	
138	N	597.8	12.6	17.4	2?	4	
139	N	612.9	13.2	15.1	....	1	
140	N	622.8	13.0	9.9	....	2	
141	S	641.9	11.3	19.1	15.0	4	Possibly max. of 13 ^m 0 about 662. Possibly several max. between Nos. 142 & 143 during gaps in obs.
142	N	670.6?	12.8	(28.7)	2.0	2	
143	N	733.6	12.1	(63.0)	1?	5	
144	N	745.0	13.0	11.4		4	
145	N	758.2	12.8	13.2	....	4	
146	N	769.0	13.0	10.8	....	4	
147	N	782.3	12.3	13.3	2.7	5	
148	S	794.9	11.4	12.6	12.4	5	
149	N	809.9	12.7	15.0	1.0	5	
150	N	815.9	12.6	6.0	....	5	
151	N	821.9	12.9	6.0		3	
152	N	829.0?	13.0	7.1	....	1	
153	N	836.0	12.7	7.0	....	5	
154	N	842.0	12.6	6.0	1.9?	3	
155	N	850.9	12.8	8.9	....	4	
156	N	861.0	13.2	10.1	....	4	
157	N	866.1	13.5-	5.1	....	2	
158	N	872.2	12.8	6.1	....	5	
159	N	878.2	12.8	6.0	0.8	5	
160	N	890.9	12.6	12.7	0.6	5	
161	N	901.0	12.6	10.1	0.9	5	Single obs. Gaps 2 days before & after. Possibly max. 13 ^m 3 about 951.2
162	N	908.1	13.3	7.1	....	4	
163	N	914.9	12.7	6.8	....	3	
164	N	923.5?	13.5-	8.6	....	2	
165	N	929.9	12.9	6.4	....	5	
166	N	937.9	12.5	8.0	0.7	5	
167	N	943.1?	12.6?	5.2	....	1	
168	N	956.0	12.9	12.9	0.9	5	

TABLE No. 1 (cont)

<u>No.</u>	<u>TYPE</u>	<u>J.D. MAX.</u> 2,443,000+	<u>MAX.</u> M_V	<u>INT.</u> d	<u>WIDTH AT</u> $13^m 0$ d	<u>Wt.</u>	<u>REMARKS</u>
169	N	963.9	12.8	7.9	1.0	5	
170	N	981.2	12.9	17.3	....	3	
171	N	988.3	12.8	7.1	1.0	3	
		2,444,000+					
172	N	018.6	12.0?	30.3	2.0	4	
173	N	027.3	11.8?	8.7	1.0?	3	Gap 3 days before
174	N	046.6	12.1	19.3	2.0?	3	Gap 3 days before start of outburst
175	S	060.2	11.6	13.6	13.0	5	
176	N	075.6?	12.9-	15.4	....	3	
177	N	081.6	12.1	6.0	0.5?	4	
178	N	088.2	12.8-	6.6	....	2	Gap 4 days before
179	N	101.9	12.7	13.7	0.6	5	
180	N	108.9	12.5	7.0	1.5?	3	Gap 2 days after.
181	N	118.1	12.5	9.2	....	2	
182	N	126.9	12.2	8.8	1.0	5	
183	N	138.1	12.3	11.2	1.2	5	
184	N	147.6?	13.0	9.5	....	2	Gaps 2 days before & after
185	N	156.0	12.7	8.4	1.2	5	
186	N	162.9	12.5	6.9	1.9	5	
187	N	170.9	12.6	8.0	2.0	5	
188	N	179.9	12.6	9.0	2.1	5	
189	N	190.0	12.2	10.1	1.0	5	Obs. at 11 ^m 5 on 189.97 rejected
190	N	198.9	12.3	8.9	1.2	5	
191	N	208.0	12.5	9.1	1.0	4	
192	N	216.9	12.5	8.9	1.8	5	
193	N	226.0	12.4	9.1	1.8?	4	
194	S	239.9	11.4	13.9	12.3	5	Obs. at 10 ^m 8 on 244.98 & 246.01 rejected
195	N	254.0	13.2-	14.1	....	5	
196	N	261.0	13.2	7.0	....	4	
197	N	274.9	13.3	13.9	....	5	
198	N	289.9	13.0	(15.0)	....	3	Possibly an outburst around 283
199	N	306.9	12.7	(17.0)	1.3-	4	Possibly an outburst around 299
200	N	315.9	12.8	9.0	1.0?	5	
201	N	331.0?	12.8?	(15.1)	....	1	Doubtful
202	N	339.8	12.9	8.8	....	3	
203	N	349.2	13.1	9.4	....	2	
204	N	364.9?	12.5?	15.7	....	1	Gap 3 days after
205	N	382.9	12.7	18.0	....	1	
206	N	400.2	12.5	17.3	....	1	Gaps 2 days before & after
207	N	412.0	12.4	11.8	....	1	Gap 5 days after
208	N	430.9	12.4	18.9	1.0?	3	Gap 8 days 417 to 425
209	N	453.1?	13.2	22.2	....	1	Gap 4 days before
210	N	460.0	12.2	6.9	1.4	5	
211	N	472.2?	13.4-	12.2	....	2	Possibly outburst may have been 1 day earlier

TABLE No. 1 (cont)

No.	TYPE	J.D. MAX. 2,444,000+	MAX M_v	INT. d	WIDTH AT $13^m.0$ d	Wt.	REMARKS
212	N	479.9?	12.7?	7.7		1	Gap 2 ^d .8 before & 1 ^d .3 after
213	S	488.2	11.5	8.3	10.5	5	
214	N	502.9	12.8	14.7		3	
215	N	513.0	13.1	10.1	....	3	
216	N	517.9	13.1	4.9	....	2	
217	N	523.0	13.2	5.1	....	2	
218	N	535.9	12.7	12.9	1.0	3	
219	N	542.8	12.8	6.9	0.5	4	Gaps 3 days before
220	N	549.5?	13.4-	6.7	....	2	
221	N	556.0	12.7	6.5	1.0	5	
222	N	571.9	12.6	15.9	1.0?	4	
223	N	579.7	12.7	7.8	....	3	
224	N	587.1	12.9	7.4	1.0	5	
225	N	599.9	12.4	12.8	0.5?	4	
226	N	609.9	12.5	10.0	0.2	5	
227	N	619.9	12.8	10.0	0.4	5	
228	N	628.9	12.8	9.0	....	5	
229	N	637.1	12.8	8.2	0.8	5	
230	N	648.0	12.5	10.9	1.1	5	
231	N	657.8	12.8	9.8	....	2	
232	N	666.8	12.4	9.0	1.2	5	
233	N	676.9	12.9	10.1	....	3	
234	N	691.8	12.6	14.9	1.1	5	
235	N	702.8	12.6	11.0	1.4	5	
236	N	711.9	12.5	9.1	....	3	
237	N	719.0	12.8-	7.1	....	3	
238	N	728.2	12.3	9.2	1.4	5	
239	N	746.8?	12.1	(18.6)		1	Gap 5 days before; Possibly max. 738
240	N	754.2	12.5	7.4	1.4	4	
241	N	761.2?	12.5	7.0		1	Gaps 5 days before & 3 ^d .5 after
242	N	767.3	13.2	6.1	....	3	
243	N	788.2	12.2	20.9	1.6	5	Trigger for supermaximum?
244	S	792.2	11.6	4.0	10.5	5	
245	N	810.1	12.7	17.9		1	Possibly outburst of $13^m.0$ on 821
246	N	826.2	12.9	16.1	....	3	
247	N	844.2	12.9	(18.0)	1.0	4	
248	N	852.0	12.4	7.8	1.0	5	Possibly outburst of $12^m.8$ on 833
249	N	860.0?	13.1-	8.0	....	2	
250	N	867.9	12.4	7.9	1.0	5	
251	N	876.0	12.9	8.1	....	3	
252	N	883.4	12.3	7.4	1.4	5	
253	N	891.9	12.5	8.5	1.0	5	
254	N	902.9	12.5	11.0	1.2	5	
255	N	909.9	12.5	7.0	1.1	5	
256	N	919.0?	12.8-	9.1	....	1	
257	N	928.0	12.5	9.0	....	3	
258	N	937.9	12.5	9.9	1.3	5	
259	S	948.9	11.4	11.0	14.0	5	
260	N	963.0	12.7	14.1	0.5	5	Gap 3 days after.

TABLE No. 1 (cont)

<u>No.</u>	<u>TYPE</u>	<u>J.D. MAX.</u> 2,444,000+	<u>MAX.</u> M_v	<u>INT.</u> d	<u>WIDTH AT</u> $13^m 0$ d	<u>Wt.</u>	<u>REMARKS</u>
261	N	968.3	12.8	5.3	0.6?	4	
262	N	973.9	12.8	5.6	....	3	
263	N	980.0	13.0	6.1	....	3	
264	N	985.9	12.9	5.9	....	4	
265	N	992.9	12.7	7.0	1.2	5	
266	N	999.9	12.7	7.0	....	5	
2,445,000+							
267	N	007.9	12.7	8.0	....	2	
268	N	017.9	12.7	10.0	2.0	5	
269	N	029.0	12.4	11.1	0.6	5	
270	N	040.0	12.6	11.0	1.5	4	Obs. at $11^m 2$ & $11^m 6$ rejected.
271	N	050.9	12.5	10.9	1.0	3	
272	N	061.0?	12.9	10.1	....	1	Gaps 2 days before & after
273	N	076.8	12.5	15.8	2.0	5	
274	S	091.2	11.5	14.4	13.0	5	
275	N	121.2	12.8	(30.0)	....	1	Gap 2 days before; possible outburst 114.8 Gap 5 days before
276	N	135.2?	12.6	14.0	....	1	
277	N	154.6	12.3	19.4	1.3	5	
278	N	162.6	12.5	8.0	1.0?	2	
279	N	174.2	12.4	11.6	....	2	Possibly a double max. with $13^m 0$ at 172.6 & then fading to $(14^m 0)$
280	N	195.6	12.7	21.4	0.6	5	
281	N	203.9	12.5	8.3	2.1	5	
282	N	209.1?	13.3	5.2	....	2	
283	N	214.2	12.8	5.1	....	1	
284	N	223.0	12.5	8.8	1.2	5	
285	N	233.9	12.5	10.9	1.3	5	
286	N	244.9?	12.2	11.0	....	1	Gaps 2 days before & after
287	N	254.9	12.0	10.0	1.6	5	
288	N	264.2	12.7	9.3	1.0	5	Obs. $11^m 9$ on 264.91 rejected
289	S	276.0	11.6	11.8	13.1	5	
290	N	290.9	12.7	14.9	0.3	5	
291	N	297.4	13.1-	6.5	....	2	
292	N	303.0?	13.4-	5.6	....	1	Gaps 2 days before & after
293	N	321.3	12.7	(18.3)	0.5	4	Possibly max. on 308.9 at $13^m 3$
294	N	336.3	12.7	(15.0)	0.4	5	Possibly max. on 330.0 at $12^m 9$
295	N	344.9	12.8	8.6	....	4	
296	N	353.9	12.7	9.0	0.9	5	
297	N	360.9	12.7	7.0	....	3	
298	N	367.3	12.7	6.4	0.7	3	
299	N	374.3	12.5	7.0	0.7	5	
300	N	381.9	12.7	7.6	0.6	5	
301	N	392.9?	12.4?11.0	....	....	1	Gaps 1 day before & 3 days after
302	N	409.9	12.7	17.0	2.0	5	

TABLE No. 1 (cont)

No	TYPE	J.D. MAX. 2,445,000+	MAX. M _v	INT. d	WIDTH AT 13 ^m 0 d	Wt	REMARKS
303	N	427.2?	12.8	17.3	....	2	Gap 2 days before
304	N	435.8	12.5	8.6	1.2	4	
305	N	468.2	12.3	(32.4)	1.4	3	Possibly max. around 459 but gap in obs. makes it impossible to be certain
306	N	477.2	12.8	9.0	....	4	
307	N	492.2	12.5	15.0	0.8	4	
308	S	518.3?	11.7	16.1	?	2	Gap 9 days before; Max may be earlier than 518
309	N	535.1	12.6	16.8	1.0	3	Gap 2 days before
310	N	541.2	13.0	6.1	....	2	
311	N	548.0	13.0	6.8	....	3	
312	N	556.0	12.7	8.0	1.4	5	
313	N	562.7	12.7	6.7	0.5	5	
314	N	577.2	12.8	14.5	0.7	5	
315	N	593.0	12.3	15.8	1.0	5	
316	N	603.3	12.7	10.3	1.2	5	
317	N	609.6	13.4-	6.3	....	1	Single observation
318	N	621.8	12.2	12.2	2.0	5	
319	N	630.9	12.8	9.1	....	1	Single observation.
320	N	642.9	12.7	12.0	1.3	5	
321	N	650.9	13.2	8.0	....	4	
322	N	656.4	12.4	5.5	1.6	5	
323	N	665.3	12.5	8.9	1.7	5	
324	N	683.9	12.0	18.6	1.9	5	
325	N	691.5	13.4-	7.6	....	2	
326	N	704.3	11.6	12.8	1.4	5	Trigger for super max.
327	S	710.0	11.4	5.7	11.2	5	
328	N	725.3	12.5	15.3	0.6	5	
329	N	736.2	12.7	10.9	0.8	5	
330	N	754.7	12.9	18.5	....	3	
331	N	768.3	12.5	13.6	0.9	5	
332	N	778.2?	12.8	9.9	....	2	Gap 2 days before
333	N	787.9	12.4	9.7	1.0	5	
334	N	795.6?	12.8-	7.7	....	1	Single observation
335	N	800.8	12.2	5.2	1.4	3	
336	N	811.8	12.3	11.0	1.5	4	
337	N	821.2	12.8	9.4	1.2	3	
338	N	837.8	12.8	16.6	2.0?	3	
339	N	847.0	12.2	9.2	1.9	5	
340	N	857.1	12.3	10.1	2.0?	3	
341	S	875.2	11.5	(18.1)	12.1	4	Possibly max. on 865
342	N	908.0	12.7	32.8	....	2	
343	N	916.8	12.7-	8.8	1.1	3	
344	N	937.9	12.6	21.1	....	3	
345	N	947.0	12.8	9.1	1.2	3	
346	N	957.1	12.3	10.1	....	3	
347	N	973.2	11.8	16.1	2.0	5	
348	N	987.0	12.4	13.8	2.1	5	
349	N	996.9	12.3	9.9	2.0	5	

TABLE No. 1 (cont)

<u>No.</u>	<u>TYPE</u>	<u>J.D. MAX.</u> 2,446,000+	<u>MAX.</u> M_V	<u>INT.</u> $\bar{d}$	<u>WIDTH AT</u> 13^m0 $\bar{d}$	<u>Wt.</u>	<u>REMARKS</u>
350	N	006.0	12.5	9.1	1.0	3	
351	N	017.1	12.5	11.1	1.8	5	
352	N	028.4	12.5	11.3	2.0	5	11 ^m 3 on 028.064 doubtful
353	S	036.4	11.4	8.0	11.3	5	
354	N	052.6	12.7	16.2	0.5	4	
355	N	059.9	12.6	7.3	0.2	5	
356	N	071.1	12.5	11.2	....	1	Single observation
357	N	078.0	12.9	6.9	....	3	
358	N	086.0	12.6	8.0	0.4	4	
359	N	095.0	12.7	9.0	0.6	3	
360	N	110.3	12.9	15.3	....	2	
361	N	119.9	13.1	9.6	....	3	
362	N	126.9?	13.1	7.0	....	1	Gap 2 days before
363	N	136.9	12.8	10.0	....	3	
364	N	144.5?	13.3-	7.6	....	1	Single observation
365	N	152.9	12.5	8.4	0.7	3	
366	N	164.2	12.5	11.3	0.8	5	
367	N	173.9?	12.8	9.7	....	1	Gap 2 days before
368	N	184.2	12.3	10.3	....	1	Single observation
369	N	193.9?	13.0-	9.7	....	1	Gap 4 days after
370	N	203.6	12.5	9.7	0.5	4	
371	N	218.6	12.0	15.0	2.0	3	Gap 3 days after
372	N	230.6	12.5	12.0	1.6	5	
373	N	241.0	12.1	10.4	....	3	
374	S	245.1	11.7	4.1	10.7	5	
375	N	273.6?	12.5	28.5	....	2	Gap 2 days before
376	N	287.6?	13.0-	14.0	....	1	Gap 3 days before
377	N	299.2	13.0	11.6	....	2	
378	N	332.5?	12.7	33.3	....	1	Gap 3 days after
379	N	342.0	13.4-	9.5	....	2	
380	N	351.9	12.5	9.9	0.9	4	
381	N	365.0	12.3	13.1	1.0	5	
382	N	375.3	12.5	10.3	1.0	5	
383	N	391.1	12.7	15.8	....	3	
384	N	409.9	12.7	18.8	0.5	4	
385	N	432.3	12.3	22.4	1.1	5	
386	N	445.9	12.7	13.6	1.4	5	
387	N	462.9	12.7	17.0	1.5	5	
388	N	476.2	12.2	13.3	2.0	5	
389	S	495.2	11.3	19.0	12.9	5	
390	N	537.2	12.8	(42.0)	1.0	5	Slow rise of 2 ^d 3 from 14 ^m 0 Possibly outbursts on 514 & 525.

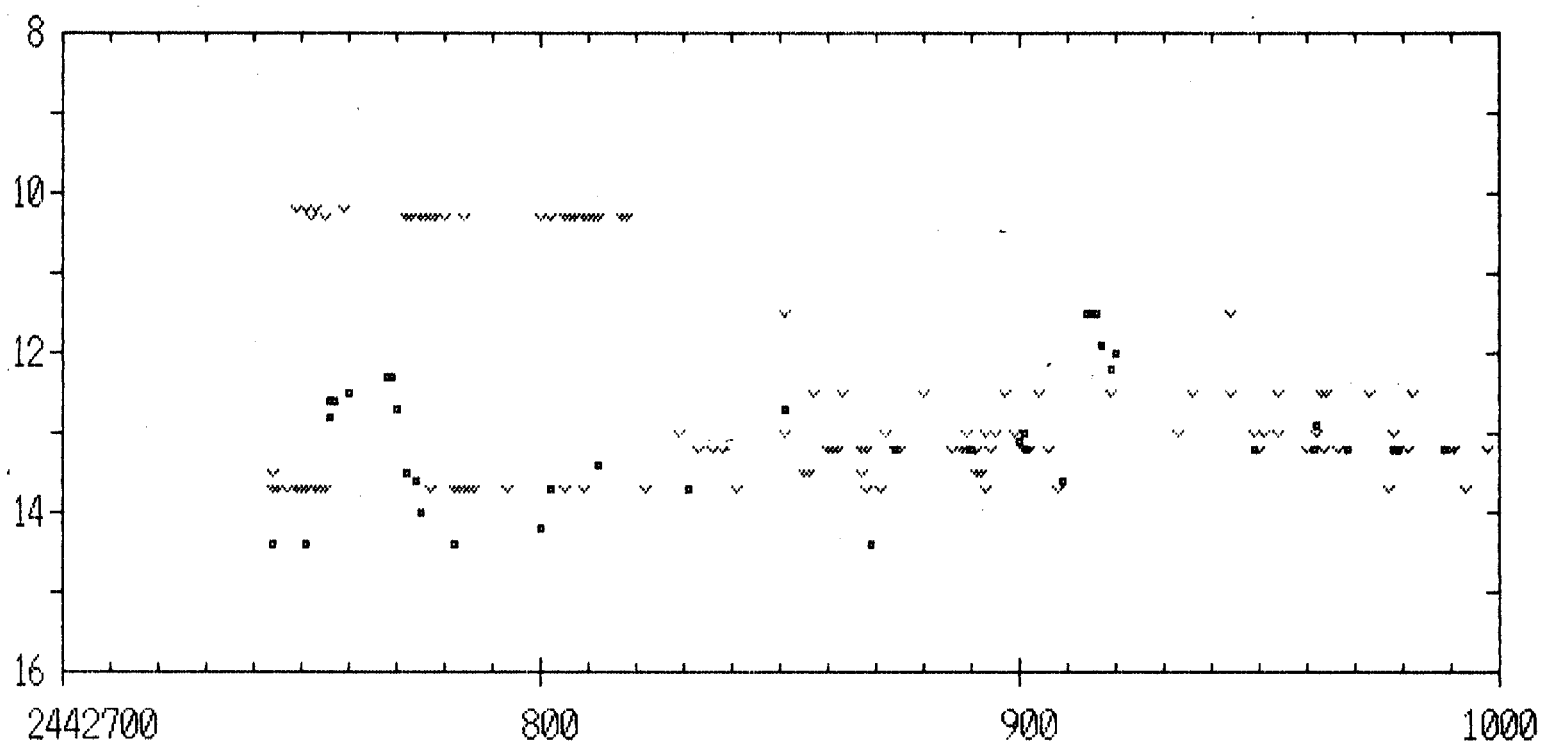


Figure 1. WX Hydri---Light Curve. 2,442,744 - 2,443,000.

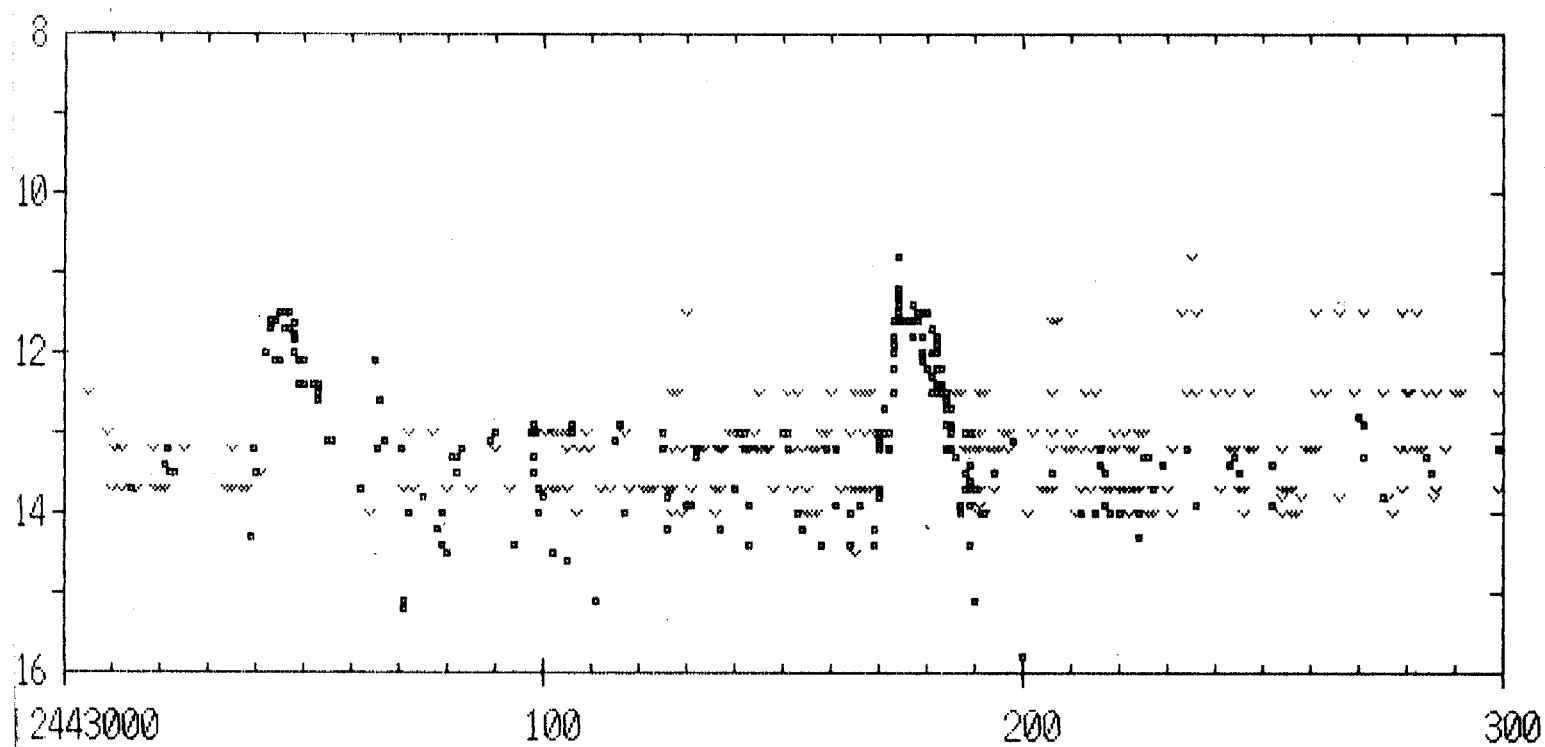


Figure 2. WX Hydri---Light Curve, 2,443,000 - 2,443,300

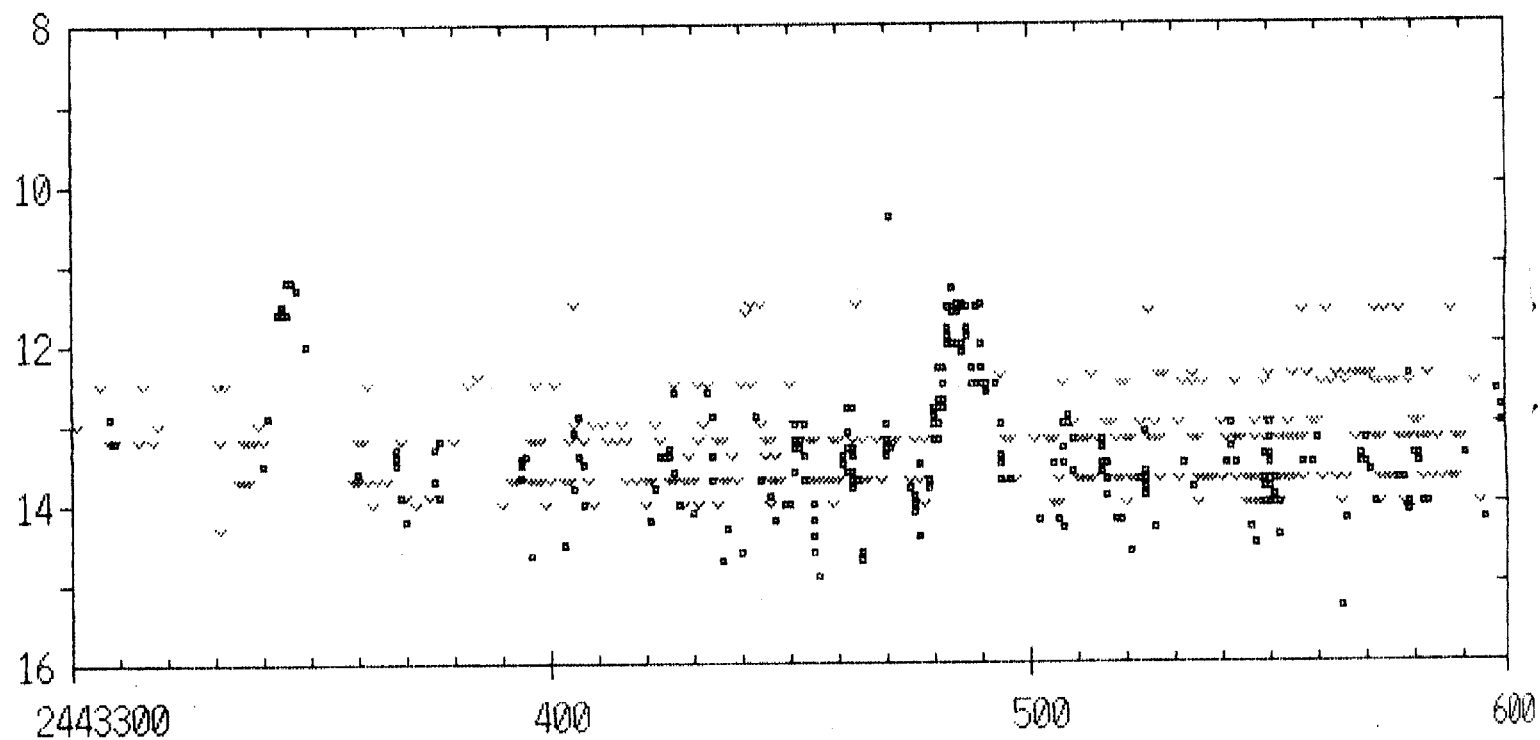


Figure 3. WX Hydri. Light Curve 2,443,300 - 2,443,600.

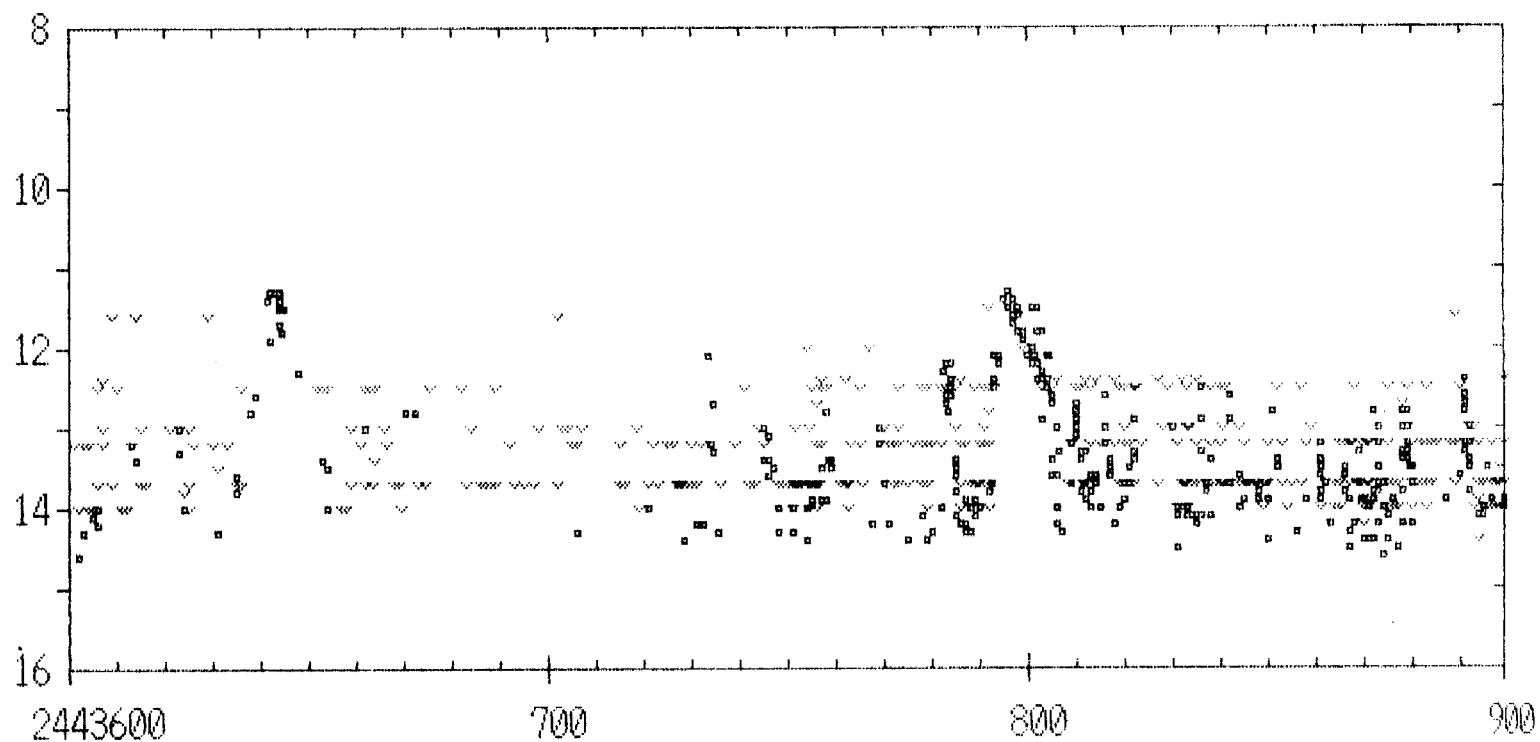


Figure 4. WX Hydri. Light Curve 2,443,600 - 2,443,900.

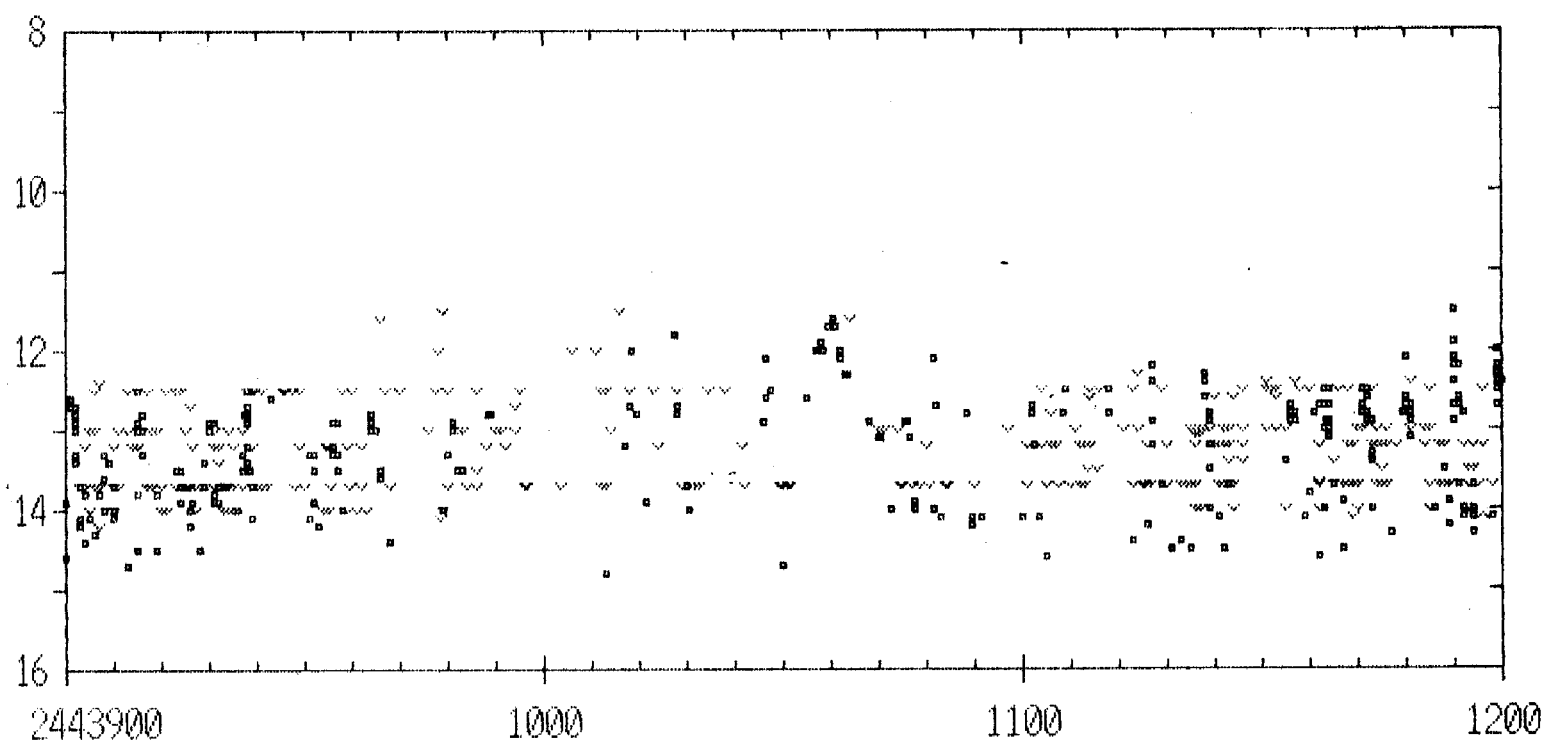


Figure 5. WX Hydri. Light Curve 2,443,900 - 2,444,200

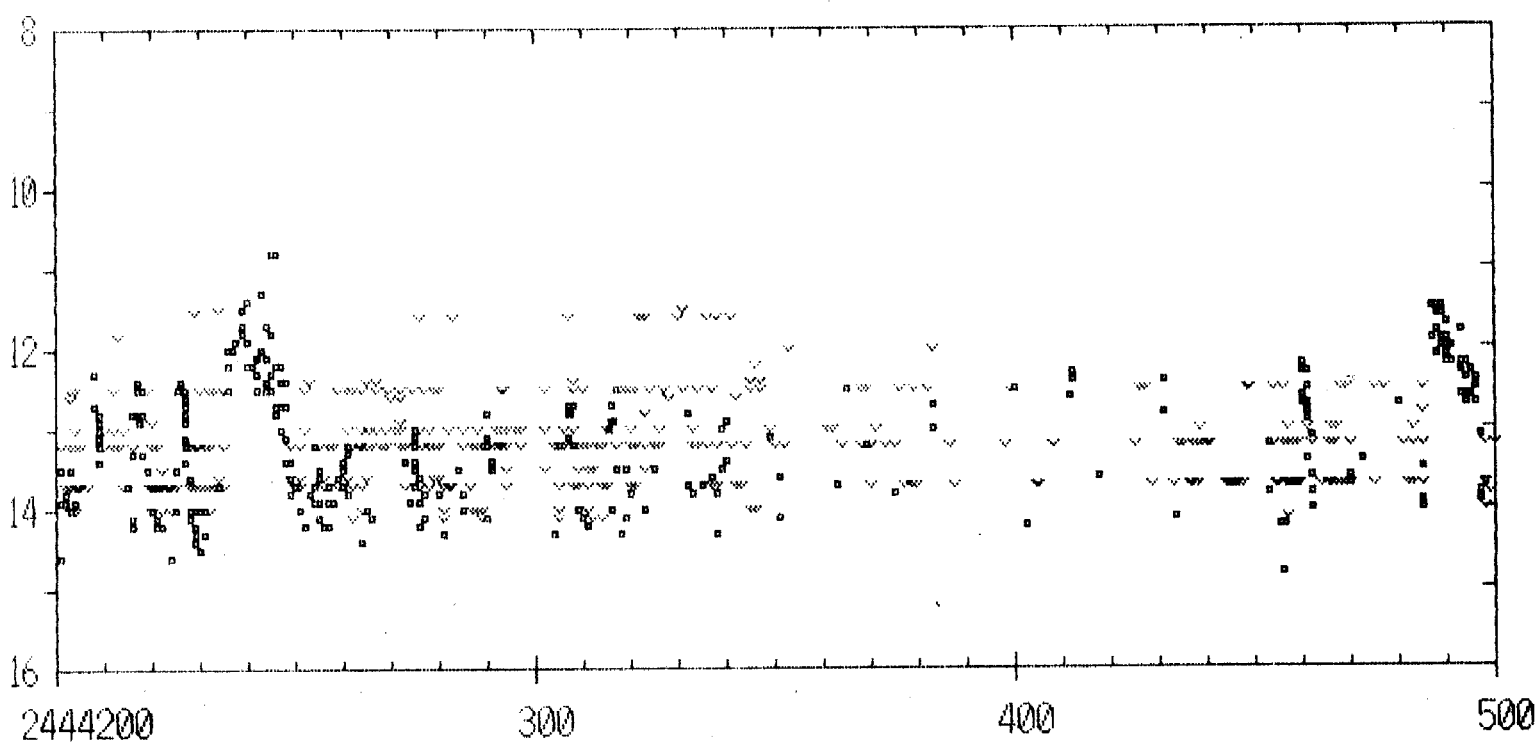


Figure 6. WX Hydri. Light Curve 2,444,200 - 2,444,500.

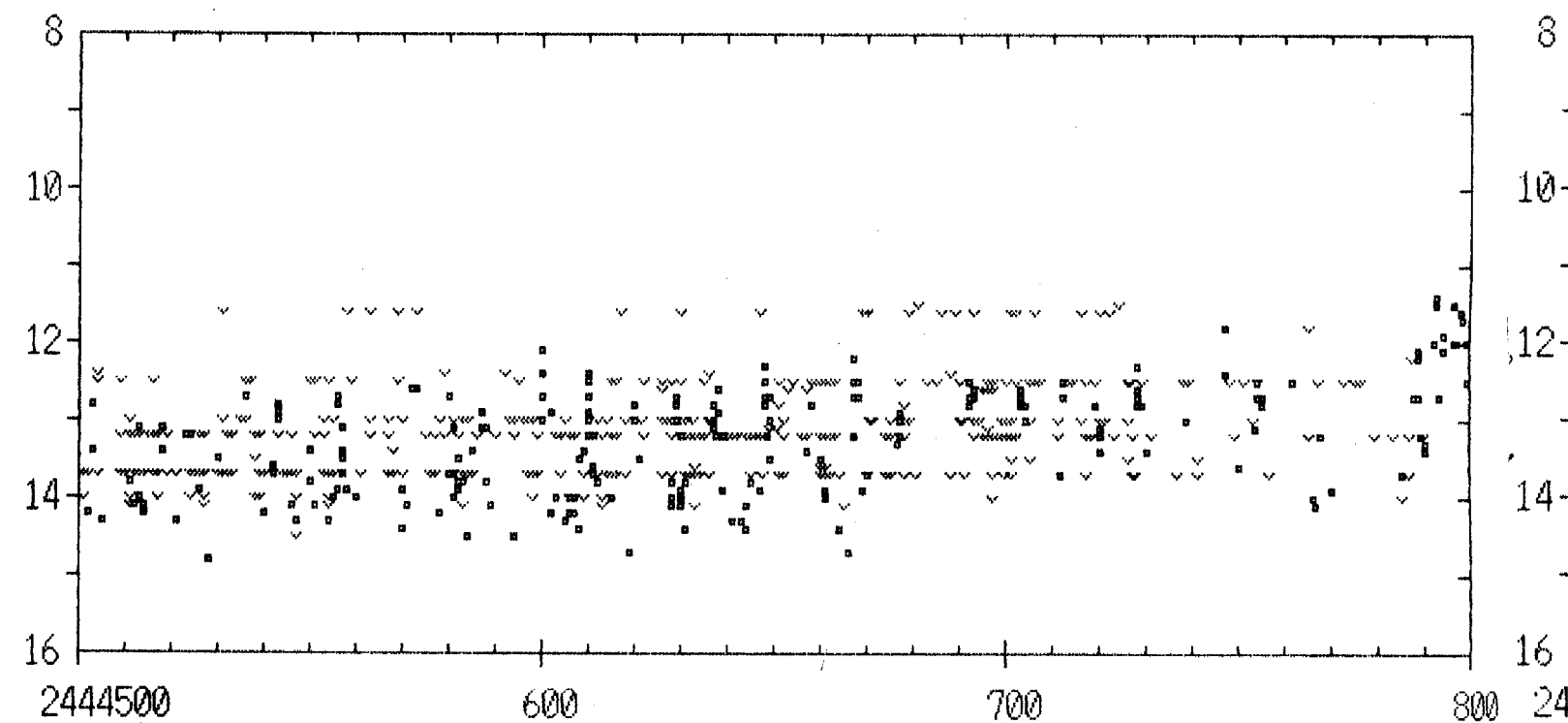


Figure 7/ WX Hydri. Light Curve 2,444,500 - 2,444,800.

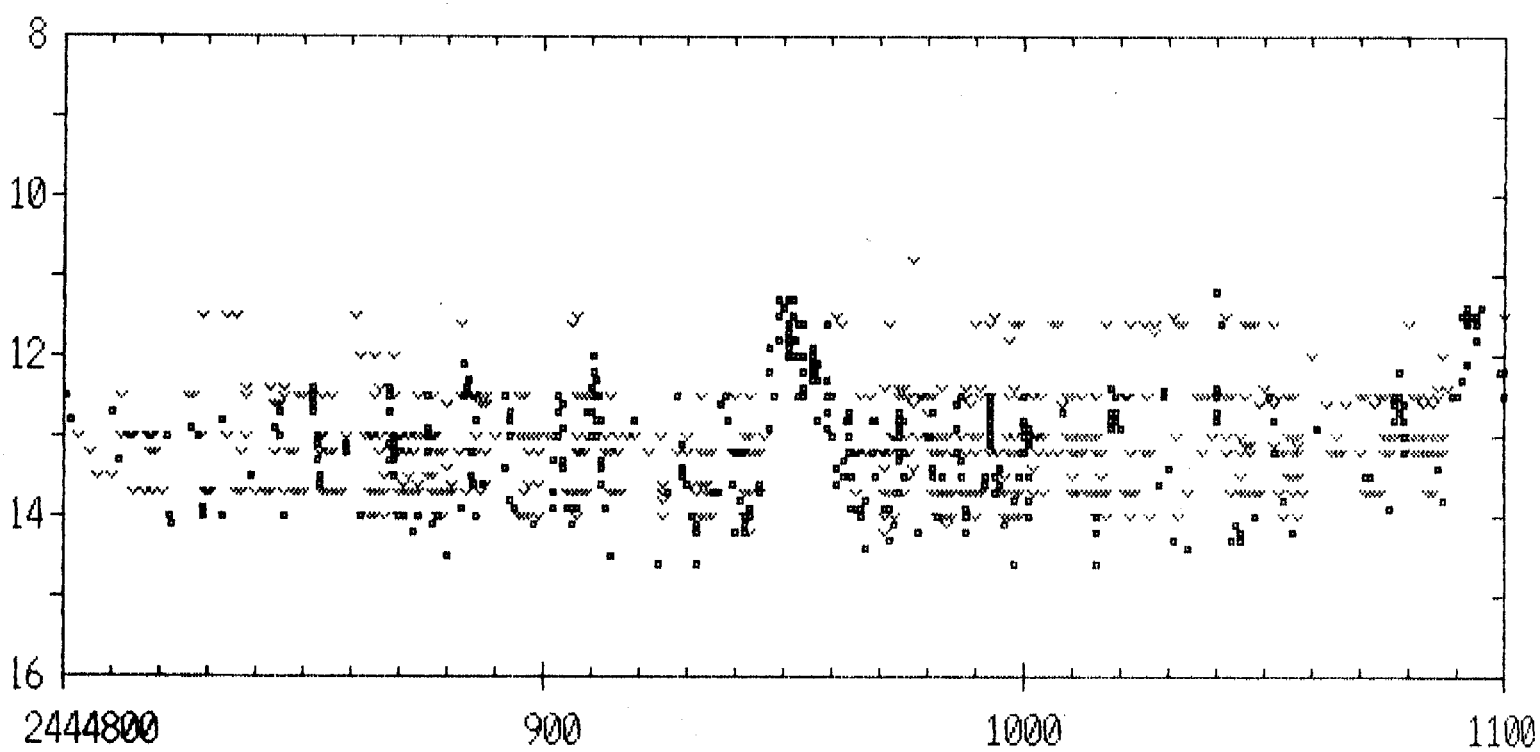


Figure 8. WX Hydri. Light Curve 2,444,800 - 2,445,100

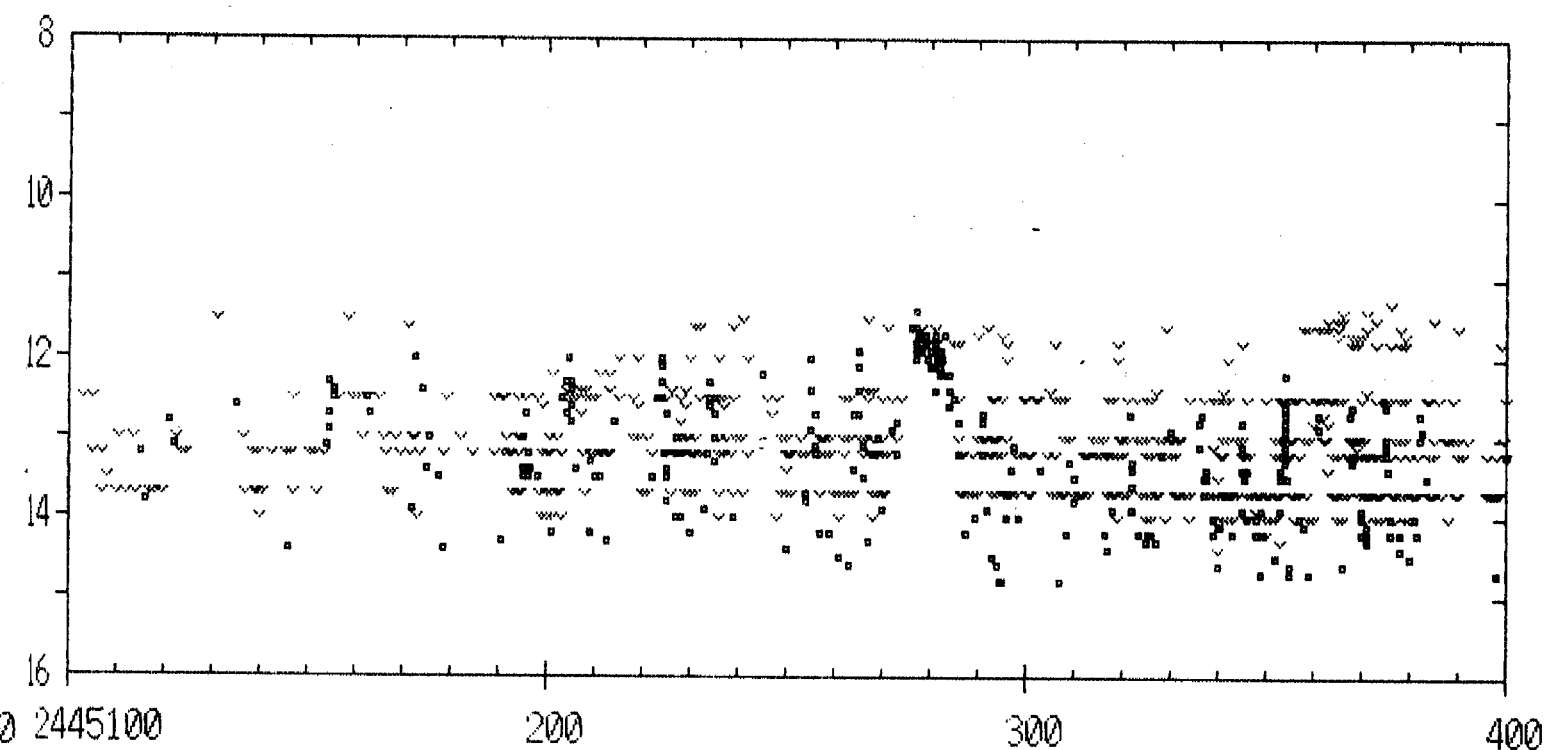


Figure 9. WX Hydri. Light Curve 2,445,100 - 2,445,400.

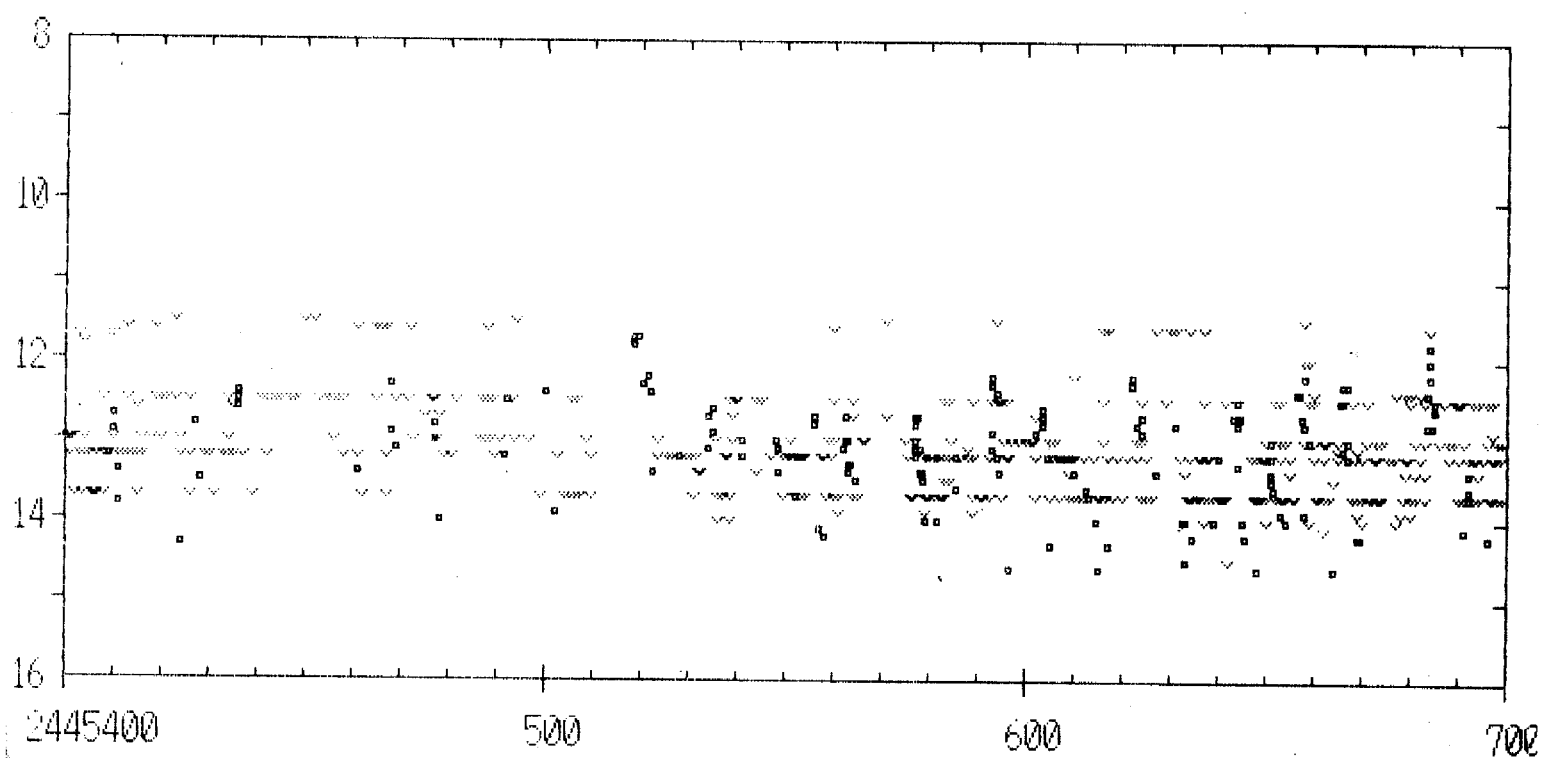


Figure 10. WX Hydri. Light Curve 2,445,400 - 2,445,700

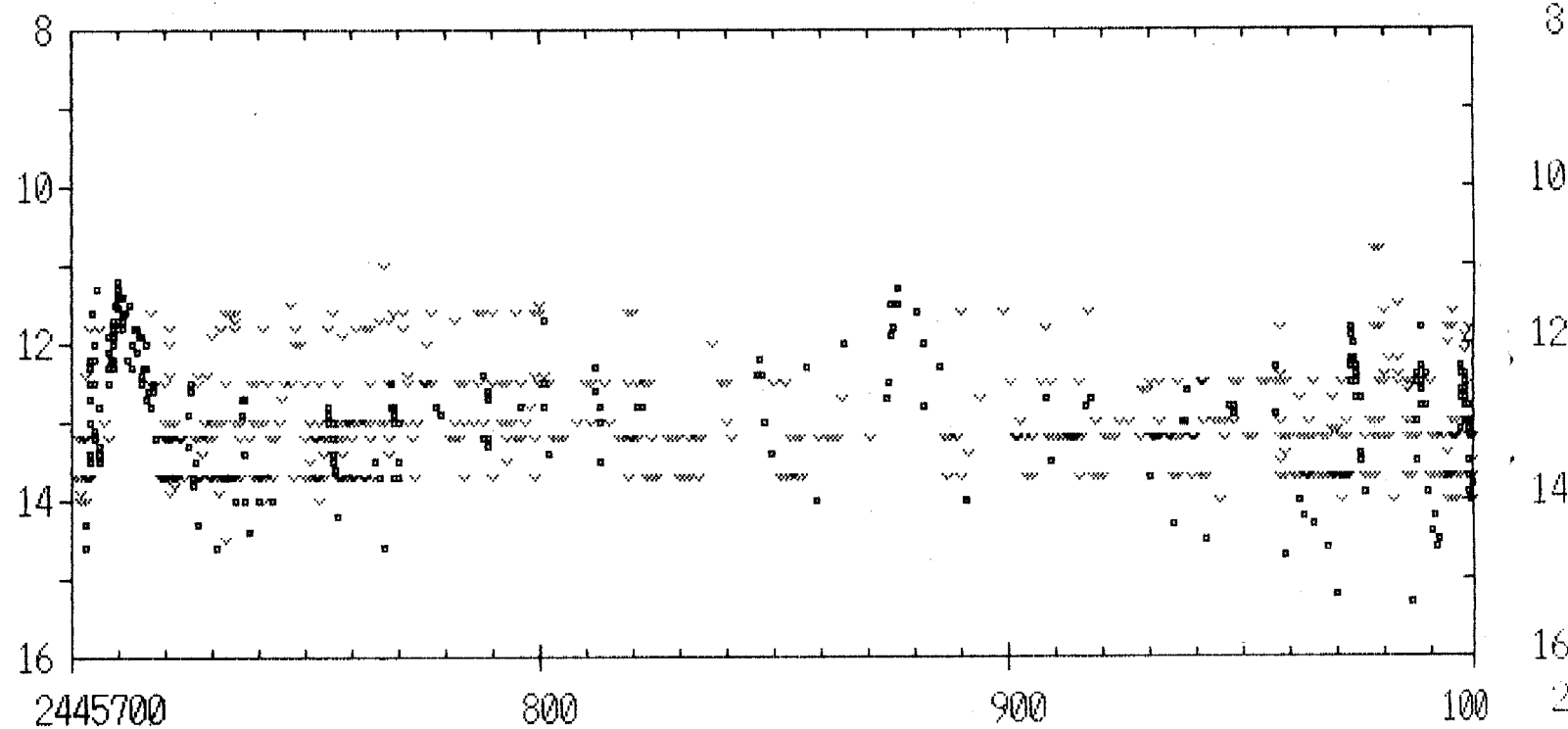


Figure 11. WX Hydri. Light Curve 2,445,700 - 2,446,000.

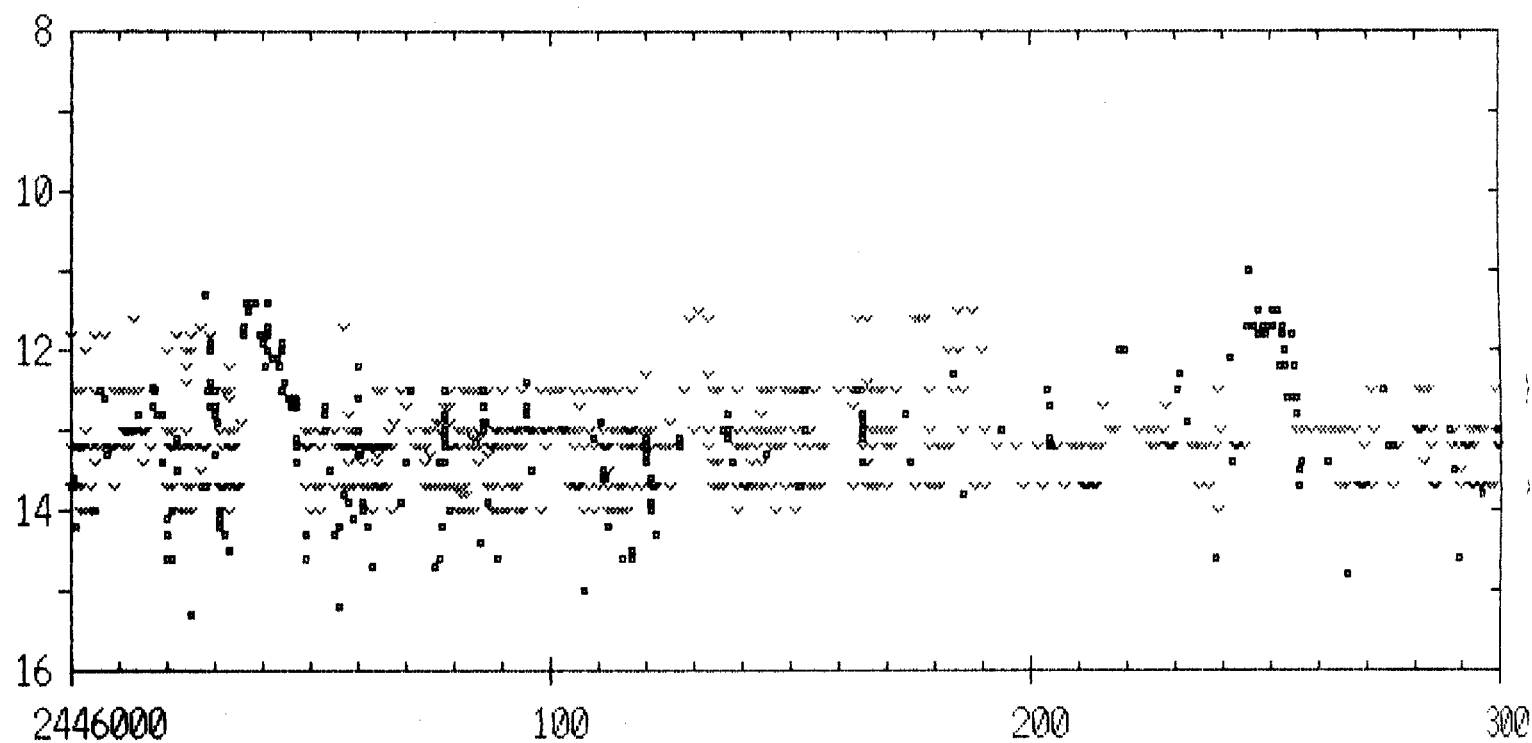


Figure 12. WX Hydri. Light Curve 2,446,000 - 2,446,300.

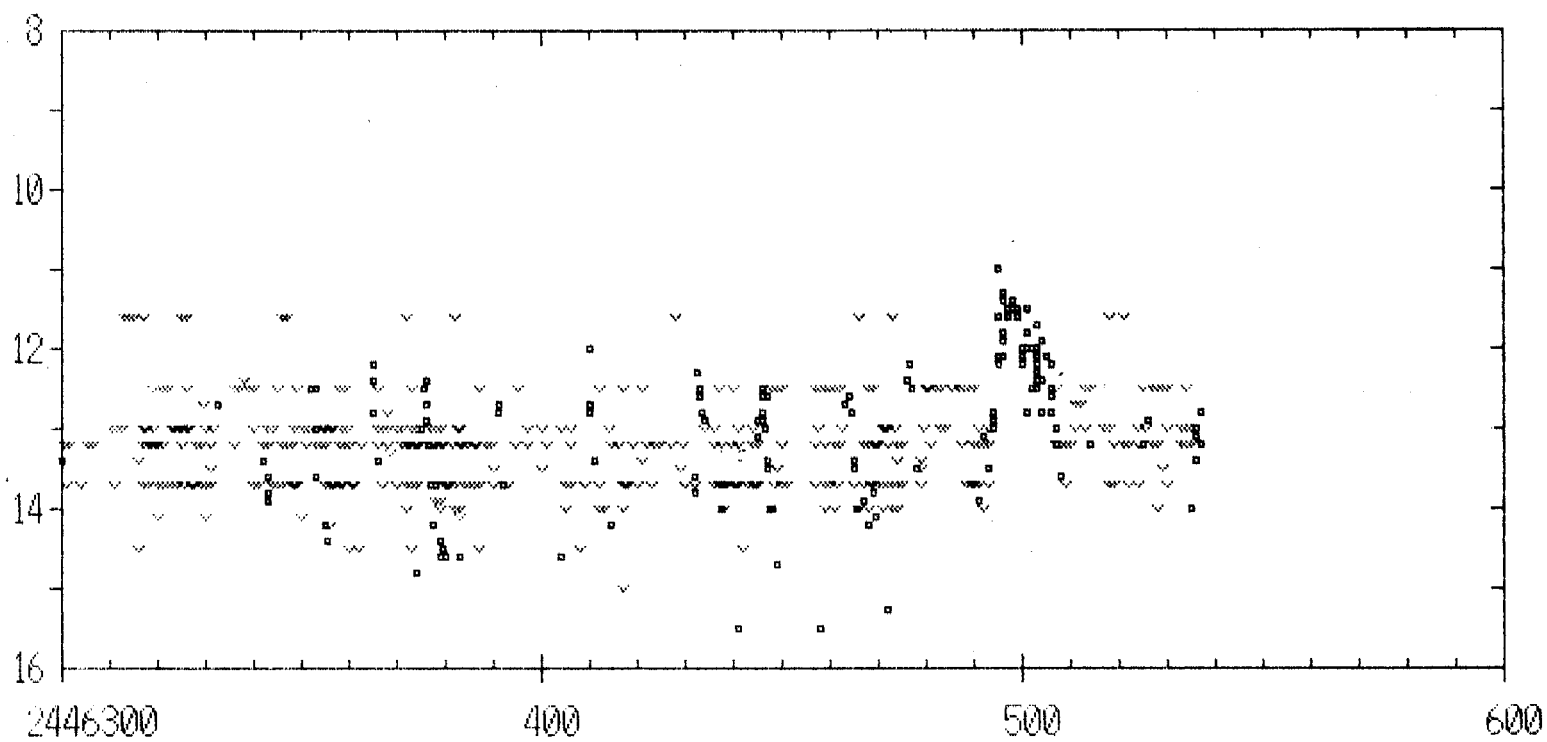


Figure 13. WX Hydri. Light Curve 2,446,300 - 2,446, 540.

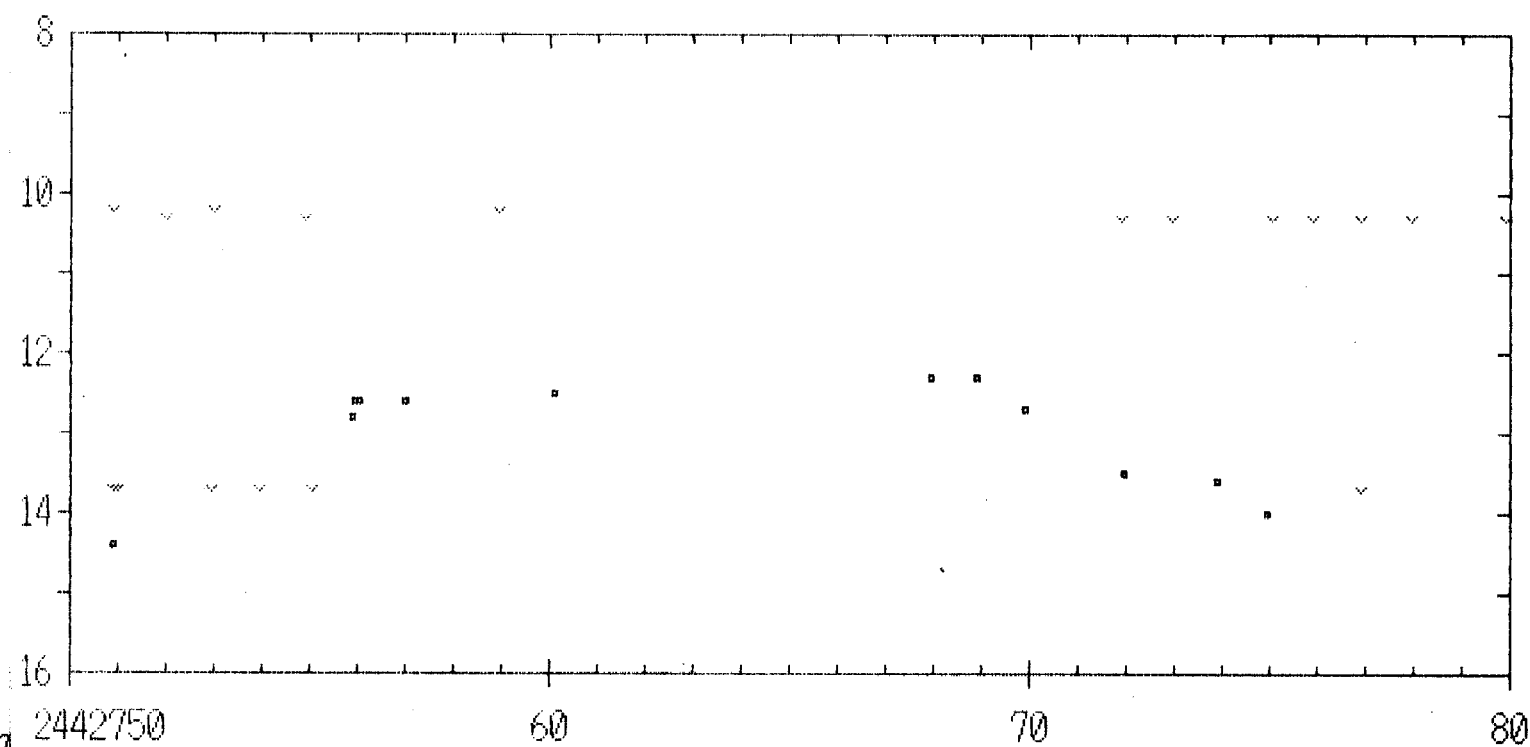
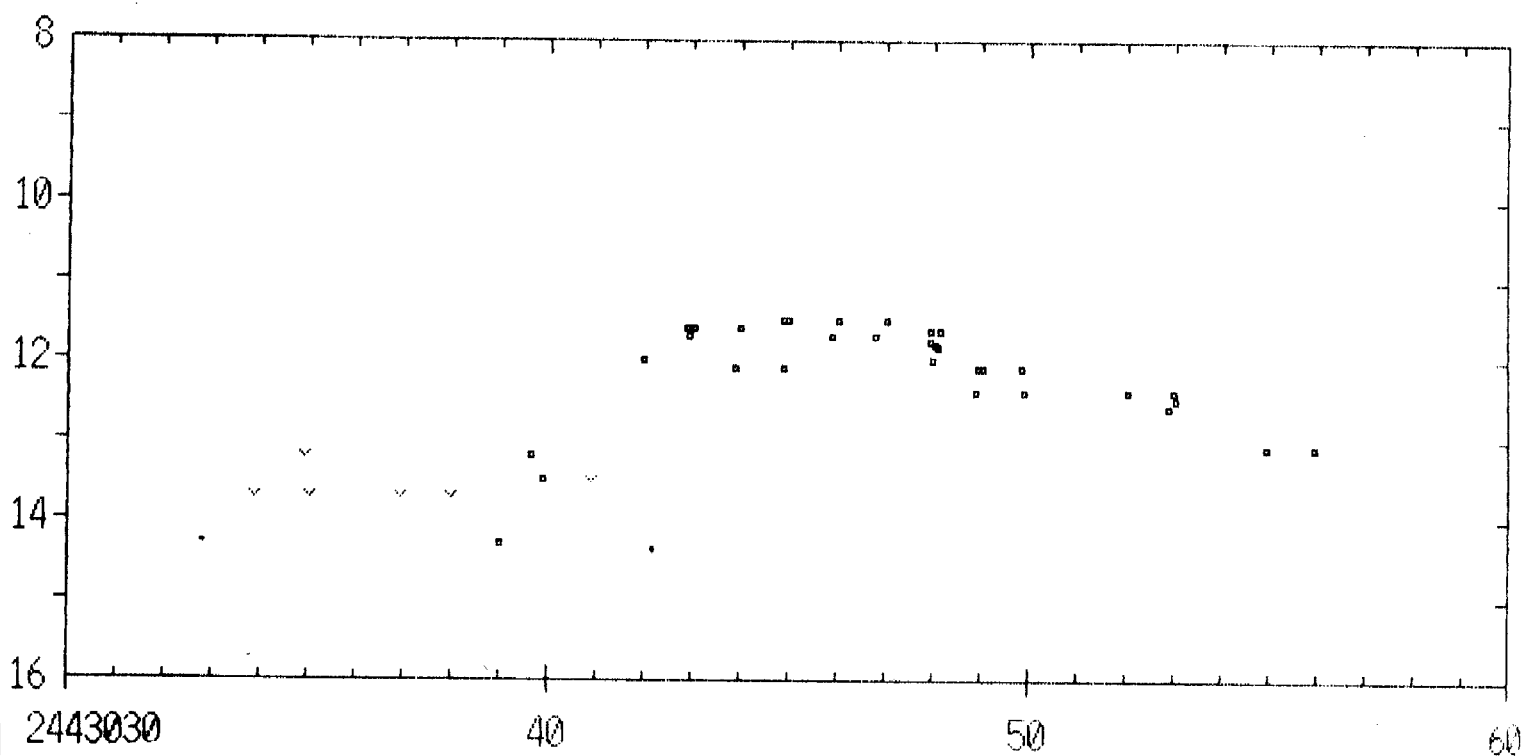
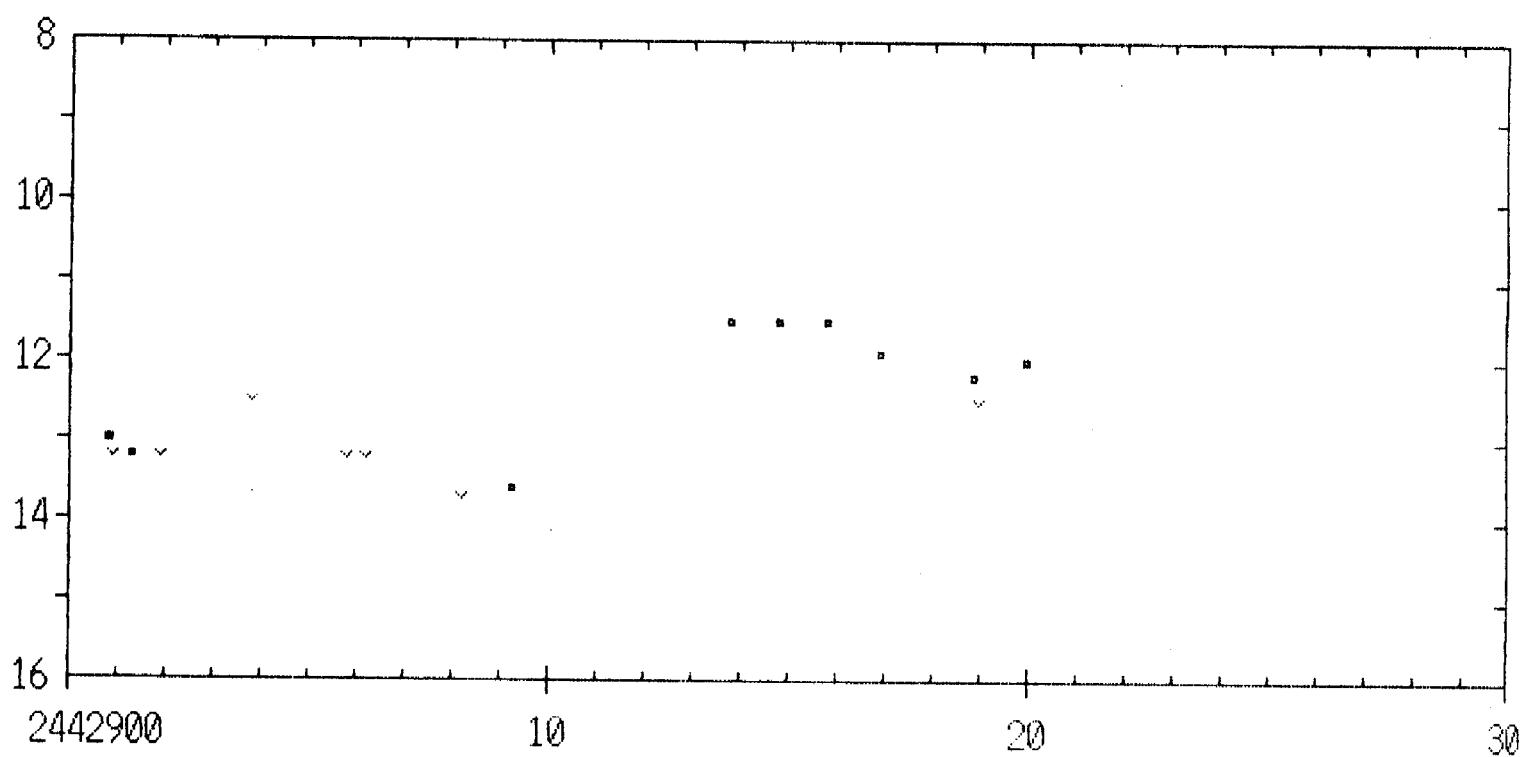


Figure 14. WX Hydri. Super outburst No. 78. 2,442,756.0.



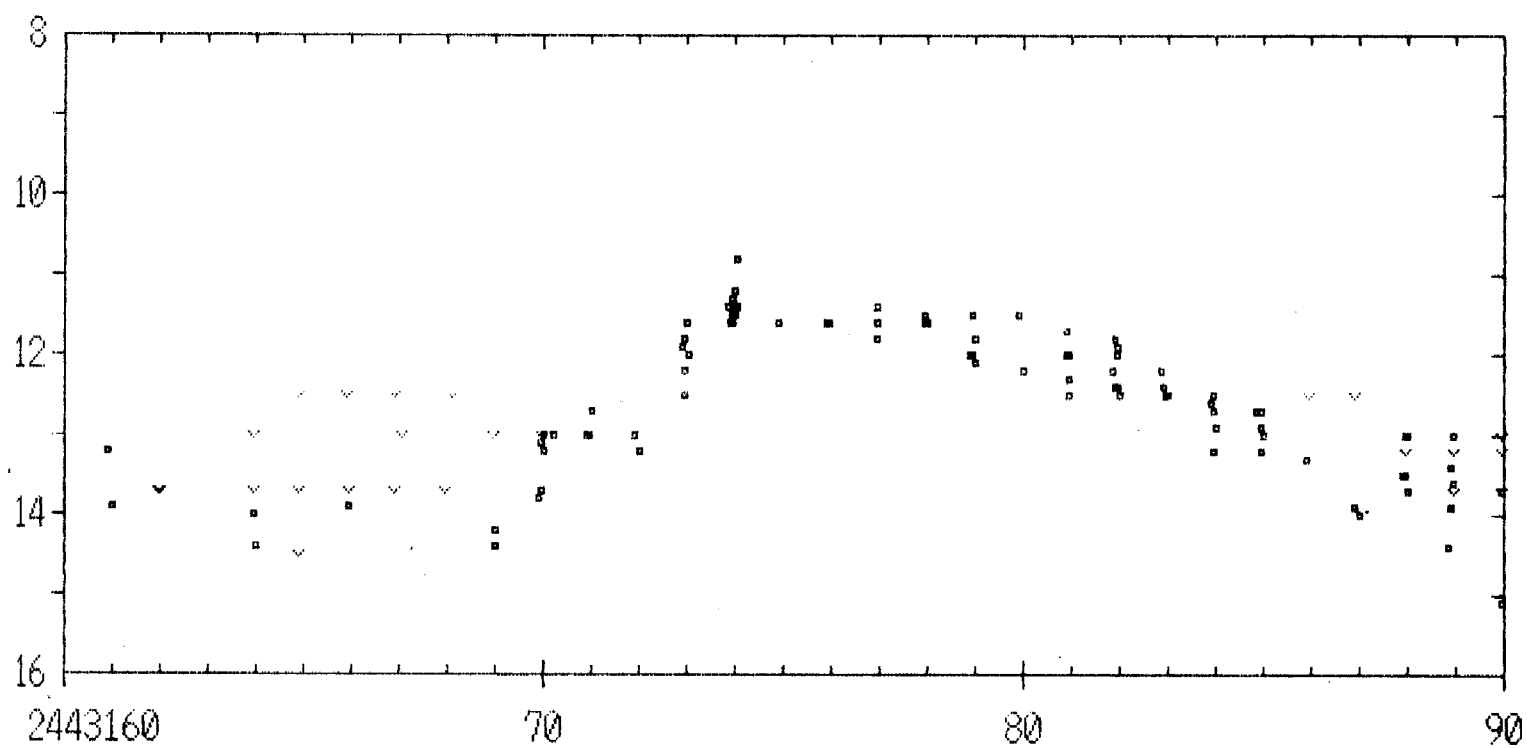


Figure 17. WX Hydri. Decline from Normal outburst No.104. 2,443,158.9?
Super outburst No.105. 2,443,174.0

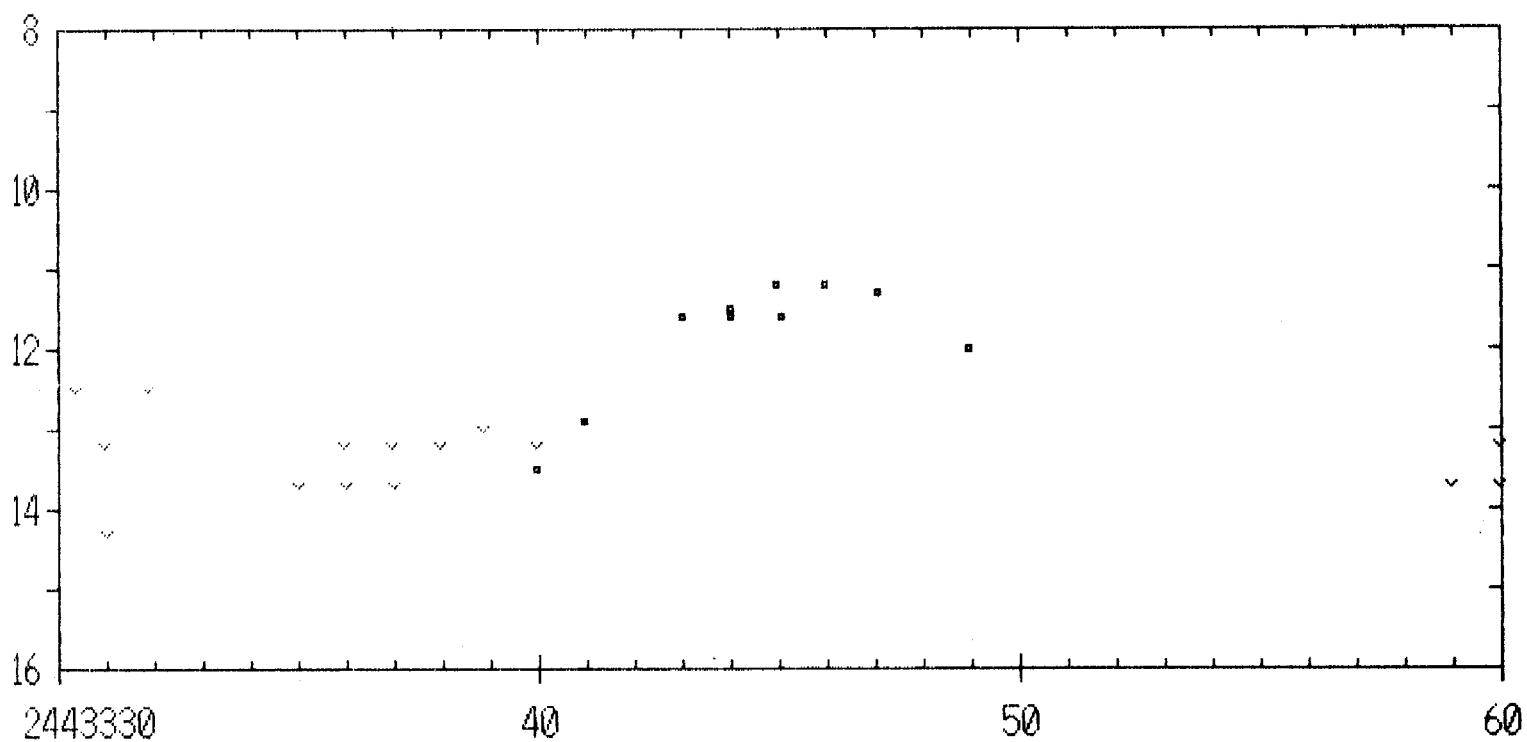


Figure 18. WX Hydri. Super outburst No.117. 2,443,345.0

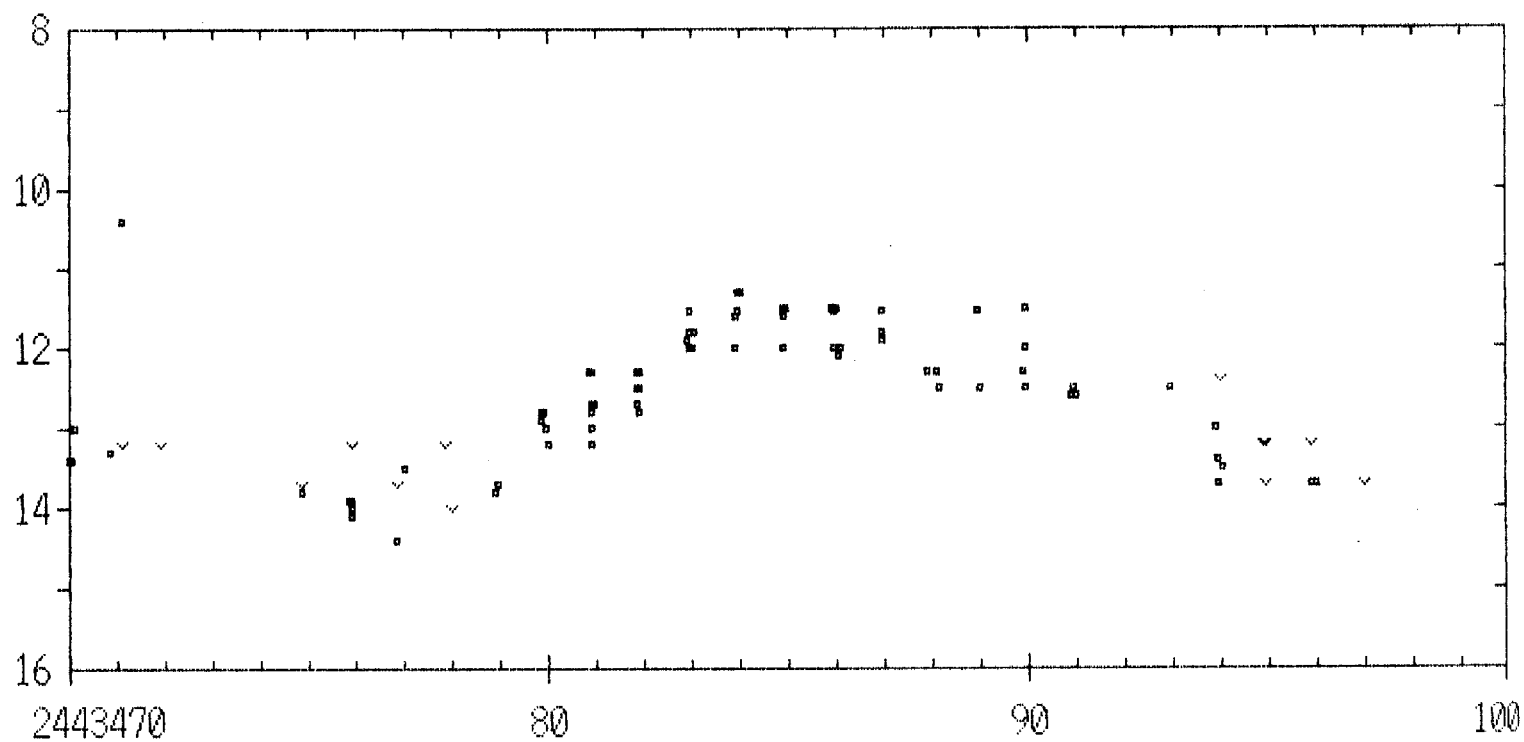


Figure 19. WX Hydri. Normal outburst No.127. 2,443,470.1 and Super outburst No. 128. 2,443,484.0

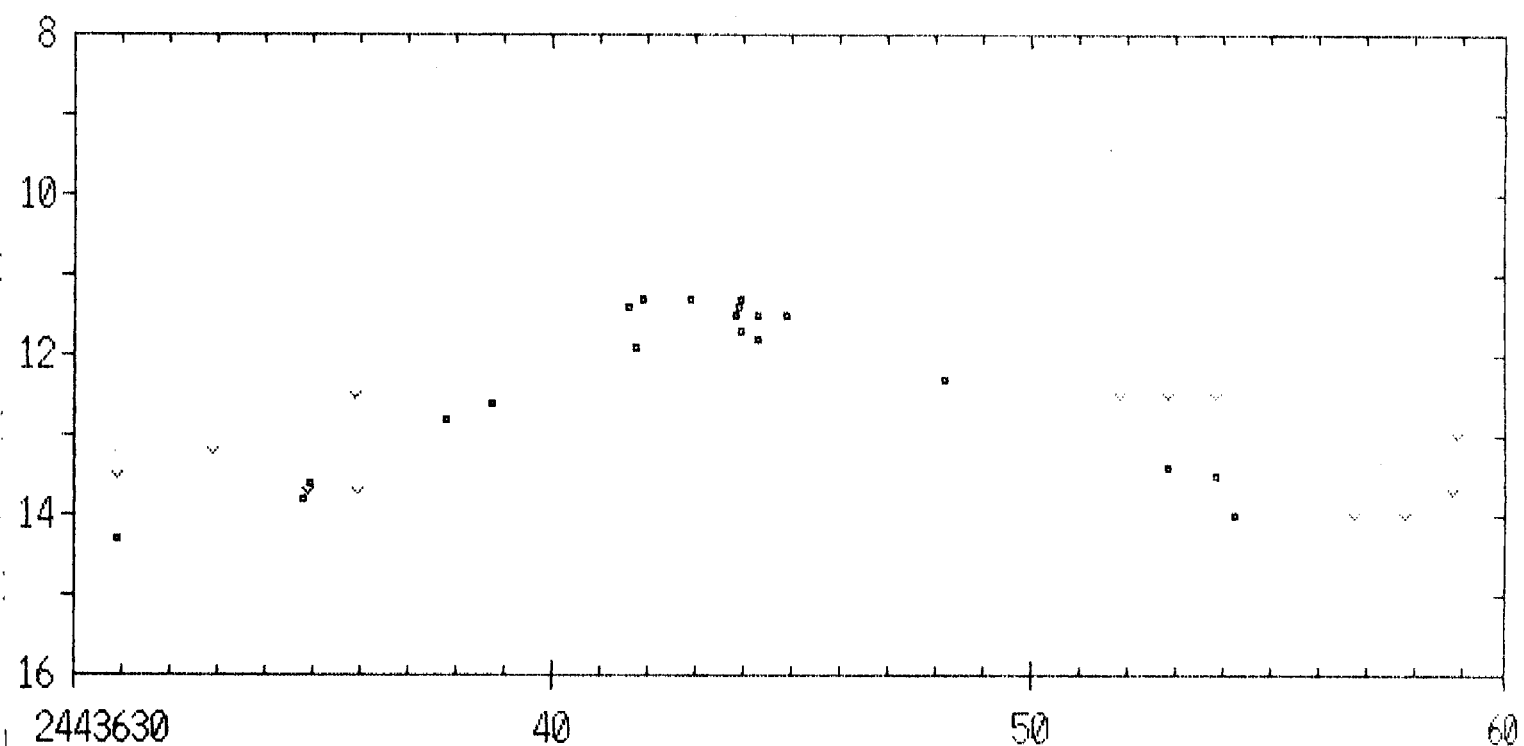


Figure 20. WX Hydri. Super outburst No. 141. 2,443,641.9.

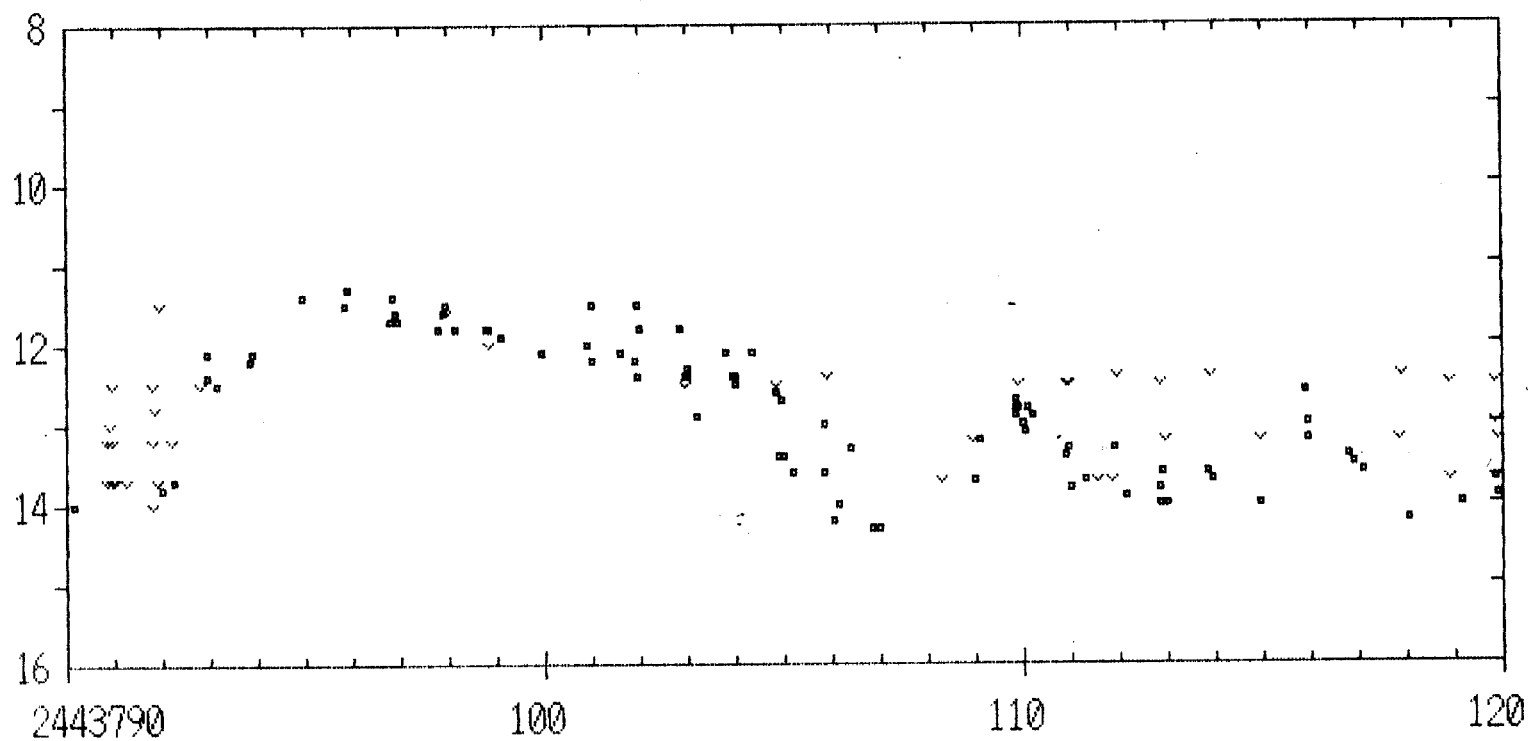


Figure 21. WX Hydri. Super Outburst No. 148. 2,443,794.9 and Normal Outburst No.149. 2,443,809.9 & Normal outburst No. 150. 2,443,815.9

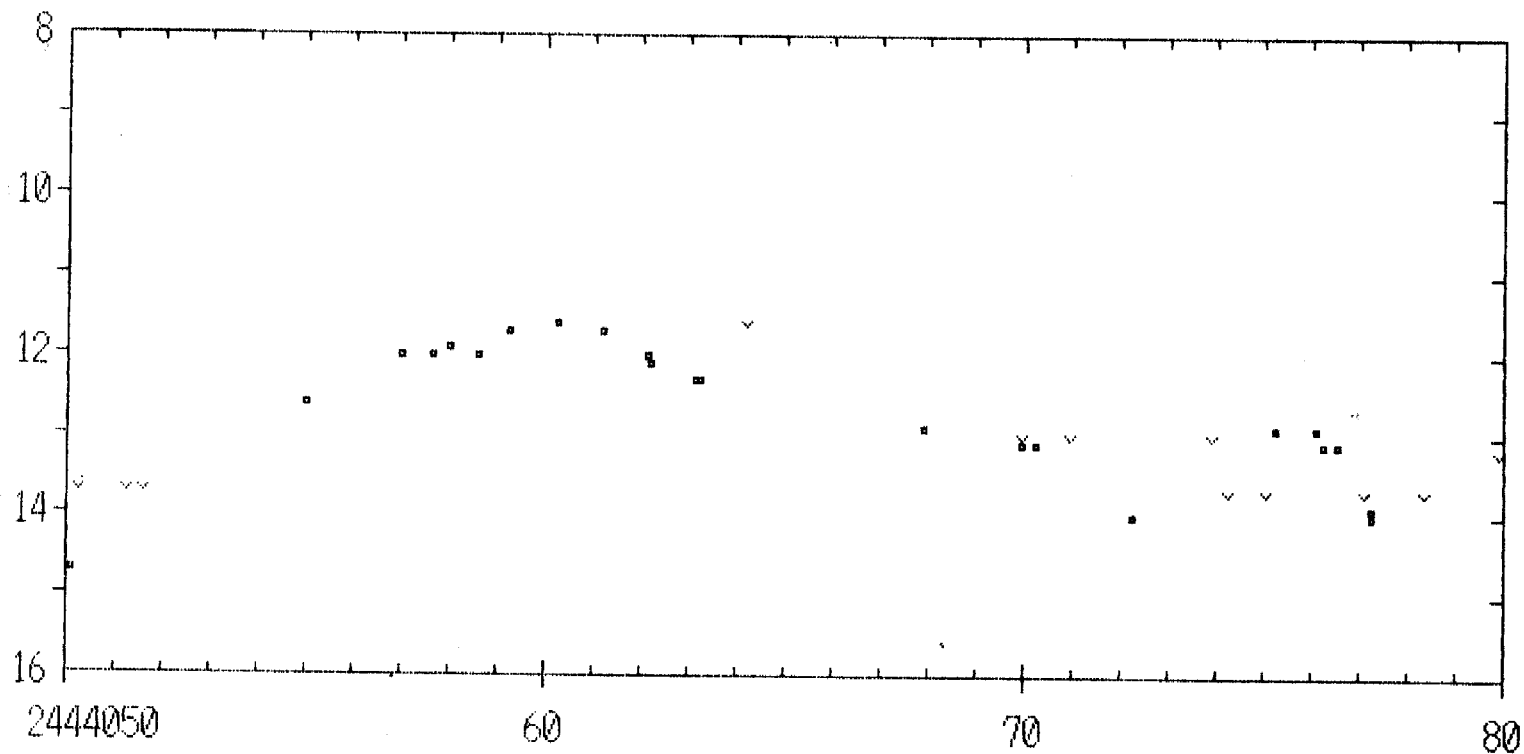


Figure 22. WX Hydri. Super outburst No. 175. 2,444,060.2 and Normal outburst No.176. 2,444,075.67

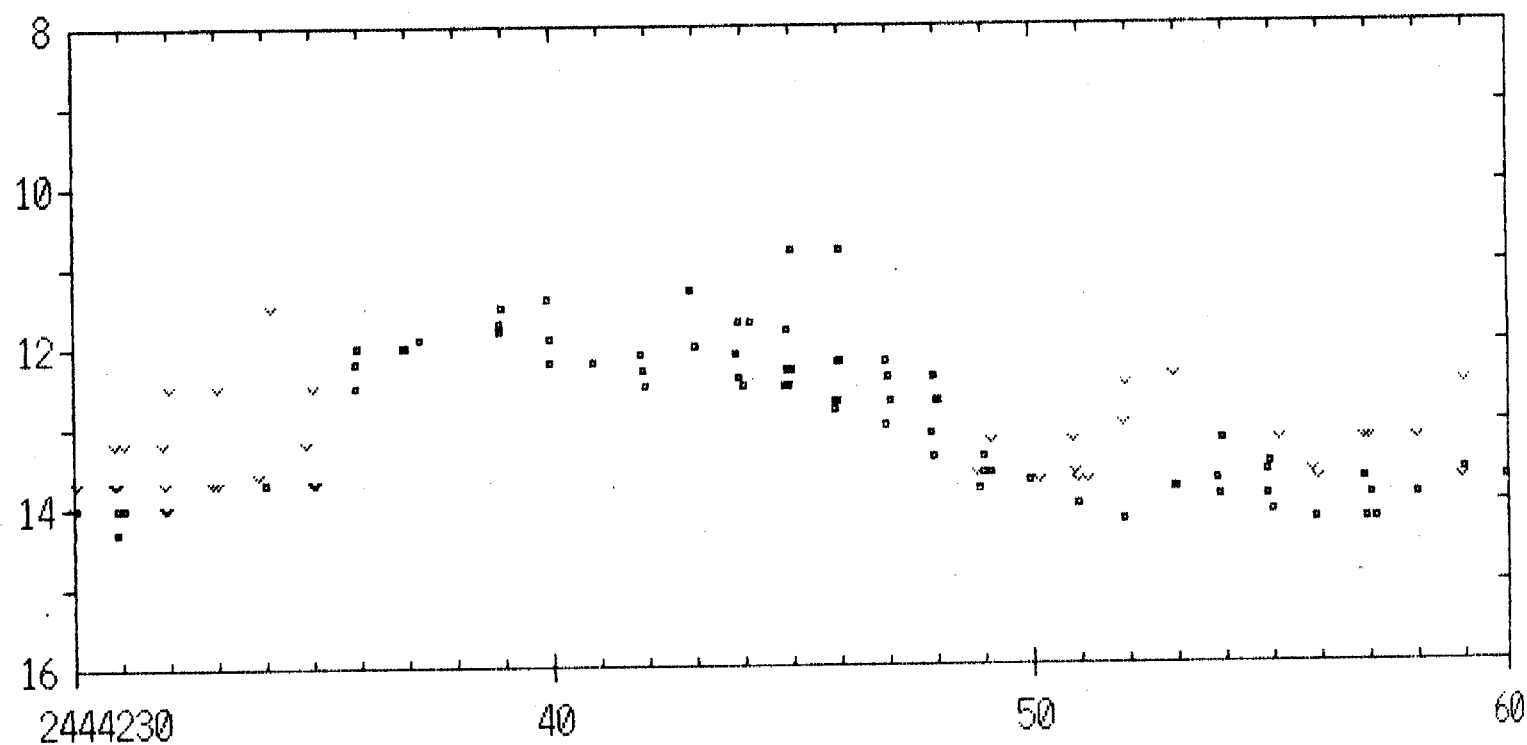


Figure 23. WX Hydri. Super outburst No.194. 2,444,239.9 and Normal outburst No. 195. 2,444,254.0

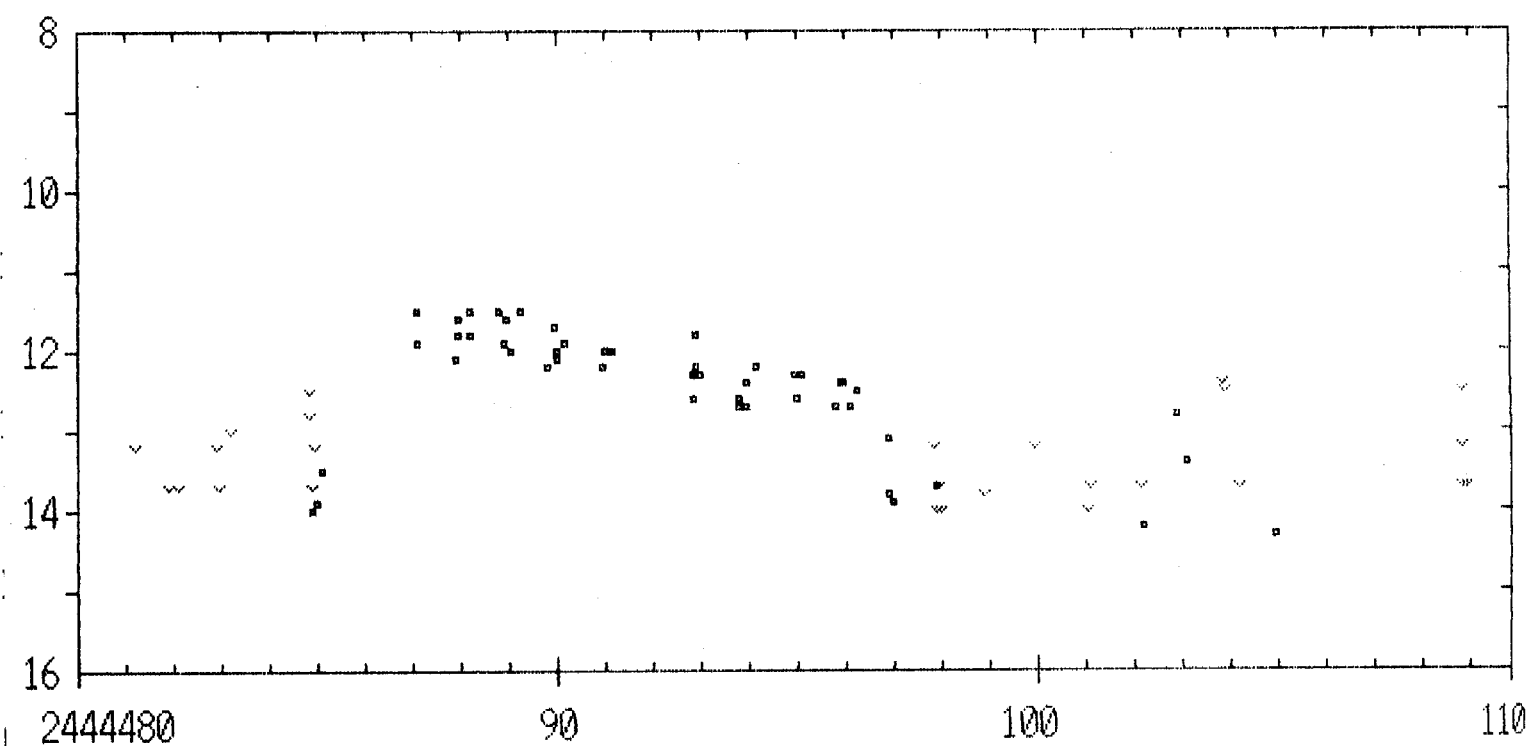


Figure 24. WX Hydri. Super outburst No.213. 2,444,488.2 and Normal outburst No. 214. 2,444,502.9

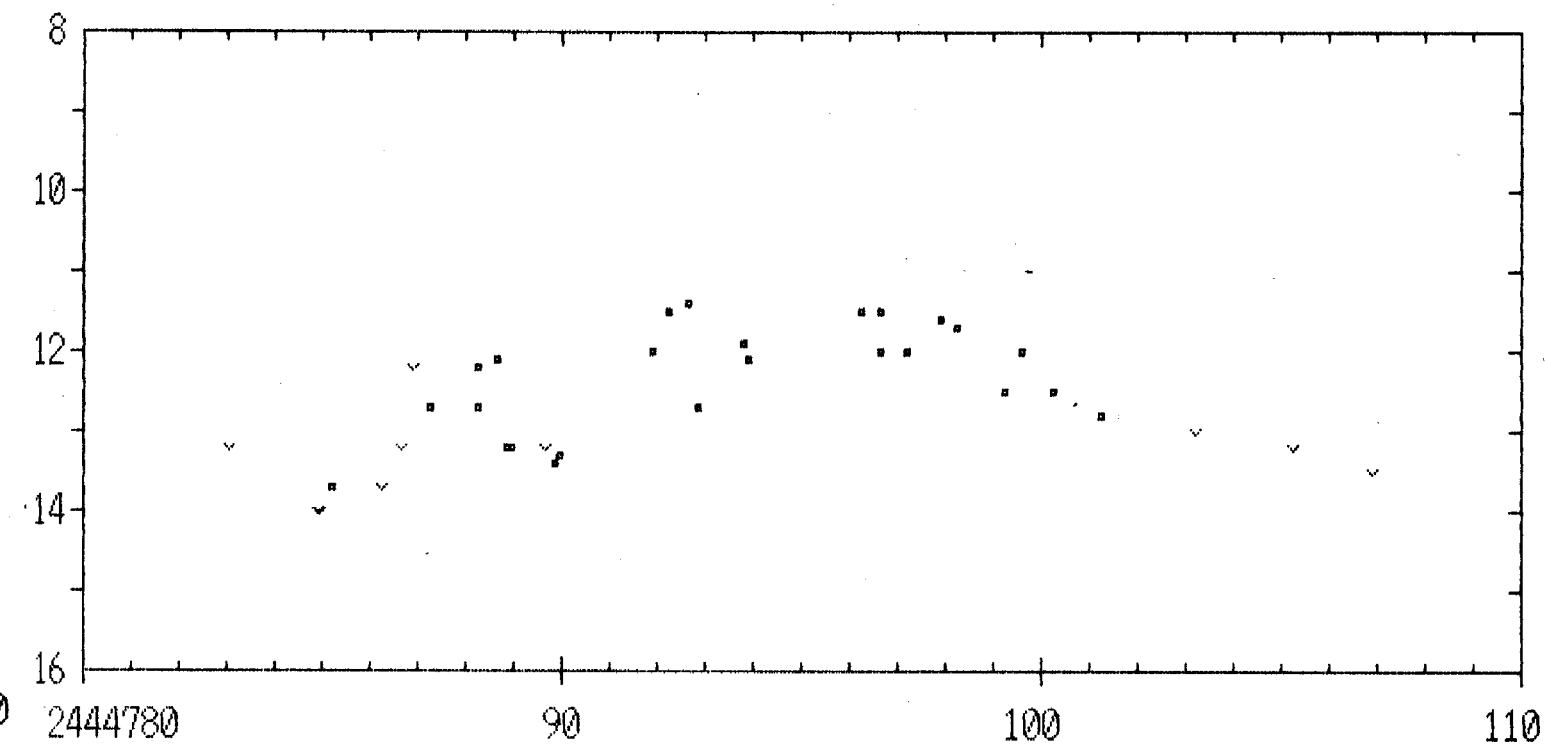


Figure 25. WX Hydri. Normal outburst No. 243. 2,444,788.2 and Super outburst No. 244. 2,444,792.2

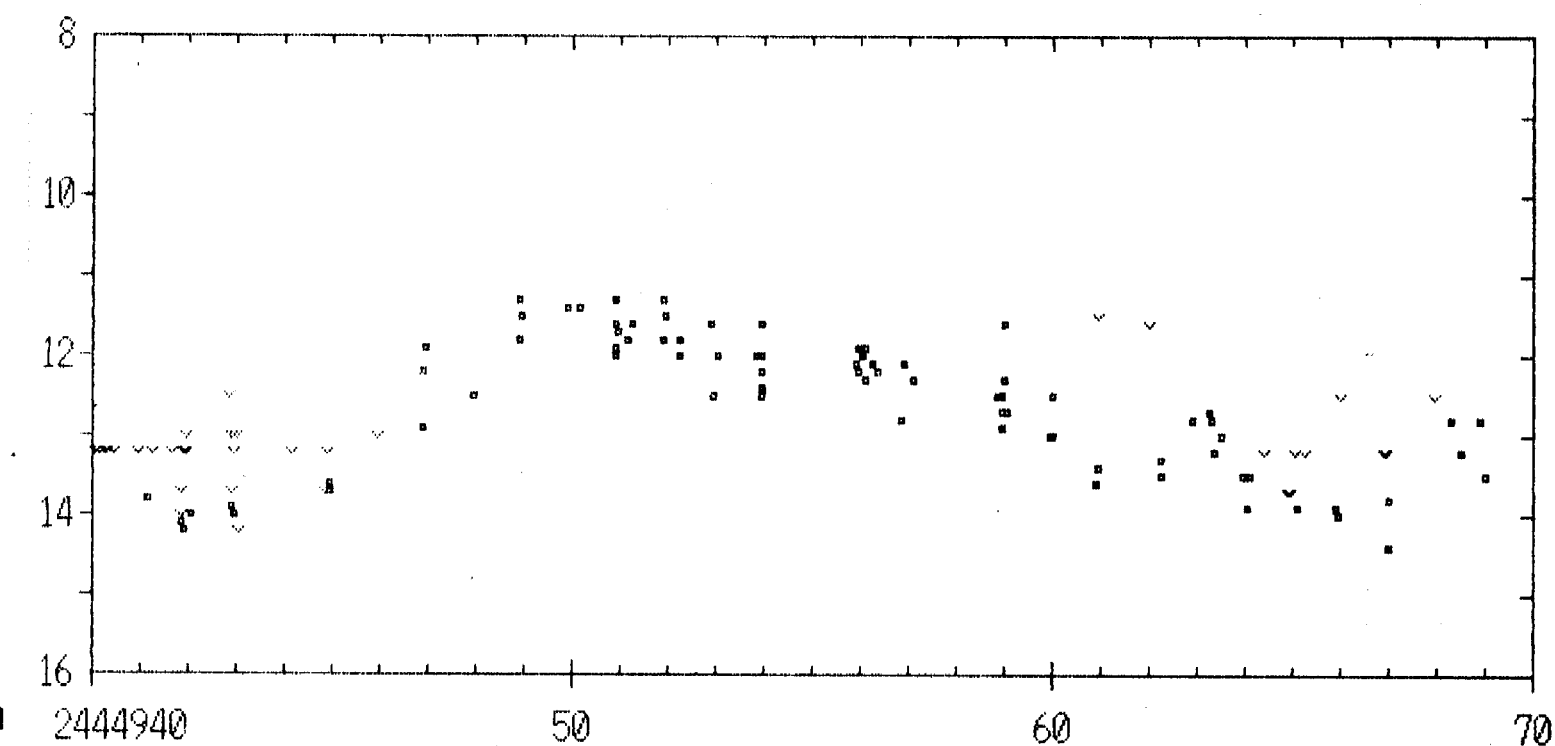


Figure 26. WX Hydri. Super outburst No. 259. 2,444,948.9 and Normal outburst No. 260. 2,444,963.0 and Normal outburst No. 261. 2,444,968.3

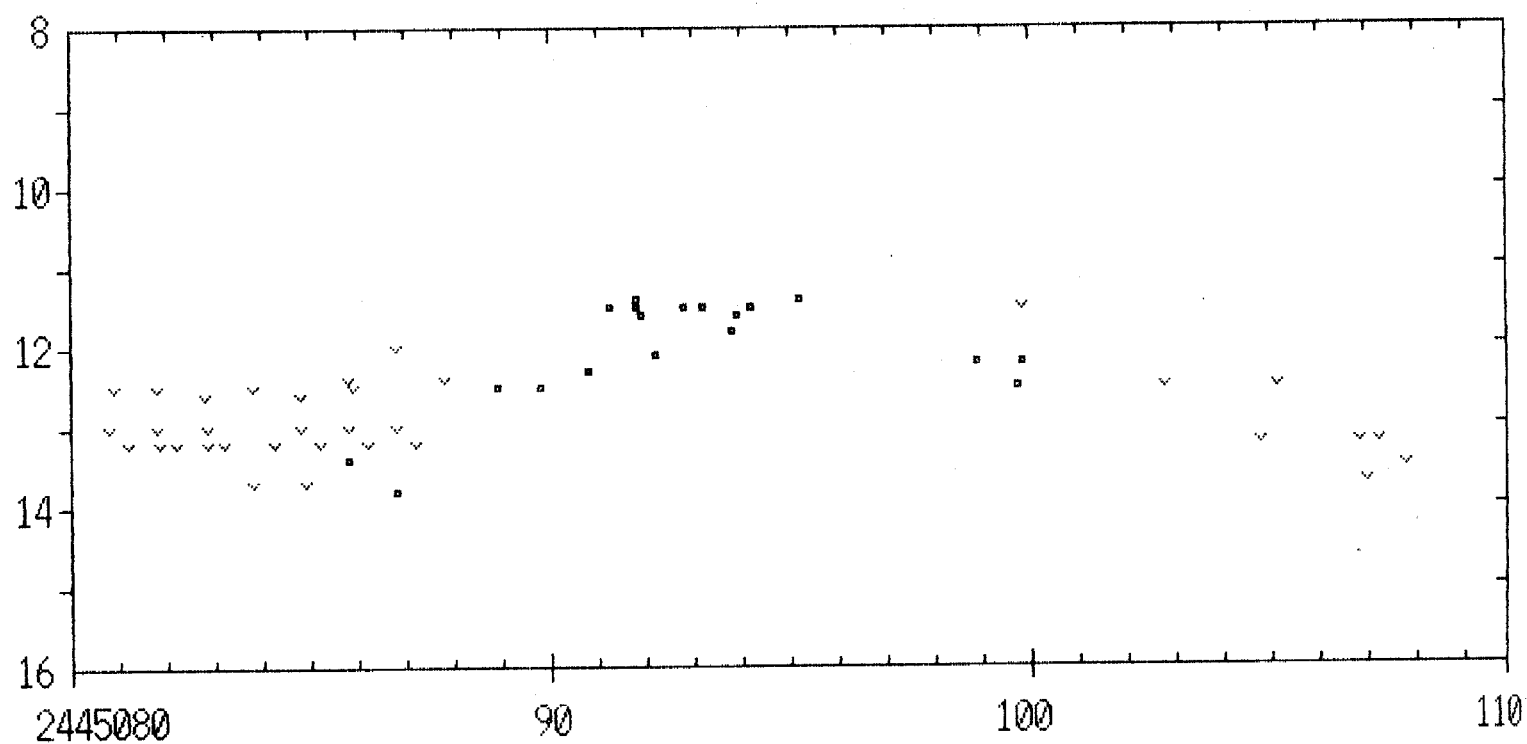


Figure 27. WX Hydri. Super outburst No. 274. 2,445,091.2.

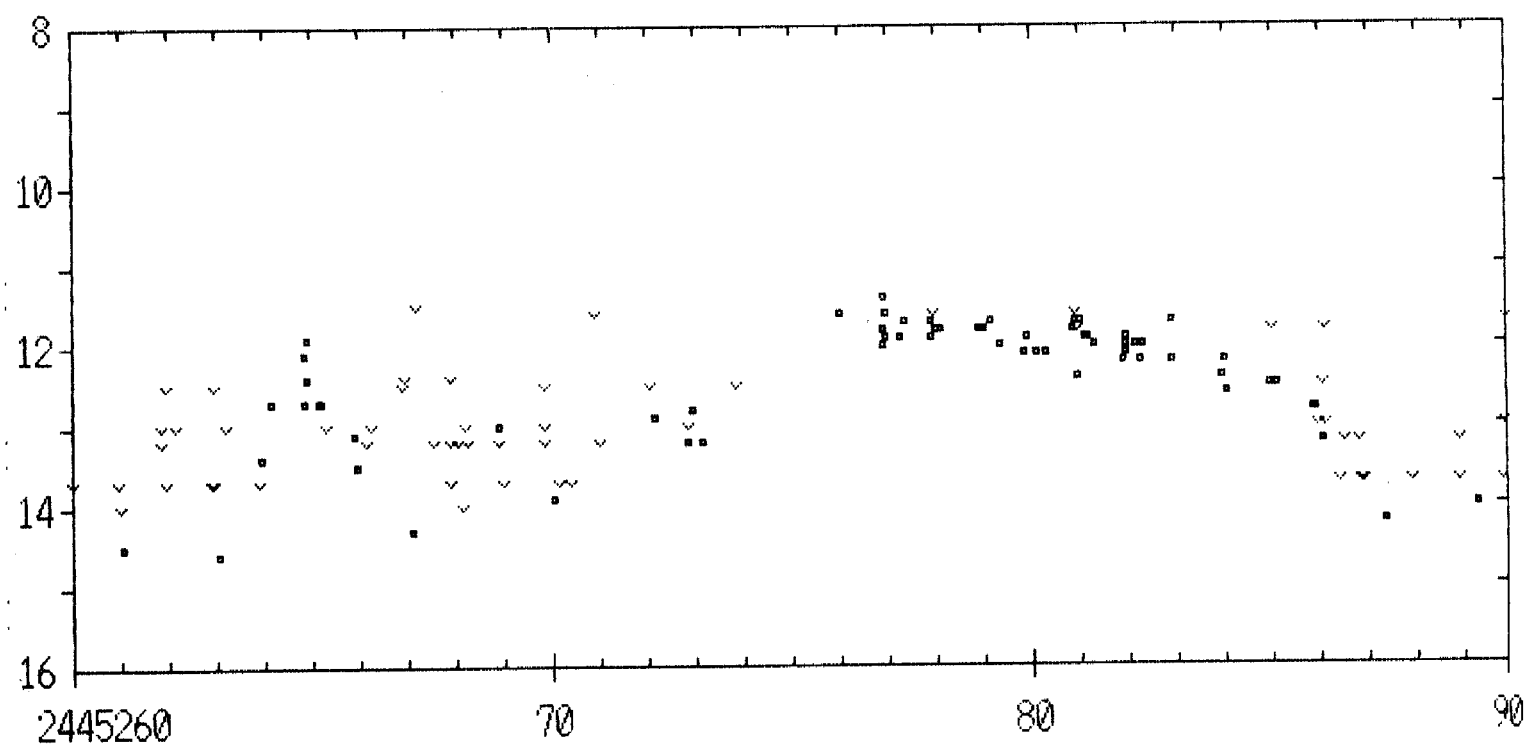


Figure 28. WX Hydri. Normal outburst No. 288. 2,445,264.2 and Super outburst No. 289. 2,445,276.0.

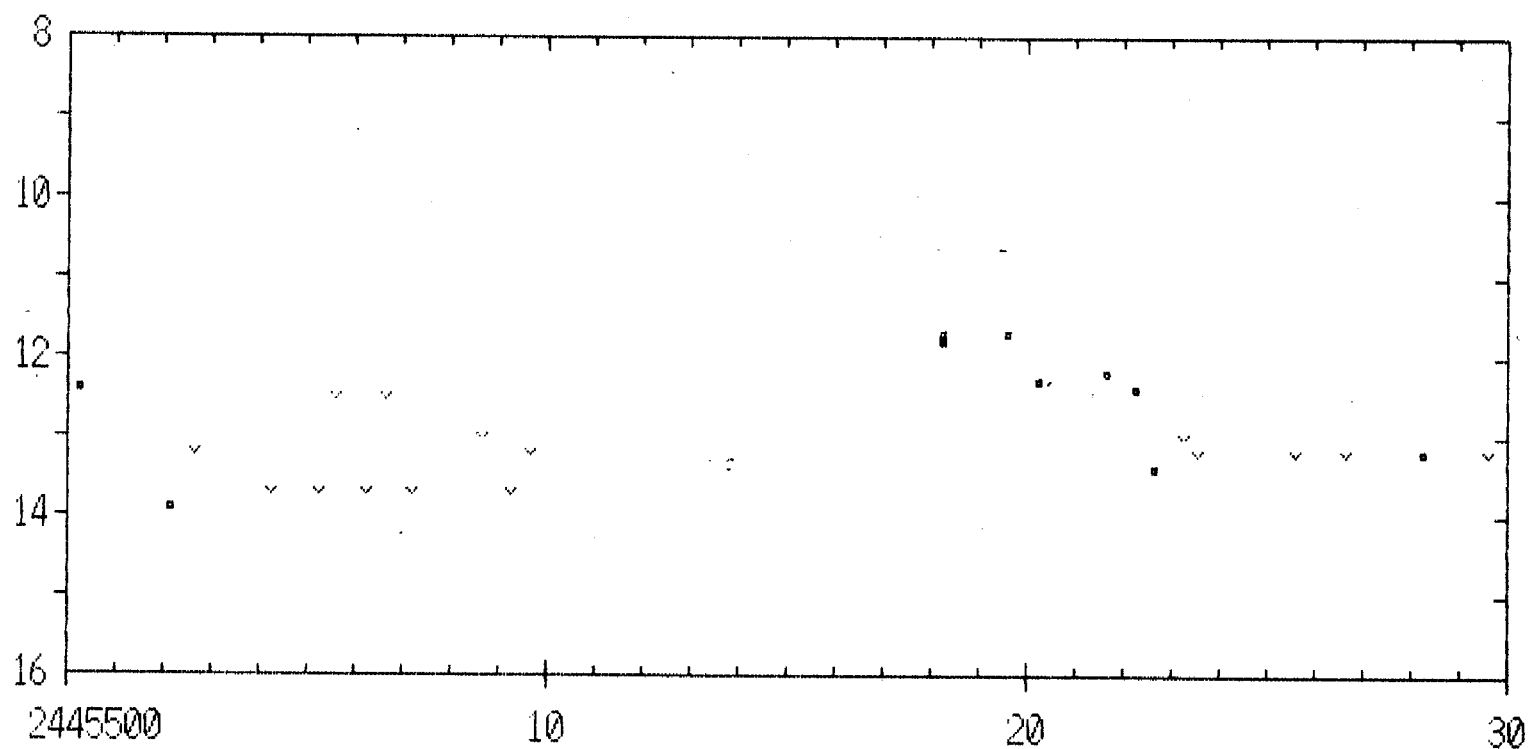
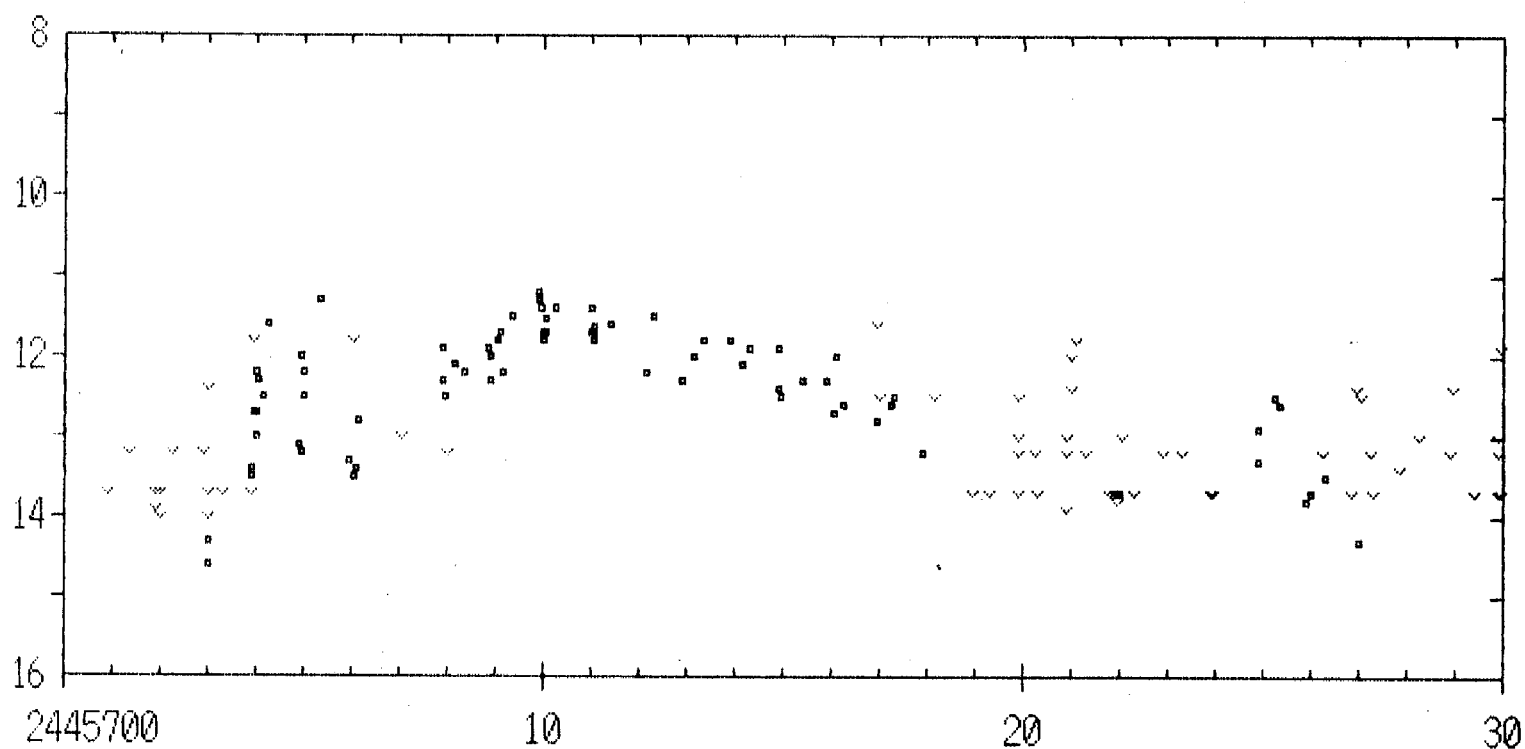


Figure 29. WX Hydri. Super outburst No. 308. 2,445,518.3
The rise was not observed as there was a gap of 9 days when no observations made.



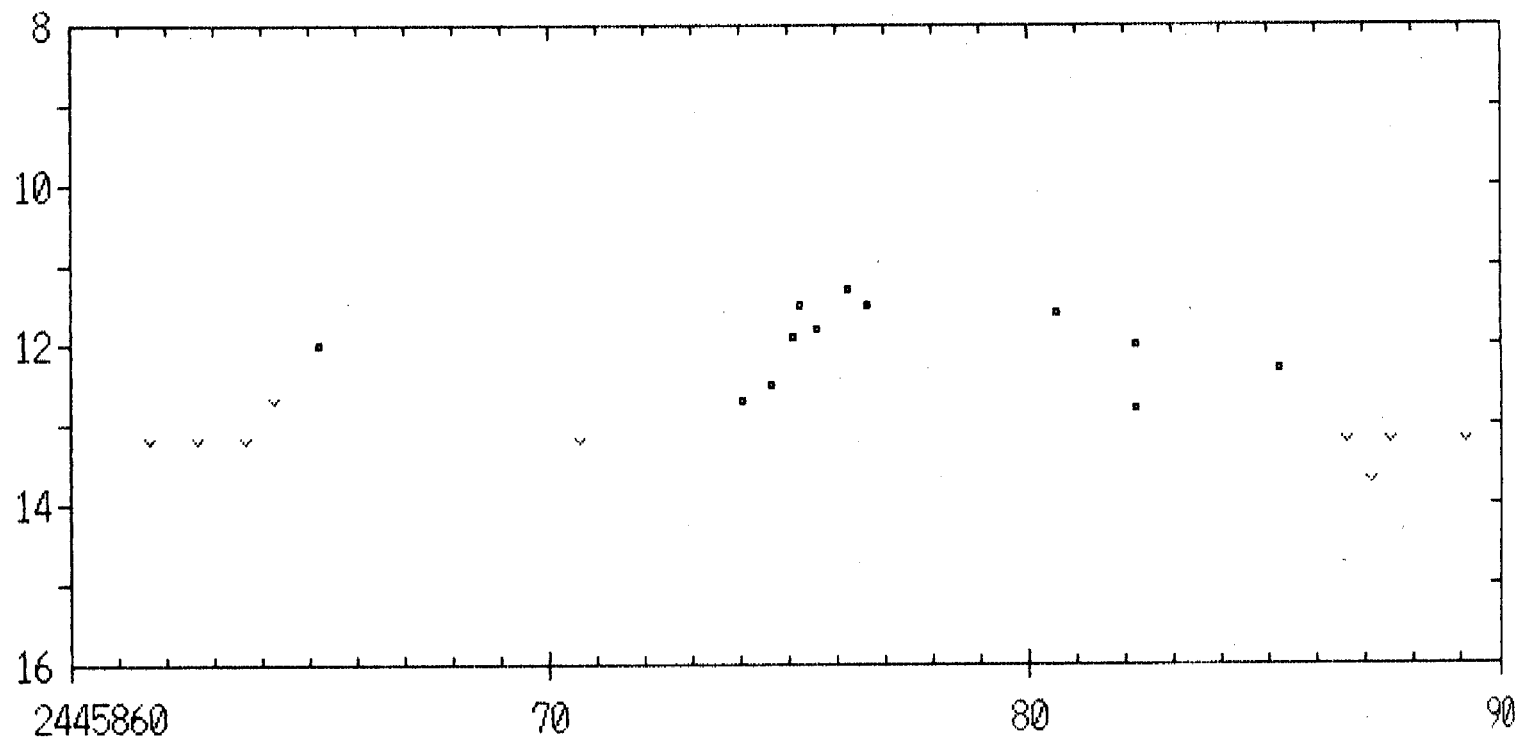


Figure 31. WX Hydri. Super outburst No. 341. 2,445,875.2.

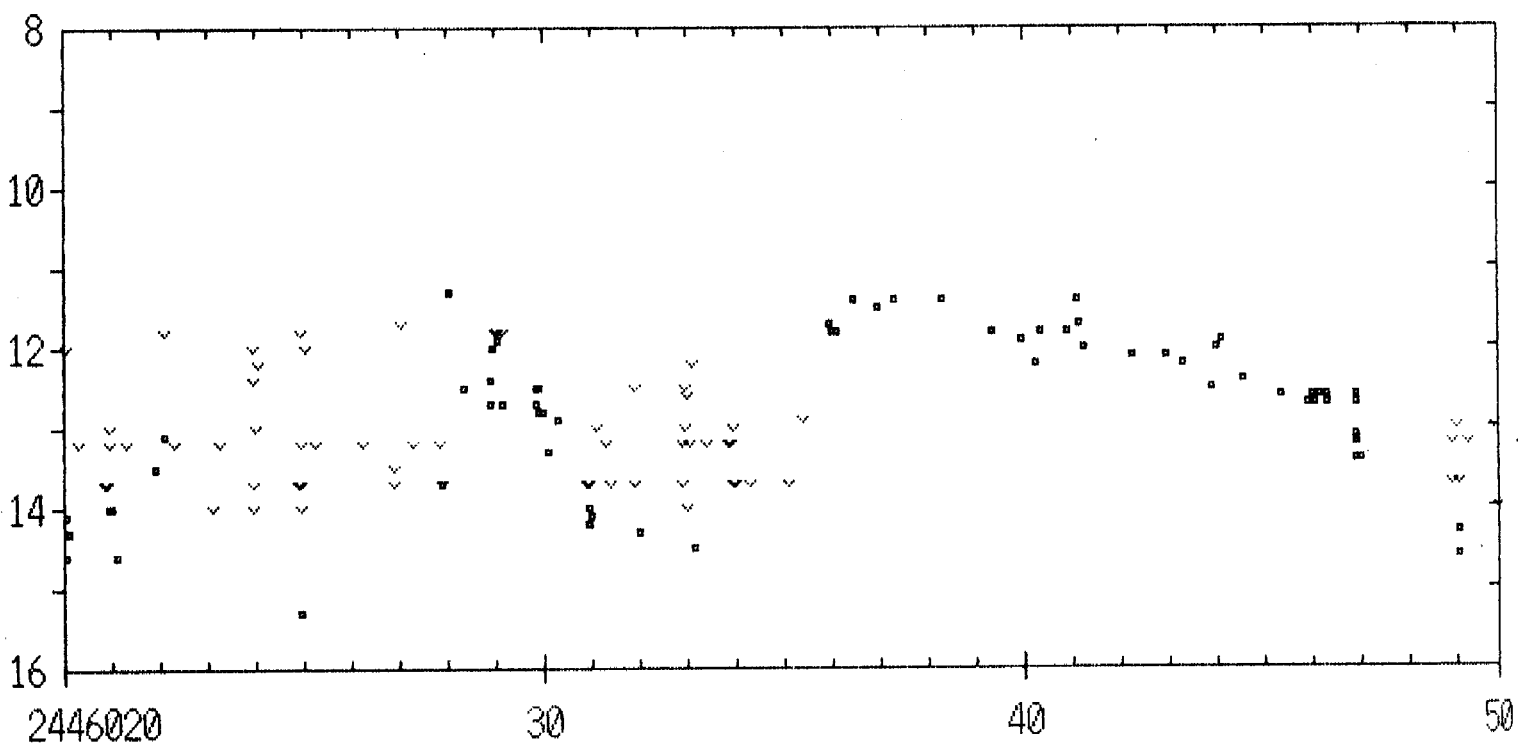


Figure 32. WX Hydri. Normal outburst No. 352. 2,446,028.4 and Super outburst No. 353. 2,446,036.4

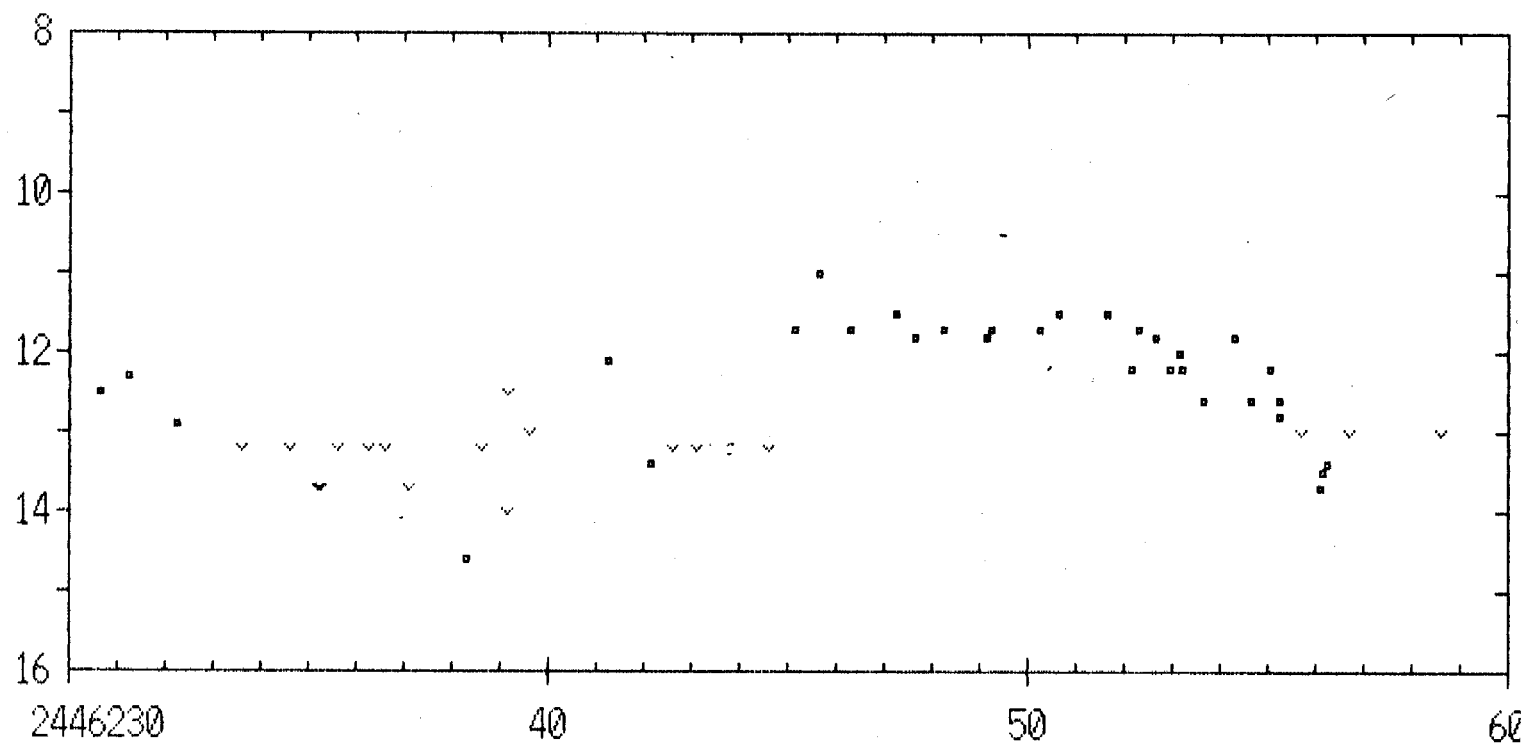


Figure 33. WX Hydri. Normal outburst No.372. 2,446,230.6 and Normal outburst No. 373. 2,446,241.0 and Super outburst No.374. 2,446,245.1

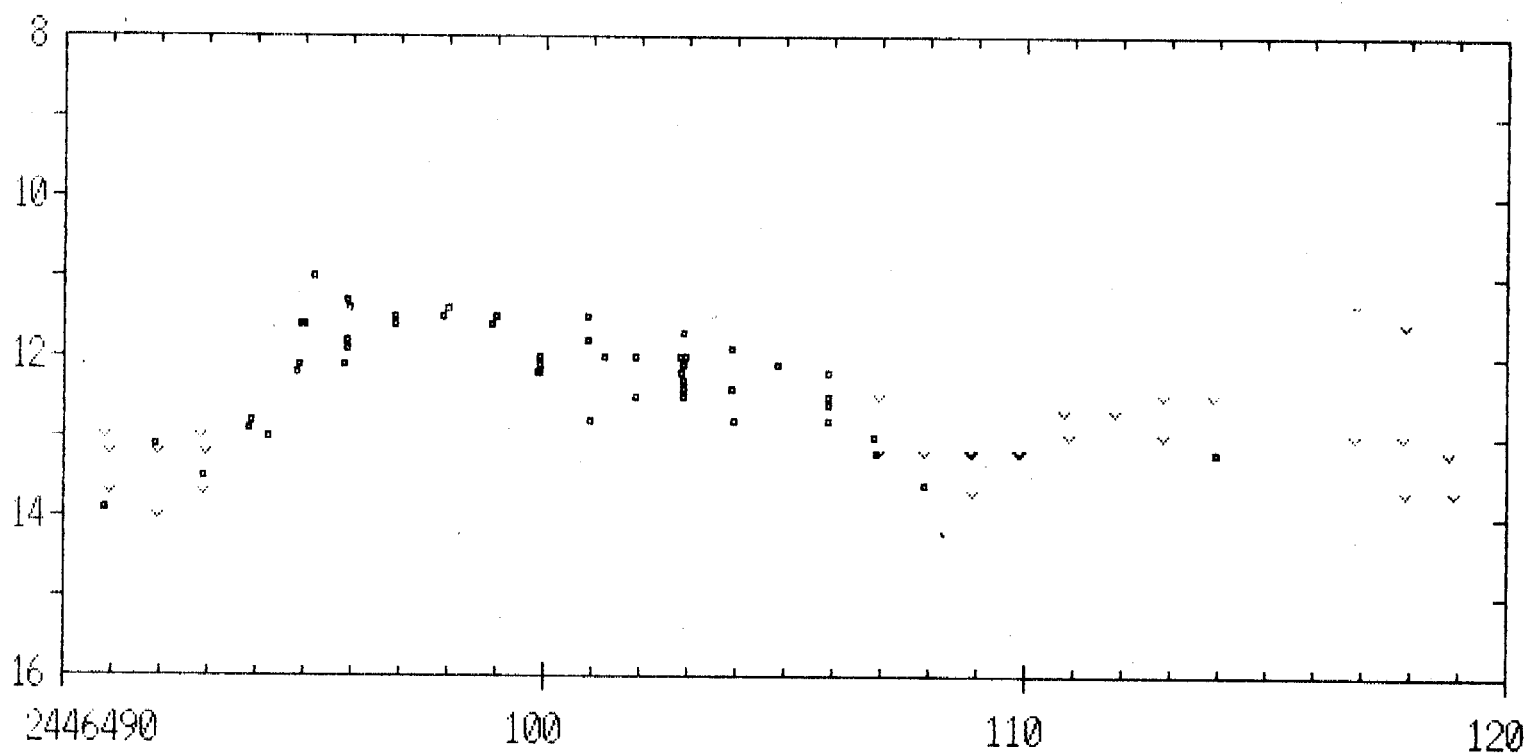


Figure 34. Super outburst No.389. 2,446,495.2. WX Hydri.

W. A. Lawson¹, P. L. Cottrell¹ and F. M. Bateson².

SUMMARY. Observations of RY Sgr are continued from previous publications.
Observations of Y Mus and U Aqr are presented for the first time.

1. INTRODUCTION

Bateson (1978) published light curves for 12 RCB stars, many of the light curves being a continuation from previous publications. This paper is the first of a series that will update observations of the RCB stars and introduce observations of RCB stars not previously published.

2. OBSERVATIONS

The light curves for RY Sgr are from 5 day means. The light curves for Y Mus and U Aqr are from 10 day means. Open circles denote single observations. The light curve about a single observation is drawn as a dashed line. Filled circles denote means derived from 2 or more observations.

The standard deviations for means derived from 5 or more observations are typically 0.15 mag., 0.12 mag. and 0.20 mag. for RY Sgr, Y Mus and U Aqr respectively. The expected decrease in the standard deviation for an increasing number of observations per mean (Waters 1966) is not found. The increased percentage of observations from the more frequent, and usually more experienced, observers in means derived from 5 to 10 observations may account for the high accuracy of these means. The standard deviation for means derived from 2 to 4 observations varies between 0.05 mag. and 0.35 mag. with no well defined average value.

The light curves are presented in Figures 1-5. Note that the magnitude scale is not constant throughout. The observations are compiled in Appendices I-III.

RY SAGITTARII

Bateson (1978) published light curves for RY Sgr to 2443394. Figures 1a-c and 2a-d show the light curve from 2443397 to 2446497. The star was already in decline at 2443397 having commenced its descent on 2443362. The star reached mag. 11.27 on 2443419, brightening to mag. 8.70 on 2443480 before falling again to mag. 12.70 on 2443574. RY Sgr slowly brightened to maximum by 2444300. A second decline (the commencement was not observed) began around 2444970, falling to mag. 12.45 on 2445028. The rise from minimum was very well observed. The well known 39 day period (Kilkenny 1982) is visible at all phases of the light curve. The observations are compiled in Appendix I.

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Y MUSCAE

The light curve from 2445049 to 2446494 is presented in Figures 3a-c. Y Mus remained near mag. 10.2 between 2445049 and 2445786 falling slowly to mag. 10.6 by 2445880. The star appears to have brightened slightly, to mag. 10.45 by 2446494. The observations are compiled in Appendix II.

U AQUARII

The light curve from 2442009 to 2446382 is presented in Figures 4a-c and 5a-f. The observations are due primarily to M. D. Overbeek and A. F. Jones. The light curve is characterised by broad shallow minima. The first, poorly covered, commenced around 2443000. Six positive observations suggest that the star fell 3 magnitudes. The star regained maximum light (mag. 11.5) by 2444000. A second decline at 2445477 reached mag. 12.85 on 2445530, brightening to mag. 12.0 between 2445600 and 2446060, falling soon after to mag. 13.5 by 2446200. The observations are compiled in Appendix III.

ACKNOWLEDGEMENTS

One of the authors (WAL) acknowledges the hospitality of Dr F. M. Bateson during a recent visit to Tauranga, made possible by a travel grant generously provided by the Dept. of Physics, University of Canterbury. The authors would like to thank the observers for their excellent observations of these interesting variable stars.

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 Kilkenny, D., 1982, M.N.R.A.S., 200, 1019.
 Waters, B. H. J., 1966, Circ. 119, Variable Star Section, R.A.S.N.Z.

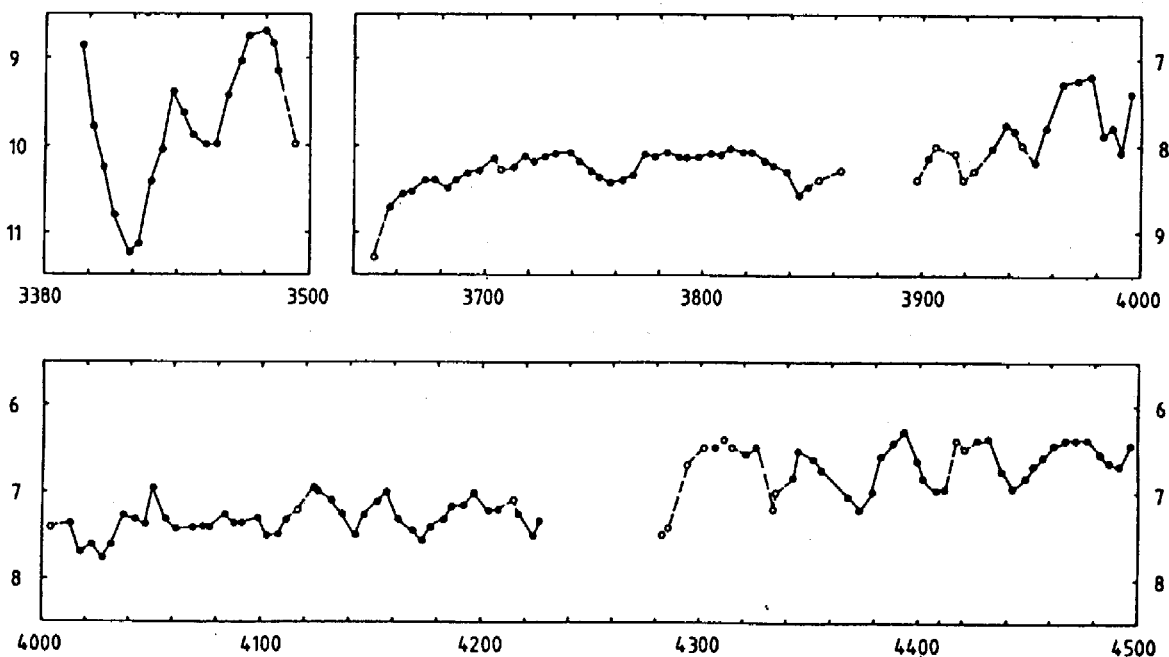


Figure 1a-c. RY Sagittarii - light curve JD 2443380 to 2444500

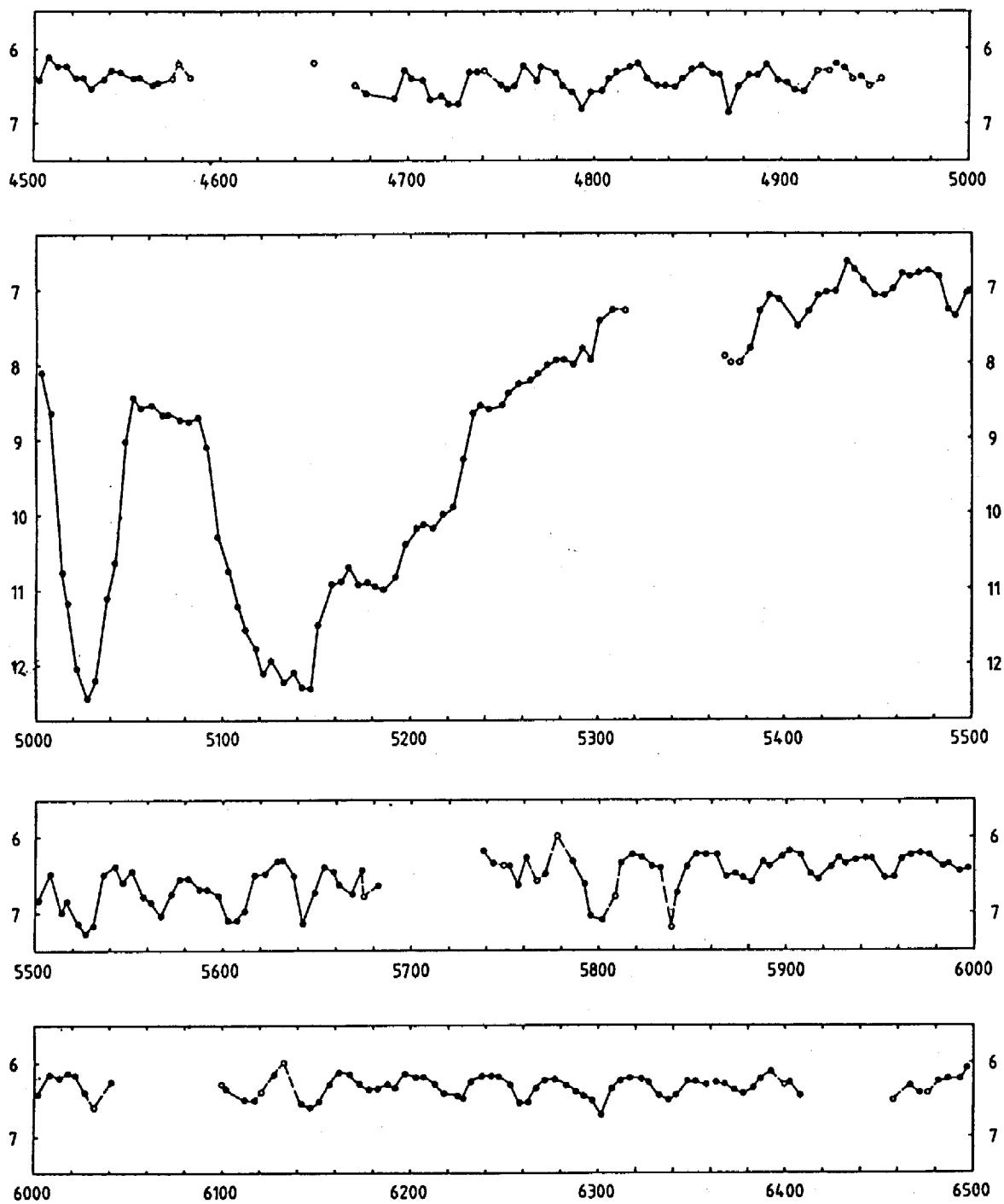


Figure 2a-d. RY Sagittarii - light curve JD 2444500 to 2446500

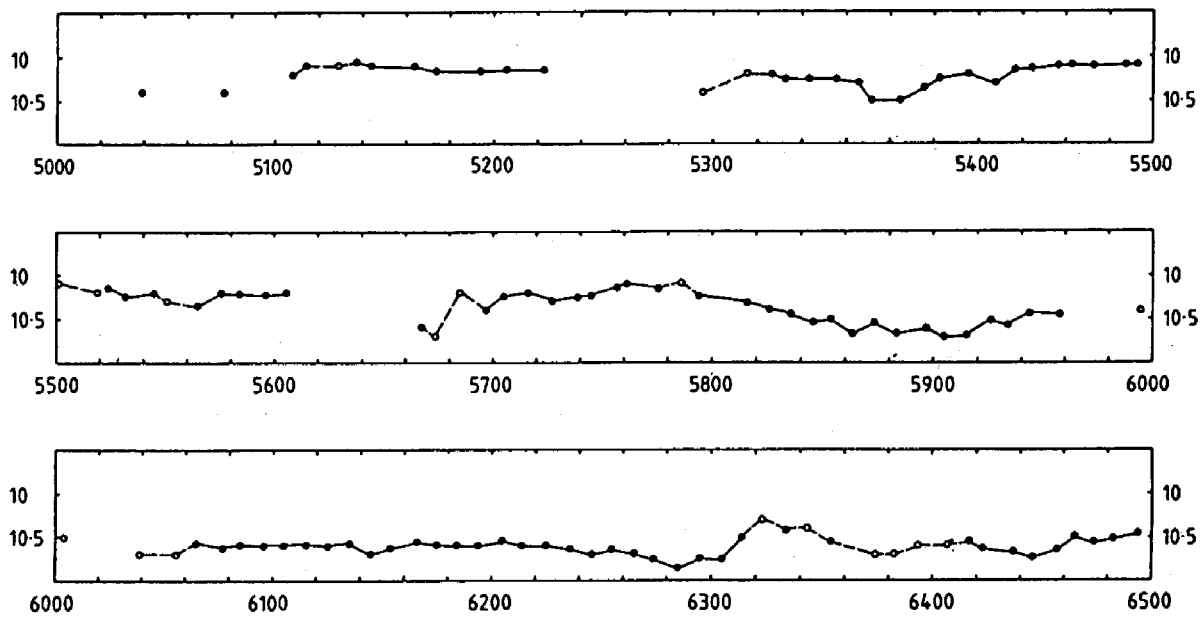


Figure 3a-c. Y Muscae - light curve JD 2445000 to 2446500

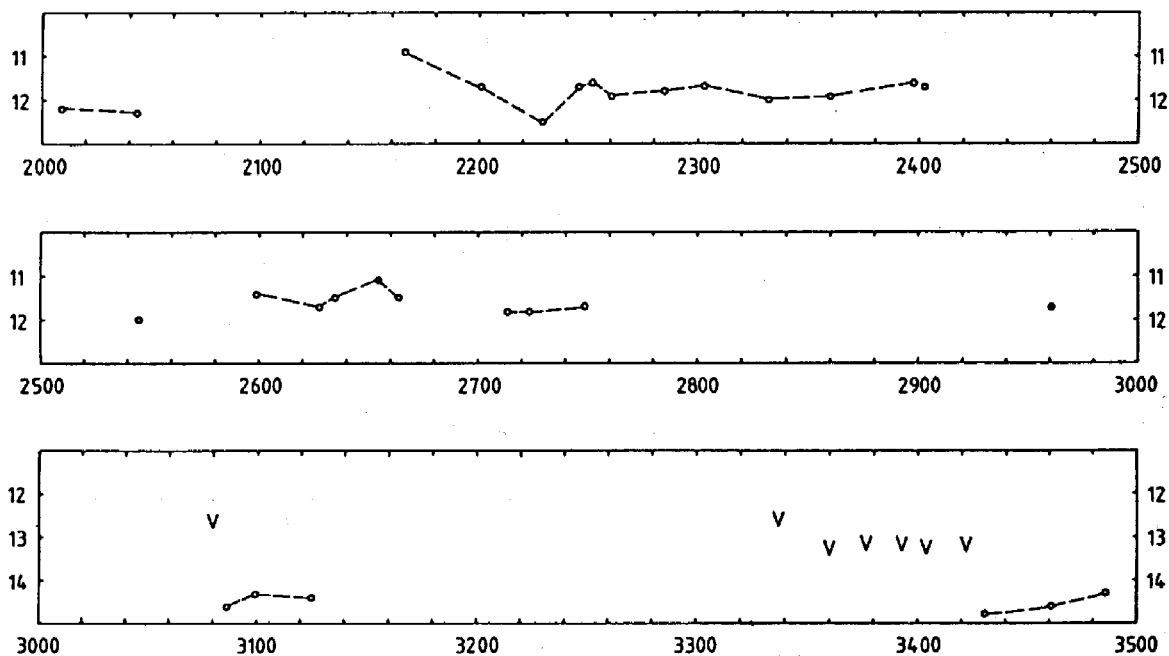


Figure 4a-c. U Aquarii - light curve JD 2442000 to 2443500

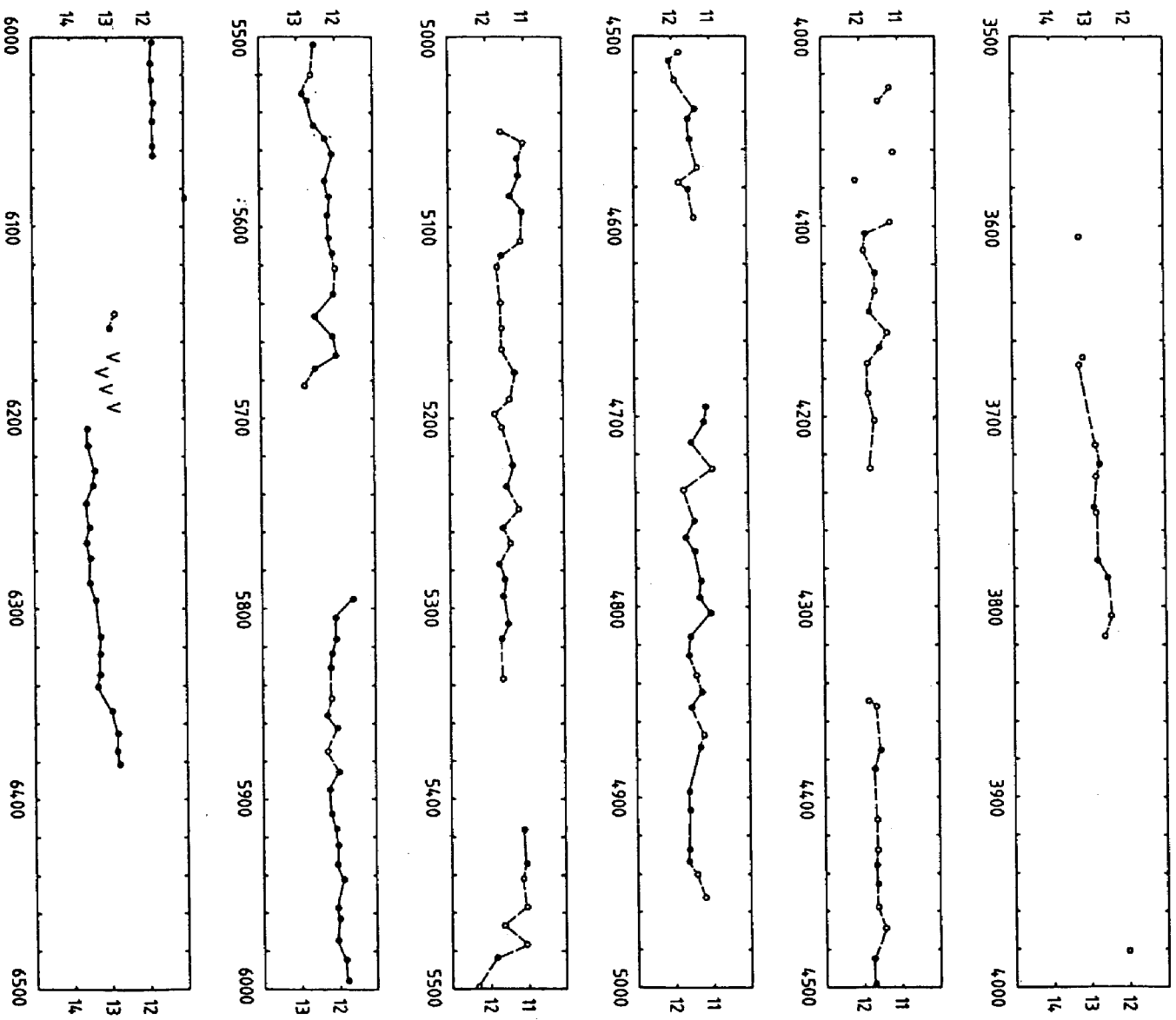


Figure 5a-f. U Aquarii - light curve JD 2443500 to 2446500

APPENDIX I

Observations of RY Sgr

5 day means

(column key = JD-2440000, visual magnitude, number of estimates per mean)

3397.3	8.85	22	3703.6	8.17	16	3996.3	7.40	2
3402.3	9.97	25	3706.9	8.3	1	4004.1	7.4	1
3406.7	10.27	23	3712.7	8.27	10	4013.3	7.35	4
3412.5	10.82	14	3717.9	8.14	5	4017.9	7.68	6
3418.6	11.27	18	3721.4	8.21	20	4023.3	7.59	8
3422.9	11.16	14	3727.3	8.13	18	4028.1	7.76	5
3427.9	10.44	21	3732.2	8.11	12	4031.5	7.60	2
3432.6	10.07	17	3738.5	8.09	13	4037.9	7.25	6
3437.5	9.40	5	3742.5	8.20	6	4042.8	7.30	4
3443.3	9.64	5	3747.9	8.31	11	4048.3	7.35	4
3447.2	9.90	12	3752.3	8.38	20	4051.0	6.95	2
3453.1	10.01	19	3756.9	8.45	26	4056.7	7.31	7
3458.0	10.00	7	3762.7	8.42	11	4061.5	7.40	7
3462.6	9.44	11	3768.2	8.36	9	4068.9	7.40	4
3469.4	9.05	2	3773.4	8.12	11	4074.0	7.38	11
3471.6	8.77	3	3777.5	8.14	12	4077.1	7.39	8
3479.6	8.70	3	3782.9	8.10	20	4083.5	7.24	11
3482.6	8.83	6	3787.8	8.15	12	4087.8	7.36	5
3486.3	9.17	5	3792.4	8.15	11	4091.7	7.37	3
3493.9	10.0	1	3797.8	8.15	11	4098.7	7.28	4
3546.3	12.0	1	3803.3	8.12	18	4102.7	7.48	6
3550.2	<10.9	1	3808.0	8.12	21	4108.3	7.47	3
3558.2	12.7	1	3812.0	8.05	19	4112.4	7.31	13
3561.3	<11.3	1	3818.1	8.10	21	4116.8	7.2	1
3566.7	<12.0	2	3822.1	8.10	13	4123.9	6.95	2
3573.7	12.70	2	3827.9	8.20	5	4126.3	6.99	11
3577.5	12.27	3	3832.3	8.25	20	4132.1	7.10	5
3582.3	11.6	1	3837.9	8.32	11	4136.7	7.25	13
3586.8	11.05	4	3844.4	8.60	4	4143.0	7.49	14
3591.9	11.13	3	3848.1	8.49	6	4147.3	7.26	7
3603.2	11.00	2	3853.0	8.4	1	4152.9	7.11	7
3606.8	10.80	3	3863.0	8.3	1	4157.3	7.01	7
3611.6	10.70	4	3898.3	8.4	1	4162.4	7.32	10
3616.2	10.55	2	3902.7	8.15	2	4168.6	7.44	17
3622.2	10.13	3	3906.3	8.0	1	4173.1	7.56	13
3629.1	10.19	2	3914.6	8.1	1	4177.2	7.40	4
3633.0	9.91	7	3919.3	8.4	1	4182.7	7.32	10
3636.7	9.69	8	3924.2	8.3	1	4186.8	7.17	14
3642.6	10.10	3	3931.8	8.05	2	4192.4	7.15	9
3646.2	10.04	5	3938.2	7.75	2	4196.8	7.02	6
3650.0	9.3	1	3942.5	7.84	5	4202.5	7.22	11
3657.1	8.72	15	3946.3	8.0	1	4208.2	7.19	6
3662.5	8.57	17	3951.7	8.20	2	4214.9	7.1	1
3667.1	8.54	9	3956.8	7.80	4	4217.4	7.25	2
3672.5	8.42	11	3963.8	7.30	3	4223.7	7.50	2
3676.8	8.42	5	3970.9	7.25	4	4226.5	7.33	3
3682.7	8.50	4	3977.1	7.20	2	4283.2	7.5	1
3686.7	8.41	8	3983.2	7.88	4	4285.8	7.4	1
3692.0	8.33	15	3987.3	7.78	5	4294.1	6.7	1
3697.3	8.31	15	3991.3	8.07	3	4302.1	6.5	1

Appendix I cont.

4306.7	6.50	2	4564.4	6.50	2	4907.4	6.56	20
4311.2	6.4	1	4567.4	6.4	1	4912.0	6.58	6
4315.2	6.5	1	4578.2	6.2	1	4918.9	6.3	1
4321.1	6.57	3	4583.9	6.4	1	4924.9	6.3	1
4325.9	6.50	2	4650.2	6.2	1	4928.5	6.21	8
4334.1	7.2	1	4671.8	6.5	1	4933.1	6.26	14
4335.2	7.0	1	4678.3	6.60	3	4937.9	6.4	1
4343.0	6.83	4	4692.6	6.67	3	4941.7	6.37	7
4346.7	6.53	6	4697.6	6.29	8	4947.2	6.5	1
4352.3	6.62	5	4702.1	6.40	5	4952.9	6.4	1
4355.7	6.75	4	4708.0	6.43	6	5002.9	8.10	6
4368.3	7.04	7	4711.8	6.68	5	5007.8	8.65	4
4372.7	7.20	4	4718.1	6.65	2	5014.1	10.77	3
4378.7	6.98	4	4721.8	6.75	2	5017.0	11.17	3
4382.5	6.60	2	4726.9	6.73	8	5022.0	12.05	2
4387.5	6.43	3	4733.1	6.32	6	5027.6	12.45	4
4393.2	6.30	6	4736.9	6.32	5	5031.8	12.20	3
4398.8	6.65	8	4740.6	6.3	1	5037.5	11.10	3
4402.3	6.85	6	4749.6	6.48	5	5042.1	10.64	5
4407.7	6.97	8	4752.8	6.56	8	5048.2	9.02	6
4412.1	6.96	8	4757.2	6.50	4	5052.3	8.44	5
4417.0	6.4	1	4762.4	6.23	8	5056.3	8.58	8
4420.9	6.5	1	4768.9	6.43	7	5062.4	8.54	7
4426.9	6.40	7	4770.8	6.25	4	5067.6	8.67	6
4432.0	6.37	10	4778.6	6.32	13	5070.8	8.67	3
4438.0	6.76	11	4783.0	6.50	10	5076.9	8.74	12
4443.1	6.95	6	4787.7	6.60	12	5082.4	8.76	7
4449.0	6.83	3	4792.8	6.82	9	5087.4	8.70	5
4453.4	6.68	13	4797.9	6.59	11	5091.1	9.09	7
4457.2	6.58	13	4804.0	6.57	3	5096.9	10.30	2
4461.5	6.46	18	4807.5	6.41	11	5103.2	10.74	8
4467.4	6.38	16	4812.2	6.33	13	5107.5	11.22	16
4471.6	6.40	8	4818.5	6.23	8	5112.4	11.54	17
4476.9	6.40	2	4822.5	6.19	10	5117.5	11.78	14
4482.7	6.56	24	4827.7	6.42	11	5112.4	12.12	13
4487.0	6.66	9	4833.6	6.48	5	5125.6	11.95	2
4491.9	6.69	10	4837.5	6.50	10	5132.7	12.23	8
4497.1	6.45	6	4842.6	6.53	19	5137.6	12.11	13
4502.9	6.44	8	4846.7	6.4	10	5142.4	12.32	13
4508.1	6.12	6	4852.1	6.27	13	5146.7	12.33	8
4512.6	6.25	10	4857.2	6.22	6	5152.3	11.47	7
4517.6	6.26	14	4862.8	6.36	10	5158.3	10.93	6
4523.1	6.40	10	4867.2	6.36	12	5162.7	10.89	15
4527.2	6.41	7	4872.0	6.85	14	5167.3	10.71	14
4531.2	6.56	5	4877.3	6.51	20	5172.4	10.94	20
4538.0	6.42	10	4882.7	6.36	14	5176.8	10.91	16
4542.3	6.30	16	4887.6	6.37	6	5181.1	10.97	3
4547.2	6.33	8	4892.2	6.21	8	5185.6	11.00	4
4553.7	6.40	11	4898.2	6.42	12	5191.6	10.83	9
4557.4	6.38	8	4903.1	6.46	11	5197.3	10.41	14

Appendix I cont.

5202.7	10.18	21	5508.0	6.49	7	5812.2	6.36	7
5206.5	10.14	12	5514.0	7.00	2	5817.6	6.25	6
5211.7	10.20	5	5517.4	6.86	8	5823.0	6.28	5
5217.4	10.00	2	5522.8	7.17	9	5828.5	6.40	3
5222.8	9.92	11	5527.3	7.28	14	5832.8	6.42	6
5227.5	9.27	12	5531.4	7.18	10	5839.1	7.2	1
5233.3	8.67	7	5536.8	6.50	4	5842.0	6.74	5
5237.0	8.55	8	5543.1	6.40	6	5846.7	6.41	10
5242.4	8.60	5	5547.0	6.62	15	5852.2	6.23	15
5248.5	8.56	9	5552.1	6.47	15	5857.2	6.25	11
5251.9	8.39	9	5557.7	6.81	23	5862.9	6.27	9
5257.6	8.27	9	5562.4	6.87	12	5868.1	6.53	4
5263.5	8.23	12	5567.5	7.05	4	5872.8	6.49	19
5268.2	8.13	14	5573.1	6.77	13	5877.0	6.55	20
5273.1	8.01	9	5577.3	6.57	19	5882.2	6.61	16
5277.9	7.96	10	5582.2	6.57	16	5888.3	6.35	12
5281.5	7.96	9	5587.5	6.69	12	5891.4	6.40	2
5287.2	8.02	10	5591.7	6.69	9	5898.3	6.27	15
5291.7	7.80	5	5597.7	6.79	7	5901.8	6.18	12
5296.4	7.97	3	5603.0	7.12	14	5907.8	6.26	14
5301.1	7.43	4	5607.6	7.12	20	5912.7	6.49	16
5308.1	7.28	5	5612.3	6.98	13	5917.2	6.57	15
5315.2	7.3	1	5616.7	6.52	11	5923.9	6.40	4
5367.6	7.9	1	5623.3	6.49	7	5927.8	6.28	13
5371.2	8.0	1	5628.8	6.33	3	5932.4	6.36	15
5376.2	8.0	1	5632.4	6.31	7	5936.9	6.32	11
5382.4	7.78	4	5637.9	6.53	6	5942.5	6.30	8
5387.3	7.30	6	5642.8	7.15	4	5946.3	6.30	3
5391.5	7.10	4	5648.6	6.73	3	5952.9	6.54	5
5396.5	7.17	3	5653.5	6.40	6	5958.4	6.53	10
5406.6	7.50	2	5658.8	6.47	3	5962.2	6.30	10
5412.6	7.30	2	5662.4	6.65	2	5967.2	6.24	10
5417.8	7.08	4	5668.9	6.75	2	5972.2	6.22	10
5421.5	7.05	4	5673.6	6.45	2	5977.3	6.23	8
5427.1	7.03	4	5675.2	6.8	1	5983.6	6.40	7
5432.9	6.64	5	5682.7	6.65	2	5987.4	6.36	13
5436.8	6.73	3	5738.2	6.20	2	5993.1	6.46	11
5442.0	6.88	11	5742.8	6.37	3	5997.8	6.41	27
5447.5	7.09	9	5749.2	6.4	1	6002.4	6.40	5
5452.6	7.10	3	5751.6	6.40	2	6007.5	6.14	7
5458.0	7.00	7	5757.3	6.66	5	6012.6	6.20	8
5462.7	6.80	7	5761.1	6.30	2	6018.2	6.13	4
5467.2	6.84	8	5767.2	6.6	1	6022.4	6.17	12
5472.1	6.80	8	5771.2	6.5	2	6027.0	6.38	9
5477.2	6.76	8	5778.1	6.0	1	6031.9	6.6	1
5482.9	6.83	3	5786.4	6.35	2	6040.8	6.25	2
5487.6	7.29	10	5792.5	6.65	4	6099.6	6.3	1
5492.1	7.36	9	5796.3	7.05	4	6101.8	6.37	3
5498.2	7.04	13	5802.0	7.11	7	6111.7	6.50	3
5501.7	6.84	7	5809.2	6.8	1	6117.4	6.50	5

Appendix I cont.

6121.2	6.4	1	6262.7	6.53	17	6399.9	6.3	1
6128.2	6.17	3	6267.4	6.37	20	6402.5	6.27	3
6133.2	6.0	1	6272.2	6.25	11	6407.6	6.45	2
6142.3	6.56	5	6277.3	6.24	5	6458.2	6.5	1
6147.1	6.60	7	6282.9	6.32	15	6467.2	6.30	2
6152.2	6.52	6	6287.6	6.39	14	6472.0	6.40	3
6157.3	6.30	4	6292.3	6.46	18	6476.2	6.4	1
6162.1	6.13	3	6297.1	6.52	12	6481.5	6.23	8
6167.9	6.16	7	6302.3	6.70	4	6486.9	6.20	4
6172.8	6.28	4	6307.2	6.36	8	6493.2	6.20	5
6177.6	6.37	7	6311.8	6.24	7	6496.6	6.06	5
6182.7	6.36	12	6317.4	6.22	10	6502.3	6.23	7
6187.5	6.30	4	6322.6	6.23	14	6506.7	6.15	2
6191.9	6.35	2	6327.1	6.26	9	6511.5	6.37	6
6196.6	6.17	3	6332.9	6.43	6	6517.4	6.40	4
6203.1	6.22	13	6337.8	6.51	10	6522.0	6.38	5
6206.6	6.20	6	6342.2	6.43	11	6527.2	6.53	8
6212.6	6.29	15	6347.5	6.23	7	6531.5	6.50	3
6218.2	6.41	8	6352.3	6.26	13	6537.9	6.27	3
6224.8	6.45	2	6358.1	6.29	13	6542.4	6.18	5
6227.6	6.48	19	6363.0	6.27	3	6547.6	6.27	3
6232.1	6.27	15	6367.5	6.28	14	6552.7	6.33	6
6237.6	6.20	20	6372.7	6.36	14	6557.8	6.38	6
6242.8	6.19	17	6377.8	6.41	13	6561.2	6.65	4
6247.0	6.21	12	6382.8	6.33	16			
6252.8	6.31	22	6387.0	6.22	5			
6257.6	6.55	19	6393.2	6.12	5			

APPENDIX II

Observations of Y Mus

10 day means

5049	10.40	2	5366	10.30	3	5545	10.20	4
5077	10.40	2	5372	10.50	3	5551	10.3	1
5108	10.20	2	5385	10.50	3	5565	10.35	2
5114	10.10	8	5396	10.35	4	5576	10.19	9
5129	10.1	1	5403	10.25	2	5584	10.20	6
5137	10.06	5	5414	10.20	5	5596	10.22	6
5144	10.10	5	5428	10.30	2	5605	10.20	6
5164	10.10	9	5437	10.15	2	5667	10.60	2
5174	10.15	6	5445	10.13	4	5674	10.70	1
5194	10.17	6	5457	10.12	5	5685	10.2	1
5206	10.15	2	5463	10.10	6	5697	10.40	3
5223	10.15	2	5473	10.12	5	5705	10.24	5
5296	10.4	1	5486	10.10	4	5716	10.20	3
5316	10.2	1	5493	10.10	5	5727	10.29	7
5327	10.20	2	5501	10.1	1	5739	10.25	4
5333	10.27	3	5519	10.2	1	5745	10.24	5
5344	10.26	5	5524	10.16	5	5757	10.13	4
5356	10/27	3	5532	10.25	2	5761	10.10	2

Appendix II cont.

5776	10.15	4	6077	10.63	3	6304	10.75	6
5786	10.1	1	6085	10.58	5	6323	10.3	1
5794	10.23	3	6096	10.59	9	6334	10.43	3
5816	10.32	5	6105	10.59	11	6343	10.4	1
5826	10.38	9	6113	10.59	8	6354	10.55	2
5836	10.44	11	6125	10.60	2	6374	10.7	1
5846	10.53	12	6135	10.57	7	6383	10.7	1
5854	10.49	14	6145	10.71	10	6394	10.6	1
5864	10.67	6	6154	10.62	15	6407	10.6	1
5874	10.53	15	6166	10.57	17	6417	10.55	2
5884	10.67	7	6175	10.62	14	6423	10.63	4
5897	10.61	10	6184	10.61	16	6437	10.67	7
5905	10.70	10	6194	10.61	8	6446	10.74	10
5915	10.68	11	6205	10.56	15	6457	10.64	7
5926	10.51	7	6214	10.60	7	6465	10.49	15
5934	10.57	12	6225	10.62	10	6474	10.56	16
5944	10.43	4	6236	10.65	13	6483	10.52	9
5958	10.45	4	6246	10.71	9	6494	10.46	19
5995	10.4	1	6255	10.64	18	6506	10.47	14
6004	10.5	1	6265	10.68	13	6515	10.44	7
6039	10.7	1	6274	10.75	11	6525	10.54	17
6056	10.7	1	6285	10.86	11	6534	10.45	2
6065	10.57	3	6295	10.75	11			

APPENDIX III

Observations of U Aqr

10 day means

1999	12.4	1	2749	11.7	1	3751	12.8	1
2009	12.2	1	2961	11.70	2	3776	12.75	2
2044	12.3	1	3080	<12.7	1	3785	12.50	2
2166	10.9	1	3087	14.6	1	3805	12.4	1
2201	11.7	1	3100	14.3	1	3816	12.6	1
2229	12.5	1	3125	14.4	1	3981	12.0	1
2245	11.7	1	3337	<12.7	1	4027	11.2	1
2251	11.6	1	3360	<13.4	1	4034	11.5	1
2260	11.9	1	3377	<13.3	1	4061	11.1	1
2284	11.8	1	3393	<13.3	1	4076	12.1	1
2302	11.7	1	3404	<13.4	1	4098	11.2	1
2331	12.0	1	3422	<13.3	1	4104	11.85	2
2356	11.9	1	3431	14.8	1	4113	11.9	1
2397	11.6	1	3461	14.6	1	4125	11.60	2
2402	11.7	1	3486	14.3	1	4134	11.6	1
2546	12.0	1	3606	13.2	1	4145	11.75	2
2599	11.4	1	3669	13.1	1	4156	11.3	1
2628	11.7	1	3673	13.2	1	4164	11.50	2
2635	11.10	2	3715	12.8	1	4172	11.8	1
2664	11.5	1	3725	12.70	3	4188	11.8	1
2714	11.8	1	3732	12.8	1	4202	11.6	1
2724	11.8	1	3748	12.83	3	4227	11.4	1

Appendix III cont.

4349	11.8	1	5092	11.05	2	5816	12.06	5
4352	11.6	1	5107	11.1	1	5824	12.15	2
4375	11.50	3	5115	11.60	2	5831	12.20	2
4385	11.65	2	5121	11.7	1	5847	12.2	1
4412	11.6	1	5140	11.6	1	5856	12.28	4
4428	11.6	1	5153	11.6	1	5863	12.03	4
4436	11.63	3	5164	11.6	1	5875	12.3	1
4446	11.60	2	5176	11.26	5	5886	11.97	6
4458	11.6	1	5190	11.4	1	5895	12.25	2
4469	11.4	1	5198	11.8	1	5908	12.15	4
4485	11.73	3	5205	11.6	1	5916	12.04	11
4498	11.70	2	5225	11.33	4	5925	11.98	4
4509	11.8	1	5236	11.50	5	5935	12.01	14
4514	12.05	2	5248	11.2	1	5943	11.85	4
4524	11.9	1	5258	11.60	4	5958	12.03	3
4539	11.35	2	5266	11.4	1	5964	11.98	5
4544	11.55	2	5277	11.68	5	5975	12.03	7
4555	11.50	2	5285	11.57	10	5985	11.80	2
4570	11.3	1	5294	11.60	4	5996	11.75	4
4578	11.8	1	5308	11.47	3	6003	11.82	10
4581	11.55	2	5316	11.63	3	6014	11.86	9
4596	11.4	1	5337	11.6	1	6023	11.84	11
4695	11.10	2	5416	11.05	2	6035	11.78	4
4703	11.15	2	5434	11.00	2	6045	11.80	8
4714	11.50	2	5442	11.1	1	6058	11.80	2
4728	10.9	1	5457	11.0	1	6063	11.80	6
4739	11.7	1	5467	11.6	1	6146	12.8	1
4755	11.40	2	5477	11.0	1	6153	12.95	2
4764	11.53	3	5484	11.80	2	6168	<13.0	2
4771	11.40	2	5499	12.3	1	6176	<13.3	4
4787	11.25	2	5504	12.55	2	6185	<13.2	5
4796	11.28	6	5520	12.6	1	6195	<13.0	2
4804	11.00	2	5530	12.85	2	6206	13.54	7
4816	11.53	4	5534	12.71	9	6215	13.56	5
4826	11.60	3	5547	12.53	3	6228	13.34	5
4836	11.4	1	5554	12.26	7	6236	13.41	10
4845	11.26	6	5562	12.07	3	6245	13.58	6
4853	11.55	2	5576	12.26	9	6258	13.50	2
4868	11.2	1	5584	12.17	12	6266	13.57	12
4874	11.30	5	5594	12.20	3	6274	13.48	5
4897	11.60	2	5606	12.17	6	6287	13.51	8
4907	11.57	3	5614	12.08	4	6296	13.34	10
4928	11.60	2	5622	12.0	1	6315	13.22	5
4934	11.64	5	5635	12.05	2	6324	13.24	7
4941	11.4	1	5647	12.55	2	6335	13.25	2
4953	11.2	1	5657	12.1	2	6341	13.30	3
5050	11.6	1	5667	12.00	2	6354	12.93	7
5056	11.0	1	5674	12.53	3	6366	12.78	4
5064	11.17	3	5683	12.7	1	6375	12.81	9
5073	11.15	2	5795	11.60	2	6382	12.74	5
5084	11.37	3	5805	12.06	5			

PHOTOELECTRIC UBV SEQUENCE FOR AG HYDRAE

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SUMMARY: Photoelectric UBV data are given for 19 comparison stars in the field of the dwarf nova, AG Hydrae.

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1. INTRODUCTION

Chart 585 in Series 13 of the "Charts for Southern Variables" (1) shows the dwarf nova, AG Hydrae, and a sequence of comparison stars identified by letters. At the request of Dr. F.M. Bateson, these sequence stars have been measured photoelectrically in the UBV system and the results are listed in Table 1.

2. OBSERVATIONS

The data were obtained with the 1.0m and 0.5m telescopes of the South African Astronomical Observatory and reduced to the "E-region" standard system (2). Observations were made in the sequence VBUUBV on a star followed by UBV on the sky. For stars fainter than about 13^m , this sequence was repeated twice to form a single observation. Sky observations were "smoothed" as described in an earlier note (3).

Mean results for each star are listed in Table 1 which uses the convention that 3 decimal places are given when the standard deviation, σ , of a mean is less than 0^m015 ; 2 decimals are given if $\sigma > 0^m015$. If $\sigma > 0^m025$, the magnitude or colour is followed by a colon and if $\sigma > 0^m05$ by a double colon. When only two observations were made, the difference between them rather than σ was used as the indicator of accuracy.

3. COMMENTS ON CHART 585

There are some small anomalies on chart 585 which might confuse the observer:

- (a) star 'm' was not seen with the 1.0m telescope; it is possibly a plate flaw or might be a variable star (4)
- (b) the star almost due south of 'e' and west of 'd' was not seen with the 1.0m, but a much fainter star is visible on an ESO print of the area (4)
- (c) star 'n' is about 20 arcseconds further south than chart 585 indicates
- (d) star 's' is about 30 arcseconds west of the 585 position and the star due north of 's' is a plate flaw (4)

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- (4) Bateson, F.M., private communication.

TABLE 1.

UBV Sequence for AG Hydrae

CHART LETTER	V	(B-V)	(U-B)	n	Notes
a	9.678	1.084	0.957	3	
b	10.631	0.705	0.272	7	
c	11.050	0.297	0.082	2	(1)
d	11.910	0.845	0.44:	2	
e	11.960	1.01	0.73	3	
f	12.600	1.058	0.79	3	
g	13.542	0.91	0.55:	2	
h	13.340	0.515	0.00:	2	
j	13.84	0.48	0.04:	3	
k	13.576	1.072	1.025	3	
l	13.91::	0.75::	0.28	2	
n	14.12	1.20:	1.03::	2	
o	14.15	0.49::	-0.02	2	
p	14.068	0.96		3	
q	15.63	0.83:		3	
r	15.27:	0.69::		2	
s	15.20	0.83		2	
t	16.02:	0.67:		2	
120	12.06	0.58	0.06	1	(2)

(1) includes a faint star in the photometer aperture (31 arcsec diameter)

(2) star on chart 585 with assigned magnitude 12.0

"t" looks wrong. Really no brighter than 13.9!
.....

VISUAL OBSERVATIONS OF THE 1985 ECLIPSE OF BL TELESCOPII

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SUMMARY: Visual observations of the 1985 eclipse of BL Tel are presented.
 These suggest mid-eclipse occurred on 1985 October 31.0 U.T.

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1. INTRODUCTION

A visual light curve of the 1983 eclipse of BL Tel was presented by Williams (1) for which, based on the limited number of observations available, the date of mid-eclipse was determined as 1983 September 14.0 U.T. (J.D. 2,445,591.5). Based on these observations it was predicted that the next eclipse would be centred on 1985 October 31 UT.

The purpose of the observations now presented was to determine the date of mid-eclipse. A series of such observations is of value in the study of this interesting binary system.

2. OBSERVATIONS

All observations were made visually using comparison stars of V magnitude previously listed (1). Six observers, listed in Table 1, provided a total of 75 estimates. These are shown in Table 2 as daily means. The first column gives the J.D. followed by the mean visual magnitude and the number of observations in each mean. These are plotted in Figure 1 using the "tracing paper" method, wherein original observations are shown as dots while crosses represent traced plots.

3. DISCUSSION

The observations give the following results:

Eclipse commenced	J.D. 2,446,337.0	
Mid-eclipse	2,446,369.5	
Eclipse ended	(2,446,402.0)	Observations hindered by twilight.
Visual magnitude at mid-eclipse:	9.6	

The interval between this and the previous eclipse is 778.0 days. This eclipse was better observed than that of 1983 due to a greater number of observers, thus providing a smoother light curve.

A comparison of the two eclipses shows the onset is sudden and well defined. However, differences in the eclipse curves will result from intrinsic variations of the bright star (2), as will the minimum magnitude attained.

The 1985 eclipse curve exhibited two well defined phases, a gradual fading to, and recovery from, magnitude 8.0 with an increased rate of variation to and from minimum. Mean values for these phases are 0.06 mag/day and 0.10 mag/day, respectively.

Duration of this eclipse was 65.5 days compared with 57.0 days for the 1983 event, which was also 1^m0 brighter at minimum. Observation of future eclipses may establish a relationship between eclipse duration and amplitude.

The successful observation of the 1985 eclipse was important as the next two events will be difficult or impossible to observe due to the proximity of BL Tel to the sun, conjunction occurring during the first week of January during the Southern summer when twilights are of long duration.

Table 3 lists dates of predicted minima based on observations of the 1983 and 1985 events. These dates are, however, subject to some uncertainty due to phase displacements which result from intrinsic variations mentioned above.

The results in this paper have not been reduced to H.J.D.

ACKNOWLEDGEMENTS

Thanks are due to Frank Bateson for his encouragement in the BL Tel programme and to those observers who provided their results.

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TABLE 1.

BL Tel--Observer's Totals

Williams, P.F.	30	
Bembrick, C.S.	25	
Goltz, W	11	
Rogers, D.J.	5	
Hickey, D.	2	
Traynor,, F.	<u>2</u>	TOTAL 75

TABLE 2.

DAILY MEAN MAGNITUDES OF VISUAL OBSERVATIONS.

<u>JD 2446000+</u>	<u>MAG (v)</u>	<u>No.</u>	<u>JD 2446000+</u>	<u>MAG (v)</u>	<u>No.</u>
309.0	7.0	1	348.0	7.70	2
313.0	7.0	1	349.0	7.77	3
315.0	7.2	1	356.0	8.25	2
317.0	7.0	1	357.0	8.45	2
318.0	7.0	1	359.0	8.5	1
323.0	7.10	2	360.0	8.63	3
324.0	7.13	3	362.0	8.90	2
325.0	7.1	1	367.0	9.0	1
326.0	7.05	2	368.0	9.25	2
330.0	7.05	2	370.0	9.6	1
331.0	7.10	2	372.0	8.9	1
333.0	7.0	1	376.0	9.2	1
334.0	7.10	3	379.0	8.9	1
335.0	7.15	3	380.0	8.73	3
336.0	7.15	2	384.0	8.30	2
337.0	7.30	3	386.0	8.25	2
339.0	7.40	2	389.0	7.8	1
340.0	7.40	3	390.0	8.0	1
341.0	7.4	1	396.0	7.4	1
343.0	7.50	4	398.0	7.35	2
345.0	7.55	2			

TABLE 3.

PREDICTED MINIMA OF BL TELESCOPII.

<u>DATE</u>	<u>JD 2440000+</u>	<u>NOTES</u>
1987 DEC 17	7147	Twilight interference.
1991 FEB 02	7925	Pre-dawn event
1993 MAR 21	8703	-
1995 MAY 08	9481	-

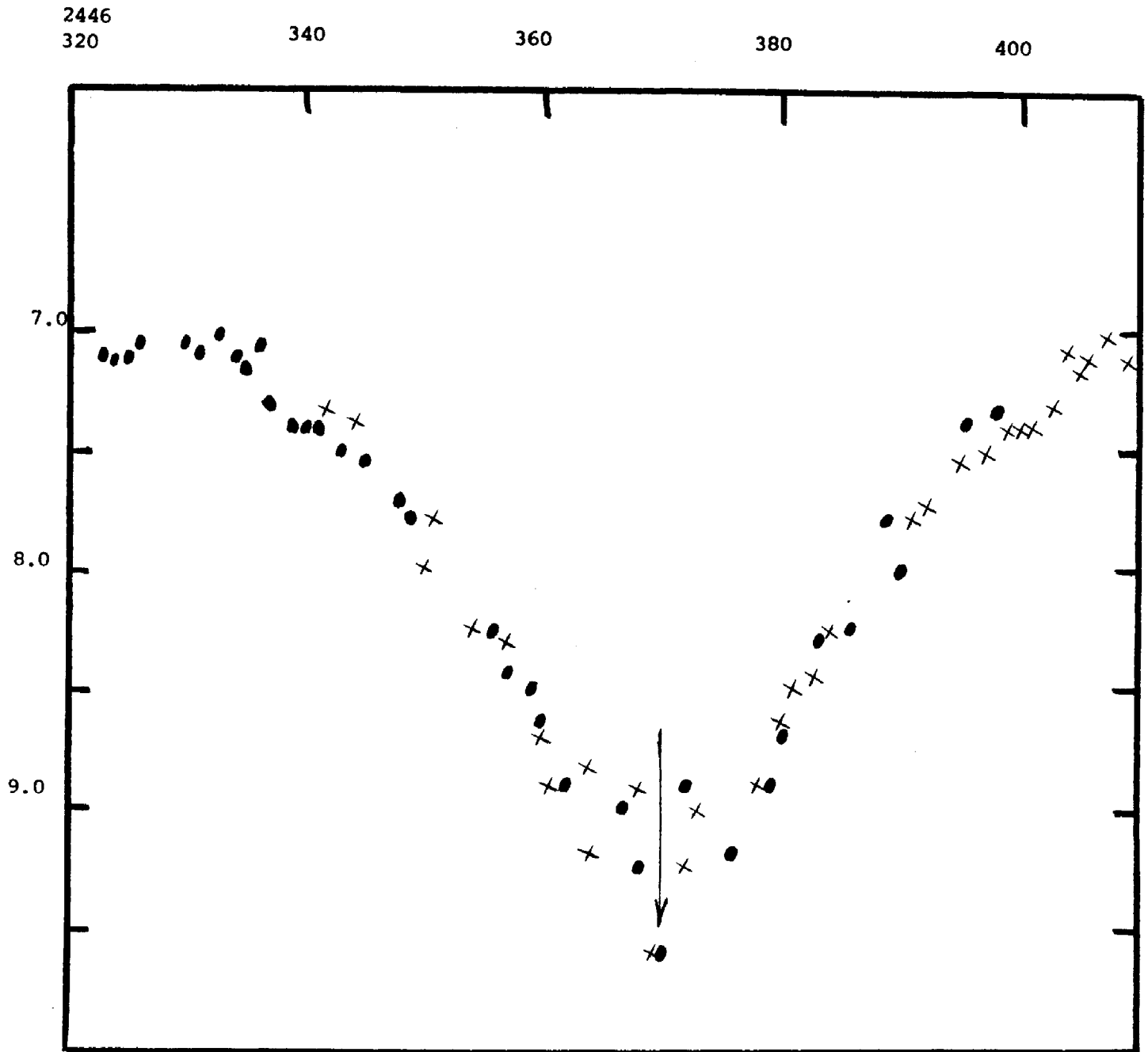


Figure 1. BL Telescopii. Light curve of 1985 eclipse.
Dots represent original plots and crosses plots
by the tracing paper method.

THE FREQUENCY OF OUTBURSTS OF THE DWARF NOVA VW HYDRI

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SUMMARY: The dwarf nova system VW Hydri has been observed by the Variable Star Section, Royal Astronomical Society of New Zealand (VSS, RASNZ) from 1953 to the present. Their collection of data through 1980 has been used to determine variations in the frequency of the outbursts of this SU UMa type dwarf nova. Patterns in the O-C curve of the times of outbursts resemble other types of dwarf novae in that intervals of more or less frequent outbursts occur with durations of up to several years. The supermaxima are found to show variations in the O-C curve for supercycles. Variations in the O-C curve for supercycles appear to be nearly independent of variations in the O-C curve for all maxima.

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1. INTRODUCTION

The dwarf nova VW Hyi was observed by members of the VSS., R.A.S.NZ beginning in 1953. Because VW Hyi is a southern circumpolar star, it has been well monitored with few gaps in the light curve. The observations of this star and a discussion of the outbursts with an analysis of the light curve have been published by Bateson (1), and Bateson and McIntosh (2). Smak (3) has investigated statistical relationships in the light curve, including the correlations between the widths and brightness of the maxima and minima. A recent work by Van der Woerd and Van Paradijs (4) showed there is a strong correlation between the length of time the system spends at minimum light and the energy released in the following outburst.

An investigation (5) into the behavior of the frequency of outbursts of two other dwarf novae, SS Aurigae and AH Herculis, showed that prolonged intervals existed when outbursts occurred consistently more or less often than the mean. It was determined that the variations in cycle length did not occur randomly from one cycle to the next. Both of these dwarf novae display a bimodal distribution of outburst duration, having outbursts classified as wide or narrow. During the intervals when outbursts occurred less frequently than the average outburst interval, the proportion of wide outbursts was higher than during those intervals of very frequent outbursts. When outbursts occurred very frequently, wide outbursts became very rare or disappeared completely for long intervals.

The present investigation is an examination of the O-C curve for VW Hyi to determine if the frequency of outbursts shows trends in a similar manner.

2. ANALYSIS

Using the mean frequency of outbursts found by Bateson (1), 27.33 days, an O-C curve was computed from the published data of the VSS., RASNZ., using the equation:

$$O-C = JD - (2,434,624.2 + 27.33 E) \quad (a)$$

where

JD is the Julian Date of the outburst and E is the epoch of the outburst. The curve is shown in the upper part of Figure 1.

In two instances maxima which were unobserved were assumed to have occurred. These were between outbursts 30 and 31 and between 80 and 81 (1). Bateson, in both of these instances, reported an outburst was suspected to have occurred. Other suspected outbursts listed in (1) were fainter than the criteria determining an outburst (magnitude 11.5) and were not included in this analysis. The effect of missing an outburst, or of assuming an outburst occurred when one actually did not, will be that a stepwise jump will appear in the O-C curve. This discontinuity will be equal to the mean frequency between outbursts of 27.33 days. This is shown by a bar in Figure 1.

VW Hyi is a SU Uma type dwarf nova and, as such, exhibits supermaxima. The mean interval between supermaxima is 178.44 days. An O-C curve was also constructed for the supermaxima. This O-C curve is also shown in Figure 1 below the O-C curve for all maxima.

To examine intervals to determine the mean frequency between outbursts, the set of data was divided into supercycles from one supermaximum to the next. In the case of other dwarf novae which have been examined in the current manner, each maximum was classified as either wide or narrow, depending on the statistical distribution of widths of maxima. In the present case, we have considered a supermaximum to be a wide maximum and all of the other maxima are placed in the narrow maximum category.

The fraction of outbursts which were wide maxima was calculated for each supercycle, with each supercycle containing one wide maximum by definition. This fraction was plotted against the mean cycle length in each supercycle (Figure 2). While the fractions shown in the figure are actually the reciprocal of the number of cycles in each supercycle, the method used in the previous work of this type used this format.

In previous analyses of other dwarf novae, the segments examined were chosen by inspection of the O-C curve. In the present case, the somewhat regular appearance of supermaxima and the existence of the supercycles was used to define the segments. While outburst frequencies can change between supermaxima, the relatively short supercycle length of approximately six months resulted in only a short interval which would contain few outbursts from two intervals of different average cycle lengths.

The supercycle length was plotted against the number of outbursts in each supercycle. This is shown as Figure 3. The plot of the average length of cycles in the seven supercycles centered around the supermaximum is shown in Figure 4. This number of cycles was chosen to avoid overlapping supercycles, some of which had only four maxima.

3. DISCUSSION

The plot of the O-C curve for the outbursts shows that there is considerable variations in the outburst frequency. The presence of apparently linear segments in the curve indicates that the outburst frequency stays essentially constant for periods of up to several hundred days. The intervals during which the cycles are longer than the average are characterized by upward sloping segments. Intervals during which the outbursts occur more frequently are characterized by downward sloping parts of the curve. The curve is flat when the outbursts occur at the expected frequency.

The average cycle length in the 54 supercycles examined ranges from 18.6 days to 44.4 days. While we chose to use the frequency of outbursts found in (1) it is interesting that at this outburst frequency the O-C curve shows an overall downward trend, suggesting that the long term value is shorter than this. For the era examined here, the mean interval between outbursts is 27.02 days.

The plot of the O-C curve for the supercycles is based on the equation:

$$O-C = JD - (2,434,848.7 + 178.44 E) \quad (b)$$

where JD is the Julian Date of the supermaximum and E is the supercycle epoch number.

The appearance of the O-C curve for the supermaxima, the lower curve in Figure 1, shows that the supercycles display periods of longer cycles or shorter cycles over many supercycles. One trend of longer than ordinary cycle length of over five years extends from JD 2,436,051 to JD 2,437,966. During this interval of ten supercycles the average supercycle length was 191.6 days. Around the end of this interval the supercycle abruptly shortened and averaged 171.0 days for eleven supercycles. Following this, the supercycle lengthened slightly and suffered more frequent changes in the cycle length than occurred over the previous ten years.

There is not an evident relationship between the behavior of the O-C curves. They seem to be independent of each other. If the times when the outbursts become frequent were merely a "speeding up" of the system, the two curves would parallel each other as the supercycles would also become shorter. Nor do the curves tend to show opposite trends. The seeming independence of the two curves suggests that the mechanism which drives the frequency of the outbursts is different from the mechanism which determines the length of the supercycles.

It is readily apparent from Figure 2 that as the cycle frequency quickens, the fraction of the outbursts which are wide maxima decreases. This same behavior was noted in the study of SS Aur and AH Her. While there was only one wide maximum per data point in Figure 2 here (by definition) there were no long intervals when the wide maxima completely disappeared as was the case for the two other dwarf novae studied to date. The effect of the decreasing fraction of the outbursts being wide maxima (i.e. supermaxima) seems here to be merely a dilution effect rather than a replacement. The O-C curve for the supercycles shows that while there was some variation of supercycle length (they ranged from 133 to 206 days in length) they did not disappear for long periods. In the case of SS Aur wide maxima (which usually appeared every 100 to 300 days) disappeared for over five years.

On the other hand, in the two systems studied previously, when the cycle time lengthened, the wide maxima appeared more frequently. Here they do not.

There is a vague but not convincing relationship between the length of a supercycle and the number of outbursts in that supercycle (see Figure 3). Table 1 contains the average supercycle length by the number of cycles in the supercycle. Supercycles of more than 6 outbursts average about 185 days in length, while those with fewer outbursts are in the 160's.

This suggests that the presence of more frequently occurring outbursts tends to stretch out the supercycle. This stretching out, if it were a large influence would cause the supercycle O-C curve to become a mirror image of the curve for all the outbursts. Figure 1 does not disclose such a relationship. The variability in the supercycle period does not seem to be strongly influenced by the changes in the overall outburst frequency. It is, at most, a second order effect.

The plot of the cycle length versus the number of cycles before or after the supermaximum is shown in Figure 4. This shows that, as supermaximum is approached, the cycles, on the average, become longer with the cycle containing the supercycle at its end being the longest (35.2 days). Then the cycle length shortens dramatically and reaches a minimum (21.5 days) at the second cycle of the next supercycle. Because some of the supercycles contained only four cycles in them while others held as many as nine, the graph in Figure 4 is not

strictly a plot of the phase in the supercycle. Smak (3) reported that there were two types of supercycles, long (L) and short (S). In type L the last two cycles in the supercycle are longer than 30 days. In type S the last two cycles are less than 23 days long. The presence of this effect is reflected in the data in Figure 4.

4. CONCLUSIONS

VW Hyi shows fluctuations in the frequency of the outbursts similar to what has been found in SS Aur and AH Her. As outbursts come more frequently, there is a tendency for narrow maxima to be increasingly in the majority while the wide outbursts, the supermaxima, continue along at a more or less constant pace. They neither disappear nor do they become rare as in other types of dwarf novae when outbursts are frequent. Although the supercycles which have the greatest number of outbursts in them are longest, the effect is slight. The tendency of the system is actually to stretch out the supercycles very slightly when the outbursts are frequent.

ACKNOWLEDGEMENTS

The vigilance of the observers of the VSS., RASNZ., has resulted in nearly continuous coverage of the light curve of this star. This removed uncertainty in the count of outbursts and simplified the interpretation of the O-C curve. Their dedication is appreciated.

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TABLE 1.

VW Hyi--AVERAGE SUPERCYCLE LENGTH

<u>No. of Cycles</u> <u>in Supercycle.</u>	<u>AVERAGE LENGTH</u> (Days)
4	167
5	161
6	179
7	184
8	185
9	186

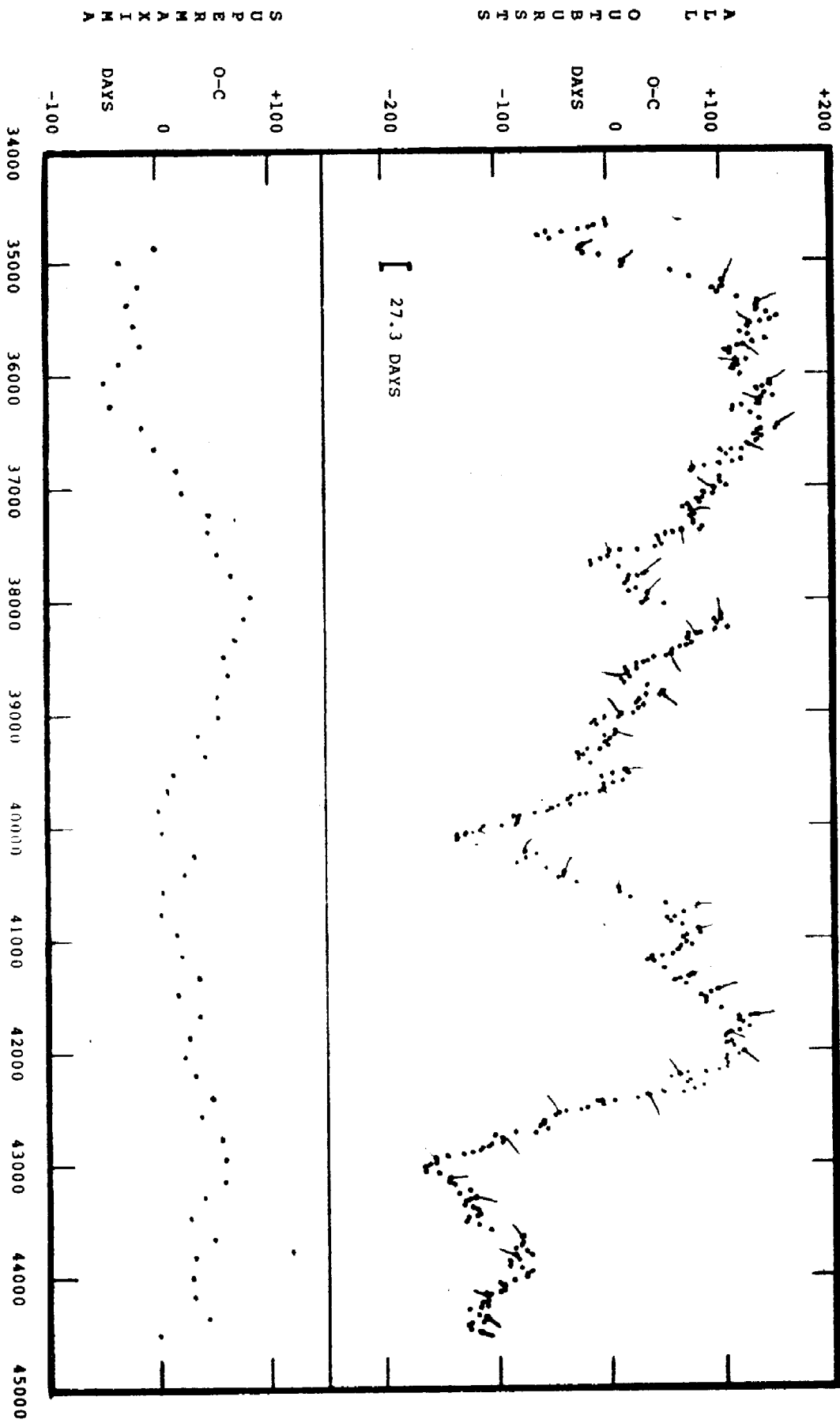


FIGURE 1. The O-C curve for VW Hydri outbursts (top curve) and supermaxima (bottom curve). In the top curve the supermaxima are marked by a dot with a tail (.) .

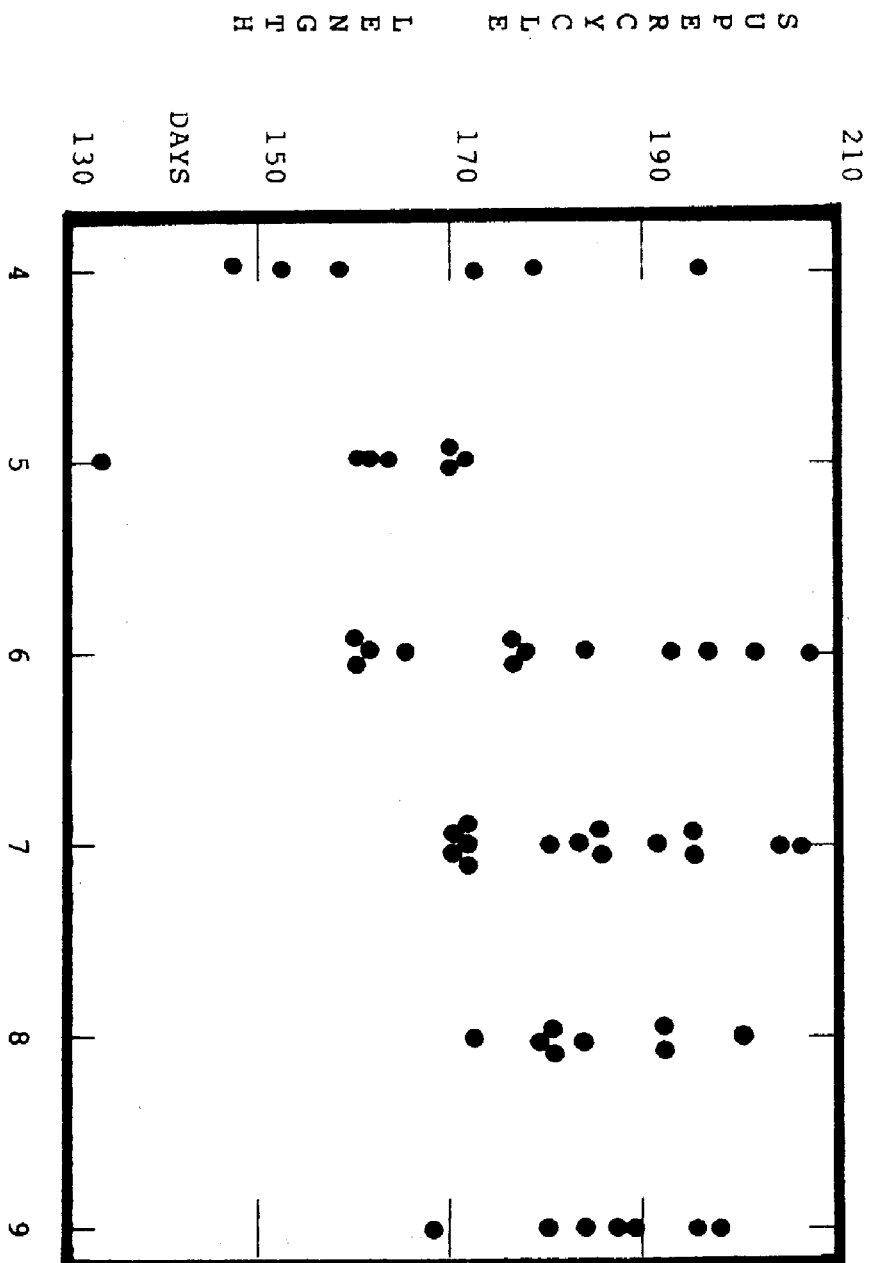


FIGURE 3. The length of a supercycle versus the number of cycles in that supercycle

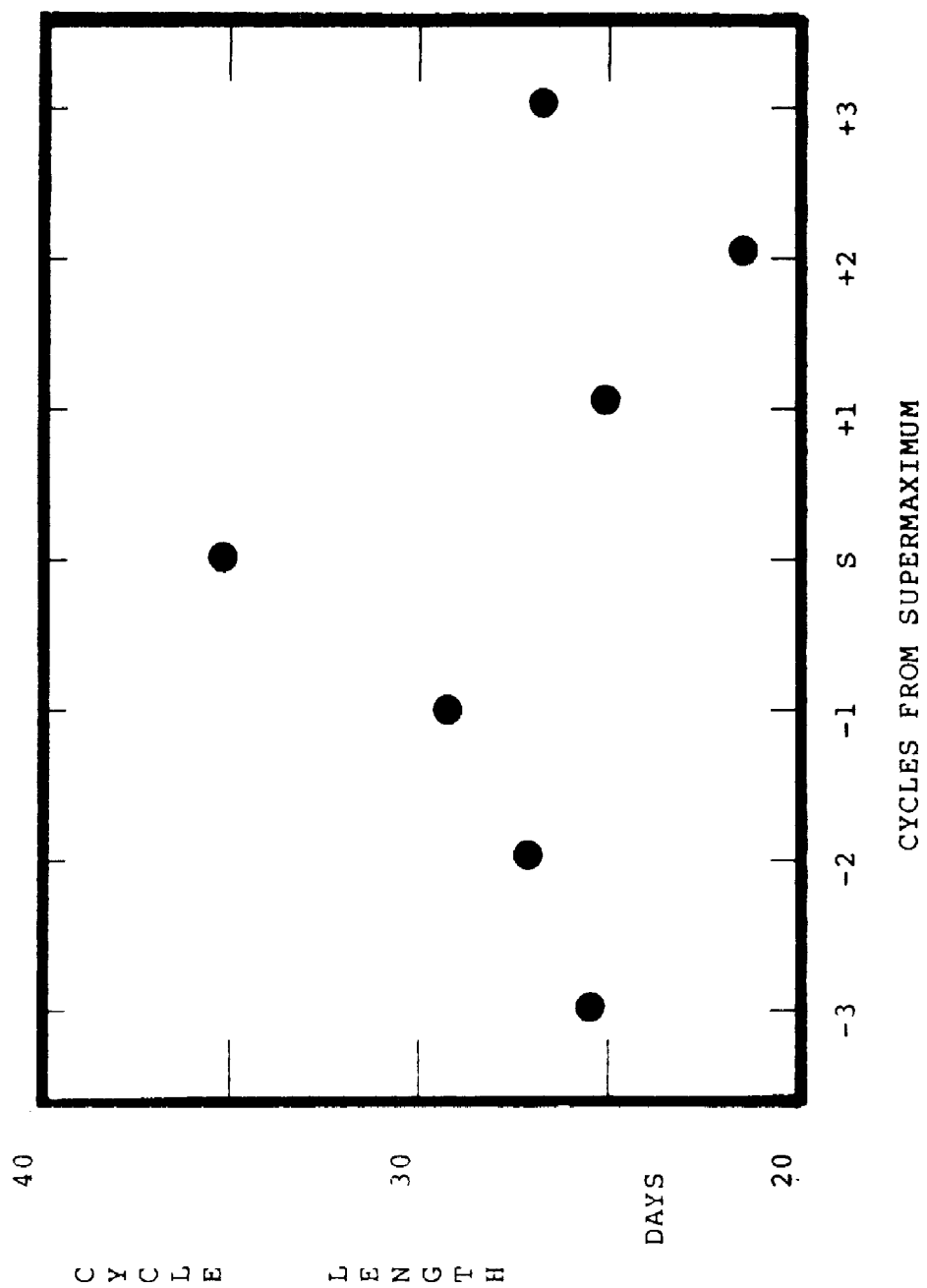


Figure 4. Cycle length versus number of cycles from supermaximum.

VISUAL OBSERVATIONS OF THE BRIGHT OUTBURSTS OF EX HYDRAE IN 1986 JULY & AUGUST.

F.M. Bateson, W. Goltz, A.F. Jones & R. McIntosh
Variable Star Section, R.A.S.N.Z.

SUMMARY: A light curve of visual observations of bright outbursts of EX Hydrae in July and August, 1986 are reproduced with a table of the individual estimates.

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1. INTRODUCTION

It has been shown (1) that bright outbursts of EX Hya, when it attains a maximum magnitude of 9.6 to 10.1, are rare events. This star is monitored closely by members of the VSS, RASNZ., with the aim of detecting such events. In 1986 two of these outbursts occurred on July 27-28 and on August 4-5.

2. OBSERVATIONS

The first outburst was detected by two of us (W.G. & A.F.Jo) on July 27 and we realised the importance of making estimates at frequent intervals. The second outburst was first seen by O.R. Hull on August 4, but it was the following night before one of us (A.F.J.) could observe. The remaining observations of this outburst are his.

A light curve, from individual observations, is shown in Figure 1. This covers the interval J.D. 2,446,630 to 2,446,660 and thus shows EX Hya at minimum before and after the two outbursts. In the figure the sign "v" indicates that the star was invisible and fainter than the magnitude indicated.

The individual observations for the same interval are listed in Table 1. Here the sign "(" before a magnitude indicates that EX Hya was invisible and fainter than the magnitude stated.

3. CONCLUSIONS

The onset of the first outbursts may have occurred between J.D. 2,446,639.2 and 2,446,639.852 during daylight. EX Hya remained at maximum that night but had started to decline the following night. The duration of this outburst was 48 hours.

The second outburst was first seen by O.R. Hull on 2,446,647. However, there was a gap of one day before his observations. The following night EX Hya had faded by almost a magnitude, remaining at that brightness as it had done during the first of these two outbursts. Weather conditions then prevented further observations for four nights by which time the star was again at minimum. We conclude that this outburst also had a duration of 2 days.

These observations show how essential it is for all observers to monitor EX Hya on every possible night. If this is not done these rare bright outbursts can easily pass unobserved due to their short duration. All observers are also requested to ring the Director immediately a bright outburst is detected. For these two outbursts the light curve and list of individual observations were sent to those astronomers particularly interested in this star. This note is published so that members can see for themselves their results.

ACKNOWLEDGEMENTS

We wish to thank all other observers for their observations.

REFERENCE

1. Bateson, F.M., Jones, A.F., & Menzies, B. 1970. Circ. 159, Var. Star Section, R. astr. Soc. of New Zealand.

TABLE 1.EX HYDRAE---INDIVIDUAL OBSERVATIONS

J.D. 2,446,000+

630.3	13.0	Ov	640.9193	10.7	Wy	647.842	9.8	H1
631.83	(12.7	H1	.929	10.8	Gp	.868	9.8	H1
633.77	13.0	H1	929	10.6	Jo			
634.78	13.3	H1	.9300	10.7	Wy	648.8278	11.1	Jo
635.2	13.3	Ov	.939	10.6	Jo	.8306	10.6	Jo
636.2	13.7	Ov	.940	10.6	Gp	.8313	10.7	Jo
.874	13.3	Gp	.954	10.7	Gp	.8319	10.6	Jo
637.2	13.0	Ov	.9714	10.6	Wy	.8333	10.6	Jo
.818	13.1	Jo	.972	10.8	Gp	.8340	10.6	Jo
638.2	13.2	Ov				.8347	10.6	Jo
.813	13.7?	Jo	641.811	12.1	Jo	.8354	10.7	Jo
			.823	12.0	Jo	.8361	10.6	Jo
639.2	13.2	Ov	.831	12.1	Jo	.8382	10.6	Jo
.852	9.7	Jo	.865	12.1	Gp	.8403	10.6	Jo
.868	9.8	Jo	.872	12.1	Jo	.8417	10.7	Jo
.875	9.7	Jo	.880	12.2	Gp	.8424	10.7	Jo
.885	9.8	Jo	.88	12.2	Mf	.8438	10.7	Jo
.888	9.8	Jo	.890	12.9	Jo	.8535	10.6	Jo
.897	9.7	Jo	.892	12.2	Jo	.8590	10.7	Jo
.901	9.7	Jo	.894	12.2	Gp	.8604	10.6	Jo
.915	9.5	Gp	.911	12.1	Gp	.8681	10.6	Jo
.927	9.7	Jo	.9165	11.9	Wy	.8729	10.7	Jo
.932	9.3	Gp	.928	12.5	Gp	.8792	10.8	Jo
.938	9.4	Gp	.9407	12.2	Wy	.8826	10.9	Jo
.942	9.5	Gp	.947	12.3	Gp	.8910	10.5	Jo
.9465	9.4	Wy	.975	12.5	Gp	.9153	10.7	Jo
.956	9.3	Gp				.9167	10.6	Jo
.961	9.3	Gp				.9174	10.6	Jo
.968	9.5	Gp	642.85	(12.1	Mf	.9201	10.8	Jo
.976	9.5	Gp	.855	12.5	H1			
			643.78	13.3	H1	652.7973	13.1	Jo
640.786	11.7?	H1	.8814	(12.7	Wy	.82	13.0	H1
.807	11.6?	H1	644.79	13.2	H1	.8333	(12.7	Jo
.844	10.7	Gp	.818	13.7	Jo	.8674	13.0	Jo
.844	12.0?	H1	.833	13.9	Jo			
.859	10.9	Gp	.845	(13.5	Jo	653.890	(12.7	Jo
.867	11.0	Gp	.847	(13.5	Jo	655.80	(12.7	Jo
.881	10.6	Gp	645.856	12.9	Jo	.819	13.3	Jo
.885	10.1	Jo	.91	(12.7	Wy	.966	(12.7	Jo
.887	10.3	Jo				657.80	(13.2	H1
.892	10.5	Gp				.81	(12.2	Jo
.8935	10.6	Wy				.87	(12.7	Mf
.894	10.5	Jo				658.79	(12.7	H1
.902	10.6	Jo				659.81	(12.0	H1
.914	10.6	Jo						
.917	10.7	Gp						

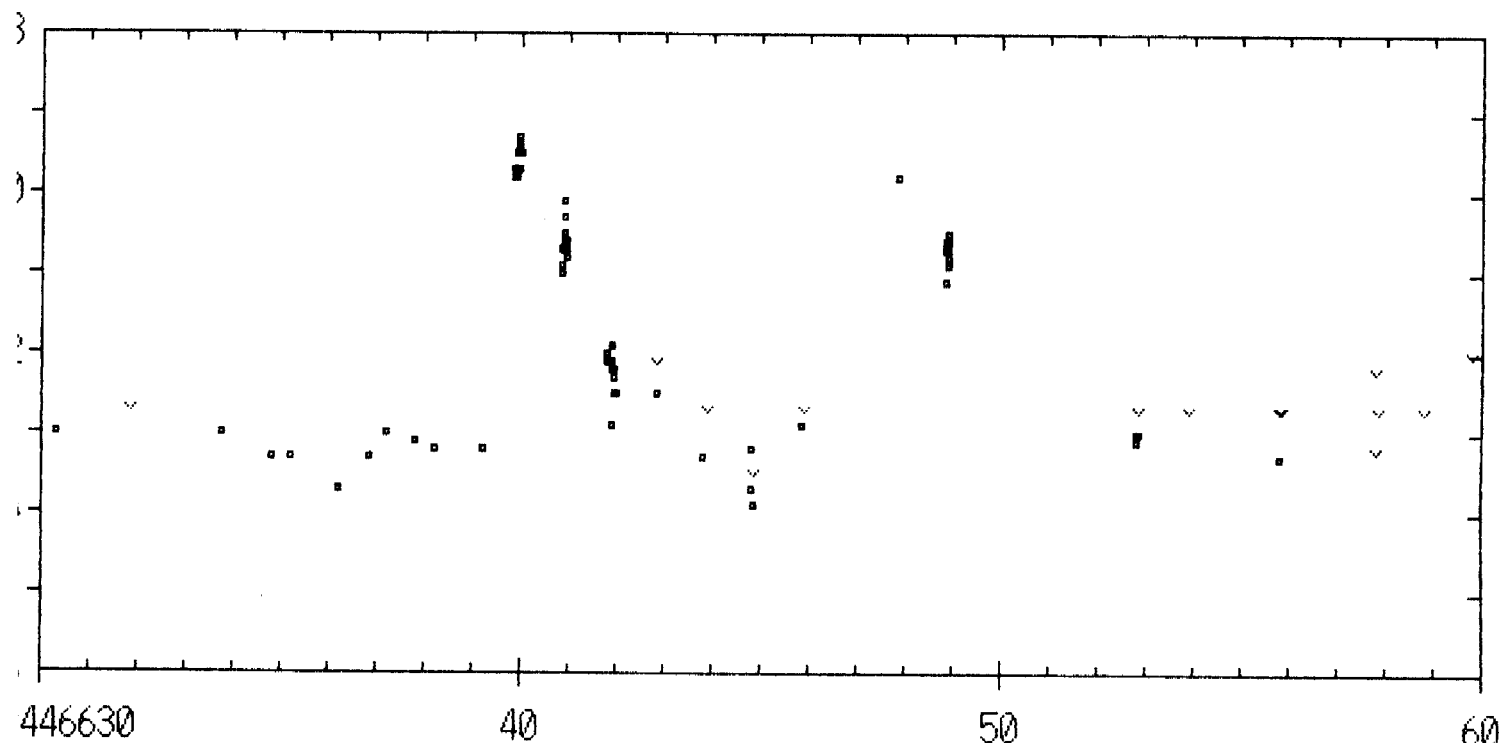


Figure 1. EX Hydrae. Light curve from individual observations
J.D. 2,446,630 to 2,446,660.

PHOTOELECTRIC UVB OBSERVATIONS OF ETA CARINAE & UY AQUARI

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Blenheim. N.Z.

SUMMARY: UVB observations are listed for Eta Carinae from January 1 to March 26, 1987 and for UY Aquarii, during its outburst on July 2, 1987.

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1. INTRODUCTION

The observations reported, and in a subsequent paper, were carried out at the Adams Lane Observatory, the co-ordinates of which are:

LONGITUDE: E. $173^{\circ} 55' 53''.5$
LATITUDE: - $41^{\circ} 30' 24''.6$

The photometer uses standard Johnson V,B,U filters and an uncooled EMI 9789QA photomultiplier tube operating at 1200V. The telescope is a 32cm f15 Dall-Kirkham optical system. The photometer diaphragm is 60". The output from the photomultiplier is converted to a frequency which is integrated by the computer data-logger for a period of ten seconds. The reduced magnitudes of the object are calculated by the computer relative to a comparison star and corrected for instrumental errors and atmospheric extinction. These calculations are done on line and the full reduction is completed after the last colour measure. The method by which this is done has been detailed (1).

2. ETA CARINAE

Three colour observations of Eta Car were made between January 1 and March 26, 1987. These are listed in Table 1.

TABLE 1.

<u>J.D.</u>	<u>V</u>	<u>B-V</u>	<u>U-B</u>
2,446,000+			
797.0028	5.67	0.74	0.07
797.9493	5.65	0.75	0.15
799.9035	5.70	0.74	0.11
801.1430	5.70	0.73	-0.03
831.9979	5.672	0.737	-0.012
837.9868	5.708	0.736	0.093
846.9556	5.701	0.734	0.005
847.9278	5.700	0.727	0.011
848.8861	5.698	0.733	0.033
851.9583	5.698	0.730	-0.004
881.0278	5.620	0.693	-0.010

3. VY AQUARI

VY Aqr, a recurrent nova, had an outburst on J.D. 2,446,978 (2). I made 23 four colour observations (V,B,U & W) between 1143 and 1209, July 2, 1987 (U.T.). The star was near the limit of my system, however, it was measurable. No oscillations were apparent. The comparison star used was 17 Aqr, which has the following colours:

$$V = 5.98; \quad B-V = +1.54; \quad U-B = +1.88$$

The mean values of my observations were: Air mass = 1.522

<u>J.D.</u>	<u>V</u>	<u>B-V</u>	<u>U-B</u>	<u>W</u> <u>(counts (Hz))</u>
2,446,000+				
978.9896	11.89	0.15	-0.54	127
979.0055	12.07	-0.10	-0.60	125

ACKNOWLEDGEMENTS

I thank Frank Bateson for his prompt advice of the outburst of VY Aqr.

REFERENCES

- (1) Allen, W.H. 1987. Southern Stars, 32, No.5, pp.159-169.
- (2) Isles, J. 1987. IAU Circ.4413.

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PHOTOELECTRIC MAGNITUDES IN THREE VARIABLE STAR FIELDS.

P.M. Kilmartin
Mount John University Observatory
Lake Tekapo, New Zealand.

SUMMARY: V magnitudes and colours are listed for comparison stars for SY & TV Hyi and V842 Cen (Nova Cen 1986).

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INTRODUCTION

V magnitudes and colours were obtained for lettered comparison stars in three fields, at the request of Frank Bateson. The measurements were made with the McLellan telescope at the Mount John University Observatory using an EMI 6094B tube. The results are listed below with the respective chart numbers published in "CHARTS FOR SOUTHERN VARIABLES."

020178 TV Hyi. Charts 809 & 811, Series 18.

<u>CHART</u> <u>LETTER</u>	<u>V</u>	<u>B-V</u>	<u>U-B</u>	<u>NOTES</u>
G	10.99	0.44	-0.0	1
H	10.32	1.01	0.71	
K	11.37	0.76	0.20	
M	12.62	1.34	1.27	
N	14.22	0.67	-0.1	1,2
P	13.55	0.80	0.1	1
r	14.68	0.6	0.0	3
s	14.18	0.6	0.0	3
t	14.47	0.9	0.7	3

NOTES: 1. U-B uncertain in moonlight.
2. Two stars in this position. Chose NW one.
3. One night only; July 9, 1987; unstable.

021979 SY Hyi. Charts 809 & 810, Series 18.

M ₁	11.7	0.73	) M on chart is double
M	11.3	1.13	)
N	12.3	0.58	
O	13.4	0.72	
P	14.9	0.60?	
Q	14.4	0.80?	
A	8.1	1.07	
B	8.9	0.52	
C	9.3	0.71	
D	9.6	0.27	
E	9.7	0.37	

NOTE: V magnitudes for stars A to E are as shown on chart 810.

<u>CHART LETTER</u>	<u>V</u>	<u>B-V</u>
p	9.16	1.06
q	9.70	1.28
r	9.99	0.58
s	10.67	0.36
t	11.30	1.96
u	11.32	0.27
v	11.36	1.23
w	12.12	0.43
x	12.20	0.66

REFERENCES

- Bateson, F.M. & Morel, M. 1985. Charts for Southern Variables, Series 18.
 Publ. by Astronomical Research Ltd, Tauranga, N.Z.
 Bateson, F.M. & Morel, M. 1987. Charts for Southern Variables, Series 19.
 Publ. by Astronomical Research Ltd, Tauranga, N.Z.

DIRECTOR'S COMMENTS

We thank P.M. Kilmartin for the foregoing sequences. In addition she has supplied one for Nova Sgr 1987, which appears in Series 20 of Charts for Southern Variables.

Visual observers should use the V magnitudes, rounded off to tenths. These sequences were circulated earlier to observers but are reproduced here to provide a more permanent record for new observers.

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UBVRI INDICES FOR NINE COMPARISON STARS FOR RY LUP1

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 S-13300 Saltsjobaden, Sweden.

SUMMARY: UBVRI indices are given for nine comparison stars in the field of RY Lupi. Hoffmeister's visual magnitudes are also included in the table.

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1. INTRODUCTION

RY Lup has been observed by members of the Variable Star Section, Royal Astronomical Society of New Zealand since September 2, 1952. Their estimates were made using the comparison stars shown on chart15, on which comparison stars were identified by letters (1). The visual magnitudes for these comparison stars were published in the booklet that accompanied the chart (1). These values were determined by Hoffmeister (2). The N.Z. observations to 30 September 1970 were published (3). Observations since then have been made available to me by Frank Bateson for use in my studies of this star.

2. COMPARISON STARS

I measured the UBVRI indices for nine comparison stars at E.S.O. Due to the fact that I primarily had the clear weather period around full moon made it hard to get observations in the U-filter, therefore the scarce amount of U-B colours. I used a Quantacon detector and its sensitivity is falling off quite rapidly towards the shorter wavelengths.

The mean values are shown in the following table, in which the visual magnitudes in column 3 are those from Hoffmeister, which are currently used by the N.Z. observers.

Table: Mean values of UBVRI indices for nine comparison stars around RY Lupi

Star	n	M _{vis}	<V>	<B-V>	<U-B>	<V-R>	<V-I>	COD
NZ 11 (a)	9(2)	9.60	9.592±.017	0.699±.017	0.277±.013	0.424±.005	0.834±.011	-40° 10 110
NZ 12 (c)	7(2)	9.80	9.710±.019	0.271±.018	0.226±.020	0.152±.016	0.336±.015	-40° 10 090
NZ 13 (d)	7(2)	10.27	10.198±.016	0.604±.011	0.095±.028	0.359±.005	0.705±.005	-40° 10 095
NZ 14 (e)	5(2)	10.38	10.302±.012	0.594±.007	0.079±.002	0.351±.005	0.717±.009	-40° 10 087
NZ 15 (f)	5(2)	10.50	10.252±.003	0.275±.017	0.173±.006	0.167±.007	0.378±.013	-39° 10 250
NZ 16 (h)	4(2)	10.90	10.808±.009	1.055±.002	0.636±.018	0.585±.002	1.156±.013	-40° 10 085
NZ 17 (l)	4(1)	11.15	10.761±.021	1.136±.004	0.772±.000	0.636±.006	1.231±.012	-40° 10 093
NZ 18 (p)	3(0)	11.60	11.463±.010	0.716±.004		0.440±.019	0.900±.003	-40° 10 111
NZ 19 (R)	1(0)	12.00	11.583±.000	0.764±.000		0.425±.000	0.893±.000	-39° 10 267

The columns in the table shows:

- 1) My star designations, with finder chart letters in parenthesis.
- 2) Number of observations on which the mean values are based, with, specifically, the number of U-B observations in parenthesis.
- 3) Your given visual magnitudes.
- 4 - 8) Mean values of indicated colour with a standard deviation calculated as,

$$\sigma^2 = \sum (x - \langle x \rangle)^2 / (n-1).$$

It must be noted here that the errors, as derived from standard star measurements, are not accurate to better than a few hundreds of a magnitude (also, of course, caused by the presence of full moon).

REFERENCES

- (1) Bateson, F.M. & Jones, A.F. 1960. Charts for Southern Variables, Series 2.
Publ. by W.M. Beynon Printing Co, Timaru, N.Z.
- (2) Hoffmeister, C. 1958. Veroff. Sternw. Sonnenberg 3, No.3.
- (3) Bateson, F.M. 1971. Circ. 168, Var. star Section, R. astr. Soc. of N.Z.

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DIRECTOR" COMMENTS ON RY LUPI COMPARISON STARS.

The V magnitudes, rounded off to tenths, are to be used from 1988 June 1 in place of the values now in use. A new chart is being prepared and I am trying to get V magnitudes for the fainter stars determined. If these become available they will be shown on the new chart.

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LIGHT CURVE OF NOVA CENTAURI 1986 (V842 Cen)

Frank M. Bateson (1) and Ranauld McIntosh (2)

- (1) Director, V.S.S., R. A.S.N.Z.
- (2) Director, Computing Section, R.A.S.N.Z.

SUMMARY: A light curve of Nova Cen 1986 (V842 Cen) is presented and discussed. Maximum brightness was 4.71 on November 26, 1986. It declined three magnitudes in 45 days. Minimum of 14.8 occurred on February 6, 1987. This was followed by a recovery to 11.3 by April 14, 1987 and the nova has remained at that brightness. The light curve resembles that of DQ Her (Nova Her 1934).

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1. INTRODUCTION

Nova Cen 1986 was discovered by R.H. McNaught (1) on 1986 November 22.7 U.T. at magnitude 5.6 (pv).

2. OBSERVATIONS

Visual observations by members of the Variable Star Section, Royal Astronomical Society of New Zealand, commenced shortly after advice of his discovery was received from R.H. McNaught. The observations used in the light curve in this paper cover the interval 1986 November 22 to 1988 January 29. A total of 718 observations were made on 279 nights. The observations were reduced using the magnitudes of the comparison stars shown on Charts 852 and 853 (2), and the V magnitudes for the lettered stars on these charts as determined by P.M. Kilmartin (3).

Photoelectric three colour observations made at the Auckland Observatory have already been published (4) and from Adams Lane Observatory (5). Two colour observations by P.M. Kilmartin, Mount John University Observatory have also been published (6). These photoelectric observations are not shown on the light curve, but the visual observations are very close to their values.

The light curve from the visual observations are shown in Figures 1 and 2, plotted as daily means. Observations per night ranged from 1 to 17 with a mean of 2.6. Naturally, estimates were most numerous when the star was close to maximum and on the initial fading. They decreased in number close to minimum.

3. DISCUSSION

There is some scatter in the observations, especially during the first stages of the decline. The nova may have been fluctuating, but scatter would be expected at this stage as observers changed apertures. There is very little scatter during the later stages of the decline and at minimum and during the initial stages of the recovery. There is scatter during the later stages of the recovery, which may be due to actual fluctuations of the nova. Once recovery was complete around magnitude 11.3 there is almost no scatter in the observations.

Table 1 shows the means for the first ten nights. This shows that the nova was close to maximum for only a few nights before a steady fading commenced.

TABLE 1

Nova Cen 1986. Daily means for First 10 DAYS.

<u>J.D.</u>	<u>MEAN</u> <u>M_v</u>	<u>Nbs.of</u>
2,446,758	5.13	6
759	4.77	11
760	4.80	14
761	4.71	16
762	4.98	12
763	4.84	7
764	4.90	17
765	4.90	8
766	4.98	11
767	5.01	9

Maximum is therefore J.D. 2,446,761 (November 26, 1986). The nova declined three magnitudes in 45 days. The decline became much steeper after J.D. 2,446,805 and faded to a minimum of 14.8 on J.D. 2,446,833, taking 29 days to decline a further seven magnitudes. The nova did not remain at minimum but commenced to rise again, first steeply and then slowly with apparent fluctuations. It recovered to magnitude 11.3 by J.D. 2,446,900 and has remained very close to that brightness throughout the rest of the observed interval.

The observations, since recovery, suggest that small variations of up to half a magnitude occur with a possible period of around 5 days. However, that statement must be treated with extreme caution, because the effect might be due to a small amount of scatter between different observers. The light curve appears to resemble that of DQ Her.

4. CONCLUSIONS

Nova Cen 1986 (V842 Cen) attained a maximum visual brightness of 4.71 on November 26, 1986. It faded three magnitudes in 45 days, after which it faded a further 7.1 magnitudes in 29 days to reach a minimum of 14.8 on February 6, 1987. It did not remain at minimum but immediately commenced to recover and in 68 days had reached magnitude 11.3, around which it has remained since. The light curve of Nova Cen 1986 appears to resemble that for DQ Her (Nova Her 1934).

ACKNOWLEDGEMENTS

We thank all observers for their estimates. We are indebted to P.M. Kilmartin of the Mount John University Observatory for the V magnitudes of the comparison stars.

REFERENCES

- (1). IAU Cir. 4274. 1986 November 24.
- (2). Bateson, F.M. & Morel, M. 1987. Charts for Southern Variables, Series 19.
Publ. by Astronomical Research Ltd., Tauranga, N.Z.
- (3). Kilmartin, P.M. 1988. Publ. 14, Var. Star Section, R. astr. Soc. of N.Z. p. 57.
- (4). Cir. M86/11 1986. Var. Star Section, R. astr. Soc. of N.Z.
- (5). Circ. M87/2. 1987. Var. Star Section, R. astr. Soc. of N.Z.
- (6). Cir. M87/4. 1987. Var. Star Section, R. astr. Soc. of N.Z.

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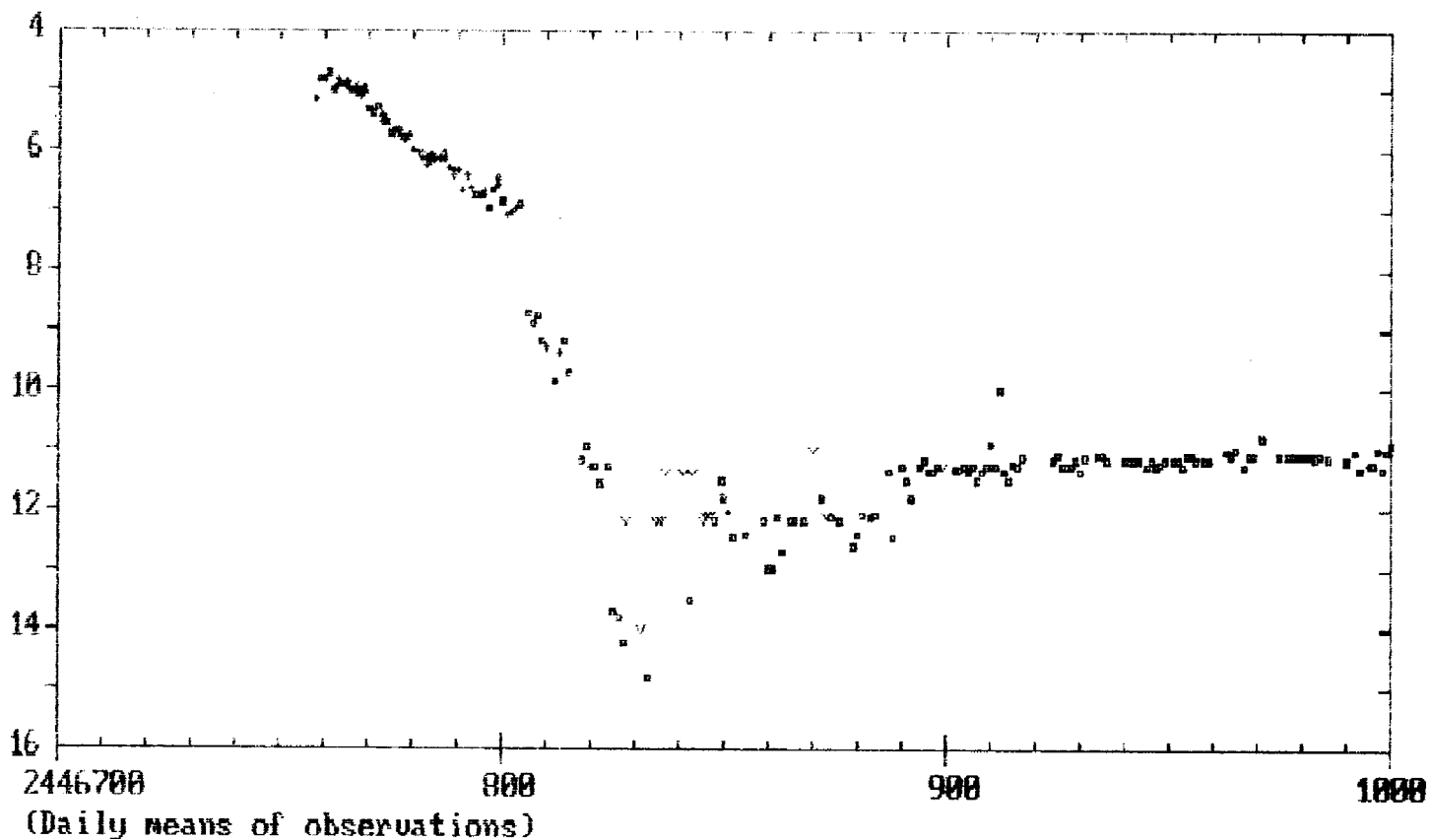


FIG. 1. Nova Cen 1986 (V842 Cen). Light curve from daily means of visual observations. J.D. 2,446,758 to 2,447,000.

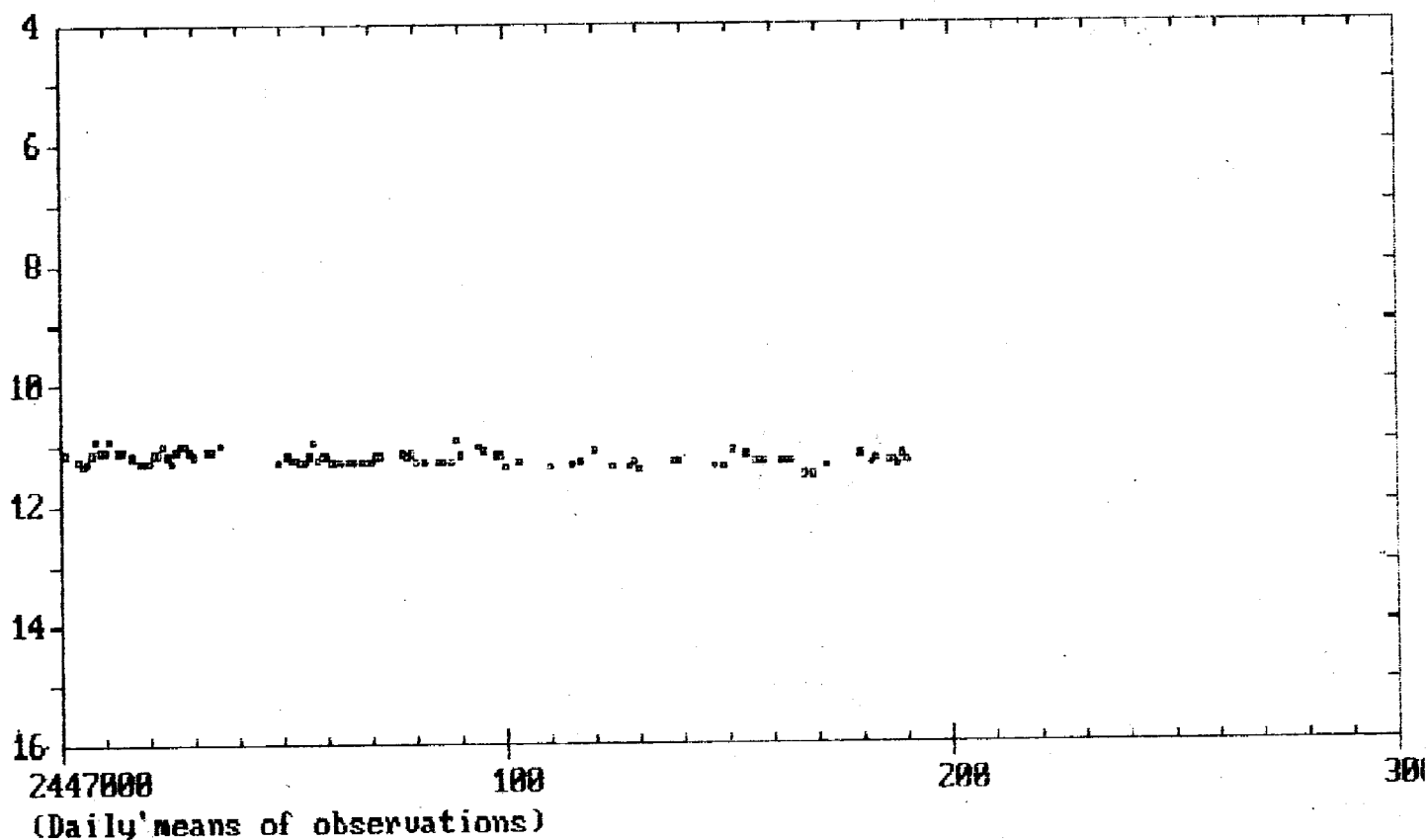


Fig. 2. Nova Cen 1986 (V842 Cen). Light curve from daily means of visual observations. J.D. 2,447,000 to 2,447,190.

A NEW DWARF NOVA IN CRATER

R.W. Fleet
Harare, Zimbabwe.

SUMMARY: The discovery of a new dwarf nova in Crater is reported.
Visual estimates are tabulated and a light curve reproduced.

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1. INTRODUCTION

In early August 1986, before conjunction, several comparison stars were chosen close to Comet Halley's predicted position for mid-October 1986. While checking against them in early November (J.D. 2,446,739.8) I noted that the 12.7 magnitude comparison had a companion of similar brightness, roughly 40 arc seconds to the north. When the field was checked again on J.D. 2,446,794.6 the companion was no longer visible. A further check on J.D. 2,446,837.6 showed the companion at magnitude 12.7 again. Observations were made weekly thereafter to try and determine the type of variation. By J.D. 2,446,900 it was clear that the object was unusual and I started making daily estimates when possible. The suspect was observed twice on J.D. 2,446,941 and a 0.2 magnitude brightening noted in two hours. The following night it was two magnitudes brighter and obviously a cataclysmic type of variable. Mike Beqbie (also of Harare) obtained confirmation estimates on this and two other nights with a 30cm reflector. In about ten days the object returned to minimum and remained there until it was too low in the evening sky for useful observations..

TABLE 1 (cont)

J.D.	M _v					2447000+	
2446000+							
946.318	13.1	966.233	15.1	990.219	15.3	000.226	15.1
947.327	13.0	967.226	15.2	991.219	15.2	001.208	15.0
948.240	13.1	970.222	15.0	992.222	15.0	002.229	15.1
949.200	13.2	972.229	15.2	993.208	15.1	003.208	15.0
950.207	13.4	974.228	15.0	994.226	15.1	004.208	15.1
951.226	13.6	975.194	15.0	995.215	15.2	005.208	14.9
952.222	14.2	976.233	15.0	996.226	15.0		
953.222	14.5	977.198	15.1	997.215	15.2		
955.21	(14.2	978.247	15.1	998.215	15.1		
958.22	(14.2	979.219	15.0	999.205	15.1		
960.211	15.0	981.198	15.1				
962.240	15.1	982.22	(14.2				
964.226	15.1	983.21	(14.2				
965.240	15.3	989.201	15.1				

VISUAL ESTIMATES. M.BEGBIE (Harare, Zimbabwe)

2446924.327	(12.7
942.298	12.5
944.265	12.6
948.280	12.7

TABLE 2.ESTIMATED VISUAL MAGNITUDES OF COMPARISON STARS.

A = 12.3
 B = 12.7
 C = 13.0
 D = 13.5
 E = 13.9
 F = 14.2
 G = 15.0

COMMENTS BY DIRECTOR

Congratulations to Richard Fleet on his discovery and the very careful manner in which he observed the object. All members are requested to observe this star. Their estimates should show complete details since it is probable that the magnitudes of the comparison stars may be amended. A new chart will be prepared and distributed.

This paper is just another example of how it pays to follow up on anything seen that appears to be unusual.

VISUAL MAGNITUDE

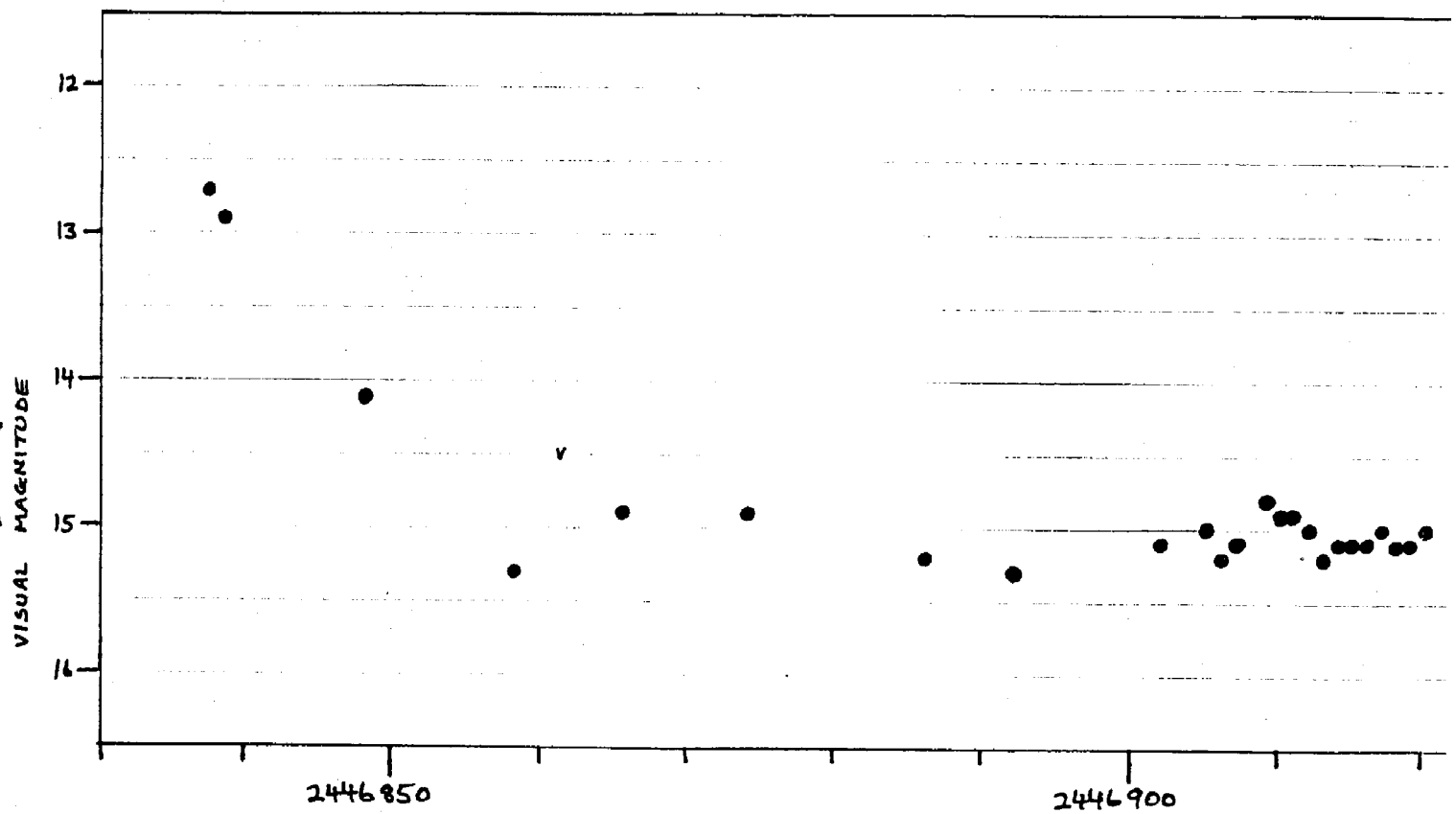


Fig.1. LIGHT CURVE OF SUSPECTED VARIABLE IN CRATERIS J.D.2,446,837-2,446,920.
NOT PLOTTED; First two observations of Table,1.
POSITION OF OBJECT: (1950): 11h 32.2m -11°29 (approx).

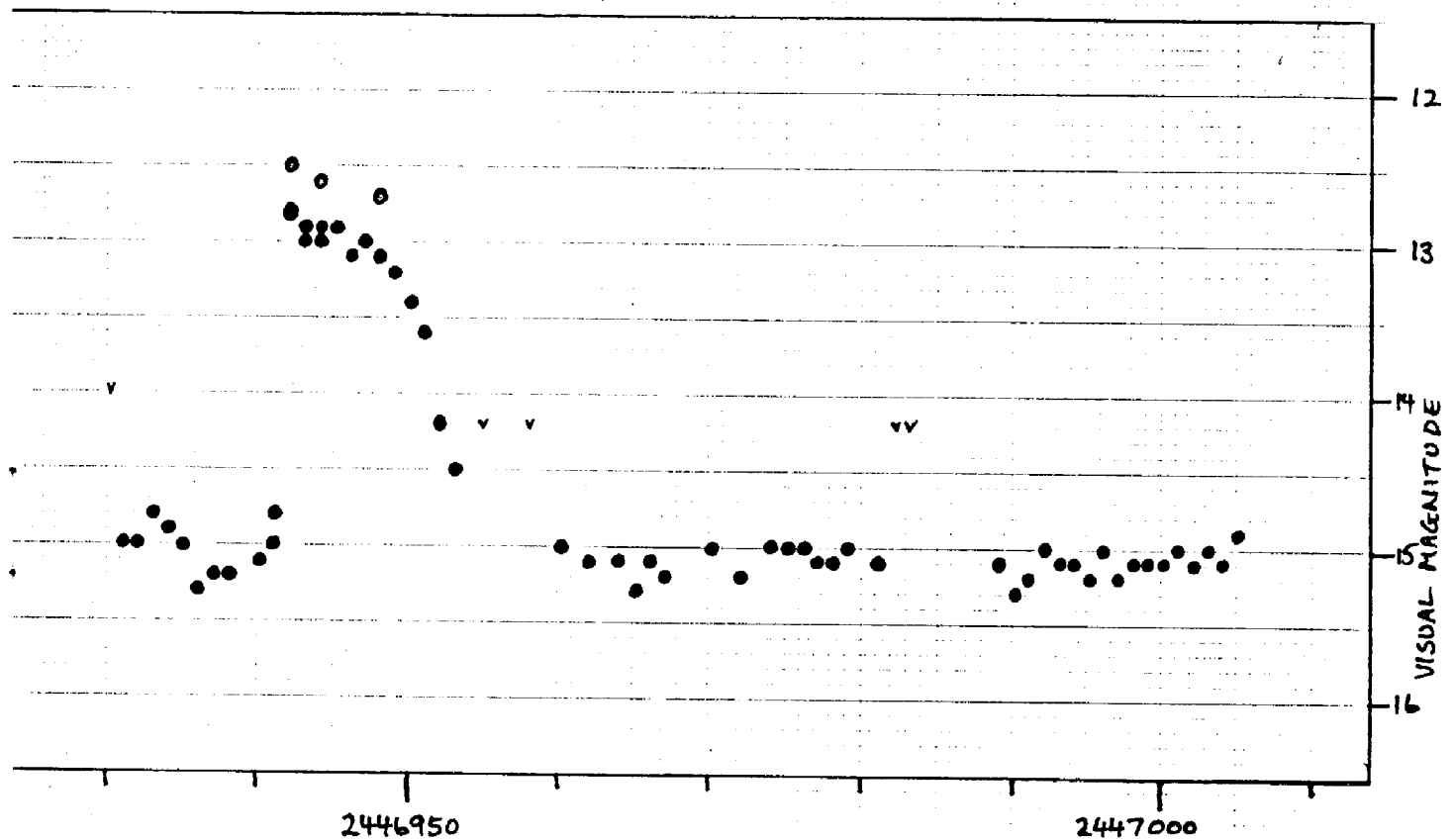


Fig.2. LIGHT CURVE OF SUSPECTED VARIABLE IN CRATERIS. J.D.2,446,930-2,447,005.
FILLED CIRCLES; OBSERVATIONS BY FLEET; OPEN CIRCLES-BEGBIE.

THE DWARF NOVA V436 CENTAURI.

Frank M. Bateson & Ranauld McIntosh

SUMMARY: Observed outbursts of V436 Cen are tabulated for the interval J.D. 2,442,949 and 2,447,192. Light curves are presented. V436 Cen is a member of the SU UMa sub-class of dwarf novae with superoutbursts and normal maxima. The results are discussed and it is shown that the mean cycle of superoutbursts changes abruptly.

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1. INTRODUCTION

Observations of V436 Cen from J.D. 2,436,256 (1958 Feb. 21) to 2,442,948 (1976 June 18) have already been published (1). That paper listed 41 outbursts, of which 14 were considered reliable; 7 reasonably certain and 20 uncertain. Hereafter we refer to that publication as Paper 1. The present paper brings the results up to 1988 January 31.

2. OBSERVATIONS

All observations were made visually by members of the Variable Star Section, Royal Astronomical Society of New Zealand. V436 Cen has been closely monitored since the publication of Paper 1. The main observing season is December through July.

Observations in August are made when the variable is low in the western evening sky, whilst in September through November V436 Cen is observed in the morning. Gaps occur in the records in all these months due to the unfavourable position of the star. This prevents the close monitoring normally given with the result that outbursts in these months can pass unobserved. There are, on the other hand, very few gaps in the records from December through July.

The majority of the observations are negative with V436 Cen being invisible.

3. OUTBURSTS

Table 1 lists all outbursts observed during the interval covered in this paper. Outbursts are divided into supermaxima (S) and narrow (N) in continuation of the table in Paper 1.

4. LIGHT CURVES

Paper 1 included no general light curve and showed only the curves for a few maxima. In this paper we therefore present an overall light curve, on a small scale, from J.D. 2,436,256 to 2,447,000. These appear in Figures 1 to 11 and give a general idea of the coverage given to this variable.

Figures 12 to 28 show expanded light curves for a number of outbursts including some from Paper 1. These enable the outbursts to be studied in detail.

All light curves have been plotted from individual observations. The symbol "v" indicates that the variable was invisible and fainter than the plotted magnitude.

5. DISCUSSION

We include in our discussion the observed outbursts in both Paper 1 and this paper.

SUPEROUTBURSTS.

Sixteen super maxima have been observed. Their mean maximum brightness is $11^m.28$ (S.D. + $0^m.24$); Range $10^m.7$ to $11^m.9$. Mean width at magnitude 13.0 is $13^d.24$ ranging from $10^d.3$ to $17^d.5$ with one uncertain width omitted. The mean interval between successive super maxima varies widely as shown in Table 2.

TABLE 2.V436 CENTAURI--MEAN INTERVALS BETWEEN SUCCESSIVE SUPERMAXIMA

<u>J.D.</u>	<u>No. of</u> <u>OUTBURSTS</u>	<u>MEAN INT</u> <u>d</u>	<u>RANGE</u> <u>d</u>
2,436,341 - 2,441,919	3	1859	1134 - 2648
2,441,920 - 2,444,382	7	352	288 - 373
2,444,382 - 2,445,159	1	777	777
2,445,160 - 2,446,955	4	449	421 - 494

The first mean interval in Table 2 is undoubtedly false because there are gaps in the observations during which super outbursts could have occurred and not been observed. This does not apply to the second interval during which it is unlikely that any superoutburst passed unobserved.

We conclude that the third mean interval in Table 2 is false, because it is probable that one superoutburst was unobserved in 1980 or 1981 between August 20 and December 2. There are large gaps in the observations in both years between these dates due to the unfavourable position of V436 Cen.

We assume that only one super maxima was unobserved. It is pure guess work to suggest when the missing superoutburst occurred, but we are inclined to suggest that it was in 1980. This would mean that the interval between outbursts 53 and the missing one would be shorter than normal. The mean cycle then lengthened.

It appears that the maximum brightness of a superoutburst falls below the mean at the superoutburst preceeding an abrupt change in the mean cycle, e.g. No. 29, $11^m.9$; No. 53 $11^m.6$. On the other hand if superoutbursts were missed in both 1980 and 1981 there was still an abrupt change in mean cycle length from outburst No. 55.

There are several examples of a normal outburst occurring shortly before the onset of a superoutburst as if the former triggered the latter. Examples are outbursts Nos. 32 & 33; 40 & 41; 50 & 51; 52 & 53. This is also seen in other dwarf novae of the SU UMa sub-class.

NARROW OUTBURSTS

There is an average of two narrow outbursts between successive super maxima, if all uncertain narrow outbursts are excluded. The mean maximum brightness of narrow outbursts is $12^m.24$ (S.D. + $0^m.22$) ranging from $11^m.9$ to $13^m.0$. The mean width of narrow maxima at magnitude 13.0 for 19 outbursts with reliable widths is $1^d.5$ (SD + $0^d.41$) ranging from $1^d.0$ to $2^d.3$.

The intervals between normal outbursts that appear to be successive varies very widely. We consider that little value can be placed on these intervals, because, despite the close monitoring, their widths are so narrow that it only needs a gap of 2 days in the observations for one to pass unobserved. All that can be stated with certainty is that narrow outbursts appear to occur at long intervals.

6. CONCLUSIONS

V436 Cen is a member of the SU UMa sub-class of dwarf novae. This can be clearly recognized from the visual light curves of the superoutbursts. The super maxima have a mean maximum brightness of $11^m.28$ compared to $12^m.24$ for the normal maxima. The respective widths at magnitude 13.0 are $13^d.24$ and $1^d.5$.

The mean cycle for superoutbursts changes abruptly after a number of cycles and it appears that the superoutburst preceding a change in mean cycle length is fainter than normal. These outbursts also seem to be triggered, at times, by a normal outburst in the same manner as has been recorded for VW Hyi and other SU UMa type variables.

Narrow outbursts have a long cycle with an average of two occurring between successive superoutbursts. However, as the widths of normal outbursts are so short it is probable that some have been unobserved and hence any conclusion about their mean cycle is meaningless.

We point out that V436 is unfavourably placed from August through November, which prevents it being as closely monitored in these months.

ACKNOWLEDGEMENTS

We thank all observers of the Variable Star Section, R.A.S.N.Z. for their careful observations.

REFERENCE

- (1) Bateson, F.M. 1977. Publ. 5 Var. Star Section, R. astr. Soc. of N.Z. pp 10-16

TABLE 1

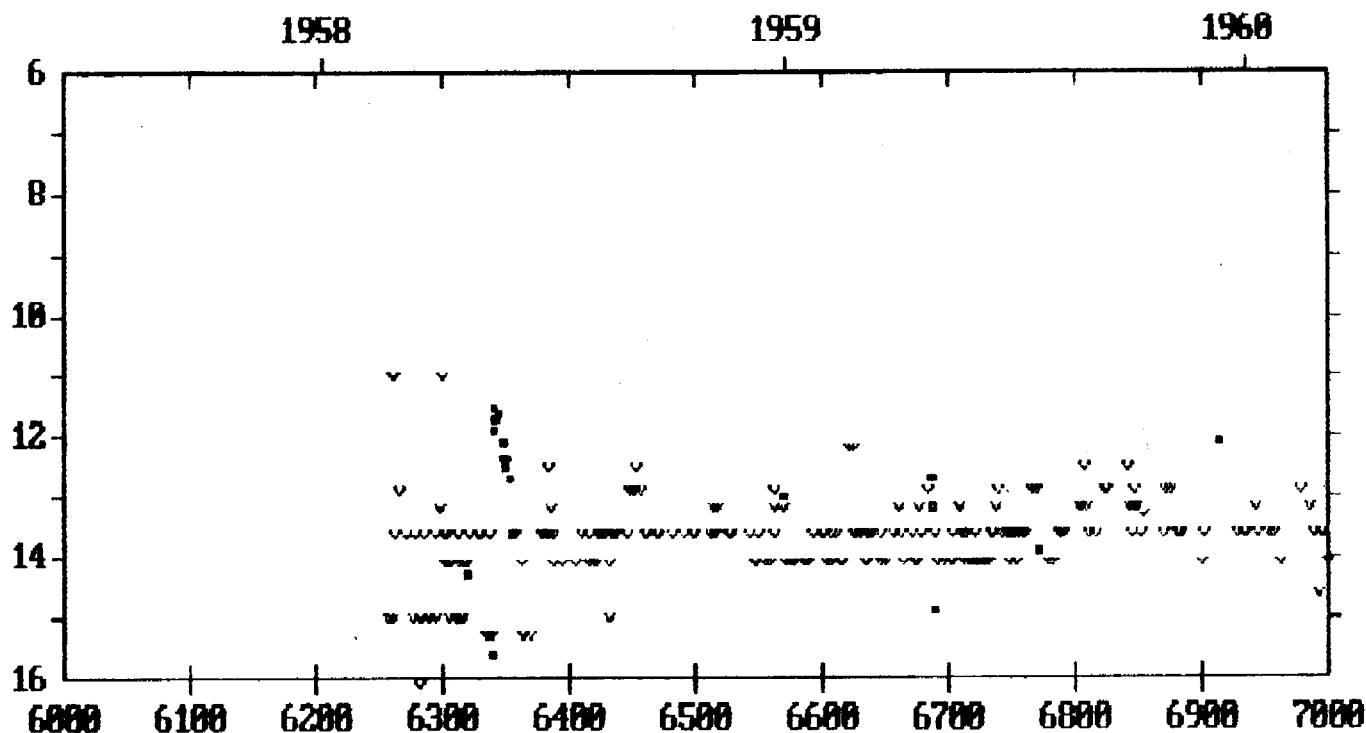
V436 CENTAURI--OBSERVED OUTBURSTS.

No.	TYPE	J.D. MAX.	MAX. M_V	INT. d	WIDTH 13.0I-D	Wt.	REMARKS
		2443000+			d		
42	N	008.9	12.2	110.7	1.0	4	
43	N	095?	13.0?	86?	...	1	A single observation. Gap 72 ^d before.
44	S	265.9	11.5	170.9	12	5	
45	N	364.9	12.2	99.0	1.0	3	
46	N	569.0	12.4	204.1	1.8	5	
47	S	638.0	11.3	69.0	15.5	5	
48	N	684.2	12.1	46.2	1	1	
49	N	849.5	12.6	165.3	...	1	A single observation. Gap 2 ^d after.
		2444000+					
50	N	005.8	11.8	156.3	2.1	3	Gap 5 ^d before
51	S	011.0	11.1	5.2	12.0	5	
52	N	370.9	11.9	359.9	2	5	
53	S	381.8	11.6	10.9	10.3	5	
54	N	632.0	11.9	250.2	1.0	5	
		2445000+					
55	S	159.0	10.9	527.0	14.4	5	
56	N	360.5	12.2	201.5	1.3	4	
57	N	559.9	12.2	199.4	1.8?	3	
58	S	653.1	11.3	93.2	12.0	5	
59	N	735.0	12.1	81.9	1.0	4	
60	N	891.8?	12.3	156.8	...	1	A single observation. Gap 2 ^d before & 3 ^d after.

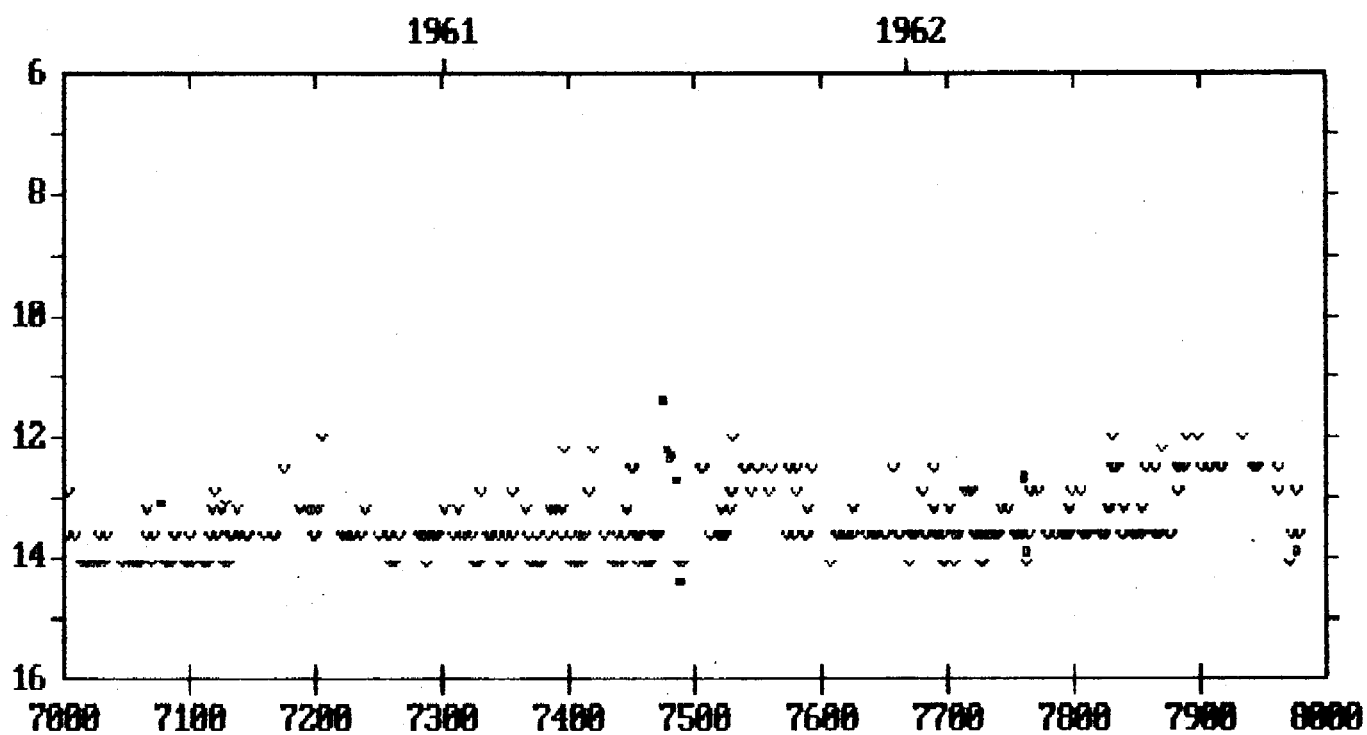
TABLE 1 (cont)

<u>No.</u>	<u>TYPE</u>	<u>J.D. Max.</u> 2446000+	<u>MAX.M_V</u>	<u>INT.</u> d	<u>WIDTH</u> <u>13.0I-D</u> d	<u>Wt.</u>	<u>REMARKS</u>
61	S	087.4	11.0	195.6	12.5	5	
62	N	221.2	12.0	133.8	1.2	3	Gap 2 ^d before
63	S	508.4	11.1	287.2	12.5	5	
64	N	526.9	12.9	18.5	....	4	
65	N	621.8	12.1	94.9	1.2	4	
66	N	803?	11.8?	181.2	...	2	Gap 4 ^d after. Not plotted on curve.
67	S	954.8 2447000+	11.0	151.8	13.6	5	
68	N	085.2?	12.1?	130.4	...	1	A single observation. Gaps 2 ^d before & after.

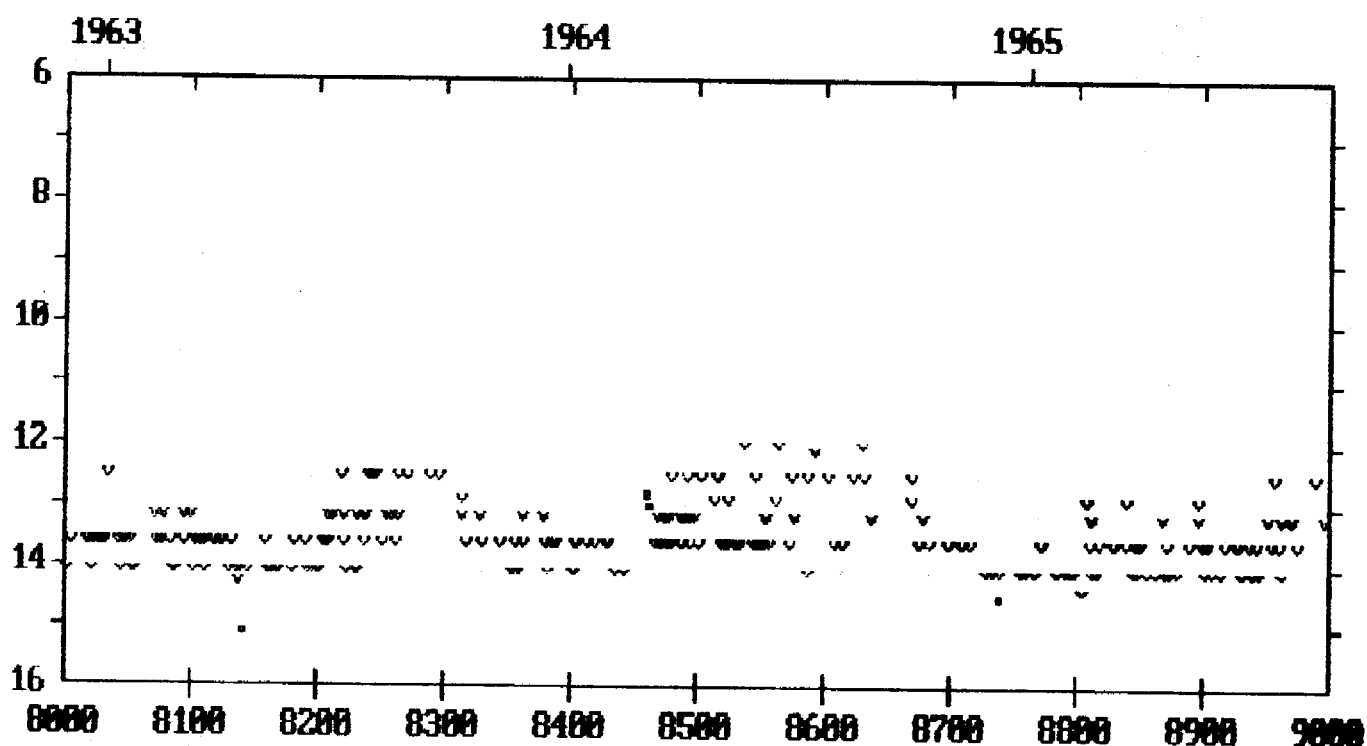
.



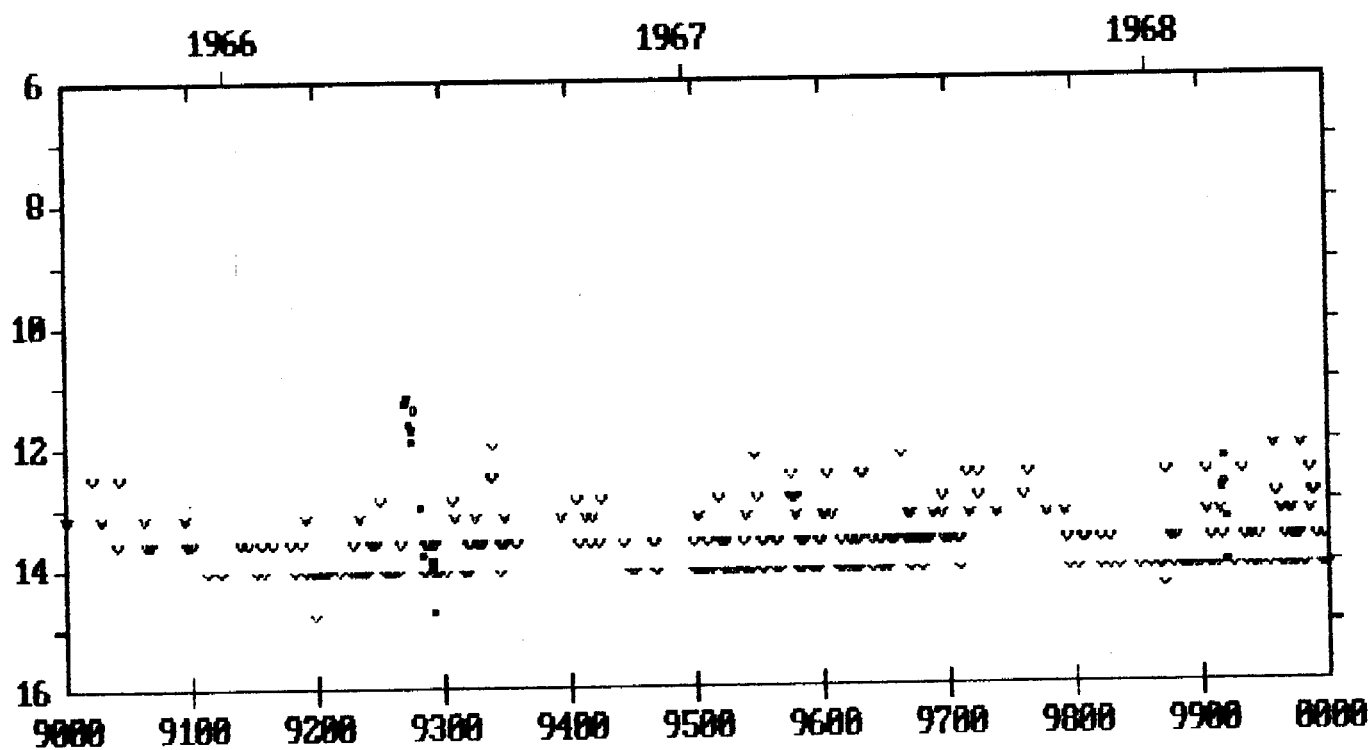
JD 2436000 - 2437000 Figure 1. V436 Cen Light curve showing outbursts
Nos. 1 to 5 from Paper 1.



JD 2437000 - 2438000 Figure 2. V436 Cen Light curve showing outbursts
Nos. 6 to 9 from Paper 1.

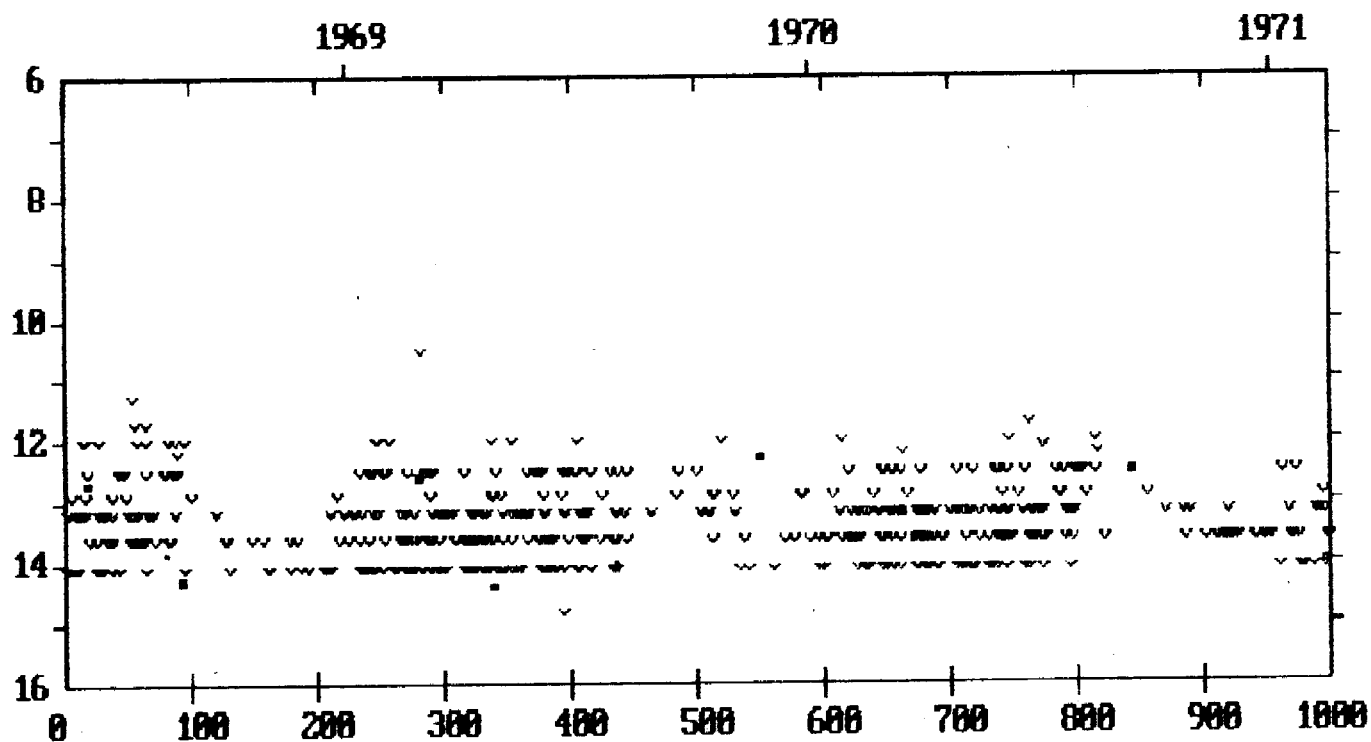


JD 2438000 - 2439000 Figure 3. V436 Cen Light Curve showing outbursts
Nos. 10 to 12 from Paper 1.



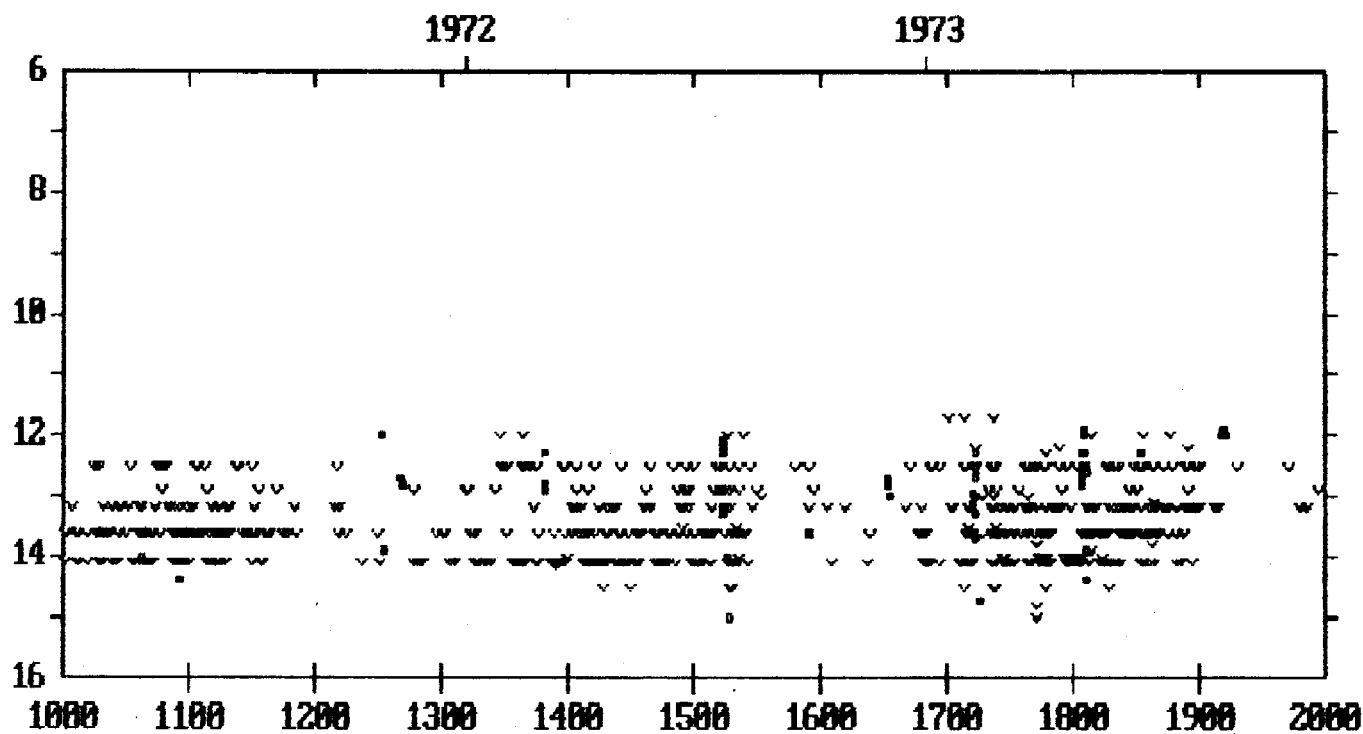
JD 2439000 - 2440000

Figure 4. V436 Cen Light curve showing outbursts
Nos. 13 to 16 from Paper 1.

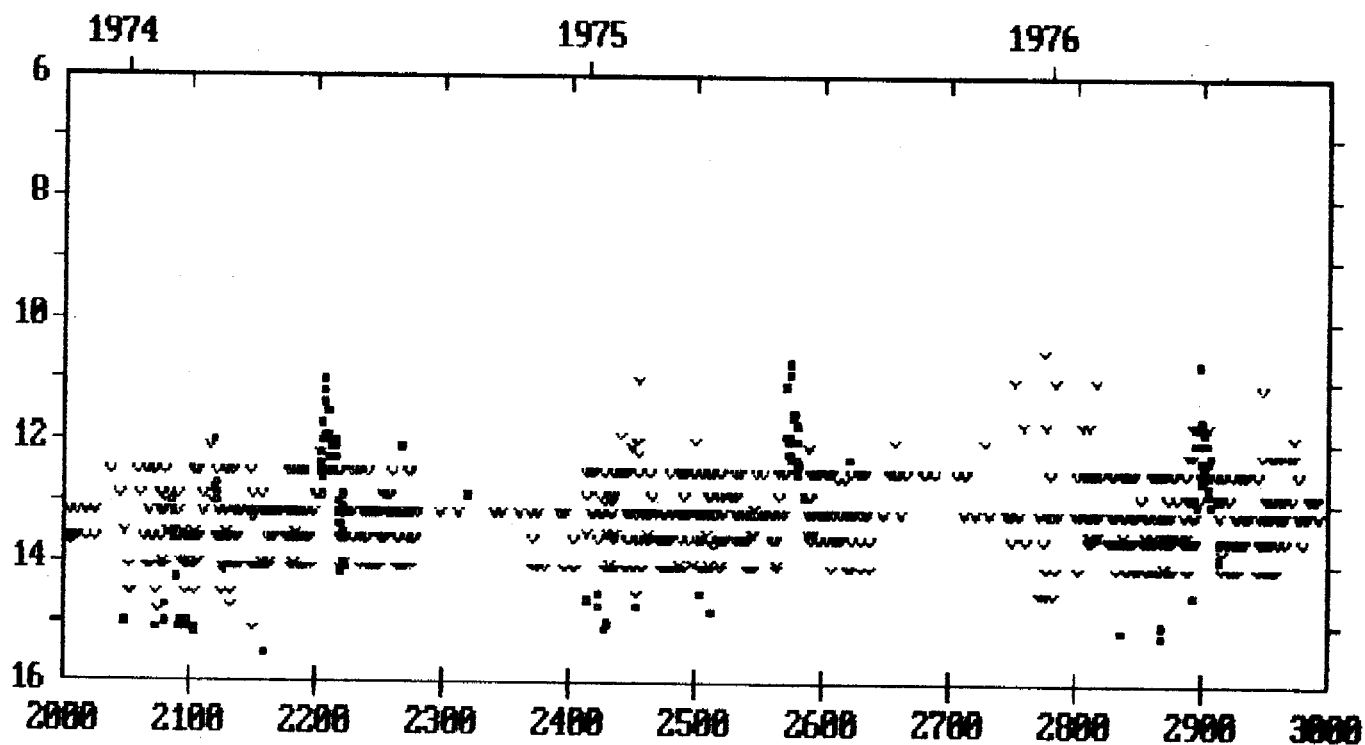


JD 2440000 - 2441000

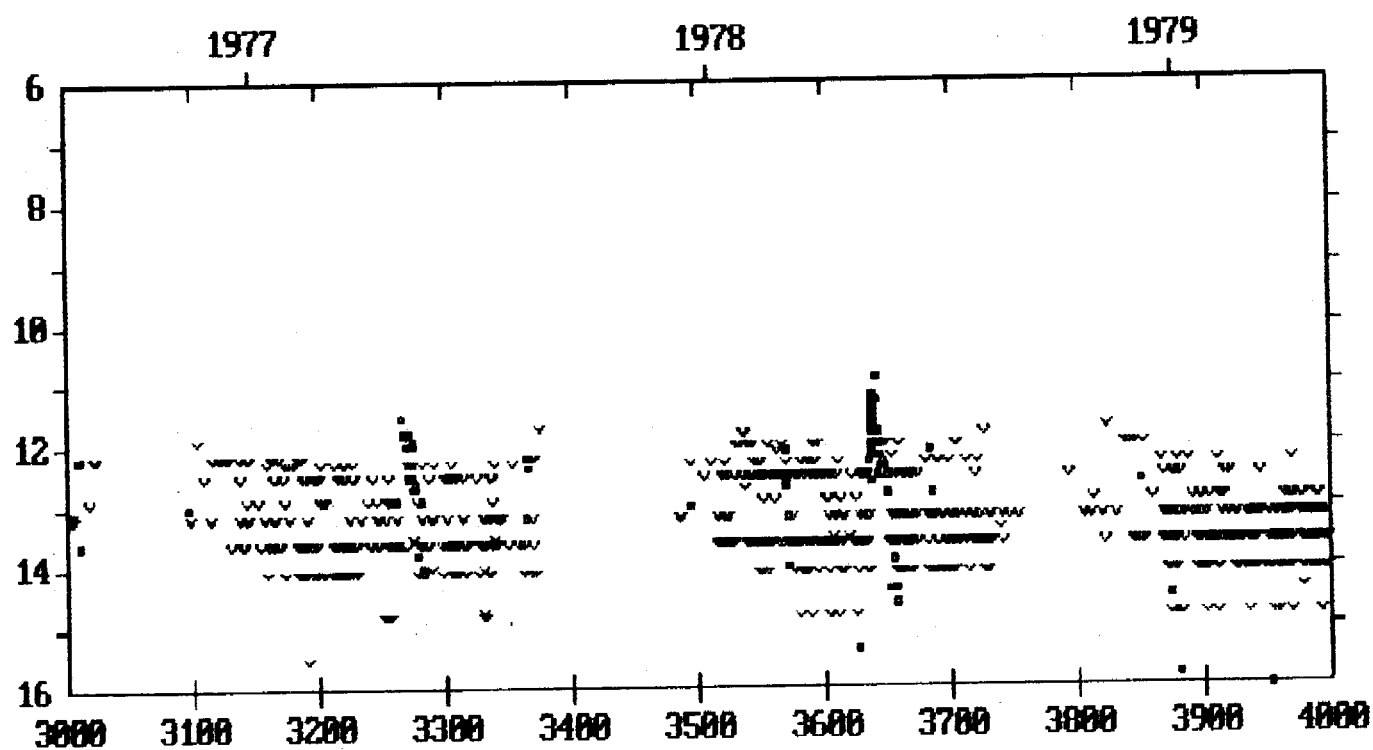
Figure 5. V436 Cen Light curve showing outbursts
Nos. 17 to 21 from Paper 1.



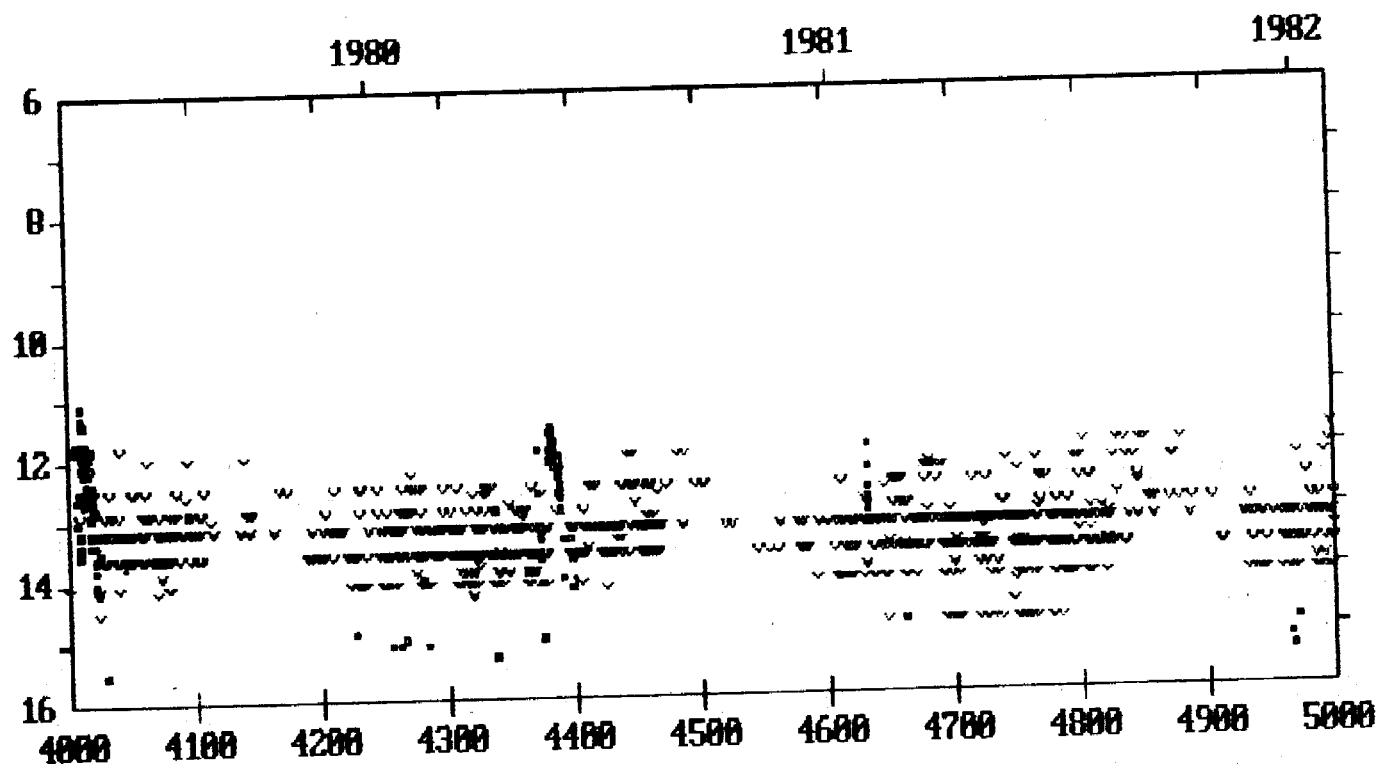
JD 2441000 - 2442000 Figure 6. V436 Cen Light Curve showing outbursts
Nos. 22 to 29 from Paper 1.



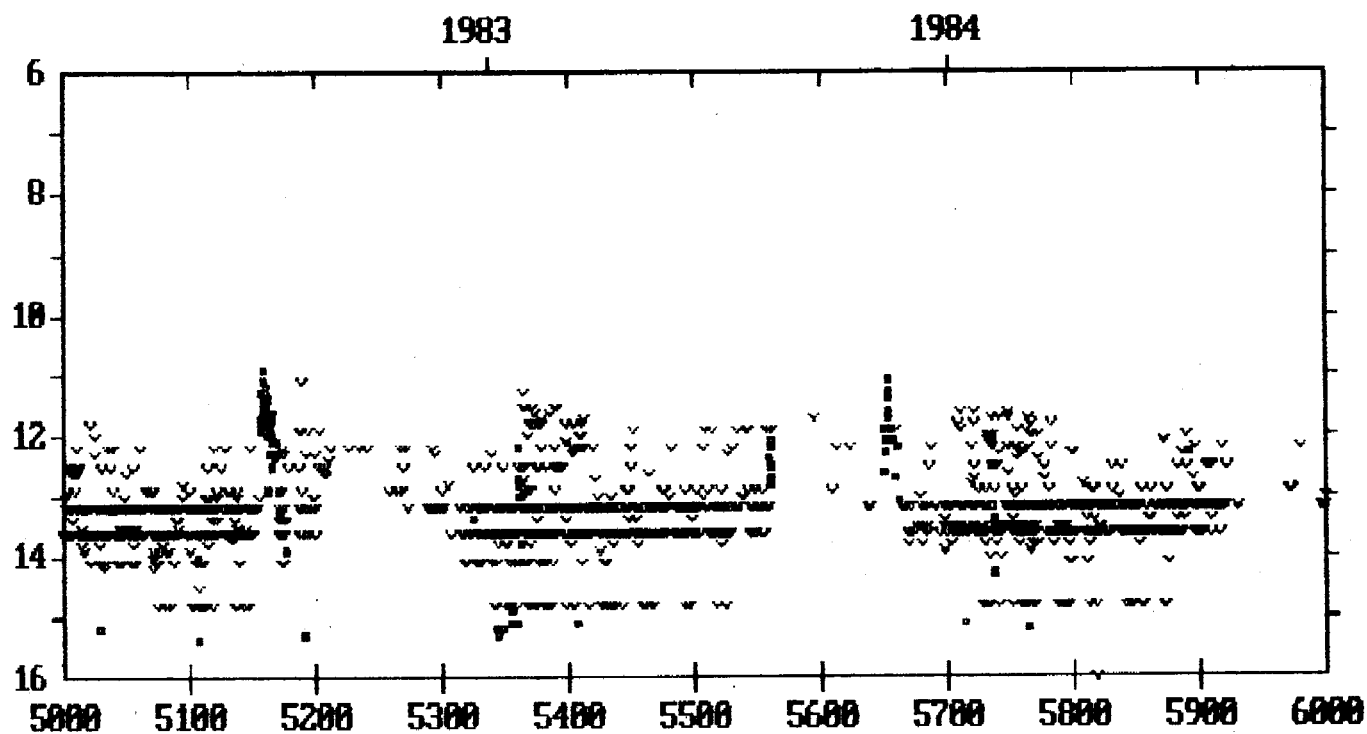
JD 2442000 - 2443000 Figure 7, V436 Cen Light curve showing outbursts
Nos. 30 to 41 from Paper 1.



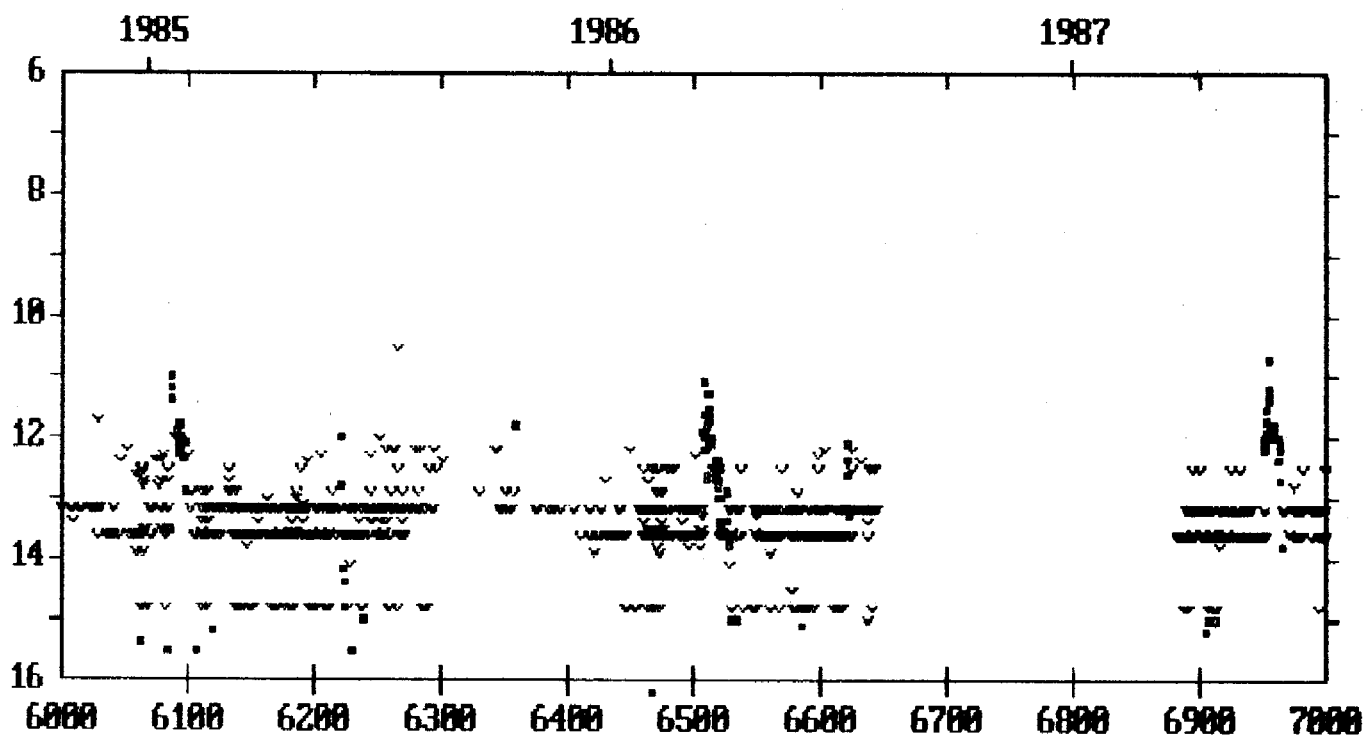
JD 2443000 - 2444000 Figure 8. V436 Cen Light curve showing outbursts
Nos. 42 to 49.



JD 2444000 - 2445000 Figure 9. V436 Cen Light curve showing outbursts
Nos. 50 to 54.



JD 2445000 - 2446000 Figure 10. V436 Cen Light curve showing outbursts
Nos. 55 to 60.



JD 2446000 - 2447000 Figure 11. V436 Cen. Light curve showing outbursts
Nos. 61 to 67.

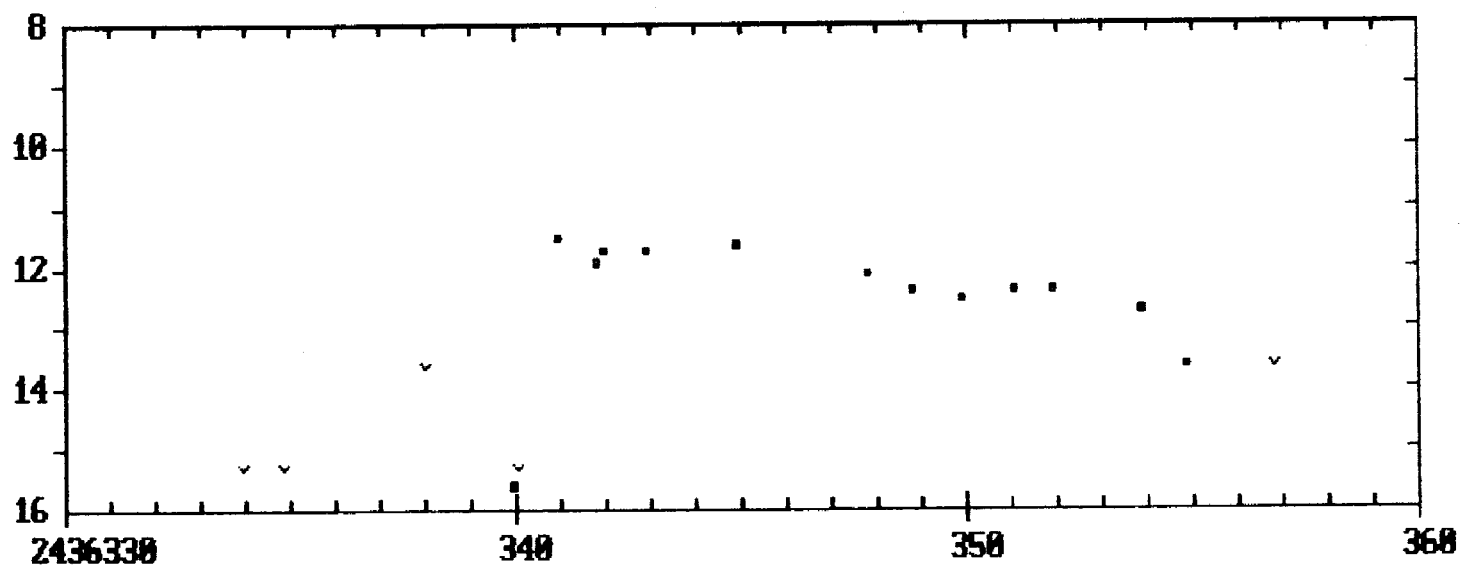


Figure 12. V436 Cen. Light curve of outburst No. 1 (Paper 1)

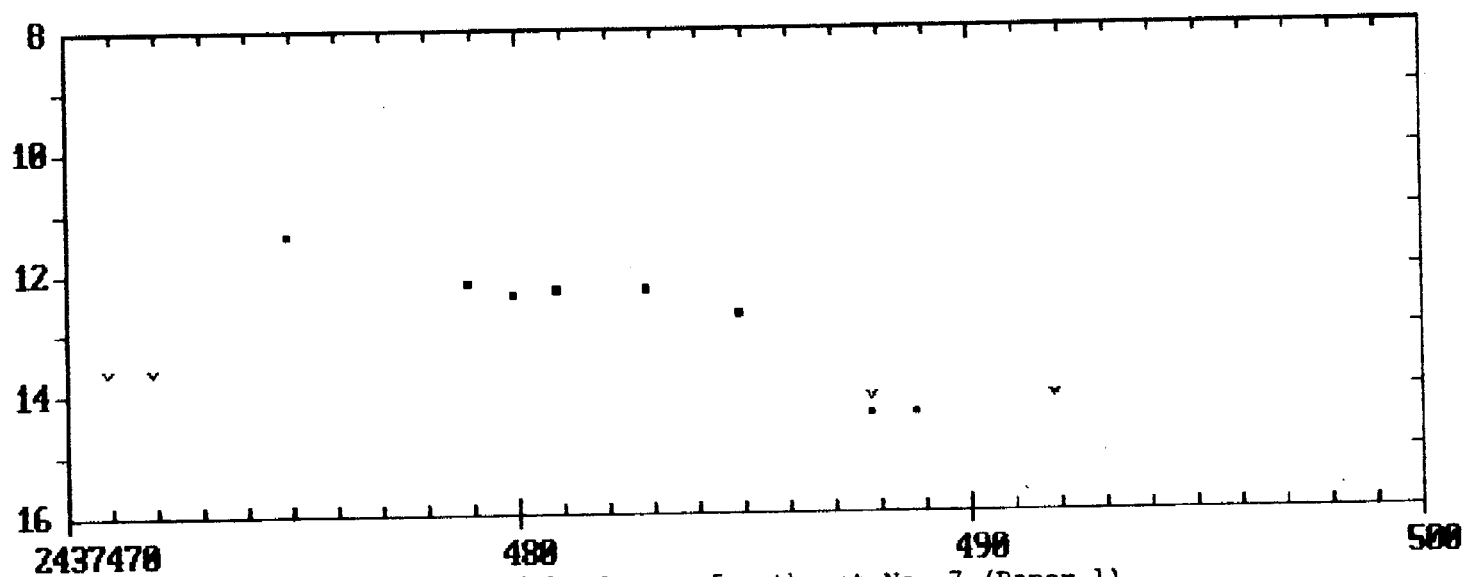


Figure 13. V436 Cen. Light Curve of outburst No. 7 (Paper 1)

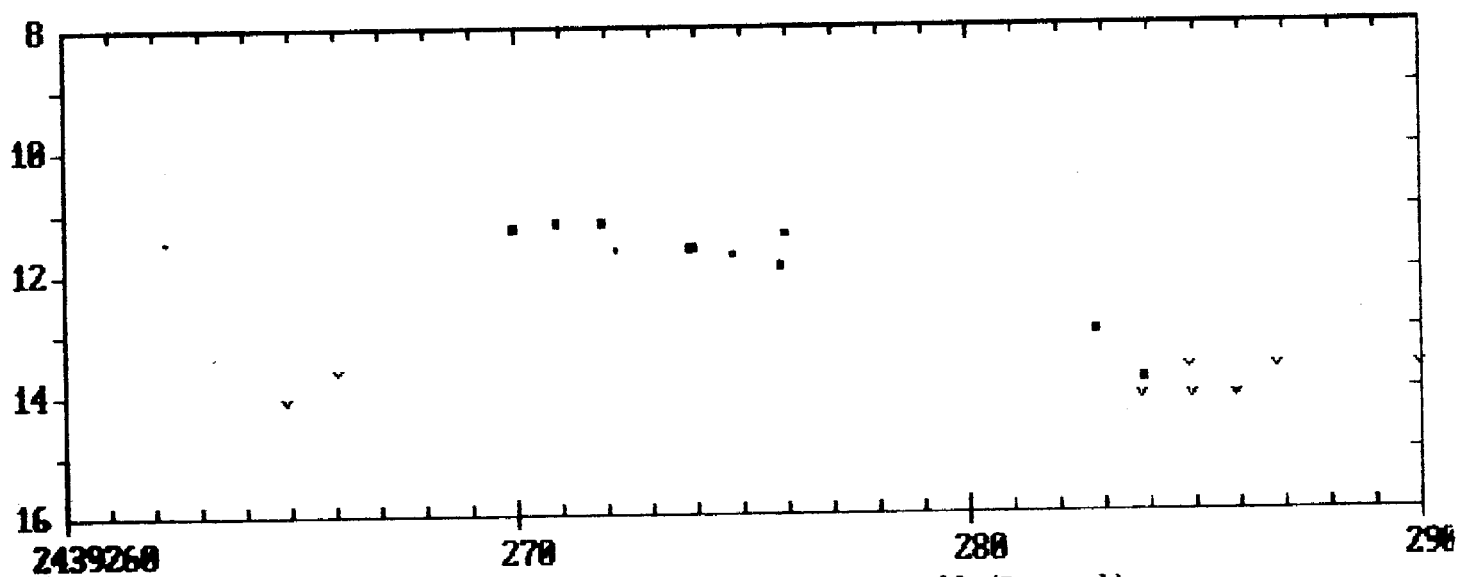
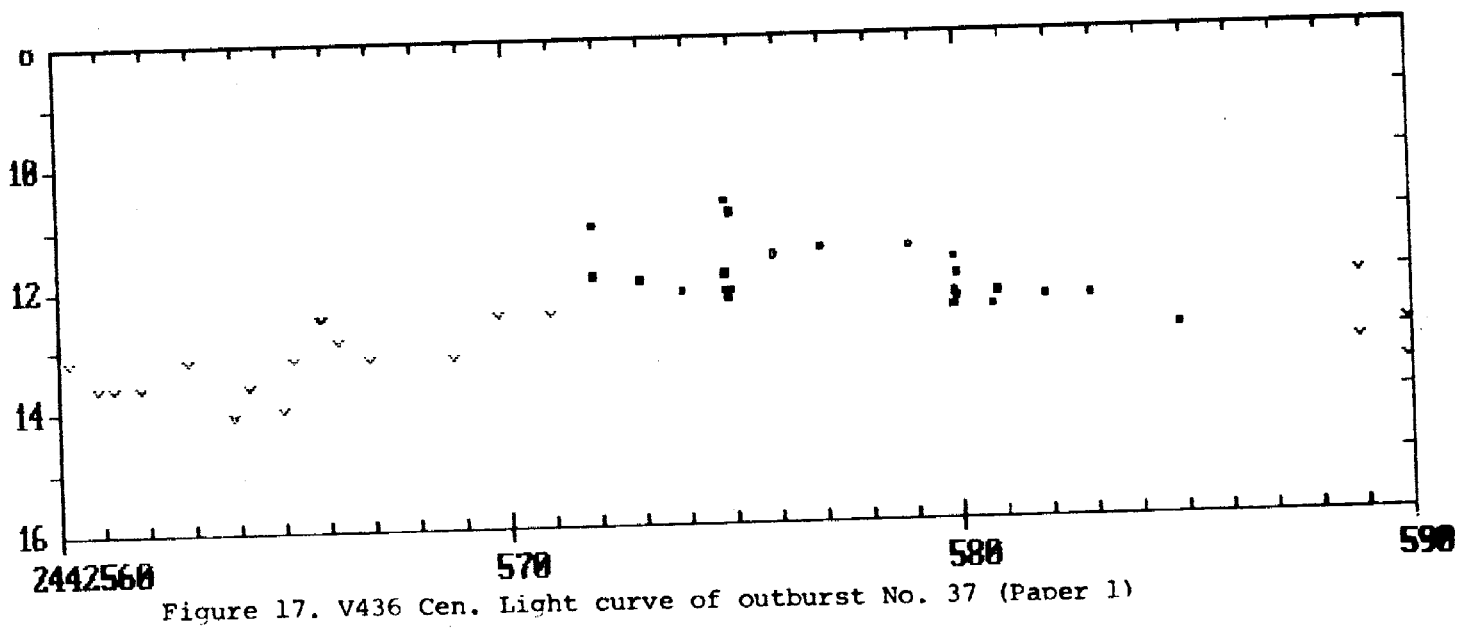
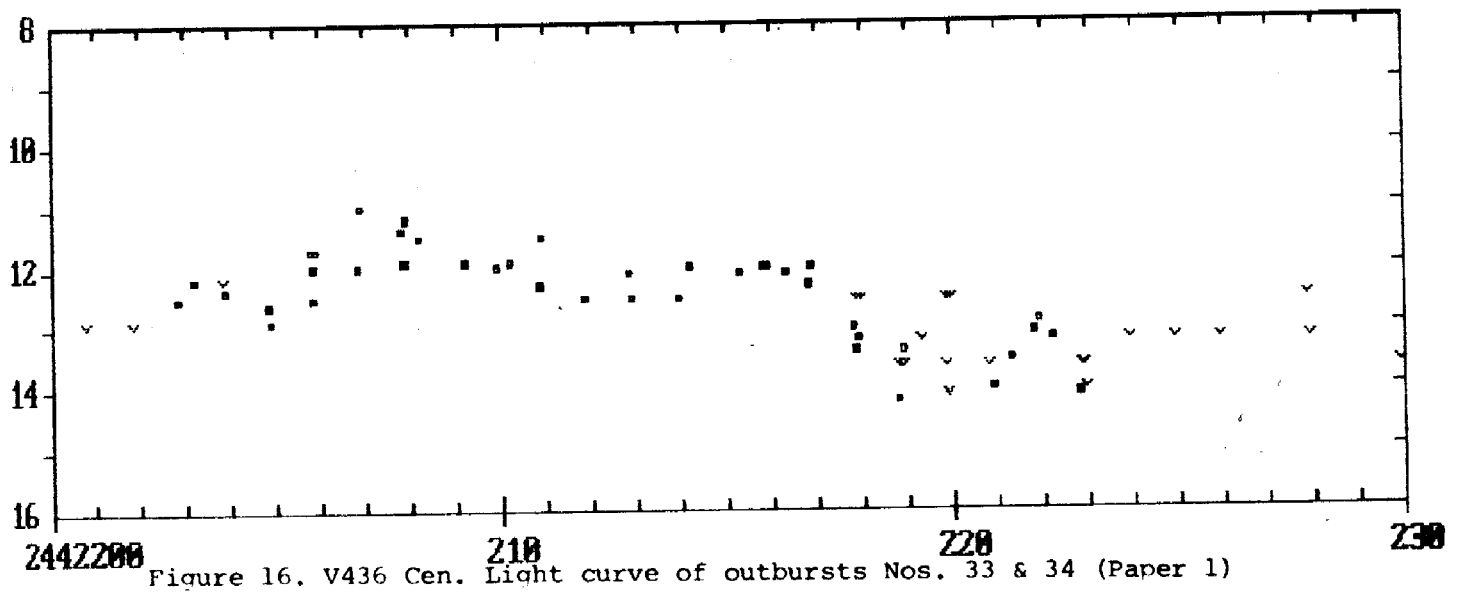
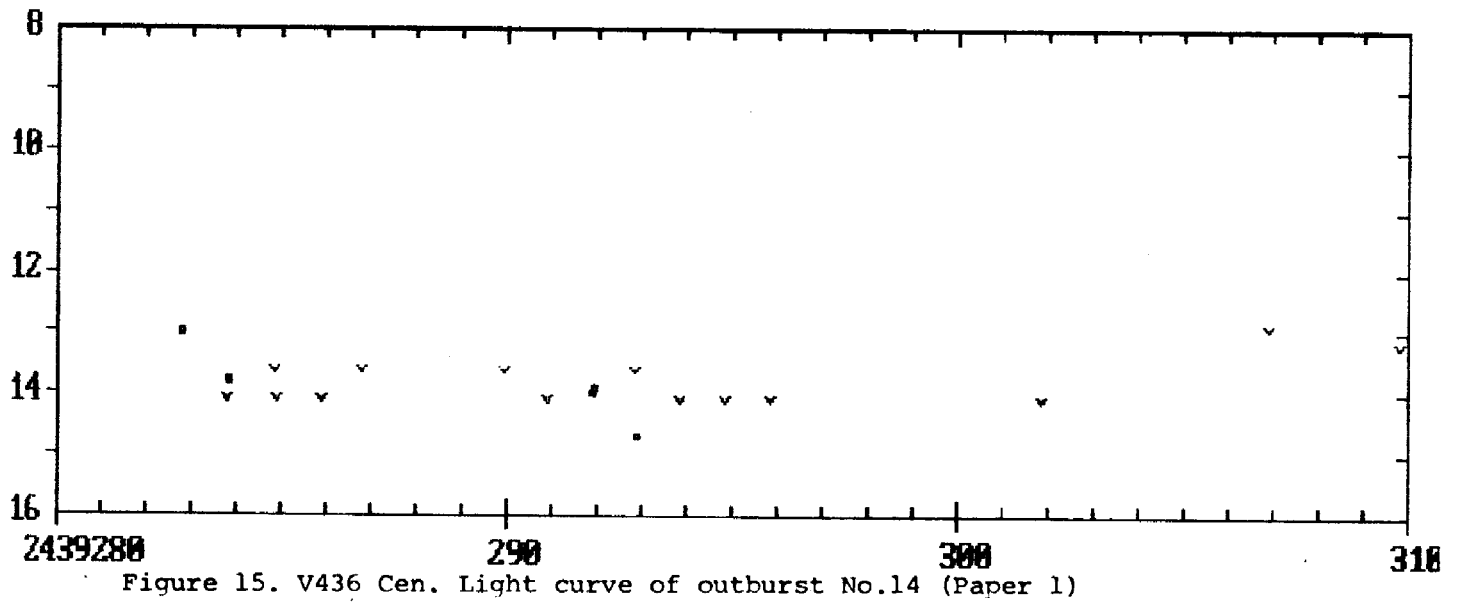


FIGURE 14. V436 Cen. Light curve of outburst No. 13 (Paper 1)



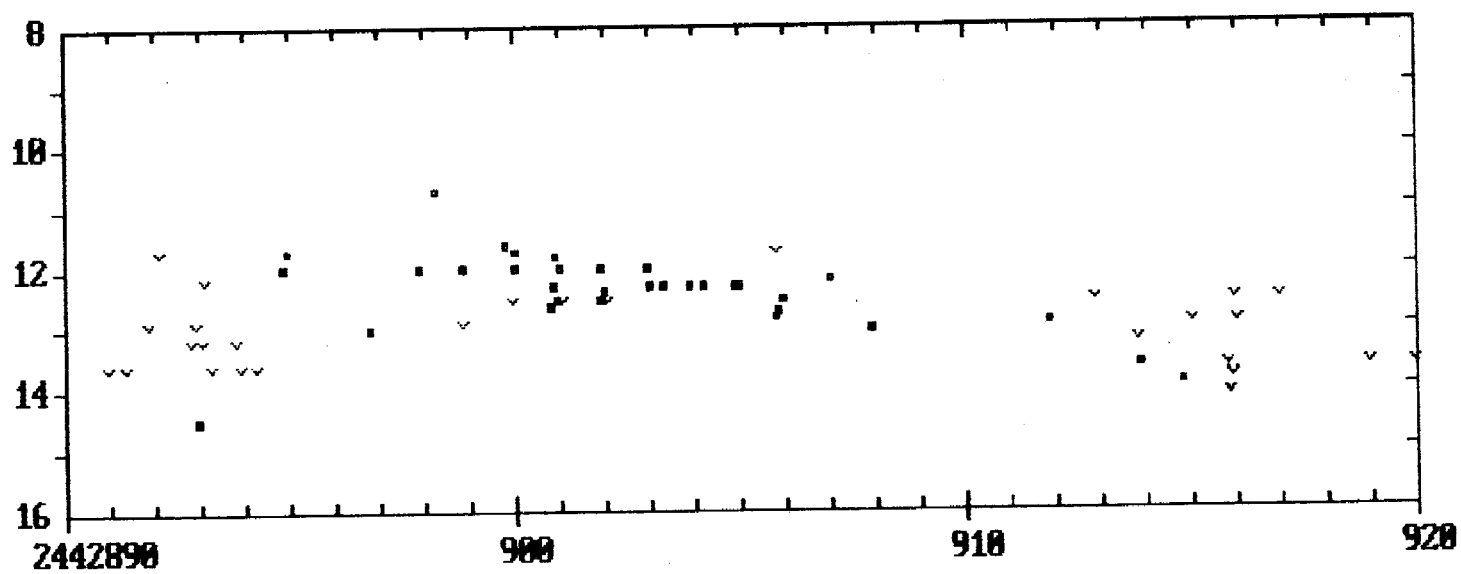


Figure 18. V436 Cen Light curve of outburst No.41 (Paper 1)

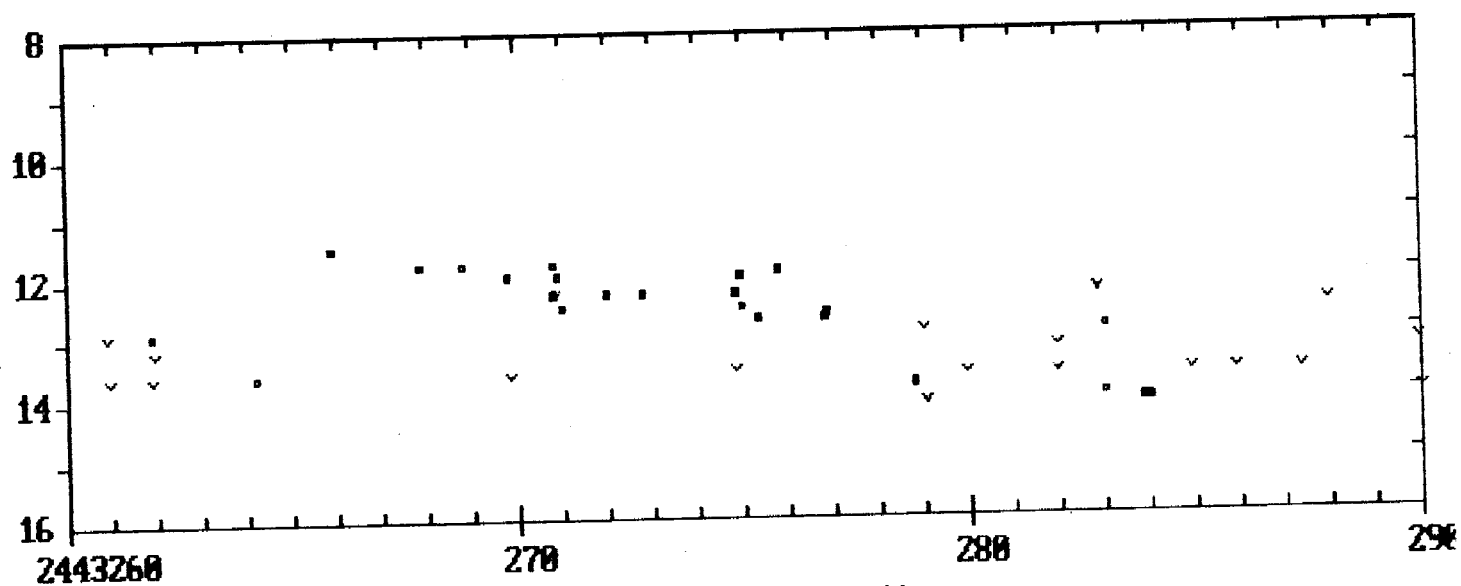


Figure 19. V436 Cen Light curve of outburst No. 44.

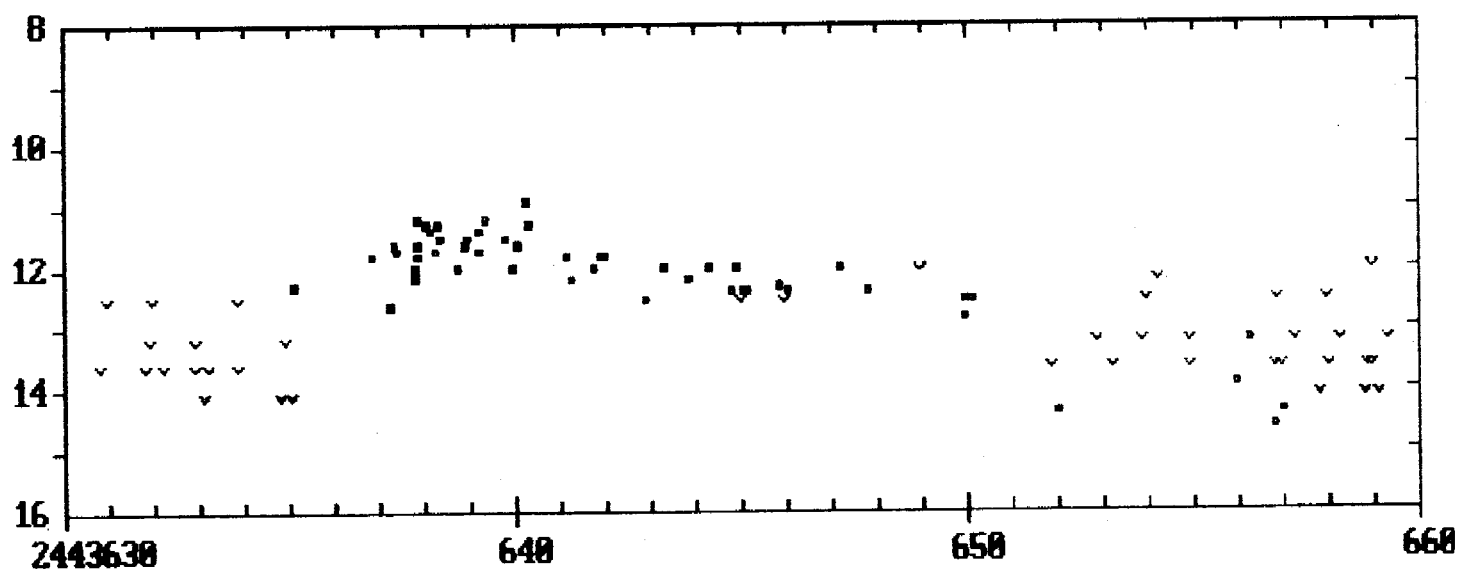


FIGURE 20. V436 Cen Light curve of outburst No. 47.

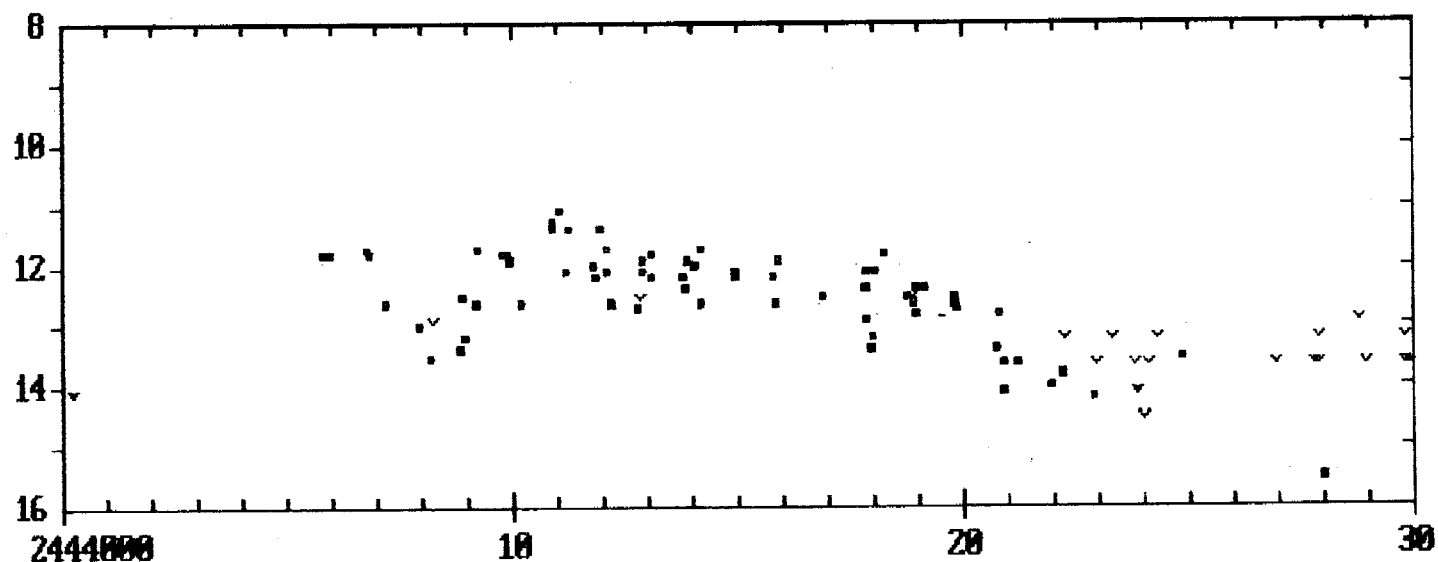


Figure 21. V436 Cen Light curve of outbursts Nos. 50 and 51.

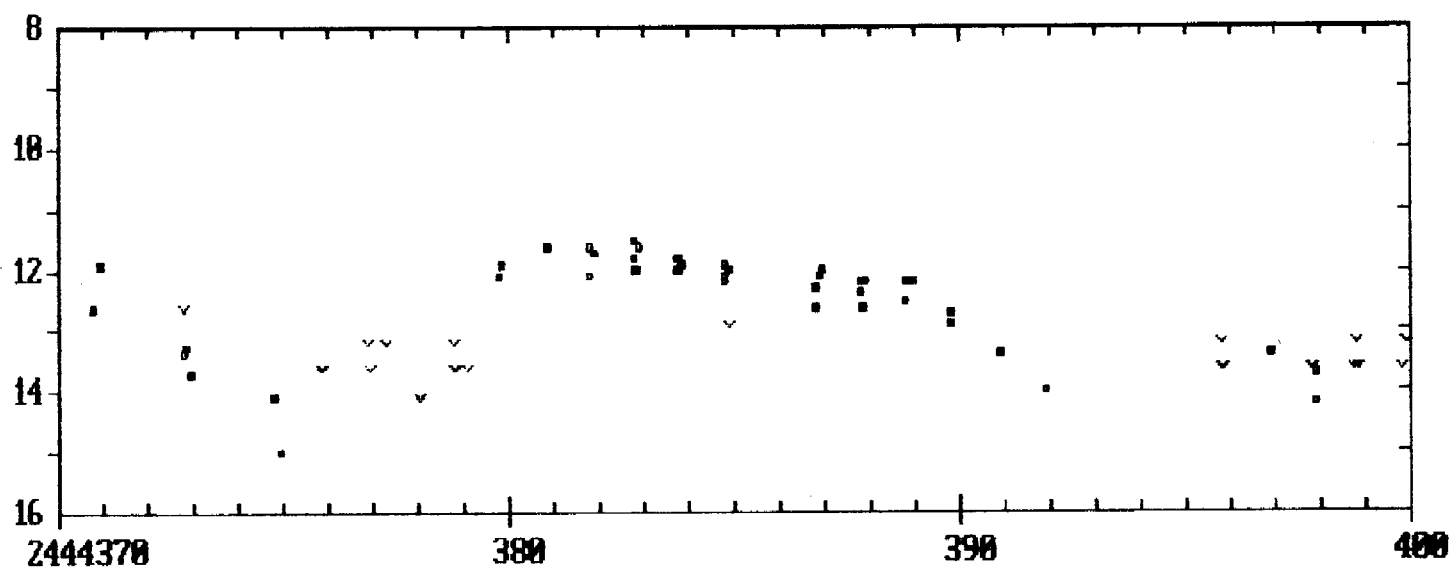


Figure 22. V436 Cen Light curve of outbursts Nos. 52 and 53.

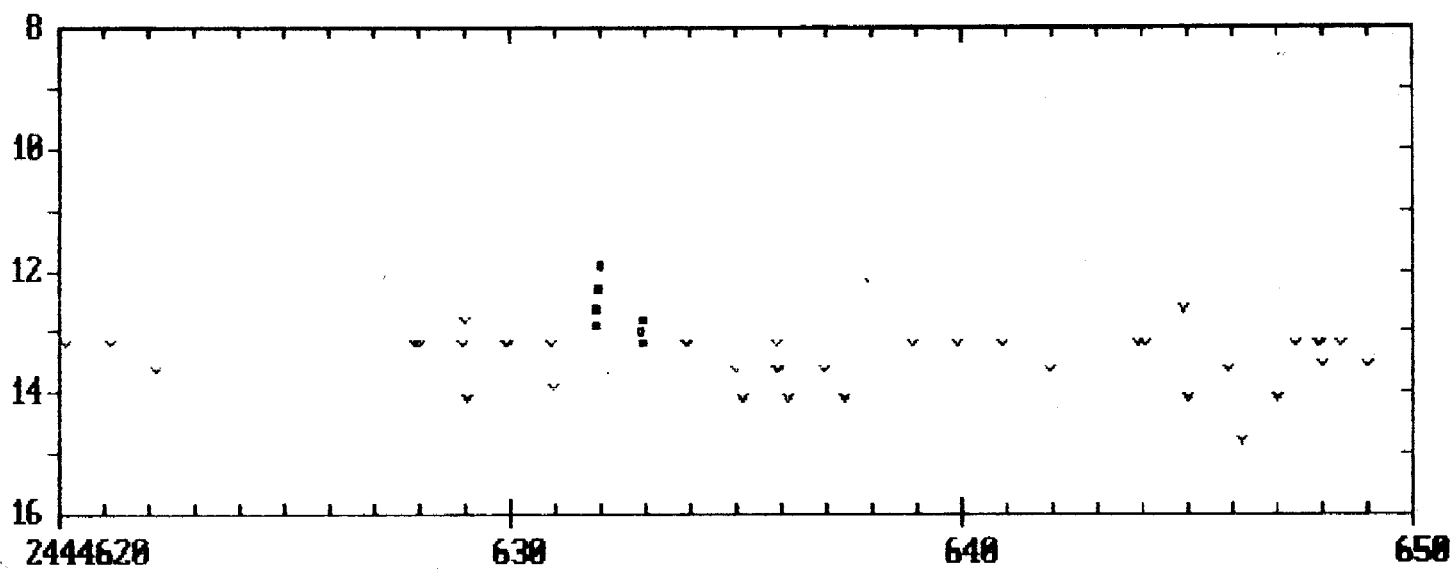


Figure 23. V436 Cen Light curve of outburst No. 54.

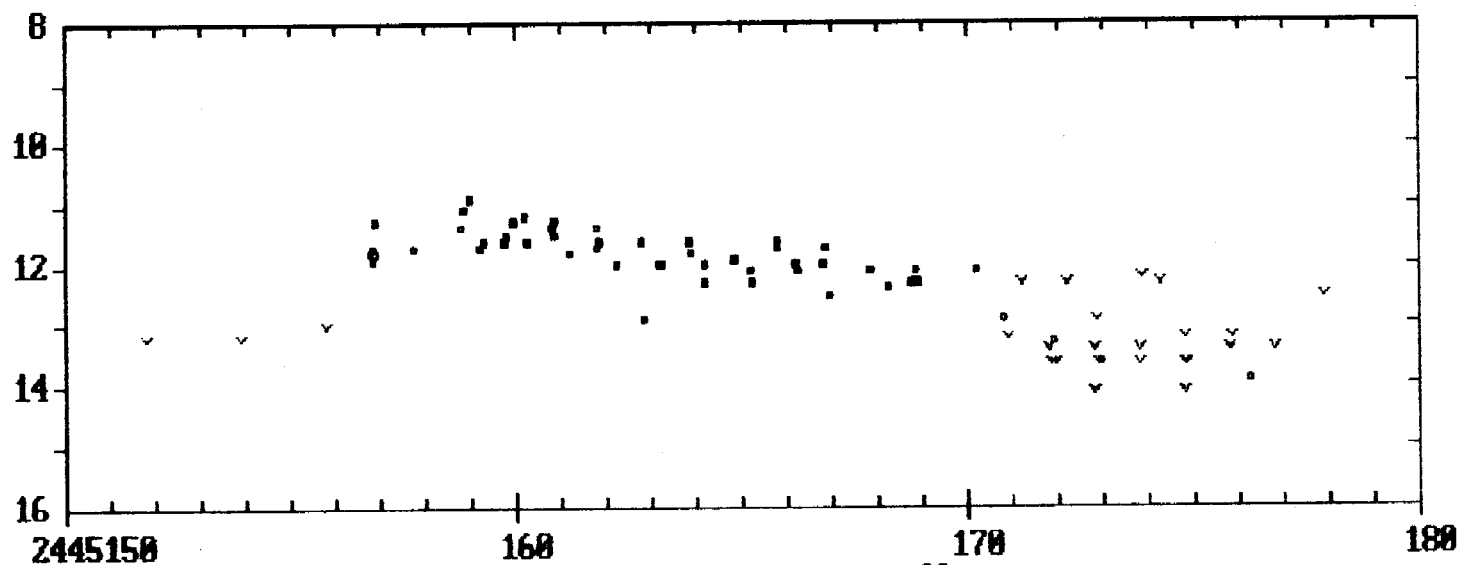


Figure 24. V436 Cen Light curve of outburst No.55

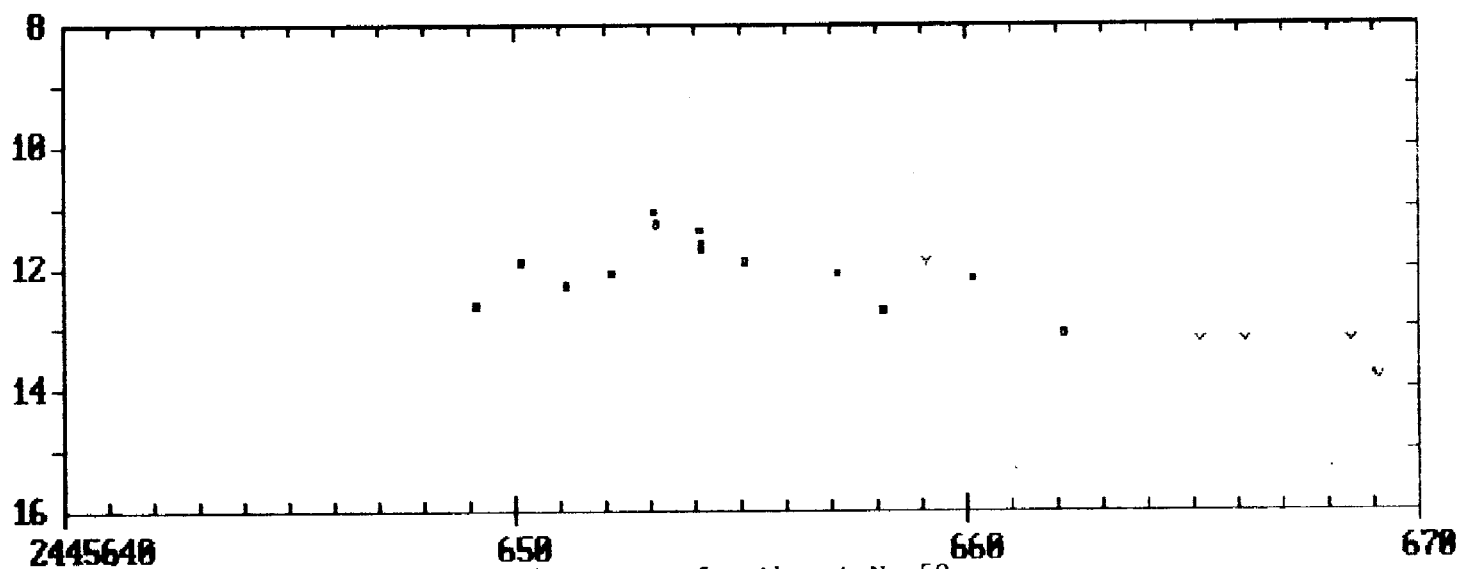


Figure 25. V436 Cen Light curve of outburst No.58.

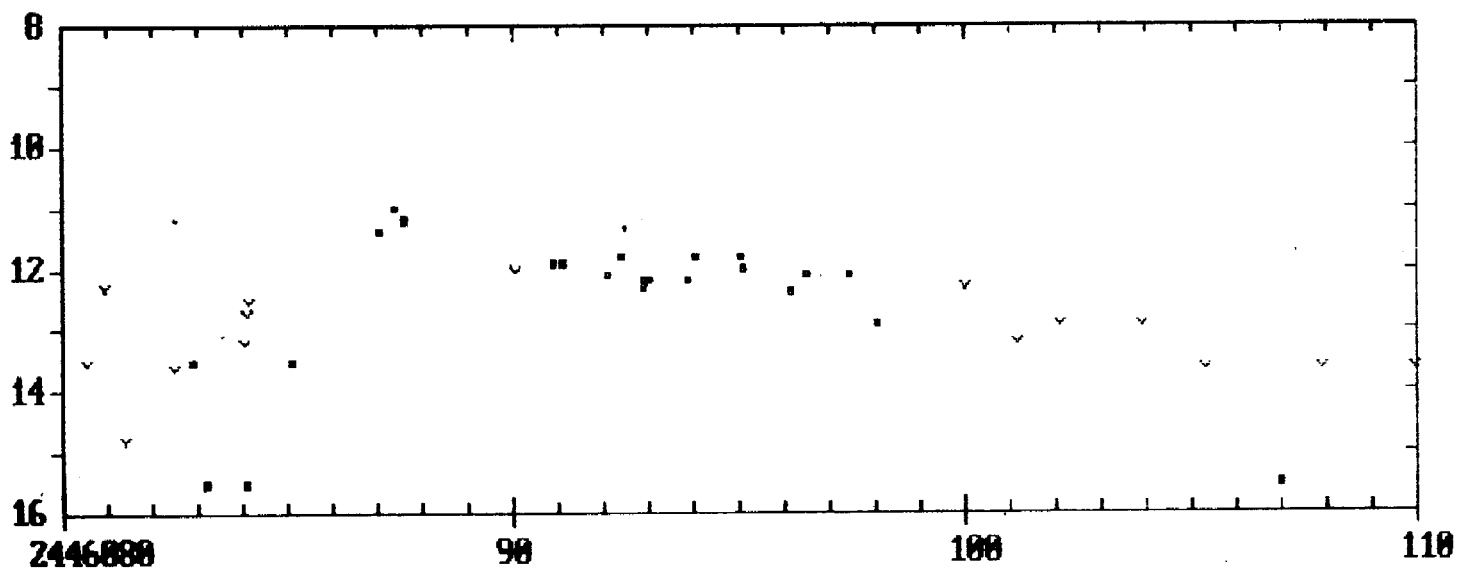


Figure 26. V436 Cen Light curve of outburst No. 61.

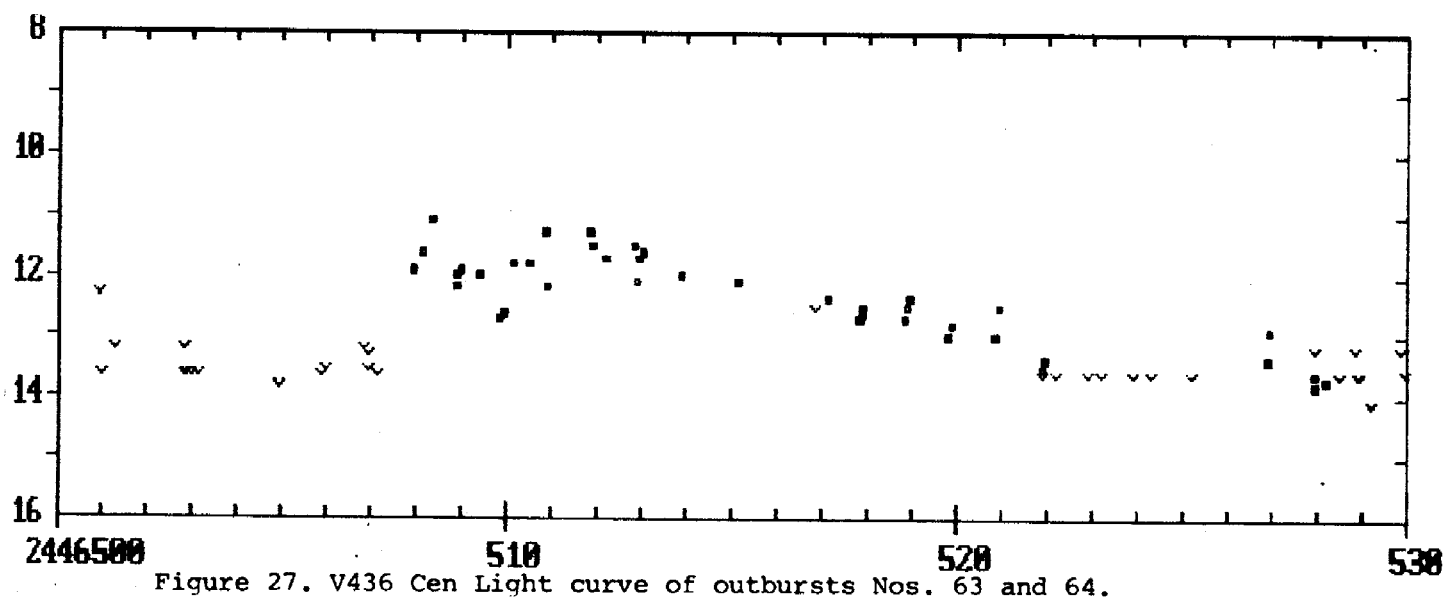


Figure 27. V436 Cen Light curve of outbursts Nos. 63 and 64.

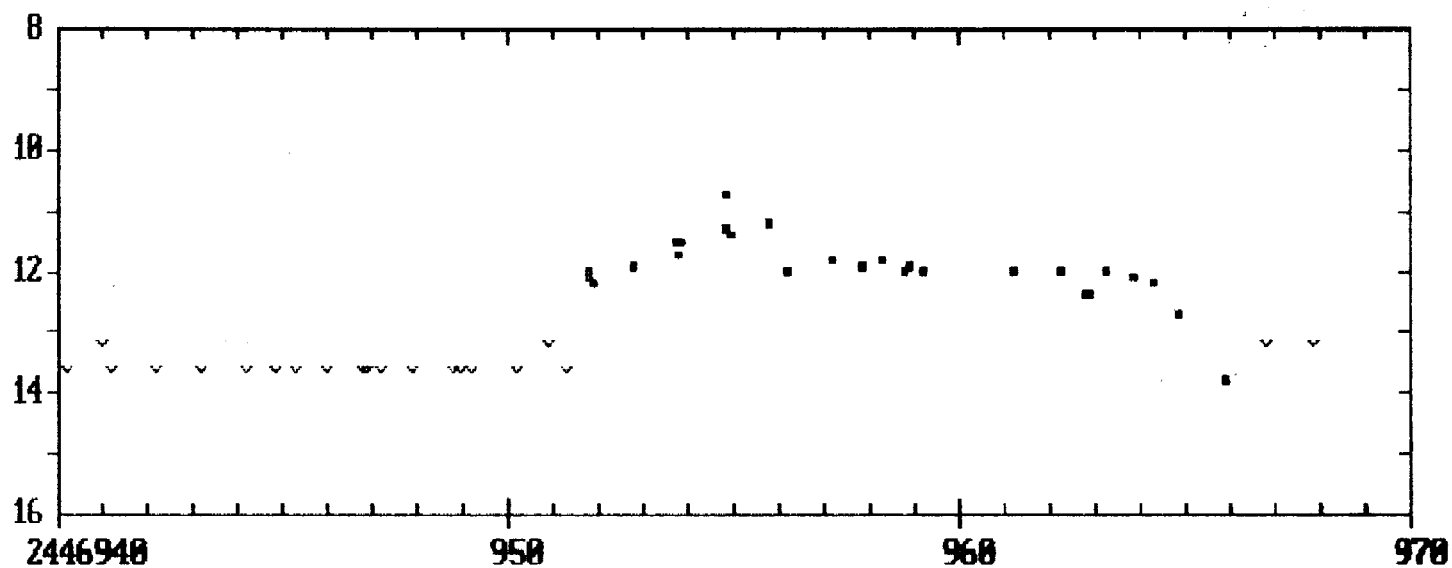


Figure 28. V436 Cen Light curve of outburst No. 67.

THREE COLOUR OBSERVATIONS OF SN1987A

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SUMMARY: Three colour observations of SN1987A are tabulated for the interval J.D. 2,446,850 to 2,447,237. A description of the photometric system at the Adams Lane Observatory is given.

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1. PHOTOMETRIC SYSTEM

The photometric system at the Adams Lane Observatory uses a 32cm Cassegrain reflector, an uncooled EMI 9789QB end window photomultiplier, a current-to-frequency converter and Johnson standardised UBV filters. The filters were standardised using E regions(1).

The photometer filter-wheel is controlled by a microcomputer and at the conclusion of the UBV measurements the magnitude of the object being observed is calculated relative to the comparison star. This calculation makes allowance for the transform coefficients of the photometric system and the airmass of the object.

The photometer control programme is very flexible and any integration period can be used with averaging of any number of observations being possible.

The reduction equations used by the programme are as follows:

$$\begin{aligned} V &= (v + \eta(B-V)) + A \\ B-V &= \mu(b-v) - .053(b-v)AM + B \\ U-B &= \psi(u-b) - 0.011(u-b)AM + C \end{aligned}$$

Where v is the measured value.

V is the standard value.

η , μ and ψ are the transform coefficients,

AM is the airmass.

A , B and C are the zero points.

Transform Coefficients

<u>DATE</u>	<u>η</u>	<u>μ</u>	<u>ψ</u>	<u>A</u>	<u>B</u>	<u>C</u>
9.6.87	-0.0585	1.1032	1.1863	0.0370	0.0290	0.5000
18.8.87	-0.1140	1.1450	1.1380	0	0	0

2. OBSERVATIONS

The observations in Table 1 cover the interval from 1987 February 23 (2,446,850) to 1988 March 16 (2,447,237). The comparison star used was Theta Dor ($V=4.82$; $B-V = 1.28$; $U-B = 1.38$).

Observations to 1987 September were combined with those results obtained at the West Melton Observatory, Christchurch, and V and $B-V$ light curves published (2).

REFERENCES

- (1) Cousins, A.W.J. & Stoy, R.H. 1963. Bull. 54 Royal Observatory
- (2) Rowe, C. & Allen, W.H. 1988. Inf. Bull. Var. stars. 3129

TABLE 1.

THREE COLOUR OBSERVATIONS OF SN 1987A

J.D.	V	B-V	U-B	J.D.	V	B-V	U-B
244+				244+			
6850.92	4.569	0.327	-0.374	7014.19	4.779	1.534	+2.442
6852.95	4.407	0.532	+0.783	7015.19	4.781	1.539	2.452
6859.88	4.374	1.094	1.907	7016.19	4.801	1.537	2.443
6861.87	4.269	1.276	2.160	7017.19	4.792	1.531	2.434
6872.94	4.099	1.474	2.411	7020.19	4.806	1.539	2.407
6876.83	4.018	1.505	2.490	7021.19	4.843	1.532	2.405
6878.99	3.972	1.494	2.470	7023.13	4.865	1.520	2.378
6879.87	3.952	1.513	2.490	7024.19	4.889	1.571	2.118
6881.92	3.889	1.496	2.490	7026.19	4.883	1.530	2.046
6886.88	3.882	1.575	2.510	7037.13	5.000	1.483	1.979
6889.87	3.650	1.540	2.760				
				7038.19	4.974	1.513	1.995
6890.89	3.645	1.672	2.560	7039.17	5.016	1.501	1.981
6894.92	3.550	1.578	2.610	7042.19	5.040	1.502	1.966
6896.04	3.519	1.578	2.640	7043.10	5.047	1.492	1.951
				7044.14	5.059	1.495	1.952
6900.88	3.424	1.524	2.530	7062.06	5.229	1.436	1.836
6901.79	3.361	1.518	2.460	7065.98	5.277	1.417	1.782
6905.89	3.324	1.520	2.480	7066.10	5.269	1.429	1.806
6906.86	3.288	1.525	2.560	7071.10	5.315	1.430	1.760
6909.04	3.176	1.536	2.530	7079.00	5.383	1.413	1.730
6909.91	3.174	1.438	2.500				
6911.79	3.163	1.518	2.540	7079.90	5.389	1.389	1.729
6913.88	3.112	1.498	2.550	7084.00	5.451	1.376	1.703
6915.88	3.089	1.512	2.518	7084.90	5.454	1.374	1.674
6917.79	3.084	1.486	2.525	7085.97	5.466	1.382	1.689
				7088.05	5.469	1.376	1.680
6919.89	3.074	1.523	2.472	7089.02	5.493	1.371	1.660
6921.78	3.049	1.494	2.479	7093.16	5.529	1.354	1.667
6926.81	3.027	1.503	2.473	7100.14	5.587	1.335	1.614
6927.81	3.029	1.477	2.500	7102.95	5.631	1.316	1.554
6929.83	3.005	1.499	2.473	7105.05	5.631	1.329	1.597
6943.77	3.062	1.527	2.462				
6946.81	3.178	1.526	2.518	7110.93	5.785	1.224	1.514
6949.83	3.240	1.567	2.569	7119.94	5.769	1.277	1.570
6950.88	3.262	1.537	2.389	7121.90	5.795	1.318	1.488
6952.21	3.348	1.545	2.590	7126.00	5.832	1.259	1.520
				7129.98	5.867	1.263	1.492
6953.78	3.333	1.562	2.644	7137.94	5.937	1.248	1.431
6953.81	3.291	1.781	2.562	7142.92	5.962	1.239	1.426
6960.20	3.759	1.540	2.436	7146.92	6.015	1.232	1.387
6960.75	3.811	1.594	2.481	7152.94	6.072	1.200	1.390
6961.89	3.881	1.711	2.377	7164.98	6.184	1.166	1.290
6966.78	4.119	1.573	2.442				
6973.78	4.313	1.549	2.446	7170.94	6.227	1.172	1.317
6977.78	4.367	1.569	2.429	7171.96	6.222	1.194	1.285
6980.23	4.405	1.583	2.538	7172.95	6.243	1.166	1.277
6980.78	4.441	1.536	2.439	7175.96	6.275	1.143	1.279
6983.26	4.500	1.560	2.551	7179.97	6.321	1.128	1.251
				7181.99	6.340	1.158	1.241
				7183.98	6.356	1.140	1.231
				7184.98	6.383	1.112	1.211
				7186.02	6.382	1.126	1.225
				7189.92	6.414	1.116	1.248
				7190.94	6.426	1.117	1.246
				7203.94	6.553	1.090	1.170

TABLE 1 (cont)

<u>J.D.</u> 244+	<u>V</u>	<u>B-V</u>	<u>U-B</u>
7209.97	6.604	1.069	+1.153
7212.94	6.647	1.056	1.120
7218.98	6.643	1.053	1.115
7234.92	6.763	1.023	1.042
7237.89	6.836	1.019	1.061

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EDITORIAL NOTE

We regret that the publication of this issue has been delayed for a number of reasons. First we wished to have the computer system operating satisfactorily; then I was absent from N.Z. for several weeks. Finally, since the death of my wife I have had to do all the typing of this issue, and I am not the excellent typiste that she was.

The next task is to issue Charts for Southern Variables, Series 20, on behalf of Astronomical Research Ltd. Then to start of Publications No. 15, for which there is already sufficient material on hand.

Readers will be interested to know that thanks to the cooperation of Ranauld McIntosh, Director of the Computer Section, we are now able to supply both print outs of the observations and a computer light curve for any variable on the observing list of the Variable Star Section. A charge is made for this service to cover the out of pocket expenses such as postages, paper and time.

All observations from 1 April 1987 are now stored in the computer and as time and funds permit all earlier records will also be so stored. However any request for observations prior to 1 April 1987 can be handled now. Those who have used this service to date are well satisfied with it.

We continue to supply alert notices for any southern variable on request. This service has been used by many institutions and has proved to be a great help in permitting observations to be obtained at the particular phases in which people are interested.

All enquiries regarding these services should be addressed to the Director.

Frank M. Bateson

BOOK REVIEWS

VARIABLE STARS by C.Hoffmeister, G.Richter & W. Wenzel. Publ. by Springer-Verlag, Berlin. 1985. Pp. 328 with 170 figures and 64 tables. Size. 24.76cm x 17.14cm. Translated by S. Dunlop. Price DM 130.

Two German editions of "VERANDERLICHE STERNE" appeared in 1967 and 1982 respectively. This English edition is a translation of the second German edition with additions on recent results. The translation has been well done with only a few minor blemishes.

The book opens with a general introduction, in which basic concepts are given for the benefit of those not familiar with the subject. This section suffers from severe compression, because it endeavours to discuss subjects such as spectral and luminosity classes; stellar populations and evolution, each within the compass of a brief sub-section. The authors could hardly do otherwise in a volume with the main objective of discussing the various and diverse nature of Variable Stars. There are, however, ample references for those who wish to read more on these introductory subjects.

The heart of the book lies in the next three chapters which deal in some detail with Pulsating, Eruptive and Eclipsing Variables respectively. These are very readable and convey a great deal of information. There are, however, a few rather curious statements. For example in Table 30 on page 87 a list of Recurrent Novae V1017 Sgr is included with the correct years of its three known outbursts. Ten pages later V1017 Sgr is included in a table of potential recurrent novae. On page 126 this star appears amongst the list of Symbiotic stars, which is correct according to its modern classification as of Z And type. BD Pav is listed as a nova, but it is now known to be a recurrent nova, but the authors cannot be blamed for classing it as a nova since its recurrent nature has only been recently found.

The discussion of individual RW Aur stars appears to be rather dated. For example, there is no mention of the fourth semi-periodicity of T Cha nor of the various cycles during which one of the semi-periodicities persist. I would have expected a diagram of radio results on the flare star, UV Cet, to match those from optical light curves. I found it difficult to understand why the chapter on Eruptive Variables should include BY Dra, RS CVn, Pulsars and Magnetic stars. These are not eruptive and should have been discussed in a separate chapter, headed Rotating variables.

This volume is well illustrated with numerous diagrams and photographs. The figures are clear, although a few are not placed close to the text in which they are discussed. There are numerous references in the text, but a few of these do not appear in the excellent bibliography. The subject index appears to be complete and a check on a number of entries did not find any missing. The same remarks apply to the separate index of stars.

Variable Stars comes in a hard cover edition, well printed and free of any typographical errors. Its production is up to the standards that one expects from Springer-Verlag.

This book is suitable for amateurs wishing to understand more of the subject. Its technical nature makes it also suitable for graduates and undergraduates, whilst professionals will find it useful for its numerous references.

I thoroughly enjoyed this work. It is one that I also keep referring to to check on references. It can be read with both profit and interest of all observers and I can recommend it to anyone interested in Variable Stars as it fills the need for a good modern reference book now that so many of the earlier works are both out of print and out of date.

INTERACTING BINARY STARS ed. by J.E. Pringle and R.A. Wade. Publ. by Cambridge University Press, Cambridge, U.K. 1985. PP.220. 23.5cm x 15.9cm. Hard cover. Price: stg. 25.00.

This book has been written as a memorial to John Whelan, who was a very good friend of the V.S.S., R.A.S.N.Z. John had been working on the book at the time of his death in 1981.

The aim of this book is to provide young astronomers with an introduction to the field of interacting binaries. It is of equal interest to the serious amateur working in this field. The editors have selected areas of particular interest to John and presented these in some detail.

There is a short preface from which the following quotation is taken: "The patient study of decades of observation has, as so often in other areas of binary star astronomy, paid handsome dividends. This is nowhere more apparent than in the records of the amateur astronomers who monitor these objects, and in particular in those records collected together by the A.A.V.S.O. and by the V.S.S., R.A.S.N.Z."

There are eight sections to this volume. They are arranged in a very logical order. Each section has been written by an expert on the topic discussed. Books with several authors often become disjointed because of overlapping and different styles. The authors all write well in a very readable manner and the Editors have presented a unified work that has avoided the pitfalls so often apparent with multiple authorship.

The first section is a very clear introduction to the basic facts that are so necessary to a clear understanding of the subject. Then follow in a logical sequence discussions on the nomenclature of the subject; binary star evolution; x-ray binaries; contact binaries and cataclysmic. These topics are dealt with from the observational viewpoint and then the theoretical.

The entire book maintains a high standard in imparting technical information in an easily understood manner. Naturally, concentration is required to assimilate the details, but such effort is well worth while. The chapters that appealed most to me were Jim Pringle's introduction; Ron Webbink's very lucid discussion of stellar evolution of binaries and the two chapters on C.V.'s, which provide both an observational and theoretical overviews of C.V.'s. Naturally there are problems which in such a volume are not discussed. This could not be otherwise without making the text so much longer and less interesting except to those deeply involved in this

The book is clearly printed and illustrated with apt and clear diagrams. An appendix tabulates the various properties of the Roche Lobes defined in the first chapter. There is an adequate bibliography, arranged under chapter headings. There appears to be no omissions from the index.

Some of the statements will date owing to the advances being continually made in understanding interacting binaries. However the basic discussions will make this book a standard text book for many years.

I commend this book to young astronomers and to the serious amateur who wishes to understand why his, or her, observations are so important.

F.M.B.

THE STUDY OF VARIABLE STARS USING SMALL TELESCOPES ed. by John R. Percy.
 Publ. by Cambridge University Press, Cambridge, U.K. 1986. Pp. 265. 25.4cm x 17.8cm.
 Hard cover. Price: stg. 20.00.

This volume records the proceedings of a symposium held at the University of Toronto in July 1985. This meeting was intended for a broad audience, including professional and amateur research astronomers, and astronomy teachers at universities with small telescopes. It reflects the trend that became apparent about a decade ago, when the value of what could be done with small telescopes and by amateurs became fully recognized.

A wide range of topics are discussed which cover all aspects of variable star observing, even including observations in the near infrared. There are a number of review papers in each section in which the book is divided. These are then followed by shorter communications on subjects that are related to the preceding review paper. Unfortunately these shorter papers, and also some of the review papers, are strongly biased towards the northern hemisphere.

The text is simple and straight-forward. It is natural that in a meeting of this sort the authors of the review papers are pushing for their own particular line of research. They deal with visual, photographic, photoelectric observations and other topics. In the chapter on other techniques I found the suggestions of R.F. Wing on observing variable stars in the infrared extremely interesting. He makes an excellent case for amateurs to observe in the near infrared from sea level. His discussion of the methods, and pitfalls, is refreshing and novel.

The outstanding paper, in my opinion, is that by C. Sterken, who discusses the role of the amateur in observational astronomy, and coordinated multisite observing programmes. This chapter is probably the only one that would appeal to those not interested in variable stars.

The most useful section for the serious amateur researcher is that which deals with searching for periodicity in astronomical data. The review paper on this subject by A.W. Fullerton is excellent. Such a paper has been needed for a long time because this subject is so often omitted from modern books on variable stars, which leaves those interested dependent on the classic books of the past. In the same section L.A. Willson contributes a most useful paper on the O-C diagram as a useful tool. These two papers and that by Sterken are those that will interest members most.

The final section contains a review paper by Russ Genet discussing the advantages of small automatic photoelectric telescopes. There is no doubt of the value of such instruments, but they tend to lose the most valuable asset of the amateur observer---his intimate knowledge of the sky. Many observers, despite the efficiency of automated telescopes, just have no desire to become part of such set up which they state tends to take the fun and interest out of observing. Genet's paper is followed by an interesting one by S.M. Rucinski who discusses the new directions in the study of variable stars. This is a thought-provoking paper since it outlines some of the possible future developments such as a two star photometer system mounted on a single telescope; panoramic detectors and even lunar occultations. He defines a panoramic detector as a rectangular array of many separate detectors capable of recording images of the sky or spectrum electronically.

This volume is well produced and the figures are clear. There are some minor errors in the index. EX Hya is incorrectly labelled EX Hyd; EO Com is given as EO Cam. Our members will find this book worth reading in parts but its emphasis on northern objects makes it more suitable to borrow rather than buy.

F.M.B.

CATAclysmic VARIABLES. RECENT MULTI-FREQUENCY OBSERVATIONS AND THEORETICAL DEVELOPMENTS. ed. by H.Drechsel, Y.Kondo and J.Rahe. Publ. by D.Reidel Publ. Co., Dordrecht, Boston, U.S.A. 1986. Pp. 805 + Xv. Hard cover. 24.8cm x 16.5cm. Price: \$US 124.00.

This volume contains the Proceedings of IAU Colloquium No. 93, Bamberg, June 1986. It is reprinted from Astrophysics and Space Science. Reproduced from camera ready copy.

Meetings to discuss the latest developments in research on C.V.'s has almost become an annual event on account of the interest in this subject. This volume contains research papers on evolution, observations at all wavelengths, accretion disks, novae, dwarf novae, magnetic C.V. systems and related objects.

This is not a book that will be read from cover to cover, but one of great interest to the research scientist working in this field. It should be on the shelves of every astronomical library of institutions engaged in research. It is essentially a reference work.

CIRCUMSTELLAR MATTER ed. by I.Appenzeller and C. Jordan. Publ. by D.Reidel Publ. Co., Dordrecht, Holland. 1986. Pp. 607 + xxiv. Limp cover 24.1cm x 16.5cm. PRICE: \$US 109.00.

Proceedings of IAU Symposium No. 122, held in Heidelberg in June 1986. Reproduced from camera ready copies.

This volume contains a wide range of research papers on bipolar flows, jets and protostars; Herbig-Haro objects; circumstellar shells and envelopes; mass-loss from cool stars; stellar coronae; mass-loss from hot stars; symbiotic stars; planetary nebulae with both general review papers and discussions of some individual objects.

This volume will be widely used by researchers as an excellent source of reference on these varied subjects.

RS OPHIUCHI (1985) AND THE RECURRENT NOVA PHENOMENON ed. by M.F.Bode. Publ. by VNU Science Press, Utrecht, Holland. 1987. Pp. 261 + viii. Hard cover. 22.9cm x 15.2cm. PRICE: DM 120.00.

The fifth recorded outburst of RS Oph in January 1985 was the reason for a Manchester Conference in December 1985. The proceedings of that conference are in this book. The reproduction is from camera-ready copies.

The importance of the 1985 outburst was that it was the first which was observed at all wavelengths from the radio to x-ray, whereas previous outbursts had only been observed in the optical. The resultant papers not only report on the 1985 outburst but also resulted in papers on allied objects, such as T Pyx; Nova Mus 1983; CH Cyg; Cyg X-1 Cas A and RCW 103. Other papers are concerned with broader aspects such as Nova Outburst modelling and its relation to Recurrent Novae; Nova shells; supernovae and their remnants and even far eastern observations of Novae before AD 1800. This mixture conveys an up to date overall view of these topics, much of which will change with time. Some papers give the impression that they were compiled in haste; no doubt to justify attendance at this conference. However, those interested in recurrent novae and related objects will derive much useful information from this book and the good references to many of the papers.

REPORT OF THE VARIABLE STAR SECTION, ROYAL ASTRONOMICAL SOCIETY OF NEW ZEALAND
FOR THE YEAR ENDED 1986 DECEMBER 31.

The year has been productive, despite the interruptions to most observers' programmes during the apparition of Comet Halley. This diverted them from their normal observing during the months in which the comet was visible. This was responsible for a decrease in the number of observations compared to the previous year.

During the year 12 Monthly Circulars were published, as well as Publications No.13 and four Newsletters.

The highlight of the year, as far as I was concerned, was an unexpected overseas trip, during which I visited E.S.O. Headquarters at Garching bei Munchen and attended IAU Colloquium No. 93 in Bamberg; IAU Symposium No. 122 in Heidelberg and the 75th Anniversary Meeting of the A.A.V.S.O. in Cambridge, U.S.A. I also visited a number of other institutions in Europe, U.K. and U.S.A. I reported to members on this world trip in CHANGING TRENDS No.14. Therefore in this report it is sufficient to say that this trip has brought enormous benefit to the Section, as will be evident in the coming months. It also served to bring the A.A.V.S.O. and ourselves into even closer co-operation.

Some other highlights and matters of interest to members are reported on below.

1. NOVA CENTAURI 1986. We congratulate Rob McNaught on his discovery of this nova, which is the brightest southern nova for many years. It has been well observed by members since its discovery.

2. DWARF NOVAE. Probably the most interesting dwarf novae during the year was EX Hya, which had two of its rare bright outbursts. The first, in July, was independently noticed by A.F. Jones and W. Goltz, both of whom then monitored this star very carefully throughout the night. The second outburst, in August, was first recorded by O.R. Hull and A.F. Jones. This outburst was again very carefully monitored at frequent intervals by Jones. The maximum brightness of these outbursts were 9.7 and 9.8 respectively. On both occasions EX Hya was at maximum for one day--probably less as the declines possibly commenced in daylight. These outbursts attracted considerable interest, and through the cooperation of Randal McIntosh light curves were supplied to several research astronomers interested in this star.

J. Smak (Poland) was supplied with all our observations of Z Cha since the Memoir (Bateson, F.M. 1978. Mon. Not.R. astr. Soc. 184 & Microfiche 184/1). Our results are being used by Smak for investigations into relationships between different parameters.

The Section took part in a co-ordinated programme on a large number of dwarf novae in February. In February and March members monitored Z Cha and OY Car closely to assist observers at E.S.O. to observe superoutbursts. Unfortunately the stars did not cooperate and had only normal outbursts. However, the super-outburst of Z Cha in August was well observed for a programme with Oxford, who were observing with IUE.

A. Gicger carried out a statistical Analysis of dwarf novae outbursts (Acta Astronomica 37 pp 29-39). I thank her for the preprint. Her investigations of the relationships between different parameters were concerned mainly with southern dwarf novae. She found a strong correlation between the orbital period and the outburst duration. This is an illustration of the value of the estimates of these objects made by members.

Thanks to the co-operation of members, alert notices on outbursts of several dwarf novae were sent rapidly to those astronomers requesting this advice.

Computer light curves for a number of dwarf novae were kindly produced by Randal McIntosh. These have been supplied to those astronomers requesting same, whilst others will appear in Publications No. 14.

Hans van der Woerd (The Netherlands) successfully completed his Ph.D. thesis on VW Hyi, for which he obtained copies of our records. I thank him for a copy of his completed thesis.

3. R CrB VARIABLES.

Considerable interest has been taken in our records of this group of stars. W. Lawson (Canterbury) spent a few days at headquarters, extracting material to use in his studies. A. Weib (West Germany) received assistance on a similar project. We have also continued to provide alert notices of the fadings of R CrB stars to the infrared astronomers at S.A.A.O.

4. OTHER PROGRAMMES.

All other current observing programmes have been maintained. A. Heck (Belgium) was kept informed by alert notices of the rises and declines of V348 Sgr. Details of our observations were also supplied to him. Other astronomers requested data on a number of variables and this information has been supplied.

5. COMPUTER PROGRAMME.

Further discussions were held with Randal McIntosh on the requirements for this programme, especially during his visit to headquarters. He expects to have the programme finalised in the coming year, which will certainly make a big difference to easing the volume of work at headquarters. I am greatly indebted to Randal for his interest and cooperation.

6. COOPERATION WITH OTHER VARIABLE STAR ORGANISATIONS.

Cooperation with the Variable Star Section, B.A.A. has continued along the lines reported in previous reports to the advantage of both organisations. My extended visit to the A.A.V.S.O. enabled Janet Mattei, their Director, and myself to have far ranging discussions to the mutual advantage of the A.A.V.S.O. and ourselves. The two organisations will continue to operate separately but with even closer cooperation.

The various national Variable Star Organisations in Australia, South Africa and Argentine have continued their very close links with us. I wish to thank their respective Directors for the very happy relationships between their sections and the VSS, RASNZ. The exchange of publications with the A.F.O.E.V. and other Northern Hemisphere organisations, reported in the last report, has continued.

7. ACKNOWLEDGEMENTS

First and foremost I wish to thank all members for their observations, be they many or few. It is their efforts that make the Section. My most sincere thanks are due to Gordon Smith, who has continued to act as Recorder. His careful and painstaking work is of immense value to the Section. I wish to express my appreciation to A.W. Dodson, W. Goltz, D. Lee and C.W. Venimore for their work on contributions to the Publications. The results of their efforts will appear in Publications 15 and later issues.

My appreciation has already been expressed in CHANGING TRENDS No. 14 to all those who made my world trip possible and to the many friends and institutions who so kindly extended hospitality during that most rewarding and stimulating trip.

1987 March 1

Frank M. Bateson
Director

OBSERVATIONS RECEIVED FOR YEAR ENDED 31 AUGUST 1986.

AITKEN, B.	5	LESLIE, Mrs. A.	319
ALBRECHT, W.B.	3474	LUMLEY, E.	264
BLANE, D.	55	MARIONI, J.C.	65
BRADBROOK, A.J.	614	MARTIN, D.S.	3
BRYANT, K.	3	MENZIES, B.	1250
CAMPOS, J.A. da S.	176	MOREL, M.	20
CASTINEIRAS, R.S.J.	71	MORRISBY, A.G.F.	297
COOPER, T.	1936	MEYERS, P.	251
COULING, G.G.	160	McCrae, A.R.	141
CRAGG, T.A.	1429	NELSON, P.	141
DINGLEY, A.	20	O'KANE, J.	154
DODSON, A.W.	397	OVERBEEK, D.	10660
DREDGE, A.C.	16	PARK, J.	7
DURHAM, D.	40	PARKINSON, M.	95
DUCOTY, R.	943	PAZZI, L.	16
EVANS, R.W.	208	PEARCE, A.	129
FIADONE, R.J.	6	PROSSER, G.L.	15
FRASER, B.	42	ROWE, G.H.	142
GOLTZ, W.	1695	ROST, F.	4
HARRIES-HARRIS, E.	761	SIMONE, C.D.	15
HENSHAW, C.	46	STABENOW, R.	1084
HERS, J.	536	SRINIVASAN, S.R.	304
HULL, O.R.	1872	STEPHANOPOULOS, G.	689
INGRASSIA, P.A.	4	TAYLOR, Dr. N.W.	1627
IVES, F.J.	826	THOMSEN, R.	27
JONES, A.J.	7143	TREGASKIS, T.B.	141
JONES, K.L.	98	VARELA, P.L.	3
JOZSA, A.	301	VENIMORE, Rev. C.W.	832
KURTZ, C.F.	76	WILLIAMS, P.	1341
		WILLIAMSON, L.J.	134

TOTAL OBSERVATIONS = 43,123.

The decrease of 1,947 observations compared to the previous year can be blamed on Comet Halley. Most members during the apparition of this comet were engaged either in observing it or in manning telescopes and in talks to the public. This caused a marked fall-off in the number of observations during the months in which the comet was visible.

The above totals, as mentioned in the Annual Report, do not include the totals from the B.A.A. Those who contribute to the A.A.V.S.O. are not marked above because there is now a complete interchange of records between the two organisations.

Eleven observers made more than 1000 observations and their contributions accounted for 70% of the total; the same as in the previous year.

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REPORT OF THE VARIABLE STAR SECTION, ROYAL ASTRONOMICAL SOCIETY OF NEW ZEALAND

FOR THE YEAR ENDED 1987 DECEMBER 31.

This year marked the 60th anniversary of the founding of what has become the Variable Star Section, R.A.S.N.Z. It is therefore fitting that it was marked by the most spectacular event in our history. That was the independent discovery of SN 1987A by Albert Jones. It was also fitting that his long and dedicated services to observational astronomy were recognized by the award of the O.B.E. Albert thoroughly deserved this honour and congratulations, on behalf of all members, have already been extended to him.

Our 60th anniversary was celebrated in Sydney by a most enjoyable function at the home of Peter and Linda Williams, which preceded a gathering at the Sutherland Astronomical Observatory attended not only by members of the Sutherland Astronomical Society but also by many members of the N.S.W. Branch of the B.A.A. and members of the V.S.S. in Australia. Several of these travelled long distances to be present. It was most appropriate that these gatherings should be held in Sydney because that was where it all started. For a few months, until the Council of the then Astronomical Society of N.Z. approved the formation of observing sections, we were the N.Z. Branch of the Variable Star Section of the B.A.A. (N.S.W.).

These functions provided the opportunity for me to meet many of our Australian members. Naturally I was expected to talk and, hopefully, this enabled those present to understand even better why visual variable star observing is so important. I have to thank Peter and Linda Williams for the super arrangements they made, and the President and members of the Sutherland Astronomical Society for the function at their observatory. My most sincere thanks are also due to Janet Mattei and members of the A.A.V.S.O. for their message of congratulations and presentation. I also thank those unable to be present who so kindly sent their congratulations and best wishes.

The appearance of SN 1987A certainly created greater interest in the observation of variable stars. This has been partly, but not entirely, responsible for the large increase in both the number of active observers and total observations for this year compared to previous years. The details appear on the final page of this report.

An event of great importance to the Section was the finalisation of the Computer programme by Ranald McIntosh. This has been under discussion for some time as previous reports have indicated. The result of Ranald's efforts was that as from 1 April, 1987, all our records are recorded on computer. This has also meant that we are now able to supply print outs and light curves for any star on our observing list. Advantage of this service has already been taken by a number of professional astronomers and institutions. They have all expressed their complete satisfaction with the service.

My personal thanks are due to Ranald McIntosh for the vast amount of work he has put into this programme to get it running properly and for coping so patiently with my requests. He and I are indebted to the Kingdon-Tomkinson Trustees for a grant to enable this programme to get started. It is intended, as funds and time, permits to process all observations prior to 1 April 1987 on to the computer. It is already possible to do this for requests for such earlier records.

During the year 12 Monthly Circulars and four issues of "CHANGING TRENDS", the Section's Newsletter were published. Publications No. 14, which should have been published during the year was delayed, firstly because it was essential to have the computer programme running smoothly. Secondly, because the sheer pressure of work which I have to do prevented this, coupled with the fact that production of the Publications is now somewhat slower since I have to type them whereas before my wife's death she, an expert typiste, did much of this work.

However, this report is the final paper for Publications 14 so it will go to the printers shortly and should be distributed in late March or early April 1988. It will be followed later in the year by Publications 15 for which there are already sufficient papers due to the assistance of A.W. Dodson, W. Goltz, D. Lee and C.W. Venimore.

The writer attended the 4th Asian-Pacific Regional Meeting of the IAU held in October in Beijing, China. This provided an opportunity to establish closer working relationships with both professional and amateur astronomers in Eastern countries. I am grateful to the Organising Committee and the IAU for a grant for this meeting.

One of the main requirements of the Section is for reliable magnitudes for comparison stars in those fields for which none have been available. I am indebted to D. Kilkenny (S.A.A.O.); P.M. Kilmartin (Mt. John) and C. Fischerstrom (Sweden) for their measurements of comparison stars for us. I have made some progress on checking the A.A.V.S.O. charts and comparing them with those we have issued and other charts. The bottle-neck here is simply the typing of the resultant comments and suggestions.

Mati Morel, with his usual care and efficiency, has supplied a number of charts which will form Series 20 of "CHARTS FOR SOUTHERN VARIABLES" published by Astronomical Research Ltd. His charts for novae were distributed either with Circulars or separately to observers.

The observational matters of interest, apart from SN 1987A already referred to, included EX Hya: Nova Cen 1986; U Sco; Nova Sgr 1987; BV Cen; Z Cha; W Men; RY Lupi amongst many others.

SN 1987A has been very well observed by almost every member. Throughout the year there have been a very limited number of nights on which no observation was possible. The preliminary daily means have been published in the Monthly Circulars each month since its discovery. Naturally, Albert Jones's discovery has attracted considerable media attention throughout the world which has also given the Section media exposure.

EX Hya was first detected by Albert Jones at a bright maximum in May. His prompt advice enabled me to notify the astronomical community via an IAU Circular. In addition the various photoelectric groups, the A.A.T. and others direct. Bill Allen, at the Adams Lane Observatory, Blenheim, obtained an excellent series of observations photoelectrically. This outburst was well followed by members. EX Hya reached a maximum of 9.6 and once again the outburst was very brief lasting less than 3 days.

Nova Cen 1986 declined very steeply in February to around magnitude 14.8. It immediately commenced to rise, with fluctuations. By April it had settled down at magnitude 11.3 and it has remained close to that brightness for the rest of the year. Its light curve strongly resembles that of DQ Her (Nova Her 1934). P.M. Kilmartin kindly supplied some two colour observations of Nova Cen, which were published in the Circ. M87/4. She has also kindly determined the magnitudes of the comparison stars which has enabled the light curve to be completed to date. Her observations were made at the Mt. John University Observatory.

Nova Sgr 1987 was discovered by Rob McNaught. The magnitudes of the comparison stars were kindly determined by P.M. Kilmartin which will enable the observations to be reduced. We also thank A.C. Gilmore & P.M. Kilmartin for a photo of the region around this nova. This nova faded fairly rapidly.

Danie Overbeek detected an outburst of the recurrent nova, U Sco, on May 15. This was well observed by members. It proved to be a very short outburst, similar to previous ones.

BD Pav, which was originally catalogued as Nova Pav 1934, is definitely a dwarf nova. , and is so classified in the 4th Edition of G.C.V.S. Albert Jones detected an outburst in May and possibly there was another in September.

Several professional astronomers are interested in the bright outbursts of BV cen, when it attains a magnitude of around 11.0. One was very well observed by several members in May. The resultant light curve was supplied to those interested.

A programme on V348 Sgr was maintained at the request of A. Heck, as in previous years. Every endeavour was made, particularly by Tom Cragg and Peter Nelson, to catch the rise of Z Cha to a normal outburst at an early stage. Despite several false alarms this has not yet been possible so the programme will continue in 1988 as Oxford is very anxious to observe a normal outburst with IUE to complete their studies of Z Cha.

Our observations, both published and unpublished, of RY Lupi covering over three decades were supplied to C. Fischerstrom (Stockholms Observatorium) for use in his Ph.D. thesis and in conjunction with observations he obtained at E.S.O. I have suspected that the original visual magnitudes of some of the comparison stars for RY Lupi, obtained by C. Hoffmeister were in error. Fischerstrom has kindly supplied UBVR values for a number of these. I am now trying to obtain magnitudes of some faint stars in this area in order to make estimates at minima more reliable.

A careful monitoring of all southern R CrB variables was maintained throughout the year. Monthly print outs of these estimates have been supplied to W. Lawson (Canterbury).

Our light curve of the 1985 superoutburst of OY Car was included in a paper by the Oxford group in Mon. Not. R. astr Soc. A.Koziewska (nee Gieger) of the N. Copernicus Astronomical Center in Poland, completed her statistical analysis of Z Cha outbursts and superoutbursts using the data supplied as mentioned in my previous report. I thank her for the preprint of her paper submitted to Acta Astronomica and for the light curve.

David Phizacklea (Headquarters student) used some of the recent observations of RY Lupi to investigate the multiple periods in this star.

Our observing programmes were extended during the year to include a number of S Dor type variables and several other unusual stars. Close attention was paid to the recurrent nova, T Pyx, which, on the basis of past outbursts, may possibly flare soon. It remained at minimum throughout the year as did other recurrent novae with the exception of U Sco already mentioned.

All other observing routine programmes were maintained throughout the year.

There was close cooperation, as usual with the A.A.V.S.O., and we supplied them with copies of all our observations of Mira variables for their predictions and other use as they desire. The Directorship of the Variable Star Section, B.A.A. has been once again taken over by John Isles who is based in Cyprus. Doug Saw remains Assistant Director and he has received each month copies of our observations of those stars north of the equator which it is better for him to process. The B.A.A. has continued to supply us with their observations of those stars south of the equator for which we will publish the combined results such as has already appeared in our publications for CN Ori.

John Isles and myself have discussed by correspondence methods of closer cooperation between the B.A.A. and ourselves. This has also included permission from Astronomical Research Ltd to publish some charts supplied to John for publication in a handbook to be published by the Webb Society. We have also established close relations with the Variable Star Observers League in Japan, with whom we now exchange publications. The same is done with some European variable star organisations. Every effort is being made to see that

all organisations use the same sequences for those stars that are observed by the different organisations.

The foregoing details cover merely some of the activities during the year, without making this report unduly long and boring.

It is fitting, however, that I pay a very sincere tribute to Gordon Smith, who now that the computer programme is operating no longer has the task of entering all the observations in the permanent records. This work he has gladly shouldered for many years and the clarity of the records are a tribute to the care with which he has carried out this work. It is true to say that very few members realise the long hours of concentrated toil that Gordon has given to the Section for so many years. It is worth mentioning that Gordon is almost 89 years young. I know that when Gordon attended the Anniversary Meeting of the A.A.V.S.O. in 1986 everybody was amazed at his vitality. Gordon we are just as amazed at what you have done for the section over so many years and we extend to you, on behalf of all members, not only our very sincere appreciation but our very best wishes for the future.

Once again it is my great pleasure to thank all observers for their observations. Theirs is a very worth while contribution and I trust that from this report and from the comments in the various issues of CHANGING TRENDS they will realise the wide use that is made of their observations by professional astronomers.

I also wish to thank the various Directors of local and national variable star organisations in Australia, South Africa and Argentine for their splendid cooperation and support.

To all members I say "Thank you" for your friendships and your understanding of the problems that beset me. Your patience in putting up with delays in correspondence and in Publications is much appreciated.

It is a real pleasure to thank Albert Jones and Danie Overbeek for their outstanding contributions during the year. I have enjoyed a very close relationship with Albert for so many years. He is always kept fully informed on all activities that affect the Section even to the extent that he gets bombarded with letters but his cooperation in all that pertains to the Section is a very strong support to myself. Danie I have also known for very many years and his constant help and encouragement has always been a tower of strength to me. We had the pleasure of long discussions whilst he and I were both in Australia at the same time last October.

Our thanks are extended to the subscribers to our various publications for their interest in our work and for supporting our activities. We hope that all those who have requested data during the year are satisfied with the results supplied. We also appreciate all those who have given grants, donations or paid for the costs of processing the data they required. Without this financial support we would have trouble in maintaining the present level of output.

Finally, my personal thanks are extended to Dr. Janet Mattei, Director, A.A.V.S.O. and to John Isles and Doug Saw of the B.A.A. for their continual interchange of observations and for the very happy relationships that exist between us.

1988 March 10.

Frank M. Bateson
DIRECTOR

OBSERVATIONS RECEIVED FOR YEAR ENDED 31 AUGUST 1987.

ADAMS LANE OBS.	28	LESLIE, Mrs. A.	248
ALBRECHT, W.M.B.	3896	LOBB, R.J.	2
AUCKLAND OBS.	4	LUMLEY, E.	279
B.A.A. (NSW)	27	MARINO, B.F.	19
BALL, S.	9	MARIONI, J.C.	77
BEGG, D.	8	MCCRAE, A.R.	77
BEMBRICK, C.	53	MCNAUGHT, R.N.	55
BENNIE, I.D.	53	MENZIES, B.	1298
BOADAS, M.C.	7	MEYERS, P.	120
BRADBROOK, A.J.	38	MOREL, M.	92
BRYANT, K.	71	MORRISBY, A.G.	303
BYRON, J.	0	NELSON, P.	506
CAMPOS, J.A. da S.	237	O'KANE, J.	85
COOPER, T.	2562	OURAL, P.S.	1
COULING, G.G.	11	OVERBEEK, M.D.	12633
CRAGG, T.A.	3225	PARK, J.	32
DE BONO, I.	10	PARKINSON, M.	29
DEIGHTON, R.	12	PAZZI, L.	8
DE Luca, Dr.C	2	PEARCE, A.	47
DINGLEY, A.	62	ROUNTHWAITE, T.	7
DODSON, A.W.	272	RUMBLE, M.	1
DREDGE, A.C.	82	SEARGENT, D.A.J.	30
EVANS, R.W.	203	SIMONE, C.D.	49
FLEET, R.W.	211	SMIT, Dr. J.A.	24
FREE, R.	4	SMITH, G.	3
GEORGE, L. St.	24	SRINIVASAN, S.R.	251
GEYSER, M.J.	31	STABENOW, R.	1485
GILLER, J.	14	STEPHANOPOULOS, G.	752
GOLTZ, W.	1910	TAYLOR, Dr. N.W.	1374
HARRIES-HARRIS, E.	559	THOMSEN, R.	73
HENSHAW, C.	486	TREGASKIS, T.B.	788
HERDMAN, G.	563	VARELA, P.	2
HERS, J.	919	VENIMORE, Rev. C.W.	649
HULL, O.R.	2849	VILLAR, W.	89
INGRASSIA, P.A.	26	WARD, D.	51
IVES, F.	930	WARD, R.	34
IZZO, J.	2	WILLIAMS, D.	1178
JONES, A.F.	10942	WILLIAMS, P.	2096
JONES, K.L.	111	WILLIAMSON, L.J.	351
JOZSA, A.	89	WINNETT, R.D.	86
		WOLF, G.	567

TOTAL OBSERVATIONS = 56.383.

Compared to the previous twelve months there was an increase of 13,260 observations, and a larger number of observers.

The above totals are for the year to 31 August so that they are comparable to previous years. This has avoided inflating the totals for one period when the Society's year was changed to the calendar year. As in previous reports the totals do not include the observations from the B.A.A. (U.K.) nor has any attempt been made to show those who also communicate results to the A.A.V.S.O.

Twelve observers made more than one thousand observations and their contributions accounted for 80% of the total. The two most prolific observers (A.F. Jones and D. Overbeek) contributed slightly under 42% of the total for the year.

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