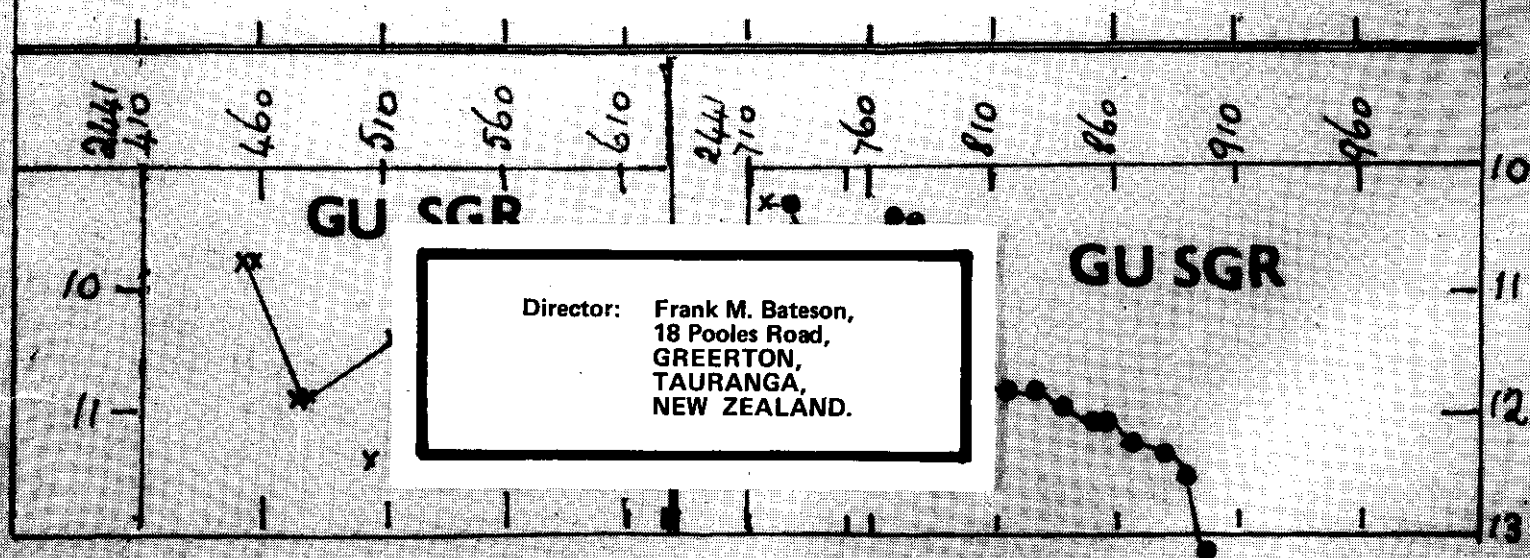


FIGURE 5

PUBLICATIONS of VARIABLE STAR SECTION, ROYAL ASTRONOMICAL SOCIETY OF NEW ZEALAND



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1977 August 15

THE DWARF NOVA CU VELORUM

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SUMMARY: Visual observations from J.D. 2,438,846 to 2,442,930 of CU Vel are discussed. Data for the 49 outbursts observed are tabulated. All outbursts were either narrow or wide, according to the time the variable was brighter than magnitude 13.0. No outbursts intermediate to these two types were observed. The mean cycle is 164.7 days. Mean maximum magnitude is 10.71 for wide maxima and 11.13 for narrow maxima. No information can be given on behaviour at minimum as CU Vel falls well below the threshold of the instruments used.

.....

INTRODUCTION: C. Hoffmeister (1949) assigned CU Vel to the U Gem class with a range of 12 to 13.5ptg. Preliminary designations for this star are S 4907; HV 8171; P 3257 and 715.1935. Kukarkin, et al (1974), whilst still quoting Hoffmeister's paper, gives the range as 10.7 to 15.5ptg with a mean cycle of 150 days.

CHARTS AND SEQUENCES: Identification charts, without sequences, were published by Hoffmeister (1957) and Brun and Petit (1959). Chart 114, showing a lettered sequence of comparison stars was published by Bateson, et al (1967). V magnitudes for most of these comparison stars were published by Bateson, et al (1971). A more complete sequence of V and B-V magnitudes by Warner (1976) has been used in the reduction of the observations discussed in this paper.

OBSERVATIONS: There are available 5,680 visual observations made by members of the Variable Star Section, Royal Astronomical Society of New Zealand. These cover the interval J.D. 2,438,846 (1954 April 13) to 2,442,930 (1976 May 31). The majority of the observations are negative with CU Vel invisible, and the magnitude of the faintest comparison star seen recorded.

All positive observations were plotted on a large scale, from which the dates of the outbursts were determined. These are shown in Table 1, where the first column gives consecutive numbers to each maximum. The second column shows the type of maximum, N being narrow, and, W wide, as discussed below. The dates determined for maximum brightness appear in the third column, whilst maxima magnitudes are shown in the fourth column, except where the observations are fragmentary, when the brightest recorded values are quoted and underlined. Successive columns then list the interval, in days, between successive maxima; the dates on which CU Vel reached magnitude 13.0 on the rise (13.0I) and on the fall (13.0D); the width, in days, defined as the time the variable was brighter than magnitude 13.0. The final column gives the number of positive observations used in determining the particulars in the preceding columns, and provides an indication of the reliability of the data quoted.

DISCUSSION: Maxima fall into two distinct types, being classed as narrow, when the width at phase 13.0I - 13.0D is 3.5 days, or less, and wide, when the width is 11 days, or more. A total of 49 maxima were observed, of which 20 were wide and 29 narrow. In successive intervals of 1,000 days from the first observation there were two or three wide maxima, and from two to five narrow maxima.

It is unlikely that many wide maxima passed entirely unobserved since this would require a gap exceeding eight days in the records. Although such gaps occurred on 88 occasions in the 22 years of observations the pattern of wide maxima recorded appears to indicate that few were missed. Narrow maxima were obviously missed because a gap of a day or so would be sufficient

for one to go unobserved.

CU Vel was observed in every month each year with the records being less numerous in the months of August, September and October, when observations had to be made close to dawn. The actual number of observations ranged from 145 in 1965 to 517 in 1975. The star was observed on 38% of the nights in 1964, 1965 and 1966, and on 60% of the nights in 1970. There were observations on an average for 48% of the nights during the entire interval. No firm statement can therefore be made as to the probable number of narrow maxima not observed.

Successive wide maxima are separated from one another by usually from one to three narrow maxima. This indicates that wide and narrow maxima do not alternate as happens with some other dwarf novae/ There is no evidence of anomalous maxima, nor of any maxima intermediate between narrow and wide.

The main features of observed outbursts, for which there are sufficient positive observations to reliably determine all parameters in Table 1 are summarised below.

MAIN FEATURES OF OBSERVED OUTBURSTS.

TYPE	No.	MAXIMUM MAGNITUDE			WIDTH AT 13.01-D.		
		MEAN	AVG. DEV.	EXTREMES.	MEAN.	AVG. DEV.	EXTREMES.
Wide	16	10.71	+0.22	10.00-11.00	14. ^d 2	+1. ^d 0	11. ^d 3-17. ^d 3
Narrow	9	11.13	+0.15	10.85-11.35	2.6	+0.2	1.5- 3.1

The mean interval between successive maxima, of all types, is 164.7 days, whilst that between successive wide maxima is 386.0 days. Both these mean intervals have large ranges as shown in the following table.

INTERVALS BETWEEN SUCCESSIVE MAXIMA.

TYPE OF MAX.		No.	MEAN INTERVAL	AVG. DEV.	EXTREMES.
FIRST	SECOND				
Wide	Wide	19	386. ^d 0	54. ^d 9	283. ^d 9 - 519. ^d 1
Wide	Narrow	19	161.6	52.8	76.3 - 359.1
Narrow	Wide	19	178.6	46.2	91.1 - 343.8
Narrow	Narrow	9	113.0	22.2	73.7 - 149.8
All	All	48	164.7	53.8	73.7 - 426.1

There appears to be no clear connection between maximum magnitude and duration of either the preceding or following minimum. Normally a relationship could be expected between the duration of minimum and the magnitude of the following maximum in the sense that the longer the minimum the brighter the following outburst. Any such relationship for CU Vel would be masked because of the small number of maxima observed, and, because it is probable that many narrow maxima were not observed.

Mean light curves were derived by tabulating the magnitudes from the large scale individual light curves at half day intervals for narrow maxima, and for half day intervals on the rise and daily intervals on the fall for wide maxima. Means were then formed from these. The zero point of reference was taken as the point of maximum brightness. Data for these mean light curves are given in Table 2. The first column gives the phase and the second column the mean magnitude for each phase. The smoothed light curves appear in Figure 1, where narrow maxima are combined in a single curve, and four examples of wide maxima are shown. These four examples are

numbered 1 to 4, according to increasing width. The corresponding numbers have been shown in column two of Table 1, when the widths have been determined from a sufficient number of observations.

The average rise in one day was 2.6 magnitudes for narrow maxima and 2.92 magnitudes for wide maxima. The latter show a wide spread of from 2.05 to 4.16 magnitudes, possibly reflecting the paucity of observations on the rising branch of the curve. The falling branches of the curves were much better observed. The rate of fall in one day averaged 0.80 magnitudes for narrow maxima and 0.11 magnitudes for wide maxima.

CONCLUSIONS: CU Vel has an extreme visual range of 10.00 to 14.5, and a mean cycle length of 164.7 days. Maxima are either wide, with a mean width at phase 13.0I-D of 14.2 days, or narrow, with a mean width of 2.6 days. Maximum brightness for wide maxima average 10.71, with a range of 10.00 to 11.00. The corresponding mean for narrow maxima is 11.13, with a range of 10.85 to 11.35.

Wide and narrow maxima do not alternate, and anomalous maxima are absent. No relationship can be established between maximum magnitude and duration of minimum, possibly because it is probable that many narrow maxima have not been observed. The mean cycle is therefore likely to be shorter than the length determined.

No information can be given on the behaviour at minimum as the variable falls well below the threshold of the instruments used.

ACKNOWLEDGMENTS: This work forms part of the research programme made possible by a grant from the Carter Observatory Board. Thanks are expressed to B. Warner for his determination of the sequence magnitudes, and to all observers for their observations.

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TABLE 1.

OBSERVED MAXIMA OF CU VELORUM.

No.	TYPE	MAXIMUM J.D.	MAG v	INT d	13.0I	13.0D	WIDTH d	OBS.
1	N	2,434,890	10.85	...	889.4	892.4	3.0	9
2	W1	2,435,233.8	10.60	343.8	233.1	245.6	12.5	26
3	N	400	12.2	166.2	399.3	402.0	2.7	1
4	W2	530	11.0	130	529.6	543.5	13.9	9
5	N	606.3	12.70	76.3	605.9	607.8	1.9	2
6	N	680.0	12.50	73.7	679.9	682.3	2.4	4
7	W3	989.8	10.60	309.8	988.3	003.5	15.2	13
8	N	2,436,348.9	11.10	359.1	348.6	351.7	3.1	6
9	W2	508.9	10.70	160.0	507.4	521.6	14.2	15

TABLE 1--OBSERVED MAXIMA OF CU VELORUM (cont).

No.	TYPE.	MAXIMUM J.D.	MAG. v	INT. d	13.01	13.0D	WIDTH d	OBS
10	N	2,436,709	<u>11.70</u>	200.1	708.7	711.2	2.5	4
11	W2	832	<u>11.1</u>	123	831.1	845.1	14.0	6
12	W3	2,437,258.1	<u>10.60</u>	426.1	256.3	271.6	15.3	10
13	N	450.9	<u>11.20</u>	192.8	450.2	453.0	2.8	5
14	W?	542	<u>11.3</u>	91.1	?	?	?	1
15	N	623	<u>11.7</u>	81	?	?	?	2
16	N	721	<u>11.6</u>	98	?	?	?	1
17	W2	890	<u>11.3</u>	169	898.1	912.3	14.2	5
18	N	2,438,139.3	<u>11.2</u>	249.3	139.1	141.5	2.4	2
19	W	291.9	<u>11.0</u>	152.6	291.6	305.8	14.2	4
20	N	394.1	<u>12.0</u>	102.2	393.9	395.8	1.9	2
21	N	491.1	<u>12.5</u>	97.0	?	?	?	3
22	W2	670.2	<u>10.8</u>	179.1	669.7	683.7	14.0	8
23	N	790.5	<u>11.0</u>	120.3	790.0	791.5	1.5	3
24	N	936.9	<u>11.2</u>	146.4	936.3	939.2	2.9	3
25	W4	2,439,152.5	<u>10.8</u>	215.6	151.4	167.7	16.3	8
26	N	315.5	<u>11.3</u>	163.0	315.1	317.9	2.8	3
27	N	422	<u>11.9</u>	106.5	?	?	?	1
28	W2	544.2	<u>11.0</u>	122.2	543.2	557.4	14.2	11
29	N	670.2	<u>11.33</u>	126.0	669.9	672.6	2.7	5
30	N	820	<u>11.1</u>	149.8	?	?	?	4
31	W2	975.0	<u>10.7</u>	155.0	974.3	988.8	14.5	20
32	N	2,440,068.4	<u>11.8</u>	93.4	068.2	070.3	2.1	3
33	N	179	<u>11.6</u>	110.6	?	?	?	2
34	W1	364.4	<u>11.00</u>	185.4	363.7	375.0	11.3	11
35	N	446.5	<u>11.8</u>	82.1	?	?	?	2
36	N	539	<u>13.2</u>	92.5	?	?	?	2
37	W3	771.9	<u>10.00</u>	232.9	771.0	786.2	15.2	28
38	N	993.0	<u>12.2</u>	221.1	?	?	?	5
39	W2	2,441,145.9	<u>10.0</u>	152.9	144.9	158.7	13.8	21
40	N	302.9	<u>11.8</u>	157.0	?	?	?	2
41	W2	491.9	<u>10.9</u>	189.0	491.0	505.1	14.1	22
42	N	666.1	<u>11.35</u>	174.2	665.6	668.1	2.5	5
43	W1	786.9	<u>11.0</u>	120.8	786.1	797.8	11.7	27
44	N	904	<u>11.6</u>	117.1	?	?	?	1
45	N	2,442,047	<u>11.6</u>	143	?	?	?	2
46	W4	260.0	<u>10.7</u>	213.0	259.7	277.0	17.3	12
47	N	418.5	<u>10.90</u>	158.5	418.0	420.6	2.6	10
48	W2	567.2	<u>10.95</u>	148.7	567.0	581.0	14.0	46
49	N	798.4	<u>11.2</u>	231.2	798.2	801.3	3.1	11

TABLE 2.

MEAN LIGHT CURVES OF CU VELORUM

PHASE d	MEAN MAG v	PHASE d	MEAN MAG. v	PHASE d	MEAN MAG. v
N		W1		W1	
-1.0	13.63	-1.0	13.77	+7.0	11.55
-0.5	12.47	-0.5	12.05	8.0	11.70
0.0	11.03	0.0	10.75	9.0	11.92
+0.5	11.30	+1.0	10.87	10.0	12.30
1.0	11.65	2.0	10.93	11.0	13.12
1.5	12.14	3.0	10.99	12.0	13.43
2.0	12.60	4.0	11.12	13.0	13.90
2.5	13.09	5.0	11.26		
+3.0	13.45	+6.0	11.42		

TABLE 2 ---MEAN LIGHT CURVES OF CU VELORUM (cont).

PHASE		MEAN MAG.	PHASE		MEAN MAG.	PHASE		MEAN MAG.
d	v		d	v		d	v	
	<u>W2</u>			<u>W3</u>			<u>W4</u>	
- 1.0	13.15		- 1.0	12.45		-1.0	(14.5	
- 0.5	12.00		-0.5	10.95		-0.5	12.70	
0.0	10.69		0.0	10.40		0.0	10.62	
+ 1.0	10.82		+ 1.0	10.52		+1.0	10.70	
2.0	10.95		2.0	10.63		2.0	10.76	
3.0	11.04		3.0	10.75		3.0	10.84	
4.0	11.11		4.0	10.86		4.0	10.92	
5.0	11.18		5.0	10.97		5.0	11.01	
6.0	11.26		6.0	11.11		6.0	11.09	
7.0	11.37		7.0	11.29		7.0	11.18	
8.0	11.47		8.0	11.42		8.0	11.30	
9.0	11.60		9.0	11.54		9.0	11.40	
10.0	11.76		10.0	11.75		10.0	11.51	
11.0	11.94		11.0	11.89		11.0	11.64	
12.0	12.26		12.0	12.08		12.0	11.83	
13.0	12.76		13.0	12.38		13.0	12.04	
14.0	13.40		14.0	13.14		14.0	12.28	
			15.0	13.80		15.0	12.62	
						16.0	13.07	

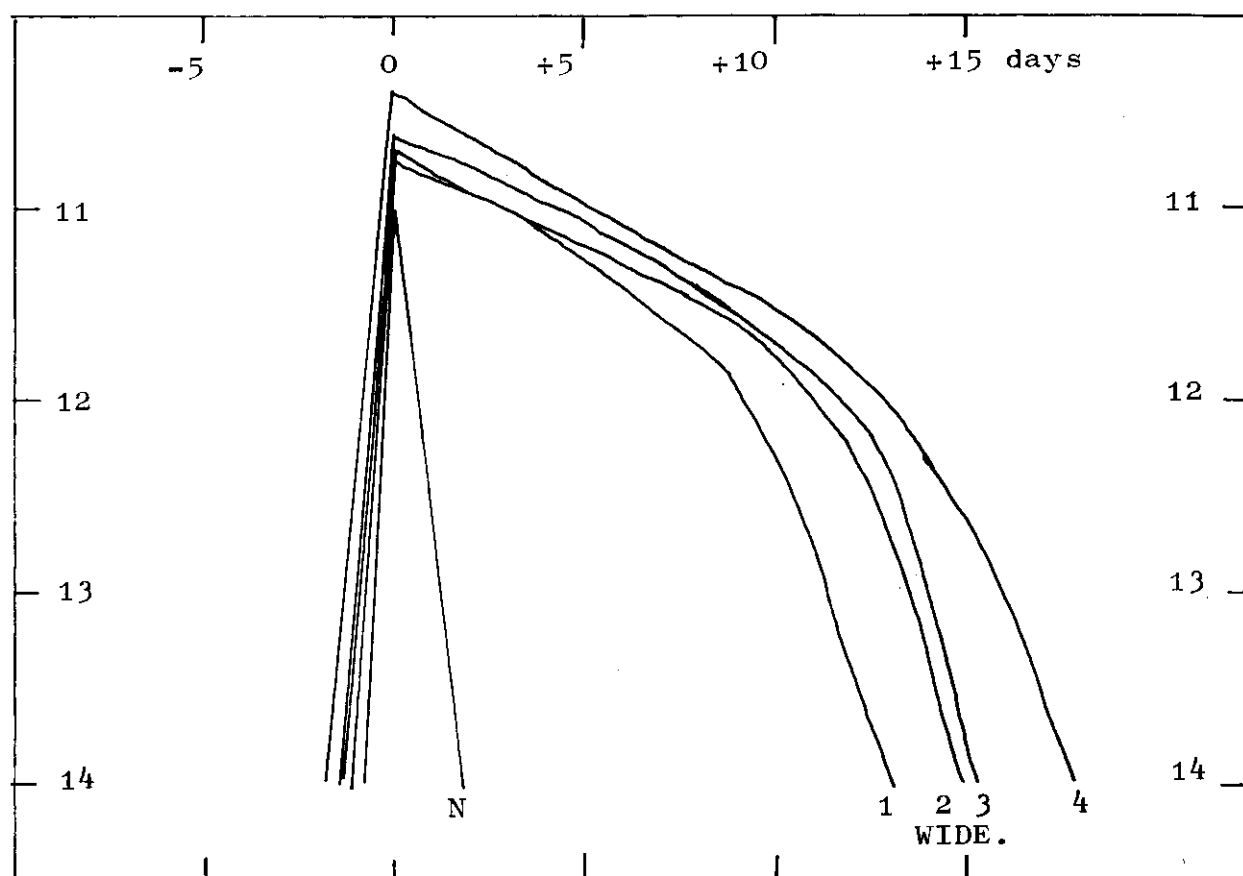


Figure 1. CU Velorum. Mean Light Curves.
 N= Narrow. Four examples of
 Wide maxima shown.

SEQUENCES FOR SOUTHERN VARIABLES

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SUMMARY: V and B-V magnitudes are published for sequences of comparison stars for T Col; RW Pup; RR Pic; RU, SU, DI Car; RT, RX and AQ Cen; AT Ara. Charts have already been published.

.....

INTRODUCTION: This paper continues the results of sequence determinations carried out at the Auckland Observatory. Details of the equipment, calibration and reduction methods were given by Bateson and Menzies (1970).

Previous results have been published by Bateson, Gordon and Menzies (1971 and 1972); Menzies (1975). The references to charts are to those published by Bateson, Jones and Stranson (1967 and 1971); Bateson, Morel and Winnett (1976).

Visual observers are requested to use the magnitudes given under "Adopted" (V magnitudes rounded off to tenths), in place of values given on the charts, or in place of the chart letters where no magnitude was published. For T Col, RR Pic, RT and RX Cen only the fainter stars from the sequence shown on the respective charts have been measured. Magnitudes brighter than these are as shown on the charts. The measures for SU Car continue the previously published part sequence. As the chart for RU Car shows several stars identified by the same magnitude the positions of those now published are shown with reference to RU Car.

ACKNOWLEDGMENTS: I wish to thank the Board of Trustees of the Auckland Observatory for the use of their 50cm Zeiss reflector and auxiliary equipment for this programme. I am grateful to Grant Christie who very kindly had the data processed through the University computer.

I also wish to express my personal thanks to Graham Blow, Peter Connolly, Phillip Ellis, Glen Rowe, Trixie Stewart and Faye Williams for their invaluable assistance on this programme.

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SEQUENCES.

051533 T Columbae. (Chart 133, Series 4).

Standard H.D. 35322. V=8.39; B-V 0.43.

<u>CHART</u> <u>DESIGNATION.</u>	<u>V</u>	<u>B-V</u>	<u>ADOPTED.</u>	<u>REMARKS.</u>
110	10.99	0.51	11.0	Harvard "h")
114	11.36	0.60	11.4	Harvard "k")
119	11.95	0.58	11.9	" " "l") H.A. 63, 11.
121	12.21	0.60	12.2	" " "m")
124	12.29	0.84	12.3	" " "n")
131	13.39	0.81	13.4	" " "o")

060650 RW Puppis. (Charts 138 & 139, Series 4).

Standard H.D. 43548. V=8.80; B-V 0.72.

71	7.21	0.36	7.2	CoD-49°2061. HD 42169.
80	7.90	0.14	7.9	-49 2074 42488.
82	8.62	0.04	8.6	-49 2106 43221.
84	8.67	1.33	8.7	-49 2089 42732.
91	9.19	0.47	9.2	-49 2091 42802.
102	9.40	0.77	9.4	Close double. Integrated magnitude. -49 2052 62 ~~42008~~
92	9.50	0.51	9.5	-49 2110 43273.
96	10.53	0.17	10.5	-49 2090
100	10.61	0.54	10.6	-50 2073
108	10.97	1.45	11.0	-49 2082
105	11.23	0.87	11.2	-50 2080
115	12.00	0.57	12.0	-49 2088
113	12.04	0.94	12.0	
119	12.00	1.58	12.0	
120	12.25	1.18	12.2	
122	12.38	0.90	12.4	
128	13.27	1.04	13.3	
...	13.87	0.68	13.9	Does not appear on Chart 139. Position 3mm South and 11mm West of "113".

063462 RR Pictoris (Chart 270, Series 7). Std.H.D.50035.V=8.41;B-V 0.47.

106	10.39	0.20	10.4
105	10.50	1.00	10.5
112	10.89	1.08	10.9
115	11.25	0.93	11.2
122	12.20	0.57	12.2
129	12.71	0.64	12.7

091365 RU Carinae (Chart 251, Series 7). Std.H.D.80710.V=6.10;B-V 1.26.

81	8.02	0.03	8.0	16mm South & 32mm East of RU CPD-65°1103
84	8.46	0.51	8.5	28mm South & 16mm East of RU -66 1001
89	8.77	0.49	8.8	-66 1000
90	8.86	0.23	8.9	8mm North & 3mm West of RU -65 1096
92	9.20	0.44	9.2	5mm North & 7mm West of RU -65 1093
97	9.49	0.08	9.5	6mm North & 17.5mm East of RU -65 1099
95	9.51	1.17	9.5	8mm South & 7mm West of RU -65 1092
100	9.86	0.44	9.9	10mm South & 5mm West of RU -65 1094
105	10.25	1.57	10.3	7.5mm due North of RU "h")
110	10.89	1.32	10.9	"k") H.A.63,11
123	12.30	0.51	12.3	"l")
129	...	...	...	Variable. Measures: "m")

2,441,695 V= 13.43 B-V 0.42
 723 13.26 0.52
 779 12.63 0.61
 786 12.42 0.57

SEQUENCES (cont).

101060 SU Carinae (Chart 284, Series 7).

Standard H.D. 88293. V=7.49; B-V 1.08.

(The following are additional to sequence published in Publications No.3 (C75), VSS,RASNZ, page 47, 1975).

<u>CHART</u> <u>DESIGNATION.</u>	<u>V</u>	<u>B-V</u>	<u>ADOPTED</u>	<u>REMARKS.</u>
k	11.06	0.10	11.1	
n	11.32	0.01	11.3	
o	10.93	0.69	10.9	Not lettered on chart 284. Is 10mm due West of SU Car.
s	11.87	0.81	11.9	
111169 DI Carinae (Chart 116, Series 4).				
Standard HD 97472. V= 6.34; B-V 1.37.				
79	7.81	0.60	7.8	CPD -69 ⁰ 1510
82	8.10	0.02	8.1	-68 1463
85	8.39	-0.03	8.4	-68 1467
84	8.42	+1.48	8.4	-68 1452
93	9.29	1.46	9.3	-69 1491
94	9.34	0.13	9.3	-68 1458
95	9.49	0.56	9.5	-69 1513
104	10.29	0.14	10.3	-68 1454
f	10.71	0.05	10.7	-69 1518
k	10.72	0.61	10.7	-69 ~~1503~~ 1504
h	10.74	0.68	10.7	-69 1507
109	10.90	0.25	10.9	-69 1515
m	11.11	0.90	11.1	...
p	11.21	1.33	11.2	...
n	11.23	1.05	11.2	...
105	11.46	0.50	11.5	-69 1486
r	11.75	0.36	11.8	...
s	12.02	0.60	12.0	...
u	12.47	0.56	12.5	...
134236 RT Centauri (Chart 295, Series 7).				
Standard H.D. 120672. V= 6.34; B-V 0.48				
104	10.30	0.94	10.3	Harvard "g")
114	11.26	0.47	11.3	" "h")
130	12.38	0.63	12.4	" "m") H.A. 63, 11.
138	13.35	0.79	13.3	" "n")
134536 RX Centauri (Chart 296, Series 7).				
Standard H.D. 120672. V= 6.34; B-V 0.48.				
110	10.51	1.19	10.5	Harvard "e")
109	10.65	0.45	10.6	" "d")
114	11.17	0.55	11.2	" "f") H.A. 63, 11.
117	11.54	0.27	11.5	" -)
121	11.55	1.44	11.5	" "g")
124	12.05	0.77	12.1	" -)
131	12.89	0.63	12.9	" "h")

SEQUENCES (cont).135935 AQ Centauri (Chart 316, Series 8).

Standard H.D. 123222. V = 7.19; B-V 0.96

<u>CHART</u> <u>DESIGNATION</u>	<u>V</u>	<u>B-V</u>	<u>ADOPTED.</u>	<u>REMARKS.</u>
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b	10.61	0.25	10.6
a	10.87	0.54	10.9
c	11.09	1.53	11.1
d	11.80	0.69	11.8
k	~~11.87~~	~~1.71~~	~~11.9~~
e	11.96	0.55	12.0
f	12.01	1.16	12.0
g	12.63	0.70	12.6
h	13.16	1.15	13.2

AQ Cen measured. $k = 13.2_v$

(See also note below).

172346 AT Arae (Chart 315, Series 8)

Standard H.D. 158667. V = 8.12; B-V 1.14

a	10.04	0.40	10.0
b	10.09	1.57	10.1
c	11.21	0.25	11.2
f	11.54	1.58	11.5
d	11.67	0.83	11.7
e	11.76	0.18	11.8
h	11.97	1.61	12.0
m	13.95	0.25	14.0
n	14.46	1.50	14.5
k	...	...	...

Probably variable. Measured range of 12.6 to 13.0 in V; with B-V being 1.2 at brightest to 0.7 at faintest. Other stars will be selected later to fill gap between "h" and "m"

.....

NOTE ON 135935 AQ Centauri.

Additional comparison stars to those listed above are given below together with their preliminary magnitudes. Using the 1950 co-ordinates these stars are easily identified on Chart 316 from the co-ordinates shown on that chart.

<u>STAR</u>	<u>R.A. 1950</u>	<u>DEC. 1950.</u>	<u>ADOPTED</u>	<u>SOURCE.</u>
CoD-34° 9376	14h 4m 9.490s	-35° 15' 14" 70	7.2	(V. R.O.B. 64)
-35 9255	3 16.154	-35 55 2.34	7.7	SP _v)
-35 9251	2 54.862	-35 46 44.40	8.5	SP _v) CAPE ANNALS
-35 9266	4 27.848	-35 23 7.74	8.6	SP _v) XV111
-35 9248	2 20.892	-35 55 51.73	9.9	SP _v)
-35 9259	3 39.556	-35 59 12.16	9.9	SP _v)
-35 9246	2 17.901	-35 27 29.11	10.1	SP _v)
-35 9250	2 51.171	-35 50 4.62	10.2	SP _v)

F.M.B.

THE DWARF NOVA V436 CENTAURI.

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SUMMARY: Observations from 2,436,256 to 2,442,948 show two main types of outbursts---supermaxima, with mean maximum brightness of 11.30_V and a mean width at phase 13.0I-D of 14.0 days, and, narrow_V maxima with corresponding values of 12.43_V and 1.8 days. Possibly a third type of maximum occurs with short, sharp peaks between 13.0 and 14.0. Many features of supermaxima are similar to those shown by VW Hyi. Lists of observed outbursts and observations are tabulated. Light curves are illustrated.

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INTRODUCTION: Maxima of V436 Cen between J.D. 2,436,256 and 2,440,038 were divided into three types, namely supermaxima, medium bright and faint (Bateson & Jones 1970). The discussion in their paper was based on step estimates because no reliable magnitudes for the sequence stars were then available.

V and B-V magnitudes for the comparison stars were subsequently published (Bateson, Gordon & Menzies 1972), and three colour magnitudes published by Warner (1976). The comparison stars are shown on chart 103 (Bateson, Jones & Stranson 1968) and No. 370 (Warner 1976; Bateson, Morel & Winnett 1977).

Warner's sequence (1976) has been used to reduce all observations with the addition of comparison star "c", V magnitude 11.3 (Bateson, Gordon & Menzies 1972).

OBSERVATIONS: Over 4,000 observations were made on 2,701 nights between J.D. 2,436,256 (1958 February 21) and 2,442,948 (1976 June 18). That means V436 Cen was observed on 40% of the nights in this interval. The star was observed every month in each year with a lower frequency of records in September, October and November when it could only be observed at a low altitude. Coverage ranged from 29% of nights in 1964 to 55% in 1974.

The majority of the visual observations were negative with V436 Cen invisible, when the magnitude of the faintest comparison star seen was recorded.

Positive observations are listed in Table 1. The negative observations that immediately precede and follow each series of positive observations are also given. The first column gives the J.D., the second column the mean magnitude, and the number of observations in each mean appears in the third column. A question mark indicates that the observation is considered very doubtful.

DISCUSSION: All positive observations were plotted on a large scale from which the dates of maximum brightness were determined. These are listed in Table 2, which is in the same form as used for CU Vel on pages 3 and 4 of this publication. A maximum that could be assigned to one of the types discussed below has such type given in the second column of Table 2, in accordance with the details below.

Forty-one maxima are listed in Table 2, of which 14 are reliable. A further 7 maxima are reasonably certain despite a limited number of observations. The remaining 20 maxima must be regarded as uncertain since they are dependent on one or two observations.

The reasons why so many maxima are uncertain are (1) V436 Cen has not been monitored as assiduously as other dwarf novae, and (2) the very short duration of many outbursts.

The 14 outbursts reliably determined fall into two distinct types, viz; supermaxima and narrow maxima. The former have an average maximum brightness of 11.30_v and a mean width at phase 13.0I-D of 14.0 days. The corresponding values for the narrow maxima are 12.43_v and 1.8 days. There are indications that there is a third class of maxima when V436 Cen rises to around 13.0, or slightly less. Such peaks are of very short duration.

The mean cycle between successive outbursts is 164 days. This is certainly much longer than the true mean cycle because many maxima have been unobserved.

The intervals between successive supermaxima are apparently distributed at random. It is suspected that they may occur at intervals of around 335 days, when allowance is made for possible supermaxima that have been poorly observed.

Light curves for the six well observed supermaxima are shown in Figure 1. The rising branch of the curves have not been well observed because of their steepness. Negative observations indicate that the rate of increase from magnitude 13.0 to the top of the initial rise is 0.4 magnitudes in 0.1 days. It appears that the rate is equally as steep below 13.0. The rates of increase for the individual supermaxima are very similar to those found for VW Hyi (Bateson 1977).

The falling branch of supermaxima curves were well observed. Four show a decrease of from 0.3 to 1.15 magnitudes between the top of the initial rise and the subsequent maximum brightness. The light curves show the following broad features on the descending branch:

- (a) Marked fluctuations in the form of small amplitude, sharp peaks. Observations are not numerous enough to establish a period for the occurrence of these peaks, although, when observations from an experienced observer are sufficient, there is an indication that the period may be around 0.06 days.
- (b) An apparent standstill, or slowing of the rate of decrease, when magnitude 12.3 to 12.5 is reached. This can last for a few days.
- (c) A steeper and smoother decline to minimum after the standstill.

The foregoing features are also apparent on the declining branch of the curves for VW Hyi (Bateson 1977).

Narrow maxima have been poorly observed, largely because of their very brief durations. Light curves of the best observed appear in Figure 2. These suggest that there are several types of narrow maxima, but the sample is too small to warrant assigning sub-types to them.

There is an apparent tendency for a third class of maxima to occur. These are probably short, sharp peaks with maximum brightness of 13.0 to 14.0.

The limited number of observations at minimum indicate that V436 Cen fluctuates around magnitude 15.0. Whether the third class of maxima are merely the peaks of such fluctuations is impossible to state on the evidence available.

CONCLUSIONS: The outbursts of V436 Cen are either supermaxima with an average maximum brightness of 11.30_v and a mean width of 14.0 days at phase 13.0I-D, or narrow maxima for which the corresponding means are 12.43_v and 1.8 days. Possibly a third type of maximum occurs with a short duration and maximum brightness of from 13.0 to 14.0.

The supermaxima light curves have many features in common with those of VW Hyi on the declining branch. These include short, sharp peaks, probably due to "superhumps"; a standstill at magnitudes 12.3 to 12.5, and, a smooth, steeper decline following the standstill.

The mean cycle is 164 days with a range from 13 to 579 days. Little value can be attached to this mean because it is obvious that many maxima have gone unobserved. The mean cycle is probably very much shorter than 164 days.

Supermaxima apparently occur at random although it is suggested that they may have a cycle around 335 days.

At minimum V436 Cen appears to fluctuate continuously around magnitude 15.0. The fainter maxima may merely represent peaks in these fluctuations.

V436 Cen has not been followed as closely as other dwarf novae. Observers are requested to monitor it more closely since this star warrants a great deal more attention.

ACKNOWLEDGMENTS: This paper forms part of the research programme made possible by a grant from the Carter Observatory Board. My thanks are due to B. Menzies and B. Warner for their work on the sequence magnitudes, and to all observers for their observations.

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 Warner, B. 1976. Publ. 4 (C76), V.S.S., R.A.S.N.Z.

TABLE 1.

OBSERVATIONS OF V436 CENTAURI.

<u>J.D.</u>	<u>MAG.</u>	<u>No.</u>	<u>J.D.</u>	<u>MAG.</u>	<u>No.</u>	<u>J.D.</u>	<u>MAG.</u>	<u>No.</u>	<u>J.D.</u>	<u>MAG.</u>	<u>No.</u>
2,436,000+											
318.86	(14.1	1	347.80	12.1	1	569.00	(13.2	1	769.79	(12.9	1
320.19	14.3?	1	348.82	12.4	1	570.00	13.0	1	770.80	13.9	1
.80	(13.6	1	349.92	12.5	1	572.01	(14.1	1	777.81	(14.1	1
321.90	(13.6	1	351.04	12.4	1	683.79	(12.9	1	902.13	(13.6	1
340.04	(14.0	1	.92	12.4	1	685.89	12.7	1	914.10	12.1	1
.95	11.5	1	353.86	12.7	1	686.91	12.7	1	928.00	(13.6	1
341.87	11.80	2	354.87	13.6?	1	687.93	13.2	1			
342.90	11.7	1	356.79	(13.6	1	688.78	(13.6	1			
344.90	11.6	1				.94	14.9?	1			
						689.98	(13.6	1			

TABLE 1 (cont)---OBSERVATIONS OF V436 CENTAURI.

J.D.	MAG.	No.	J.D.	MAG.	No.	J.D.	MAG.	No.	J.D.	MAG.	No.
2,437,000+			2,439,000+			2,441,000+			2,441,000+		
070.95 (13.6 1			868.09 (14.1 1			092.86 (13.2 1			915.87 (13.2 1		
075.90 13.1 1			869.16 14.4 1			.92 (14.1 1			917.82 12.0 1		
077.94 15.2? 1			870.95 (12.5 1			093.04 14.4 1			919.86 11.9 1		
471.92 (13.6 1			874.95 (13.6 1			.84 (14.1 1			920.81 12.0 1		
474.89 11.4 1			915.90 (13.6 1			251.16 (14.1 1			929.81 (12.5 1		
478.92 12.2 1			916.96 12.8 1			254.15 12.0 1			2,442,000+		
479.91 12.4 1			917.21 12.3 1			256.15 13.9 1			044.93 (12.9 1		
480.86 12.3 1			.94 12.7 1			268.15 12.7 1			049.07 15.0 1		
482.84 12.3 1			918.94 13.3 1			269.12 12.8 1			051.11 (14.1 1		
484.91 12.7 1			919.21 14.0 1			278.14 (14.1 1			073.05 (14.5 1		
487.78 14.4? 1			922.18 (15.0 1			374.16 (14.1 1			.98 15.1 1		
488.80 14.4 1			2,440,000+			.89 (12.5 1			075.00 (14.8 1		
491.84 (14.1 1			016.88 (13.2 1			381.88 12.3 1			084.00 (13.5 1		
758.98 (13.6 1			017.79 12.7 1			382.92 12.85 2			085.90 13.0 1		
761.00 12.65 2			018.77 (13.6 1			386.91 (14.1 1			086.90 13.5 1		
762.11 13.9 1			086.85 (13.2 1			520.82 (12.9 1			087.99 13.40 2		
.96 (14.1 1			089.88 (12.5 1			.89 (12.5 1			088.94 14.3 1		
973.13 (13.6 1			092.81 14.3 1			521.84 12.9V 1			089.92 (13.6 1		
976.14 13.9? 1			093.81 (14.1 1			522.81 12.23V 3			091.60 (13.6 1		
977.14 (12.9 1			337.92 (13.6 2			.91 12.2 1			.87 15.1 1		
978.14 (13.6 1			338.85 14.4? 1			523.81 13.25V 2			.96 (13.6 2		
2,438,000+			340.89 (12.5 2			524.85 (13.2 1			092.98 15.0 1		
135.93 (14.1 1			341.80 (14.0 1			525.79 (13.6 1			093.00 (14.0 1		
136.96 14.3 1			541.15 (14.1 1			526.83 14.0? 1			095.93 (13.6 2		
139.97 (14.1 1			550.10 12.3 1			.86 (14.1 1			096.04 15.1 1		
141.94 15.1? 1			561.11 (14.1 1			590.20 (13.2 1			.90 (14.0 1		
142.93 (15.0 1			660.93 (14.1 1			.20 13.6? 1			.92 (13.6 2		
443.09 (14.1 1			.99 13.2 1			591.20 (12.5 1			.97 (14.1 1		
460.01 12.8 1			661.98 (12.2 1			595.19 (12.9 1			097.03 15.1 1		
461.90 13.0 1			662.00 13.2 1			640.15 (13.6 1			.17 (14.5 1		
466.99 (13.6 1			666.84 (12.9 1			653.13 12.75 2			.92 (14.1 1		
739.13 (14.1 1			670.94 13.6 1			655.11 13.0 1			098.03 15.00 2		
740.09 14.5 1			673.84 (14.1 1			666.09 (15.0 1			099.04 15.10 2		
756.12 (14.1 1			821.82 (13.6 1			721.94 (14.1 1			.91 15.1 1		
2,439,000+			842.23 12.5 1			722.05 13.03V 2			.93 (13.6 1		
266.05 (13.6 1			856.20 (12.9 1			.98 13.33 3			103.00 (14.5 1		
.85 (14.0 1			995.88 (14.1 1			723.19 12.65 2			.90 15.2 1		
269.92 11.30 2			996.88 14.0? 3			.97 12.55 2			.92 (13.6 1		
270.91 11.2 1			998.90 (13.6 1			724.05 12.40 2			104.17 15.1 1		
271.90 11.2 1			2,441,000+			726.16 14.7 1			.85 (14.0 1		
272.94 11.4 1			060.93 (13.6 1			807.04 (14.1 1			117.00 (13.0 1		
273.89 11.60 2			061.88 (13.2 1			.11 (13.6 1			118.88 12.8 1		
274.81 11.7 1			.90 14.0 1			.91 12.62 5			119.91 12.0 1		
275.87 11.9 1			062.90 (13.6 1			808.02 12.3 1			120.91 12.87 3		
282.79 13.0 1			066.89 (14.1 1			.90 12.22 4			121.92 (13.6 1		
283.85 13.8 1			.92 14.1 1			809.11 12.3 1			159.30 (13.2 1		
285.89 (14.1 1			.93 (14.1 1			.99 12.55 2			.85 15.5 1		
290.88 (14.1 1			067.97 (14.1 1			810.88 12.5? 1			.88 (14.1 1		
291.93 13.95 2						.88 (13.2 1			188.86 (14.1 1		
292.91 14.7 1						.96 13.9 1			.90 (13.6 1		
293.85 (14.1 1						811.03 14.4 1			.93 13.2? 1		
						.90 (14.1 1			189.87 (14.1 1		
									190.97 12.5 1		
									191.86 (14.1 1		

TABLE 1 (cont).---OBSERVATIONS OF V436 CENTAURI.

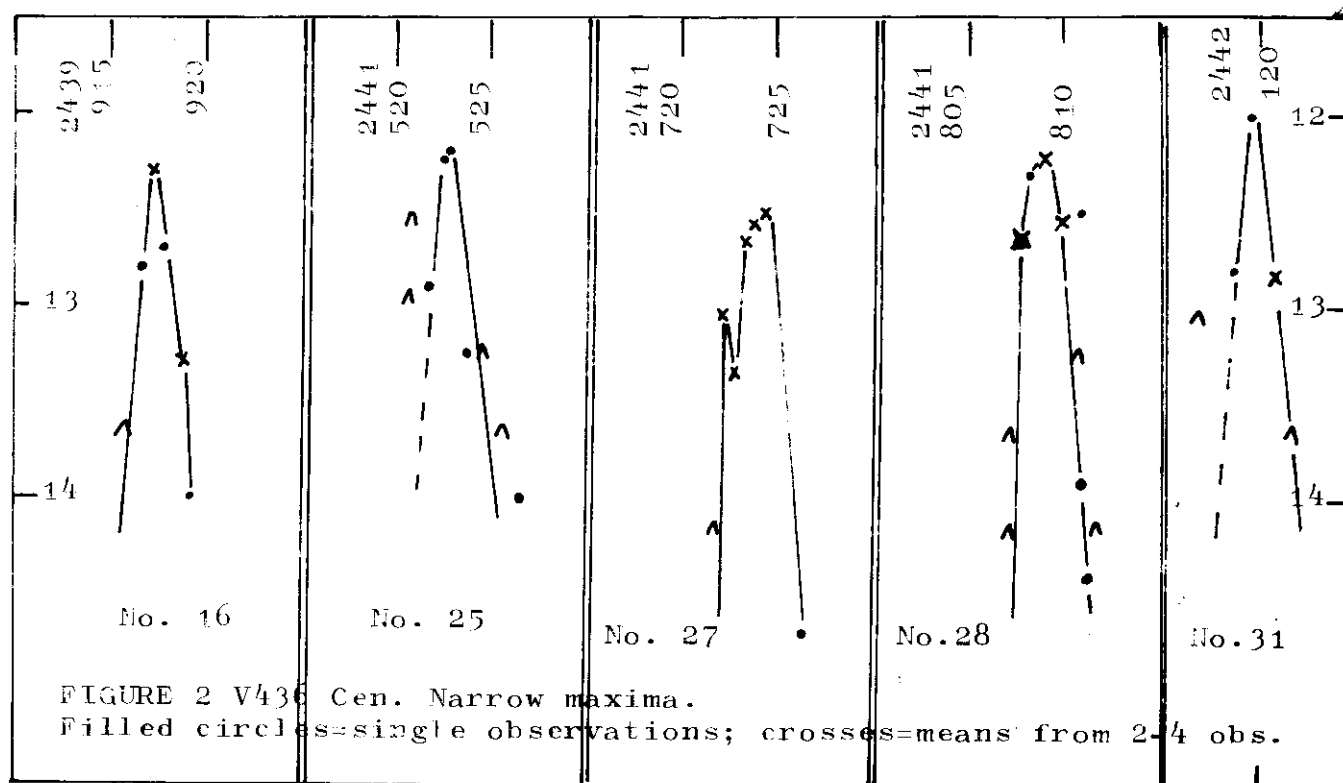
J.D.	MAG.	No.	J.D.	MAG.	No.	J.D.	MAG.	No.	J.D.	MAG.	No.
2,442,000+			2,442,000+			2,442,000+			2,442,000+		
201.86(12.9		1	420.21(13.2		1	619.22(13.2		1	900.90 12.24		5
202.87 12.5		1	422.99 14.7		1	620.81 12.3		1	901.93 12.35		4
203.20 12.2		1	423.97(13.6		1	621.88(14.1		1	902.97 12.15		2
.91 12.4		1	424.05 14.5		1				903.32 12.3		1
204.89 12.75		2	.47(13.2		1	818.00(13.5		1	904.05 12.30		2
205.85 11.97		4	.90(12.9		1	.42 13.5		1	.94 12.30		2
206.88 11.50		2	425.93(13.2		1	.92(12.5		1	905.86 12.66		3
207.93 11.58		5	427.99 15.1		1	819.91(12.5		2	906.98 12.2		1
209.20 11.9		1	428.01(14.1		1	833.96(13.6		1	907.89 13.0		1
210.05 11.95		2	430.06 15.0		1	835.05 15.1		1	911.85 12.9		1
.88 11.90		2	.11(14.1		1	.91(13.6		1	912.83(12.5		1
211.83 12.5		1				864.93(14.1		1	913.85 13.6		1
212.88 12.30		2	452.97(13.6		1	865.09(12.5		1	914.79 13.9		1
214.07 12.25		2	453.02 14.7		1	.23 12.5?		1	915.87(14.1		1
215.31 12.1		1	.92(13.2		1	866.23(13.2		1	929.88(13.6		1
.85 12.00		2	454.02(14.5		1	.96(14.1		1	.93 13.6		1
216.30 12.1		1				867.80 15.0		1	930.02(12.5		1
.82 12.15		2	502.23(13.2		1	.90(14.1		2	.89(12.5		1
217.86 13.20		3	.70 14.5		1	.95 15.2		1	933.23(13.6		1
218.85 13.80		2	.84(13.2		1	868.90(14.1		1			
219.30(13.2		1	.87(14.1		1	892.80(13.2		1			
.92(14.1		1				.96 14.5		1			
220.81(13.6		1	511.94(13.6		1	893.03(13.2		1			
.89 14.0		1	512.91 14.8		1	.25(13.6		1			
221.30 13.5		1	513.84(12.5		1	.92(13.6		1			
.86 13.00		2	514.84(13.2		1	894.23(13.6		1			
222.20 13.2		1	516.86 13.2		1	.90 11.85		2			
.79 14.1		1	.91(13.2		1	896.78 13.0		1			
265.90(13.6		1	570.93(12.5		1	897.89 12.0		1			
267.82 12.1		1	571.89 11.50		2	898.23 10.7		1			
.86(14.1		1	572.96 12.0		1	.84 12.0		1			
			573.91 12.2		1	.87(12.9		1			
313.20(13.2		1	574.84 11.80		8	899.82 11.6		1			
319.20 12.9		1	575.91 11.6		1	900.01 11.85		2			
341.25(13.2		1	576.94 11.5		1						
			578.89 11.5		1						
			579.90 12.23		6						
			580.81 12.40		2						
			581.90 12.4		1						
			582.92 12.4		1						
			584.85 12.9		1						
			588.86(13.2		1						

TABLE 2---OBSERVED MAXIMA OF V436 CENTAURI.

No.	TYPE	MAXIMUM J.D.	MAG. v	INT. d	13.0I	13.0D	WIDTH d	No. of OBS.
1	S	2,436,341	11.5	...	340.7	354.1	13.4	12
2	N	571?	13.0	230	...	...	...	1
3	N	686	12.7	115	685.6	687.1	1.5	4
4	N	772?	13.9	86	...	...	...	1
5	?	914?	12.1	142	?	?	?	1
6	?	2,437,074	13.1	160	...	...	...	2
7	S	475	11.4	401	474.3	485.4	11.1	8
8	N	760	12.65	285	759.9	761.3	1.4	3
9	N	975	13.9	215	...	...	...	1

TABLE 2 (cont)---OBSERVED MAXIMA OF V436 CENTAURI.

NO.	TYPE.	MAXIMUM J.D.	MAG. v	INT. d	13.OI	13.OD	WIDTH d	No. of Obs.
10	N	2,438,138?	14.3	163	...	...	...	2
11	?	458?	12.8	320	?	?	?	2
12	?	741?	14.5	283	...	...	...	1
13	S	2,439,271	11.2	530	269.6	282.8	13.2	11
14	?	291	13.95	20	...	...	...	3
15	?	870?	14.4	579	...	...	...	1
16	N	917	12.3	47	916.9	918.2	1.3	5
17	N	2,440,017?	12.7	100	?	?	?	1
18	N	089?	14.3	72	...	...	...	1
19	?	550	12.3	461	?	?	?	1
20	N	661?	13.2	111	...	...	...	3
21	?	841?	12.5	180	?	?	?	1
22	N	2,441,254	12.0	413	254.0	255.3	1.3	2
23	N	267	12.7	13	?	?	?	2
24	N?	380?	12.3	113	?	382.1	?	3
25	N	522.9	12.2	142.9	521.7	523.8	2.1	10
26	?	652?	12.75	129.1	?	?	?	3
27	N	724.1	12.40	72.1	723.1	725.0	1.9	12
28	N	808.9	12.22	84.8	807.8	810.1	2.3	16
29	S?	919	11.9	110.1	?	?	?	3
30	N	2,442,085	13.0	166	?	?	?	5
31	N	119.9	12.0	34.9	118.8	121.0	2.2	5
32	N	191?	12.5	71.1	?	?	?	2
33	S	206.9	11.50	15.9	202.7	217.7	15.0	37
34	N	221.9	13.00	15.0	...	...	...	6
35	N	267?	12.1	45.1	?	?	?	1
36	?	318?	12.9	51	?	?	?	1
37	S	578	11.5	260	571.4	585.1	13.7	26
38	N	621	12.3	43	?	?	?	1
39	N	819?	13.5	198	?	?	?	1
40	N	865?	12.5	46	?	?	?	2
41	S	898.2	10.7	33.2	894.8	912.3	17.5	34



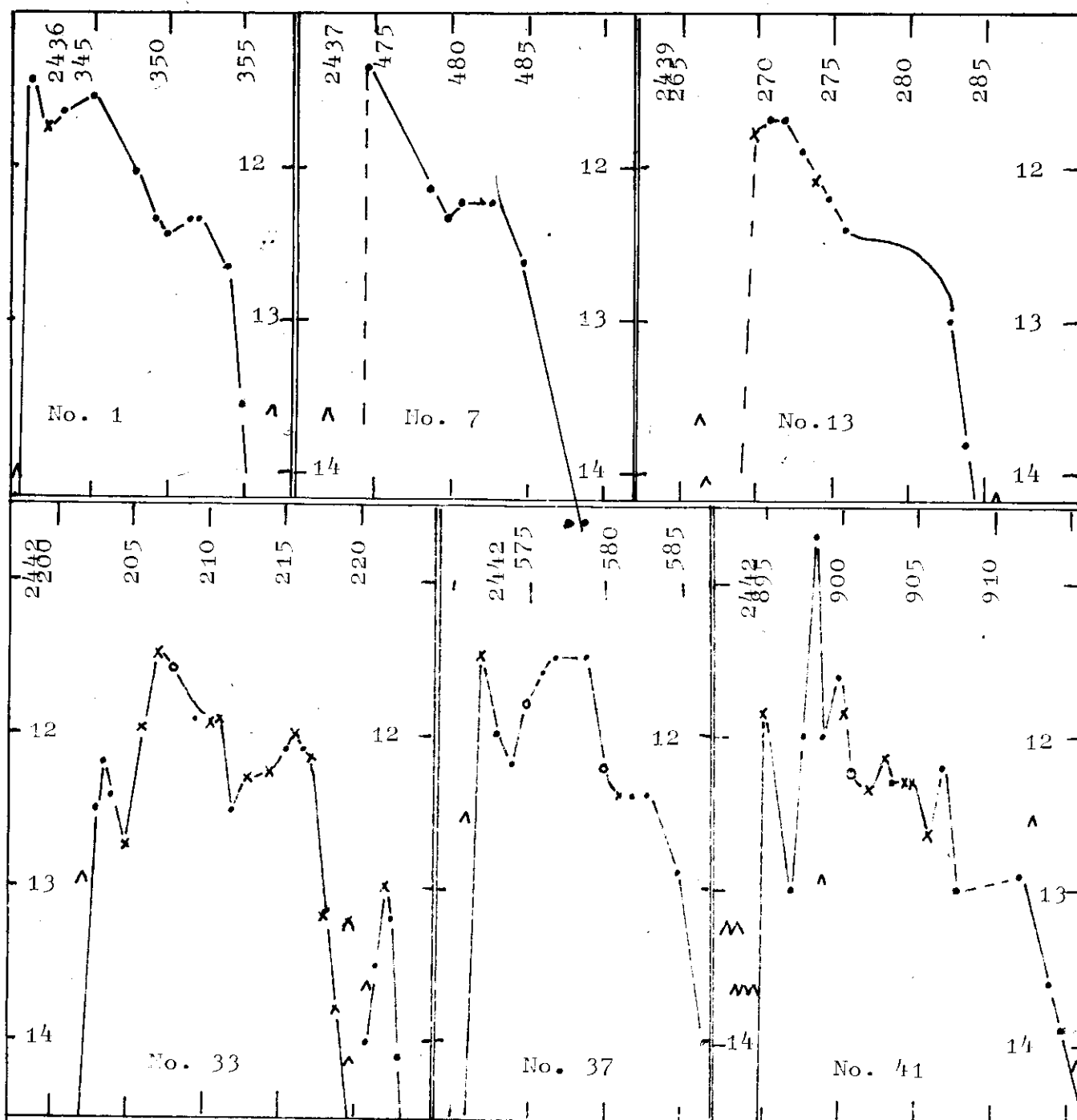


FIGURE 1. V436 CENTAURI. Supermaxima.

Filled circles=single observations; Crosses=Means from 2-4 observations; Open circles=Means from 5, or more, observations.

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SUMMARY: Eighteen years of observations give the elements for RW Pup: EPOCH Max. $2,436,906 \pm 340.88$ days. Minimum to maximum 160.84 days. Mean Range: 9.34^{V} to 14.13^{V} . Mean light curves are used to produce a standard light curve.

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INTRODUCTION: Observations cover the interval J.D. 2,435,864 (1957 January 25) to 2,442,492 (1975 March 20).

Charts 138 and 139 were published (Bateson, *et al*, 1967) on which provisional magnitudes were given for comparison stars. These were revised by Menzies (1977), whose values have been used to reduce all observations.

DISCUSSION: Figure 1 shows the light curve from individual observations. A standard light curve from ten day means appears in Figure 2.

Table 1 lists the observed dates of maxima and minima. For both maxima and minima the first column gives the J.D., the second column the magnitude; the third column the interval between successive maxima, or minima. The fourth column gives the O-C residuals from the elements given below. The fifth column in the case of maxima gives the interval, in days, from the preceding minimum.

The period from maxima is 340.88 days; from minima 341.53 days. The mean interval between minimum and the following maximum is 160.84 days. The mean O-C value for maxima is ± 5.6 days; for minima ± 6.4 days.

The elements derived from the observations are:

EPOCH MAXIMUM J.D. $2,436,906 \pm 340.88^{\text{d}}$. M-m 160.84^{d} .
Maximum Magnitude: Mean 9.34^{V} Range. $8.8 - 10.2^{\text{V}}$.
Minimum Magnitude: Mean 14.13^{V} Range. $13.9^{\text{V}} - 14.5^{\text{V}}$

ACKNOWLEDGMENTS: Observers are thanked for their records.

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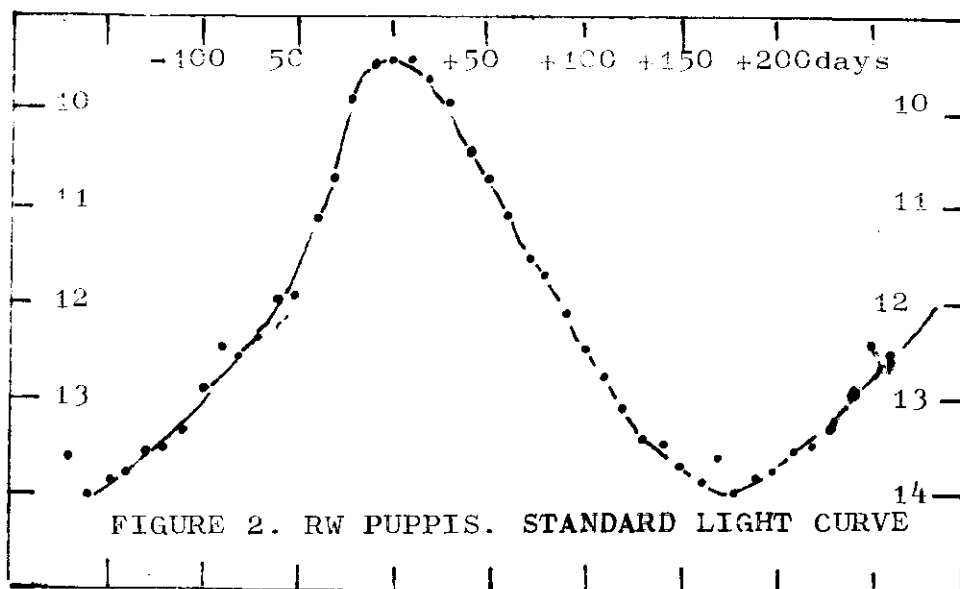
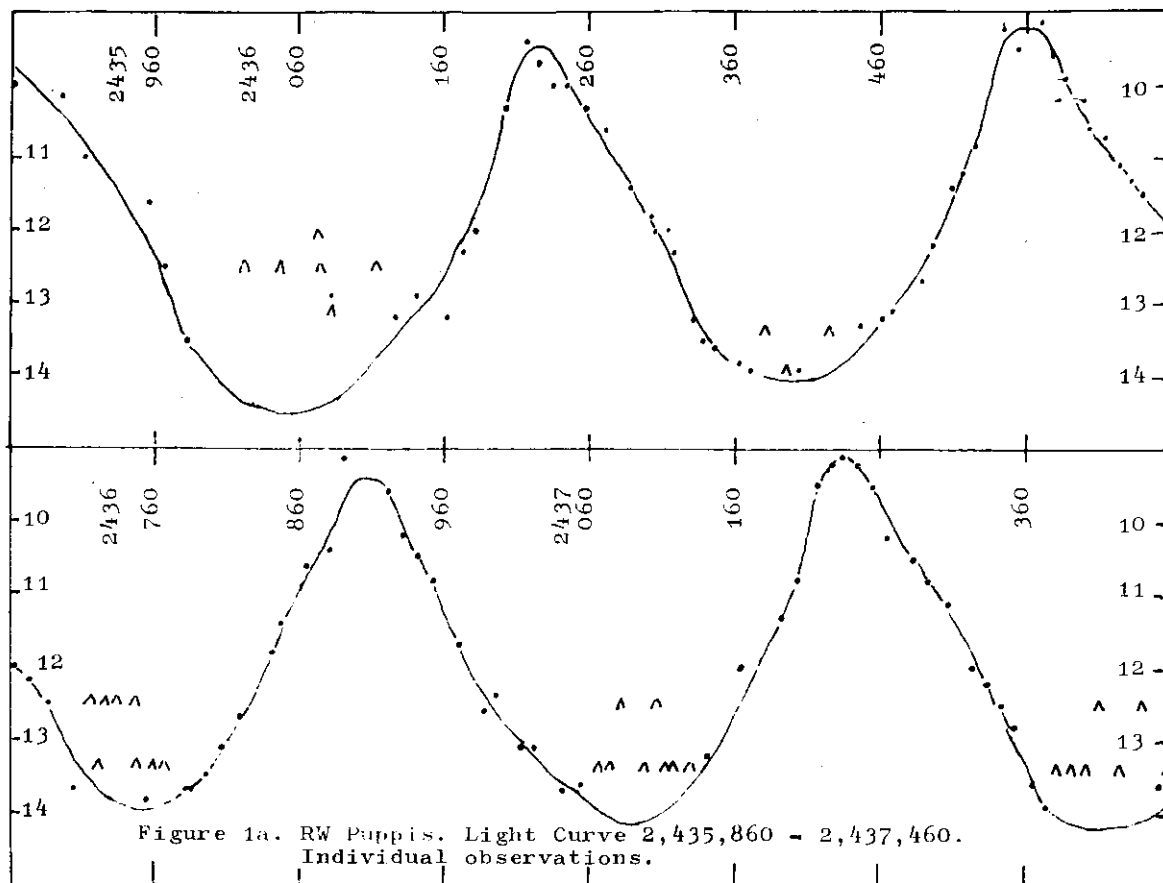


TABLE 1.

OBSERVED MAXIMA AND MINIMA OF RW PUPPIS.

MAXIMA					MINIMA			
J.D.	MAG. v	INT d	O-C d	M-max. d	J.D.	MAG. v	INT d	O-C d
2,436,224	9.5	...	$\pm$ 0	178	2,436,046	14.5	...	-17
559	9.2	335	- 6	165	394	14.1	348	-10
906	9.4	347	+ 0	154	752	14.0	358	+ 7
2,437,232	9.1	326	- 15	156	2,437,076	14.1	324	-10
587	9.2	355	- 1	170	417	14.0	341	-10
939	9.6	352	+ 10	182	757	14.1	340	-11
2,438,273	9.6	334	+ 3	165	2,438,108	14.3	351	- 1
623	10.2	350	+ 13	162	461	14.2	353	+11
943	9.8	320	- 8	155	788	14.1	327	- 2
2,439,291	9.8	348	- 1	154	2,439,137	14.0	349	+ 6
630	8.9	339	- 3	166	464	14.0	327	- 8
977	9.4	347	+ 3	174	803	13.9	339	-10
2,440,302	9.5	325	- 13	147	2,440,155	14.5	352	+ 1
649	8.8	347	- 7	152	497	14.1	344	+ 2
989	9.4	340	- 8	146	843	14.1	346	+ 7
2,441,336	8.8	347	- 1	156	2,441,180	14.0	337	+ 3
669	9.3	333	- 9	153	516	14.2	336	- 1
2,442,017	9.0	348	- 2	159	858	14.1	342	$\pm$ 0
356	9.0	339	- 4	162	2,442,194	14.1	336	- 5

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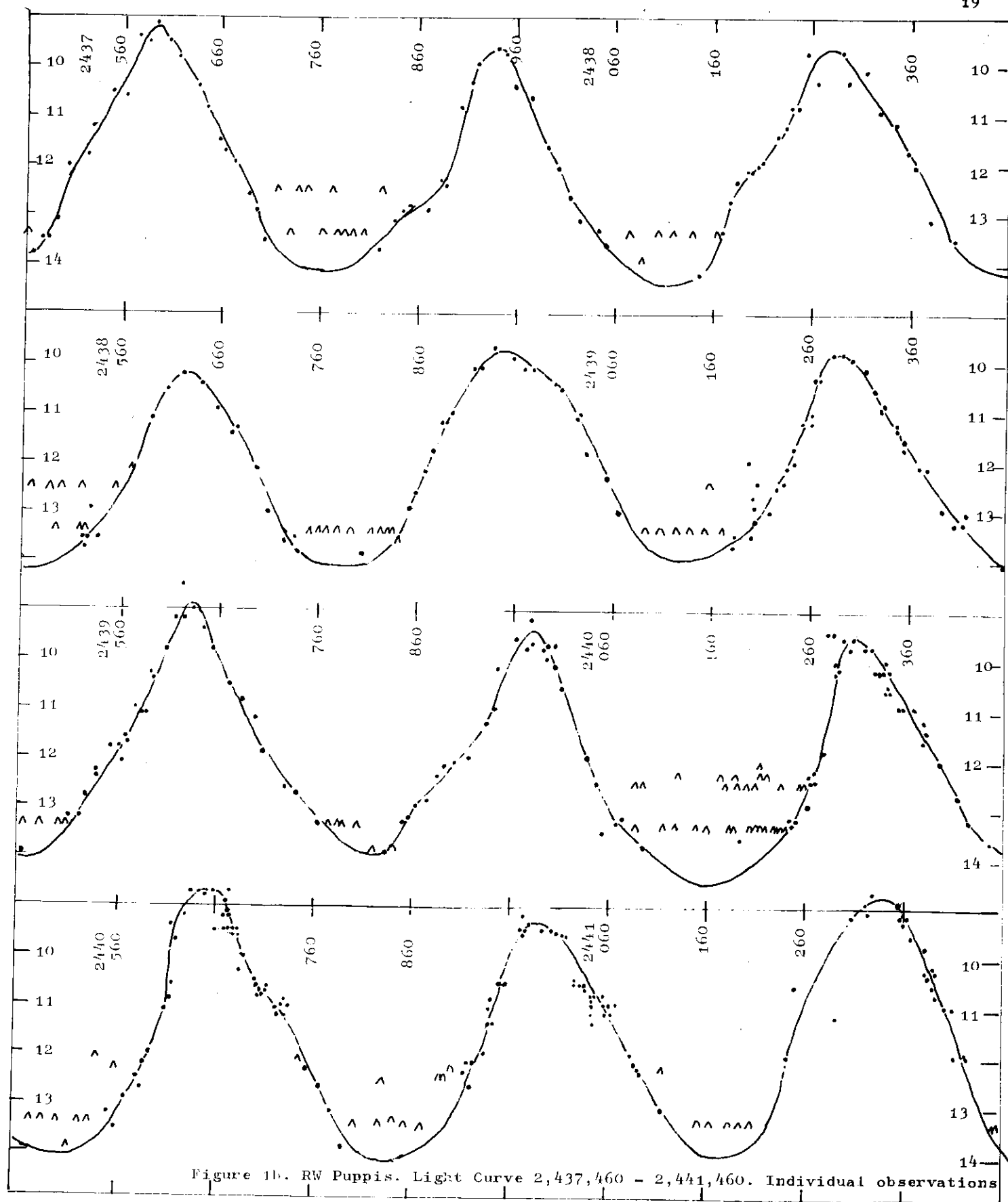
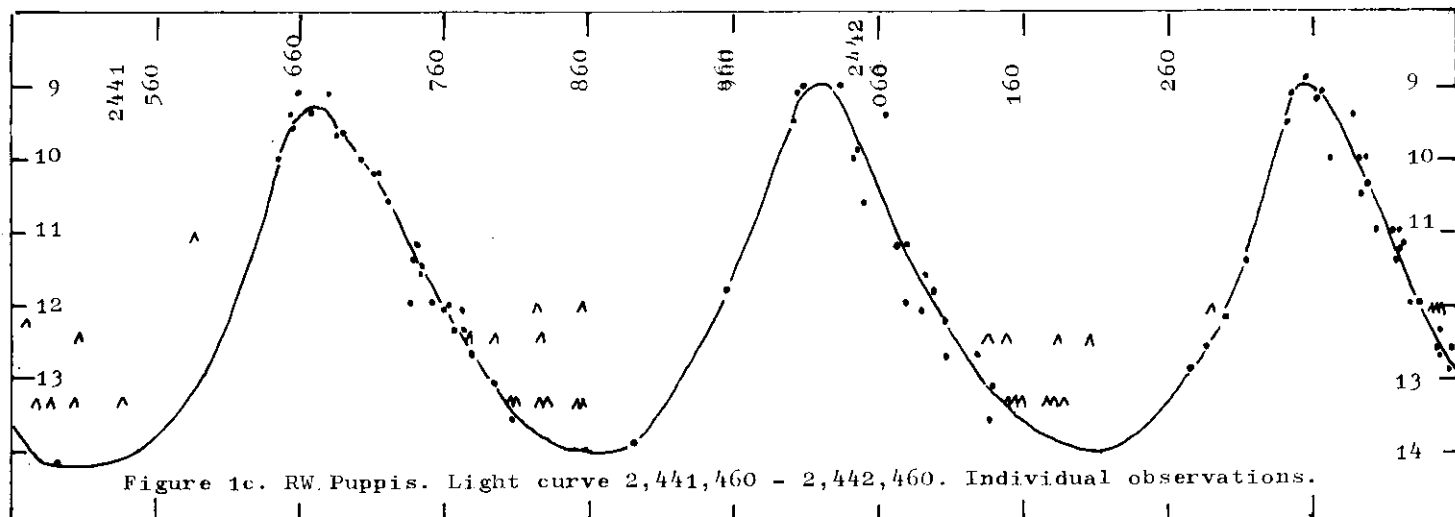


Figure 1b. RW Puppis. Light Curve 2,437,460 - 2,441,460. Individual observations



RR PICTORIS (Nova 1925).

Frank M. Bateson

Ten day means from 2,440,950 to 2,443,090 are given in Table 1. Earlier observations have appeared in many Circulars of the Section from No. 16 to 189. The results now published have been corrected in accordance with the magnitudes of the comparison stars determined by B. Menzies (1977).

The means show that there has been a very slow irregular decline during the past 2,000 days. The overall decline is very slight. There is, at times, an indication of short period oscillations superimposed on longer cycles of 50 and 350 days approximately. These variations amounted to 0.3 magnitudes, at the most, and are generally less. They can best be regarded as irregular oscillations around a very slowly decreasing mean magnitude.

A few V magnitudes from the Auckland Observatory are included in Table 1. These are fainter than the visual means and seem to indicate that RR Pic varies slightly on a short time scale.

REFERENCE:

Menzies, B. 1977. Publ. V.S.S., R.A.S.N.Z. No. 5.

RECURRENT NOVAE, SYMBIOTIC VARIABLES, AND BINARY EVOLUTION*

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SUMMARY

The present evolutionary status of T CrB, as a prototypical recurrent nova, is discussed. It is suggested that this system is a relatively young object of this type, having undergone perhaps ten nova-like outbursts so far. The frequency of outbursts is expected to increase, culminating in the gradual transformation of this binary into a symbiotic variable. The anticipated rate of evolution is sufficiently high that secular changes in the behavior of a recurrent nova or symbiotic variable should be observable in some systems within a human lifetime.

INTRODUCTION

Among the nearly 300 catalogued galactic novae, fewer than a dozen have been observed to erupt more than once. The first object of this type to be identified (if we discard the probably spurious case of V529 Ori = Hevelius's nova 1667 [see Ashbrook, 1963]) was T Pyxidis, whose first three outbursts (1890, 1902, 1920) were discovered on the Harvard patrol plates by Henrietta Leavitt (1920). This is by no means the best-observed object of this type, however, an honor which must be shared among RS Oph, T CrB, WZ Sge, and V616 Mon. The first two of these are relatively bright at minimum, and favorites among amateur observers; the third is, with the possible exception of AM CVn, the shortest period binary known; the fourth is the famous X-ray nova of 1975, A0620-00.

Largely through the efforts of Walker, Kraft, and Mumford in the 1950's and early 1960's, it is now widely believed that all novae, and dwarf novae as well, occur in close binary systems in which one component is gradually being stripped of its envelope by the tidal forces of its companion. In the case of the classical novae and dwarf novae, the binary periods range from ~ 0.064 for V436 Cen (Warner, 1975) to 0.685 for GK Per (Paczynski, 1965b). These systems presumably consist of a low-mass main sequence red component, losing mass to a white dwarf companion.

The recurrent novae apparently pose an anomaly in this regard. Binary periods are well-established for two of these systems: WZ Sge at 0.0567 (Krzeminski and Smak, 1971), and T CrB at 227^d₅ (Paczynski, 1965b). (An optical and X-ray flux variation with $P = 7.8$ was detected in V616 Mon [Matilsky et al. 1976], but this cannot yet be identified with certainty as an orbital effect.) WZ Sgr, which achieved a maximum luminosity of only $M_v = +4$ (Warner, 1976), typical of dwarf novae rather than novae at maximum, is arguably a dwarf nova with an extremely long interval between outbursts, and will not be considered further. T CrB, however, has long been known to have an M3 giant for a lobe-filling component (Adams and Joy, 1921). In this respect, it is typical of the other recurrent novae for which direct evidence of the secondary exists (even though the binary periods remain unknown): RS Oph, a semi-regular variable at minimum (Tempesti, 1975) which has a large infrared excess (Feast and Glass, 1974), and V1017 Sgr, which

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shows a G5IIIp spectrum (Kraft, 1964), both clearly have evolved giant secondaries. Indeed, Warner (1976) has argued that it is the presence of these luminous components generally in recurrent novae, as opposed to the very faint companions of classical novae, which accounts for the smaller amplitude of outburst among the former.

THE EVOLUTIONARY STATUS OF RECURRENT NOVAE.

If we suppose that T CrB is typical of recurrent novae, several other peculiarities emerge. This system is a double-lined spectroscopic binary with an unusually massive blue component, as shown by Kraft (1958). Paczynski (1956b), in revising Kraft's orbital solution, obtains $M_{\text{blue}} = 1.9 M_{\odot}$ for an assumed orbital inclination of $i = 68^{\circ}$, corresponding to grazing eclipses. This is embarrassingly large for a white dwarf, which has a limiting mass of $1.4 M_{\odot}$ unless very rapidly rotating. Even more peculiar is the large mass ratio of the giant to blue component, $q = 1.4 \pm 0.2$. Paczynski (1965a) showed that binaries with late-type convective Roche-lobe filling stars are unstable to runaway mass exchange, unless the lobe-filling star is significantly less massive than its companion, reaching enormous mass transfer rates (Paczynski and Sienkiewicz, 1972; Plavec, Ulrich and Polidan 1973).

These circumstances led to the suggestion that T CrB, which shows an accretion disk (Kraft, 1958) but no evidence of the huge rates ($\dot{M} \sim 0.1 M_{\odot}/\text{yr.}$) theoretically possible, is only now first reaching the mass-exchange phase, and that perhaps the blue component is not a white dwarf at all, but a main sequence star (Harmanec, 1974). Webbink (1976a) showed that many details of the outburst of this variable could be explained on the assumption that it corresponded to the sudden transfer of a large ($\sim 5.2 \times 10^{-4} M_{\odot}$) mass of gas from the giant into an accretion disk around a main-sequence star.

If we suppose the accretion model of T CrB to be correct, it is possible to estimate the number of prior outbursts this system has undergone, and to outline its evolution in the very near future (astronomically speaking). We note that, with the sole exception of V1017 Sgr, all recurrent novae are individually characterized by outbursts which repeat with remarkable fidelity. This suggests that, whatever the physical mechanism which modulates mass transfer, the actual exchange tends to be "quantized," i.e., the amount of mass transferred varies insensibly from one outburst to the next.

In its initial phase, the long-term development of runaway mass transfer from a convective star follows the approximate relation,

$$\dot{M} \approx -A(\Delta M)^q, \quad (1)$$

where ΔM is the total amount of mass already transferred and A is approximately constant for any particular system. This implies a mass loss rate from the convective star varying as $(t_0 - t)^{-q/(q-1)}$, where t_0 is some future time at which, in the above approximation, the mass loss rate becomes infinite. (This merely reflects the breakdown of approximations used to obtain equation [1]). The parameters A and q may be estimated using the formalism developed by Jędrzejec (see Paczynski and Sienkiewicz, 1972). For giant star models comparable to the M3III giant in T CrB, $A \approx 0.20 M_{\odot}/\text{yr}$, $q \approx 2.0$, if ΔM is in $M_{\odot}$.

We can now estimate the current mean mass exchange rate from the amount of material per outburst, $\delta M \approx 5.2 \times 10^{-4} M_{\odot}$, and the recurrence time scale, $\tau = 80$ yr. From equation (1), we obtain $\Delta M \approx 0.0057 M_{\odot}$, which suggests that this variable had undergone perhaps ten outbursts, or so, prior to its recurrence in 1946. (Strictly speaking, this step is not valid, since equation [1] assumes smoothly varying continuous mass transfer.) Furthermore, we may expect the recurrence time scale

to decrease with time, with $T_{\text{out}} N^{-2}$, where N is the number of outbursts which the system has undergone. (The reader should be cautioned against applying this relation rigorously, however, as the mechanism which triggers eruptive mass loss is not well-understood - see Wood [1977]).

SYMBIOTIC VARIABLES AS THE DESCENDANTS OF RECURRENT NOVAE

What may we expect for the immediate future development of this object? The gradually increasing frequency of recurrence will have several effects. First, the growth in the mean accretion rate by the companion star will cause that star to become overluminous for its mass, giving it the spectral appearance of a much hotter and more luminous star. This effect is quite independent of the energy liberated by the infall of matter, i.e., of the persistence of an accretion disk, and comes from the internal thermal readjustment of the star to its increasing mass (see, for instance, Webbink, 1976b). If a system is seen at minimum with an accretion disk, however, the hot, luminous boundary layer at which the disk meets the accreting star will, since the boundary layer is thin compared with the dimensions of that star, but nevertheless may radiate a comparable luminosity or more, give that star the appearance of a hot subdwarf, lying somewhat below the main sequence in the Hertzsprung-Russell diagram, but far above the positions of isolated white dwarfs. This accounts for the subdwarf appearance of the blue components in T CrB and RS Oph. The growing average mass transfer rate will thus ultimately raise the light level of the system at minimum, as the blue component contributes a larger share of the binary luminosity in the visible region. The detection of the sudden minimum preceding the eruption of T CrB in 1946 (Peltier, 1945) is thus possible only because this system is apparently a young recurrent nova (as attested by its long recurrence time scale), in which the giant dominates the visual region.

The second consequence of increased activity is that the accretion disk itself becomes a more prominent feature of the system. As the recurrence interval decreases to the order of the decay time scale of the accretion disk, that is, the viscous time scale of the disk (which, in T CrB, is ~ 4 binary periods), the disk no longer decays appreciably between outbursts. This contrasts with T CrB, for instance, in which the hydrogen emission lines from the disk had nearly disappeared from its spectrum taken by Berman (1932). The presence of a massive accretion disk at the moment of mass ejection by the giant will alter the manner in which the ejected mass circularizes its orbit (which event was associated by Webbink [1976a] with the principal outburst of T CrB). We expect this to occur less violently, over a longer time scale, as less energy is dissipated in dissolving the mass injected into the disk near the outer edge of the disk (the disk will transfer angular momentum to the injected mass), than in requiring the mass to dissipate all its excess orbital energy at constant angular momentum. Thus, as a system evolves, its variability is dominated less by the dispersal of an accreted mass into a circular orbit about the blue star, and more by modulations of disk and boundary layer luminosities as viscous processes operate on the variable mass in the disk. As the injection frequency increases, this variation in disk luminosity can be expected to diminish, as the mass of the disk becomes large compared with injected mass (assuming, indeed, that the mass outflow from the giant remains essentially quantized).

The third, and structurally most significant, consequence of increased activity follows directly from this increase in disk luminosity.

Ultimately, the energy output of the binary is limited by the requirement that the radiation pressure not exceed gravity, i.e. the Eddington limit. For a fully ionized gas, whose principal source of opacity is scattering by electrons, this limit is

$$L_{\text{crit}} = 3.765 \times 10^4 L_{\odot} (M/M_{\odot}) , \quad (2)$$

where M is the mass of the accreting object. This is to be compared with the rate at which energy is being generated by the infall of material to the surface of the accreting star,

$$L_{\text{acc}} \approx 3.08 \times 10^7 L_{\odot} \left(\frac{M}{M_{\odot}} \right) \left(\frac{R}{R_{\odot}} \right)^{-1} \left(\frac{\dot{M}}{M_{\odot}/\text{yr}} \right) . \quad (3)$$

For a solar-type star, L_{crit} and L_{acc} are equal for $\dot{M}_{\text{crit}} \approx 1.22 \times 10^{-3} M_{\odot}/\text{yr}$.

Indeed, since M/R varies rather little for main sequence stars, this limit holds for a wide range of systems.

This limiting luminosity is far smaller, by a factor of ~ 100 , than the maximum mass transfer rates predicted theoretically above. As the level of activity in the binary rises the situation arises inexorably in which infalling material generates so much energy that a rapidly rising fraction of the mass stripped tidally from the giant component is blown out of the system by the fraction which is accreted. Indeed, this phenomenon may occur much earlier than inferred above, because photoionization of the infalling, partially ionized gas from the giant gives it a far higher opacity than electron scattering alone. This can significantly reduce the critical luminosity (equation [2]), and hence $\dot{M}_{\text{crit}}$, the accretion rate at which radiation-driven mass outflow from the system can occur.

Are there observable counterparts, then, for this advanced stage of evolution for a recurrent nova? It has long been suspected that the symbiotic variables are indeed giant-containing binary systems with similar binary periods (see Boyarchuk, 1975, for a review). The association of these objects with extremely rapid mass transfer and supercritical accretion was made by Plavec, Ulrich and Polidan (1973), Webbink (1975), and Paczynski (1976). But it was Bath (1977) who showed that a system of just the type described above could reproduce many of the observable outburst features of the symbiotic variables.

This association of recurrent novae with symbiotic variables is not new. Indeed, T CrB and RS Oph are occasionally included among the more broadly defined symbiotic variables (see, for instance, Merrill, 1958; and Sahade, 1967). V1017 Sgr has been officially reclassified from recurrent nova to symbiotic variable (Kukarkin, et al., 1974). What we have done here is to provide an evolutionary link between these categories.

It follows from this interpretation that, if recurrent novae are rapidly evolving, symbiotic variables should be evolving even more rapidly. We emphasize that this conclusion depends only upon assuming that T CrB is typical of recurrent novae to the extent that it has a lobe-filling giant and an unstable mass ratio; it does not depend upon the nature of the blue component, or the cause of the outburst, although the rate of evolution may not be so extreme if the accretion model of T CrB (Webbink, 1976a) is incorrect. Certainly, ample evidence exists,

among the symbiotic variables with the longest observational records, of secular changes in the behavior of these objects -- AG Peg (Merrill, 1959) and BF Cyg (Jacchia, 1941) are cases in point.

EVOLUTION IN OUR LIFETIME?

The fascinating questions for the astronomer is, just how rapidly are these objects evolving? Is it possible that one may observe significant evolution in some object from the recurrent novae stage, towards symbiotic variability, or from symbiosis to yet a more advanced stage within a human lifetime? The implications from T CrB are intriguing: ~ 140 outbursts and ~ 800 years, at most, to reach supercritical accretion in that system. Given that at least half a dozen genuine recurrent novae, and more than two dozen confirmed symbiotic variables are known, and the likelihood expressed above that T CrB is among the least evolved of these objects, the exciting prospect, nearly unknown in astronomy, is opened for observing significant, dramatic, and at least broadly predictable transformation occurring in an astronomical object within a tantalizingly short period of time.

A large share of both the responsibility and the reward in either supporting or refuting the evolutionary processes outlined here will rest with the amateur astronomer. He is best equipped to conduct the very long-term systematic monitoring of these variables which is required. At the same time, it is important to document the past behavior of these objects, a task already undertaken by the author in respect to the recurrent novae. This information will hopefully provide greater insight into the detailed nature of these systems, and allow the extension of the interpretation of T CrB to other systems.

The transformation described here is by no means the final chapter in the evolution of these binaries. A much more detailed discussion of these objects, and their place among the cataclysmic variables will be given elsewhere.

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THE DWARF NOVA --- V442 CENTAURI.

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SUMMARY: The results of 5,359 observations of V442 Cen are discussed. These cover the interval J.D. 2,434,824 to 2,443,183. A total of 266 outbursts were recorded. These are divided into anomalous, wide and narrow types, each of which are sub-divided according to widths and rates of increase. The mean cycle is 24.48. The light curve is reproduced.

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INTRODUCTION:

Bateson and Jones (1970) discussed V442 Cen on the basis of provisional magnitudes for the comparison stars. They derived a mean cycle of 25.14 from 163 maxima observed during the interval J.D. 2,434,824 to 2,440,038. A further 28 maxima were observed between 2,440,039 and 2,440,952 (Bateson, 1972). These gave a mean cycle of 25.86.

Charts 101 and 102 (Bateson, Jones and Stranson, 1968) showed the comparison stars identified by letters. V and B-V magnitudes for these stars were subsequently determined (Bateson, Gordon and Menzies, 1972).

OBSERVATIONS:

Members of the Variable Star Section, Royal Astronomical Society of New Zealand, have made 5,359 observations on 3,634 nights of V442 Cen between J.D. 2,434,824 (1954 March 22) and 2,443,183 (1977 February 8). Observations were made on 43.5% of the total nights. The variable

was very well observed during the first seven months each year, but coverage in the remaining five months, especially in the southern spring, decreased sharply because the star was less favourably placed.

Coverage varied widely from year to year in accordance with the general weather conditions, and more importantly according to the number of observers operating. Table 1 lists the number of nights on which observations were made each month. The bottom row of figures shows the percentage of the total nights on which observations were made. This takes no account of the number of observations each night.

TREATMENT:

The V magnitudes for the comparison stars have been used to derive the deduced magnitude for each observation, with the exception of those using star "q" for which the V magnitude was not determined. A value of 13.7_v was adopted for this star on the basis of step estimates.

All observations were plotted on a large scale, from which the data used in the following discussion was obtained.

OUTBURSTS:

Table 2 lists 266 maxima observed. The availability of reliable magnitudes for the comparison stars has enabled previously published lists of maxima (Bateson & Jones, 1970; Bateson, 1972) to be revised and corrected.

Maxima are numbered consecutively in the first column of Table 2, irrespective of whether an intervening maximum was unobserved. The second column gives the type for each maximum in accordance with the discussion below. The Julian Date of maximum brightness is given in the third column, and the maximum magnitude in the fourth column. The latter is underlined when V442 Cen was only observed at an intermediate magnitude. The interval, in days, between successive maxima is given in the fifth column. This interval is enclosed in brackets when it appears probable that the maxima listed were not consecutive, because an intervening maximum passed unobserved.

The next three columns give the Julian Date on which V442 Cen reached magnitude 13.0 on the rise (13.0I); on the decline (13.0D), and the width of maximum at phase 13.0I-D. Similar data is given in the succeeding three columns for magnitude 14.0. The number of positive observations used to determine the data in the preceding columns is shown in the final column. Negative observations often have defined the probable slope of the curve, and provided an indication of the type of maximum when positive observations have been few.

TYPES OF OUTBURSTS:

Seventy-three maxima were sufficiently well observed to determine accurate information on all the parameters given in Table 2. These were grouped according to widths at magnitude 14.0, and, according to the time taken to rise from 14.0 to maximum brightness. The first of these criterion separated maxima into two classes, i.e., those with widths at phase 14.0I-D greater than 8.5 days and those with widths less than 7.3 days (No maxima had widths between 7.3 and 8.5 days). The rise times were then used to divide these two groups into the following types:

A1 = Rise greater than 5.0 days.
 A2 = Rise from 3.0 to 4.9 days.
 W1 = Rise from 2.0 to 2.9 days.
 W2 = Rise from 0.9 to 1.9 days.
 N1 = Rise from 1.5 to 4.3 days.
 N2 = Rise from 0.9 to 1.4 days.
 N3 = Rise from 0.6 to 0.8 days.
 N4 = Rise 0.4 or 0.5 days.
 N5 = Rise 0.2 or 0.3 days.

The first four types above represent wide maxima, A1 and A2 being anomalous having a much slower rise than normal, and W1 and W2 having widths exceeding 8.5 days, but with much more rapid rises than those of A1 and A2.

The last five types are narrow maxima with widths less than 7.3 days. The following table lists for each type; the number of examples; mean maximum magnitude; mean widths at 13.0I-D and at 14.0I-D; the mean rise and decline times, in days, for the same phases. The final two columns give respectively the rate per 0.1 at which the variable rose to, and declined from, maximum brightness from or to magnitude 14.0.

MEANS FOR TYPES OF MAXIMA.

TYPE	No.	MEAN MAX. MAG.	MEAN WIDTHS		MEAN RISE TIMES		MEAN DECLINE TIMES		MEAN RATES Per 0.1	
			13.0 I-D	14.0 I-D	14.0I-Max	13.0I-Max	Max-13.0D	Max-14.0D	RISE	DECLINE
			d	d	d	d	d	d	M _v	M _v
A1	9	12.13	10.84	15.89	7.45	5.41	5.43	8.44	0.03	0.02
A2	10	12.18	7.55	9.60	3.66	3.16	4.39	5.94	0.05	0.03
W1	7	12.19	7.00	10.16	2.47	2.10	4.90	7.69	0.07	0.03
W2	2	12.05	7.30	9.95	1.40	0.70	6.60	8.55	0.16	0.02
N1	14	12.46	2.70	5.33	2.10	1.19	1.51	3.23	0.08	0.06
N2	14	12.41	2.44	4.72	1.17	0.70	1.74	3.55	0.14	0.05
N3	7	12.31	2.59	4.64	0.71	0.39	2.20	3.93	0.24	0.04
N4	6	12.37	2.11	4.03	0.45	0.23	1.88	3.58	0.36	0.05
N5	4	12.52	1.95	4.95	0.25	0.12	1.83	4.70	0.60	0.03

There is a marked difference in the rise rates between the anomalous maxima (A1 and A2) and the ordinary wide maxima (W1 and W2). The rates of rise and decline for the former differ only slightly. The latter have much faster rises than declines, and their rises are comparable with the narrow maxima.

The narrow maxima show a progressive and rapid increase in rise rates from N1 to N5, and, a general, but much smaller progressive decrease in the decline rates.

In Table 2 the second column shows the maximum type for each of the 73 well observed maxima in accordance with the discussion above. The remaining maxima which are probably of a definite type have been so listed with the type followed by a question mark. When, however, a maximum could only be termed wide or narrow it is shown as "W" or "N". This is followed by a question mark if the allocation is merely probable but not certain. Finally there are a number of maxima, which, because of the lack of both positive and negative observations, could be either

wide or narrow. These are shown with a question mark only.

The Light Curve, on a small scale, is shown in Figures 1a - 1d. This curve for the poorly observed outbursts can be drawn in different ways, and for such outbursts the dashed lines merely indicate the possible slope. Examples of the various types of maxima, on a larger scale, are shown in Figures 2 (types A1 and A2); 3 (W1 and W2) and 4 (N1-N5).

FREQUENCY OF OUTBURSTS:

Table 2 includes 182 maxima which appear to be successive. These give a mean cycle of $24.^d48$, with a range from $12.^d0$ to $48.^d7$. The longer intervals suggest that, at times, the frequency of outbursts decreases. Negative observations are sufficiently frequent and close together in time to make the possibility of a maximum being missed in these intervals slight.

There are eight complete intervals of 1,000 days. The number of outbursts in these intervals range from 24 to 39. This wide range reflects the closeness, or otherwise, with which the variable was monitored in successive intervals of a thousand days. Table 2 lists 266 maxima, of which 53 are wide; 167 narrow and 46 indeterminate.

The mean interval between successive wide maxima (A1, A2, W1 and W2) is $158.^d0$, with a range from $30.^d1$ to $412.^d5$. Wide maxima were always immediately preceded and followed by narrow maxima at mean intervals respectively of $27.^d8$ and $29.^d1$. However, there was no pattern of wide and narrow maxima alternating, nor in the number of narrow outbursts that preceded, or followed, each wide maximum. It would be difficult to trace a definite pattern because of the lower frequency of observations in the last five months each year.

The mean interval between successive narrow maxima was $25.^d1$, with a range from $14.^d0$ to $38.^d6$.

CONCLUSIONS:

V442 Cen has two distinct types of wide maxima with widths at phase 14.0I-D exceeding 8.5 days, and five types of narrow maxima. The wide maxima are clearly separated into those with abnormally slow rises, followed by an almost equally slow decline, and, those with a more rapid rise and a much slower decline. The narrow maxima are grouped into five types according to their rise rates, which are comparable to those found for VW Hyi (Bateson, 1977a).

The mean cycle for V442 Cen is $24.^d48$, placing it amongst the dwarf novae with short mean cycles. It differs from some others of short mean cycle, e.g. VW Hyi (Bateson, 1977a); WX Hyi (Bateson, 1976), in not having supermaxima. These appear to be replaced for V442 Cen by anomalous maxima with very slow rises. Supermaxima, however, are not confined to dwarf novae of short mean cycles (see Bateson, 1977b), although it is a common feature for such stars.

There is little difference in the mean magnitude for the various types of maxima of V442 Cen. It ranges from $12.^m05_v$ to $12.^m52_v$. This is a smaller range than shown by many other dwarf novae. No information can be given concerning behaviour at minimum since the variable falls to well below the thresholds of the instruments used. Flickering, or short term variations, appear to occur at times but the visual evidence on this is inconclusive.

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TABLE 1.

V442 CENTAURI---NUMBER OF NIGHTS OBSERVED BETWEEN 1954 MARCH 22
AND 1977 FEBRUARY 8.

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTALS
1954	...	...	3	16	16	14	16	13	5	6	7	6	102
1955	16	11	19	19	17	16	15	6	6	11	11	14	161
1956	16	12	17	12	10	19	13	12	7	8	9	12	147
1957	17	12	12	9	14	18	17	8	3	7	5	10	132
1958	13	10	12	22	18	21	13	13	11	5	8	13	159
1959	16	15	15	21	15	19	13	10	7	11	6	3	151
1960	11	15	15	13	15	14	17	5	6	6	9	8	134
1961	13	10	16	17	11	20	9	14	6	8	8	11	143
1962	13	12	15	14	10	15	15	12	5	7	5	10	133
1963	14	10	15	17	16	14	12	11	2	7	7	8	133
1964	9	9	17	15	17	13	7	6	1	8	5	8	115
1965	8	19	13	18	13	14	10	5	6	4	3	6	119
1966	10	11	18	15	20	14	14	11	1	7	4	6	131
1967	16	16	15	19	15	19	14	7	3	5	6	7	142
1968	15	21	15	17	24	18	18	13	5	4	6	7	163
1969	18	19	24	23	16	19	16	10	1	9	7	7	169
1970	15	20	19	19	23	18	20	8	1	4	6	7	160
1971	13	17	19	25	30	23	17	10	4	7	7	5	177
1972	15	17	24	24	22	24	24	16	3	5	2	11	187
1973	19	27	28	27	30	26	19	14	1	4	5	5	205
1974	22	27	28	21	24	24	24	19	5	3	8	13	218
1975	26	22	28	23	26	25	26	16	6	7	4	14	223
1976	19	26	30	26	26	24	21	15	...	...	5	17	209
1977	21												21
TOTALS	355	358	417	432	428	431	370	254	95	143	143	208	3634
% of POSSIBLE	50	57	60	63	60	63	52	36	14	20	20	29	43.5

TABLE 2.

OBSERVED MAXIMA OF V442 CENTAURI.

No.	TYPE	MAXIMUM J.D.	MAG _v	INT d	13.OI	13.OD	WIDTH 13.OI-D	14.OI	14.OD	WIDTH 14.OI-D	No.
1	N?	2,434,828	12.5	...	...	830.1	?	...	...	...	2
2	N	844?	13.2	16.0	...	...	...	...	...	...	2
3	N?	864	12.5	20.0	...	865.3	?	...	...	...	4
4	N2	891.5	12.5	27.5	891.0	894.0	3.0	890.5	895.9	5.4	4
5	N2	913.0	12.5	21.5	912.3	914.7	2.4	911.8	918.5	6.7	6
6	N	932	13.3	19.0	...	...	...	...	...	...	3
7	W?	960	12.2	28.0	...	963.8	...	...	...	...	4
8	?	2,435,020?	13.4	(60.0)	...	...	...	...	...	...	3
9	?	034?	13.1	14.0	...	...	...	...	...	...	1
10	N2	115.9	12.1	(81.9)	115.3	118.0	2.7	114.5	120.2	5.7	4
11	N1	138	12.5	22.1	137.5	139.0	1.5	135.9	140.3	4.4	5
12	A1	174.0	11.8	36.0	169.2	177.8	8.6	168.3	180.7	12.4	9
13	N	202?	13.1	28.0	...	...	...	...	...	...	1
14	N	228	12.5	26.0	227.8	229.5	1.7	...	...	...	2
15	N1	251.9	12.5	23.9	250.7	252.9	2.2	249.9	253.8	3.9	5
16	N5	270	12.7	18.1	269.9	271.0	1.1	269.8	274.4	4.6	4
17	N?	288.3	12.9	18.3	287.9	?	?	...	...	...	2
18	N2?	306.0	12.0	17.7	305.2	307.0	1.8	...	...	...	5
19	?	320?	13.2	14.0	...	...	...	...	...	...	2
20	N1?	368.8	12.4	(48.8)	367.8	369.2	1.4	...	...	...	4
21	?	384?	13.2	15.2	...	...	...	...	...	...	1
22	N?	414?	13.0	30.0	...	...	...	...	...	...	3
23	?	439	12.5	25.0	...	...	...	...	...	...	3
24	N	467?	12.7	28.0	...	...	...	...	...	...	2
25	N2	489	12.4	22.0	488.1	490.0	1.9	487.7	492.1	4.4	5
26	N?	503?	12.7	14.0	?	503.9	?	...	...	...	2
27	N4?	523	12.4	20.0	522.7	525.4	2.7	...	...	...	2
28	N1	552	12.5	29.0	550.2	554.0	3.8	547.7	554.6	6.9	4
29	N	565.5	12.7	13.5	565.0	566.8	1.8	...	...	...	3
30	W1	586.5	11.9	21.0	584.4	591.6	7.2	584.2	593.5	9.3	7
31	N2?	634.0	12.3	(47.5)	633.3	635.7	2.4	...	...	...	3
32	N5	656.0	12.3	22.0	655.8	658.0	2.2	655.7	660.1	4.4	5
33	N?	671?	13.3	15.0	...	...	...	...	...	...	1
34	N	686	12.7	15.0	685.8	687.5	1.7	...	...	...	2
35	A1	708	12.2	22.0	697.8	719.9	22.1	690.3	725.7	35.4	10
36	N4?	732.2	12.6	24.2	732.0	733.6	1.6	...	...	...	3
37	N3?	763.5	12.5	(31.3)	762.9	764.5	1.6	...	...	...	3
38	N?	780.1	12.4	16.6	?	785.5	?	...	...	...	4
39	N	807	12.6	26.9	806.5	809.4	2.9	...	...	...	2
40	N	824?	13.4	17.0	...	...	...	...	...	...	1
41	N2	846.0	12.4	22.0	845.3	848.8	3.5	845.0	851.0	6.0	6
42	A1	875.0	12.4	29.0	869.8	877.9	8.1	869.5	880.3	10.8	5
43	N	901.9	12.6	26.9	900.9	902.2	1.3	...	...	...	2
44	N	927?	13.1	25.1	...	...	...	...	...	...	3
45	N?	958?	12.7	31.0	955.5	958.7	3.2	...	...	...	3
46	?	970?	13.3	12.0	...	...	...	...	...	...	1
47	A1	994.9	12.2	24.9	990.0	999.1	9.1	988.4	000.6	12.2	9
48	N3	2,436,020.9	12.7	26.0	020.7	022.0	1.3	020.3	023.9	3.6	4
49	N?	054?	13.7	33.1	...	...	...	...	...	...	2
50	N	074	12.7	20.0	073.3	076.8	3.5	...	...	...	3
51	W?	114.2	12.3	(40.2)	...	...	...	...	...	...	3
52	N?	145	12.3	30.8	...	...	...	...	...	...	1
53	N?	171	12.3	26.0	170.2?	172.7	2.5?	...	...	...	2
54	W?	201	12.3	30.0	?	202.9	?	...	...	...	4
55	N3	224.2	12.4	23.2	224.0	226.5	2.5	223.5	230.0	6.5	4
56	A1	276.0	12.4	(51.8)	268.2	282.8	14.6	266.5	284.0	17.5	7
57	N	297?	13.5	21.0	...	...	...	...	...	...	1
58	N1	312.2	12.4	15.2	311.3	313.9	2.6	310.4	314.8	4.4	6

TABLE 2 (cont).

No.	TYPE	MAXIMUM J.D.	MAG _v	INT d	13.OI	13.OD	WIDTH 13.OI-D	14.OI	14.OD	WIDTH 14.OI-D	No.
59	N	2,436,338	12.4	25.8	?	338.3	? ^d	...	...	...	2
60	N	352.0	12.2	14.0	351.8	353.0	1.2	...	...	...	2
61	W1	376.0	12.3	24.0	373.7	380.2	6.5	373.6	382.9	9.3	7
62	N?	406?	12.6	30.0	...	...	...	...	...	...	1
63	N	420	12.5	14.0	418.6	421.5	2.9	...	...	...	3
64	N?	436.8	12.5	16.8	435.5	440.0?	4.5?	...	...	...	2
65	N	456	12.6	19.2	...	...	...	...	...	...	1
66	N	498.7	12.5	(42.7)	498.0	500.0	2.0	...	...	...	3
67	W?	559.0	12.4	(60.3)	558.1	563.0?	4.9?	...	...	...	5
68	N	595	12.8	36.0	593.7	596.0	2.3	...	...	...	3
69	N3	626.4	12.4	31.4	625.9	630.1	4.2	625.7	630.8	5.1	3
70	?	654.8	12.4	28.4	?	658.0	?	...	...	...	2
71	N	691	12.4	36.2	689.8	?	?	...	...	...	2
72	N1	718.9	12.3	27.9	717.9	720.4	2.5	716.8	721.5	4.7	5
73	N?	738	12.4	19.1	...	...	...	...	...	...	2
74	A1	757.0	12.2	19.0	753.5	762.3	8.8	751.3	766.5	15.2	6
75	N	808?	13.6	(51.0)	...	...	...	...	...	...	2
76	N	823.2	12.1	15.2	?	825.7	?	...	...	...	2
77	W	851.2	12.3	28.0	847.3	855.2	7.9	...	...	...	5
78	N	882?	12.8	30.8	...	...	...	...	...	...	1
79	?	914?	12.3	(32.0)	...	...	...	...	...	...	1
80	A2	938	12.4	24.0	934.5	943.2	8.7	934.3	944.5	10.2	5
81	N	962.5	12.5	24.5	?	964.4	?	...	...	...	2
82	N	986.2	12.3	23.7	?	987.9	?	...	...	...	3
83	N	2,437,003	12.5	16.8	...	...	...	...	...	...	2
84	N	020	12.4	17.0	019.3	021.8	2.5	...	...	...	5
85	W	041.2	12.0	21.2	039.3	045.7	6.4	...	...	...	7
86	N	087	12.3	(45.8)	086.4	088.5	2.1	...	...	...	4
87	N?	108?	13.3	21.0	...	...	...	...	...	...	1
88	N	122?	12.7	14.0	...	...	...	...	...	...	1
89	N	136?	13.3	14.0	...	...	...	...	...	...	2
90	?	159.8	12.1	23.8	?	163.7	?	...	...	...	3
91	?	184	13.5	24.2	...	...	...	...	...	...	1
92	N	196?	13.2	12.0	...	...	...	...	...	...	2
93	N	236?	13.5	(40.0)	...	...	...	...	...	...	1
94	W?	264	12.2	28.0	...	...	...	...	...	...	2
95	N	291?	13.6	27.0	...	...	...	...	...	...	1
96	W	303.8	12.0	12.8	302.5	308.3	5.8	...	...	...	3
97	N	327.9	12.7	24.1	327.5	328.8	1.3	...	...	...	2
98	N	342?	13.4	14.1	...	...	...	...	...	...	1
99	W?	366.0	12.4	24.0	?	370.2	?	...	...	...	5
100	N?	401.9	12.5	(35.9)	400.8	404.1	3.3	...	...	...	3
101	W?	435.9	12.2	(34.0)	?	440.2	?	...	...	...	4
102	N2	469.4	12.3	33.5	468.6	470.8	2.2	468.4	472.3	3.9	5
103	W?	539.3	12.6	(69.9)	?	540.6	?	...	...	...	5
104	?	593?	12.4	(53.7)	...	...	...	...	...	...	1
105	W?	620.6	12.6	27.6	619.8	?	?	...	...	...	3
106	N?	660?	12.7	(39.4)	?	662.0	?	...	...	...	3
107	?	686.0	12.2	26.0	?	689.8	?	...	...	...	4
108	W2	728.2	12.0	(42.2)	727.5	735.8	8.3	726.3	736.6	10.3	5
109	N4?	765.8	12.1	37.6	765.3	768.1	2.8	...	...	...	3
110	N?	796.4	12.3	30.6	...	...	...	...	...	...	4
111	N	836.9	12.3	(40.5)	836.0	837.8	1.8	...	...	...	2
112	N	862.8	12.1	25.9	862.2	865.0	2.8	...	...	...	4
113	W	890.0	12.1	27.2	887.0	892.9	5.9	...	...	...	4
114	N?	917?	12.3	27.0	...	...	...	...	...	...	2
115	N	942	12.9	25.0	...	...	...	...	...	...	3
116	?	980?	12.4	(38.0)	...	...	...	...	...	...	3
117	N	2,438,031.0	12.5	(51.0)	030.5	032.7	2.2	...	...	...	3
118	N	048	13.1	17.0	...	...	...	...	...	...	2
119	?	071	12.4	23.0	?	073.4	?	...	...	...	3
120	N	099.9	12.4	28.9	099.3	101.0	1.7	...	...	...	4

TABLE 2 (cont).

No.	TYPE	MAXIMUM J.D.	MAG _v	INT d	13.OI	13.OD	WIDTH 13 _d OI-D	14.OI	14.OD	WIDTH 14 _d OI-D	No.
121	N	2,438,122.8	12.6	22.9	122.2	124.1	1.9			...	3
122	?	151?	12.4	28.2	...	...	...	...	...	...	1
123	N	178	13.2	27.0	...	...	...	...	...	...	3
124	N3?	202	12.5	24.0	201.4	202.6	1.2			...	2
125	A1	229	12.2	27.0	225.5	234.3	8.8	223.0	239.2	16.2	5
126	?	272?	12.6	(43.0)	...	...	...	...	...	...	1
127	?	299?	12.8	27.0	...	...	...	...	...	...	1
128	?	328?	12.4	(29.0)	...	...	...	...	...	...	2
129	?	361	12.6	(33.0)	...	...	...	...	...	...	2
130	N1?	386.1	12.4	25.1	384.5	388.3	3.8	...	...	...	4
131	W?	411.1	12.4	25.0	?	416.4	?	...	...	...	5
132	A2	483.0	12.3	(71.9)	480.0	487.2	7.2	479.8	488.5	8.7	6
133	?	507?	13.2	24.0	...	...	...	...	...	...	2
134	N4?	523	12.2	16.0	522.8	525.8	3.0	...	...	...	5
135	N?	540?	12.6	17.0	...	...	...	...	...	...	1
136	A2	559	12.1	19.0	556.3	564.0	7.7	555.9	564.5	8.6	5
137	N?	594	12.4	(35.0)	...	...	...	...	...	...	2
138	N	630	12.6	(36.0)	...	...	...	...	...	...	2
139	N	678?	12.7	(48.0)	...	...	...	...	...	...	3
140	?	709?	12.4	(31.0)	...	...	...	...	...	...	3
141	?	736?	12.7	(27.0)	...	...	...	...	...	...	2
142	N?	756	12.4	20.0	?	758.2	?	...	...	...	3
143	W	807.9	12.1	(51.9)	807.3	813.8	6.5	...	...	...	6
144	N	846.2	12.6	(38.3)	846.0	847.0	1.0	...	...	...	2
145	N	880.9	12.5	34.7	879.9	883.2	3.3	...	...	...	3
146	?	918?	12.3	(37.1)	...	...	...	...	...	...	2
147	?	975?	12.6	(57.0)	...	...	...	...	...	...	1
148	?	997?	13.4	22.0	...	...	...	...	...	...	2
149	N	2,439,029	12.3	(32.0)	...	...	...	...	...	...	2
150	?	068?	12.2	(39.0)	...	...	...	...	...	...	2
151	?	123?	12.4	(55.0)	...	...	...	...	...	...	2
152	N	152.9	12.3	29.9	152.3	153.2	0.9	...	...	...	4
153	A2	199.4	12.4	(46.5)	196.0	202.3	6.3	195.6	205.6	10.0	14
154	N2	231.2	12.7	(31.8)	230.9	231.8	0.9	230.3	233.9	3.6	3
155	N	253.2	12.7	22.0	252.2	255.8	3.6	...	...	...	3
156	N1	274.8	12.7	21.6	272.8	275.9	3.1	272.5	279.6	7.1	4
157	N1	293.8	12.5	19.0	292.8	296.1	3.3	292.3	300.0	7.7	10
158	W?	327.7	12.1	(33.9)	...	...	...	...	...	...	8
159	W?	357.8	12.2	30.1	...	...	...	...	...	...	2
160	N	416.5	12.0	(58.7)	416.1	419.3	3.2	...	...	...	2
161	N1	504.0	12.8	(87.5)	503.8	504.2	0.4	502.5	508.2	5.7	6
162	W2	546.9	12.1	(42.9)	546.2	552.5	6.3	546.0	555.6	9.6	7
163	N	604	12.4	(57.1)	603.6	606.5	2.9	...	...	...	2
164	W1	632	12.3	28.0	630.7	637.0	6.3	629.6	643.7	14.1	4
165	N?	661?	12.6	29.0	...	...	...	...	...	...	1
166	?	722.8	11.9	(61.8)	...	...	...	...	...	...	2
167	?	821?	12.4	(98.2)	...	...	...	...	...	...	1
168	?	861	12.4	(40.0)	...	...	...	...	...	...	1
169	W?	904	12.3	(43.0)	902.2?	908.0	5.8?	...	...	...	9
170	N	939	12.6	(35.0)	937.8	941.2	3.4	...	...	...	5
171	N2	971.2	12.2	32.2	970.0	973.3	3.3	969.8	974.5	4.7	7
172	N1	2,440,004.3	11.6	33.1	002.9	007.8	4.9	002.4	009.6	7.2	15
173	N	034	12.3	29.7	...	...	...	...	...	...	1
174	N	063.8	12.4	29.8	063.2	065.6	2.4	...	...	...	3
175	?	100	12.2	(36.2)	...	...	...	...	...	...	1
176	?	132?	12.7	(32.0)	...	...	...	...	...	...	1
177	?	153?	12.8	(21.0)	...	...	...	...	...	...	1
178	?	180?	13.2	(27.0)	...	...	...	...	...	...	1
179	W?	216.2	11.6	(36.2)	?	222.9	?	...	...	...	3
180	N	262.5	13.2	(46.3)	...	...	...	...	...	...	2
181	N2	295.5	12.5	33.0	294.7	297.3	2.6	294.5	298.4	3.9	8

TABLE 2 (cont.).

No.	TYPE	MAXIMUM J.D.	MAG _v	INT d	13.0I	13.0D	WIDTH 13.0I-D	14.0I	14.0D	WIDTH 14.0I-D	No.
							d			d	
182	W1	2,440,326.9	12.3	31.4	324.2	331.4	7.2	324.0	332.5	8.5	12
183	N3?	360.0	12.4	33.1	359.6	361.5	1.9	...	...	...	3
184	N2?	386.9	11.6	26.9	386.2	388.3	2.1	...	...	...	3
185	N	404.0	12.7	17.1	...	...	...	...	...	...	2
186	N	426?	12.8	22.0	...	...	...	...	...	...	1
187	W	445.0	12.2	19.0	442.9	450.0	7.1	...	...	...	5
188	?	520.0	12.3	(75.0)	...	...	...	...	...	...	2
189	N	536.0	12.3	16.0	534.3	537.8	3.5	...	...	...	2
190	?	568	12.4	(32.0)	...	...	...	...	...	...	1
191	N	601.0	12.4	(33.0)	600.7	603.2	2.5	...	...	...	3
192	N	626.5	12.4	25.5	625.9	627.5	1.6	...	...	...	4
193	N1?	648.9	12.4	22.4	647.9	650.9	3.0	...	...	...	7
194	?	667?	12.4	18.1	...	...	...	...	...	...	1
195	W?	697.0	12.3	30.0	...	...	...	...	...	...	4
196	N	726?	12.8	29.0	...	...	...	...	...	...	1
197	N	746.9	12.4	20.9	746.5	749.1	2.6	...	...	...	2
198	N3?	773.0	12.4	26.1	772.6	774.5	1.9	...	...	...	5
199	N	794.0	12.6	21.0	793.0	794.2	1.2	...	...	...	4
200	N?	813?	12.6	19.0	...	...	...	...	...	...	2
201	N?	884	12.7	(71.0)	...	...	...	...	...	...	2
202	N?	968	12.3	(84.0)	?	970.1	?	...	...	...	4
203	N	990?	12.9	22.0	...	...	...	...	...	...	2
204	N	2,441,012.5	12.4	22.5	011.7	013.8	2.1	...	...	...	7
205	N	035	12.5	22.5	...	...	...	...	...	...	1
206	N	050	12.6	15.0	...	...	...	...	...	...	2
207	N2	064.5	12.1	14.5	063.9	067.1	3.2	063.5	068.9	5.4	13
208	A1	090.9	11.8	26.4	086.7	094.8	8.1	085.8	097.9	12.1	19
209	N1	116.9	12.6	26.0	116.1	117.6	1.5	115.1	120.5	5.4	10
210	N	136	12.5	19.1	...	...	...	...	...	...	1
211	N	157?	12.9	21.0	...	...	...	...	...	...	3
212	?	230?	13.3	(73.0)	...	...	...	...	...	...	1
213	N	279	12.5	(49.0)	278.2	280.7	2.5	...	...	...	3
214	W?	307.1	12.3	(28.1)	...	...	...	...	...	...	4
215	N	335.6	12.7	28.5	...	...	...	...	...	...	2
216	N	368?	12.5	(32.4)	...	...	...	...	...	...	1
217	N2	386.9	12.5	18.9	386.4	387.8	1.4	385.7	390.0	4.3	11
218	N5	403.9	12.6	17.0	403.8	405.6	1.8	403.7	409.6	5.9	4
219	N3	422.1	12.2	18.2	421.7	423.8	2.1	421.4	425.8	4.4	12
220	A1	470.8	12.0	48.7	466.2	475.6	9.4	465.4	476.6	11.2	16
221	N	505.9	12.2	35.1	505.6	508.1	2.5	...	...	...	4
222	N5	524.2	12.5	18.3	524.1	526.8	2.7	523.9	528.8	4.9	5
223	N	544.9	12.4	20.7	544.6	546.8	2.2	...	...	...	3
224	?	601?	12.8	(56.1)	...	...	...	...	...	...	2
225	N4?	665.9	12.6	(64.9)	665.7	666.5	0.8	...	...	...	4
226	N1	683.3	12.8	17.4	682.0	684.3	2.3	681.0	684.4	3.4	9
227	N1	712.9	12.2	(29.6)	711.4	715.0	3.6	710.7	715.3	4.6	12
228	N3	735.6	12.3	22.7	734.9	737.9	3.0	734.8	738.4	3.6	23
229	A2	762.2	12.0	26.6	759.1	767.1	8.0	758.9	768.0	9.1	38
230	N1	797.5	12.5	35.3	796.2	799.3	3.1	796.0	800.1	4.1	22
231	N4	824.2	12.0	26.7	823.8	826.4	2.6	823.7	827.6	3.9	15
232	N4	841.8	12.7	17.6	841.7	843.6	1.9	841.4	845.5	4.1	14
233	N4	862.9	12.7	21.1	862.7	863.6	0.9	862.5	865.1	2.6	10
234	W	898.4	12.0	(35.5)	892.9	902.4	9.5	...	...	...	13
235	?	970?	12.4	(71.6)	...	...	...	...	...	...	1
236	?	2,442,004?	12.9	(34.0)	...	...	...	...	...	...	2
237	W1	060.5	12.3	(56.5)	058.7	064.6	5.9	058.3	068.2	9.9	10
238	N3	093.8	12.0	33.3	093.5	096.2	2.7	093.0	097.5	4.5	21
239	N2	122.9	12.5	29.1	121.8	124.7	2.9	121.6	126.1	4.5	10
240	A2	153.3	12.2	30.4	150.1	157.2	7.1	149.9	158.7	8.8	15
241	N4	185.2	12.3	31.9	184.9	188.1	3.2	184.7	189.7	5.0	9
242	A2	219.8	11.9	34.6	216.6	224.8	8.2	215.2	227.4	12.2	29

TABLE 2 (cont).

No.	TYPE	MAXIMUM J.D.	MAG _v	INT _d	13.OI	13.OD	WIDTH 13.OI-D	14.OI	14.OD	WIDTH 14.OI-D	No.
							d			d	
243	N2	2,442,245.9	12.4	26.1	245.7	247.3	1.6	244.6	248.2	3.6	6
244	N3	273.1	12.2	27.2	272.7	275.0	2.3	272.4	277.2	4.8	10
245	N?	298	12.2	(24.9)	...	...	...	...	...	...	2
246	?	350?	12.7	(52.0)	...	...	...	...	...	...	1
247	?	367	12.9	(27.0)	...	...	...	...	...	...	1
248	W	406.2	12.3	(39.2)	402.7	408.1	5.4	...	...	...	13
249	N	440.5	12.2	34.3	?	442.6	?	...	...	...	2
250	N5?	472	12.5	31.5	471.9	473.7	1.8	...	...	...	5
251	W1	507.7	12.2	35.7	505.8	514.4	8.6	505.5	516.2	10.7	39
252	N1	550.5	12.6	42.8	548.8	551.7	2.9	548.4	553.6	5.2	12
253	N5?	589.1	12.5	38.6	588.9	590.1	1.2	...	...	...	5
254	A2	627.9	12.1	38.8	624.8	633.0	8.2	624.5	635.1	10.6	9
255	?	664?	12.9	(36.1)	...	...	...	...	...	...	1
256	?	722?	12.2	(58.0)	...	...	...	...	...	...	1
257	N?	757?	12.7	(35.0)	...	...	...	...	...	...	2
258	?	789?	12.9	(32.0)	...	...	...	...	...	...	2
259	A2	816.8	12.4	27.8	813.6	821.2	7.6	813.2	822.1	8.9	14
260	N4	844.8	12.5	28.0	844.7	846.2	1.5	844.4	848.2	3.8	8
261	N2	871.5	12.6	26.7	870.7	873.2	2.5	870.2	874.2	4.0	18
262	W1	914.2	12.0	42.7	911.6	918.9	7.3	911.3	920.6	9.3	20
263	N4	950.1	12.0	35.9	949.8	952.4	2.6	949.6	954.4	4.8	22
264	W	991.2	11.9	(41.1)	991.1	998.2	7.1	...	...	...	5
265	?	2,443,104	12.1	(112.8)	...	...	...	...	...	...	2
266	A2	177	12.0	(73.0)	173.8	180.3	6.5	172.5	181.4	8.9	13

(N.B. Figures for V442 Cen appear from page 37 onwards)

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SEQUENCE FOR WX HYDRI

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Magnitudes for the comparison stars shown on Charts 313 & 314 (Bateson, Morel & Winnett, 1976) are given below. Visual observers should use the V magnitudes, rounded off to tenths, as given in the fifth column. Star "f" was established as the standard for the sequence, using values of HD 12270, HD 12477 and HD 13578 published by Cousins & Stoy (1963).

CHART LETTER	mV	B-V	U-B	ADOPTED	No. of Obs	REMARKS
f	10.25	+0.41	0.00	10.2		Standard
g	10.32	+0.51	+0.03	10.3	5	2 Obs. in U-B
k	10.79	+0.43	+0.06	10.8	3	2 Obs. in U-B
m	10.78	+1.11	+1.0:	10.8	3	1 Obs. in U-B
n	11.56	+0.53	+0.09	11.6	3	2 Obs. in U-B
o	11.46	+1.17	+1.3:	11.5	3	1 Obs. in U-B
q	12.36	+0.53	+0.16:	12.4	3	1 Obs. in U-B
r	12.5	+0.9	+0.7	12.5	5	
s	13.2	+0.6	+0.1	13.2	3	
t	13.0	+0.9	+0.4	13.0	3	
u	13.7	+0.8	+0.3	13.7	6	Rather wide scatter; cause unknown. Variability, if any, not much greater than 0.1m.
w	14.0	+0.8	+0.6	14.0	3	Is shown on chart 314. On scale of that chart "w" is $4\frac{1}{2}$ mm S. and 2mm W. of "r".

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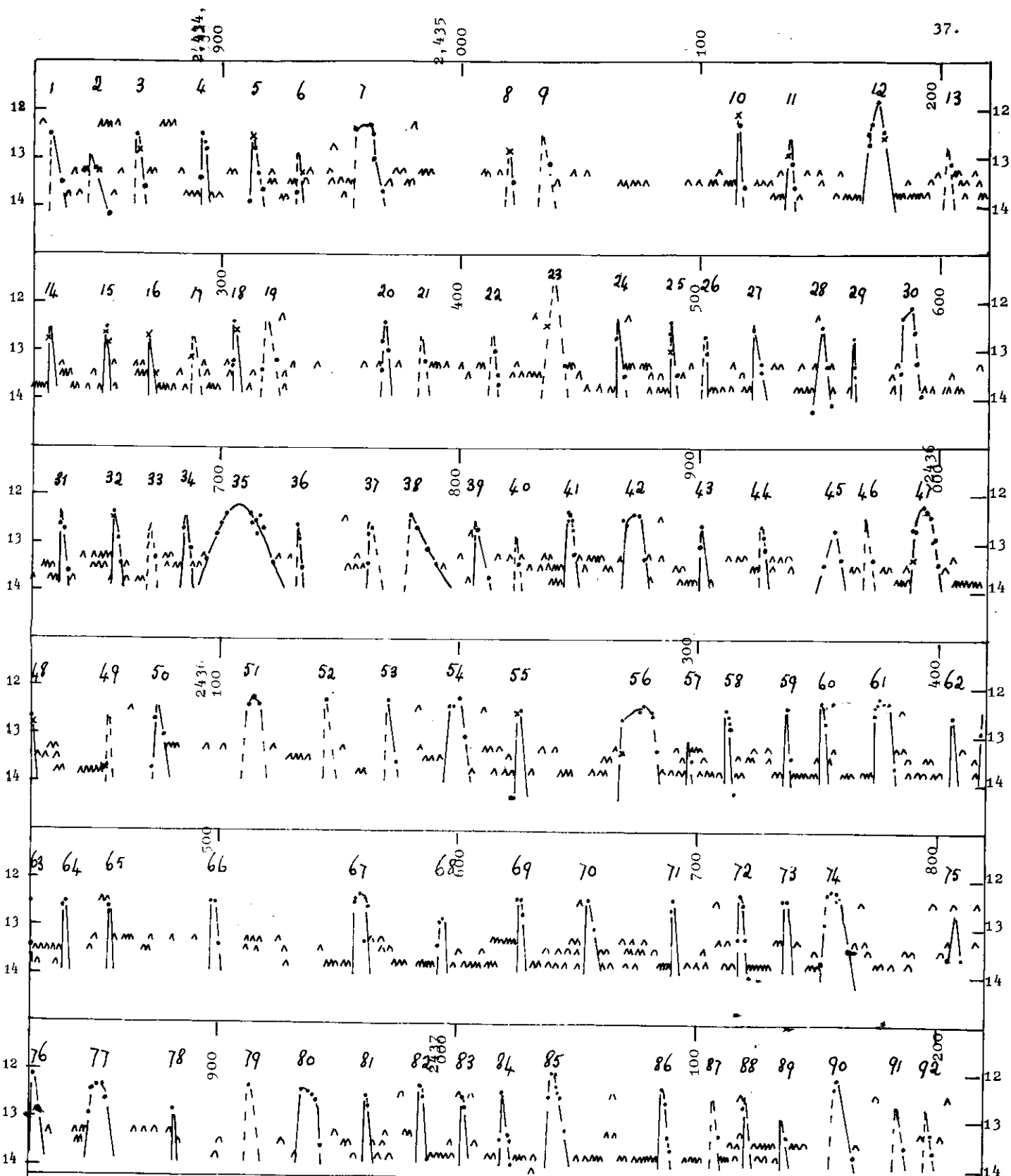


FIGURE 1a. V442 Centauri. Light Curve 2,434,820 to 2,437,220. Dots Single obs. Crosses Means 2 obs.

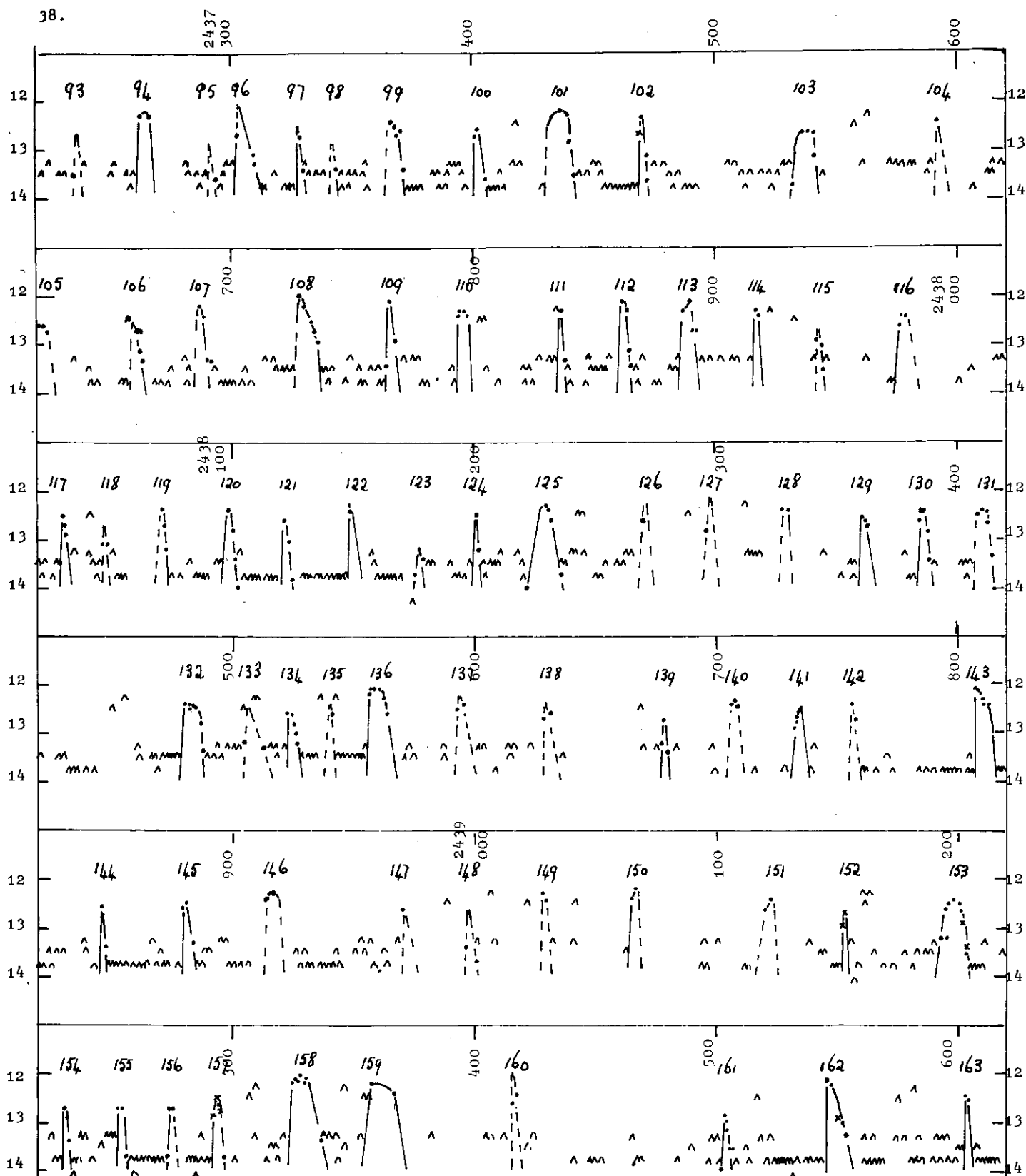


FIGURE 1b. V442 Centauri. Light Curve 2,437,220 to 2,439,620. Dots single observations. Crosses means from 2-3 observations.

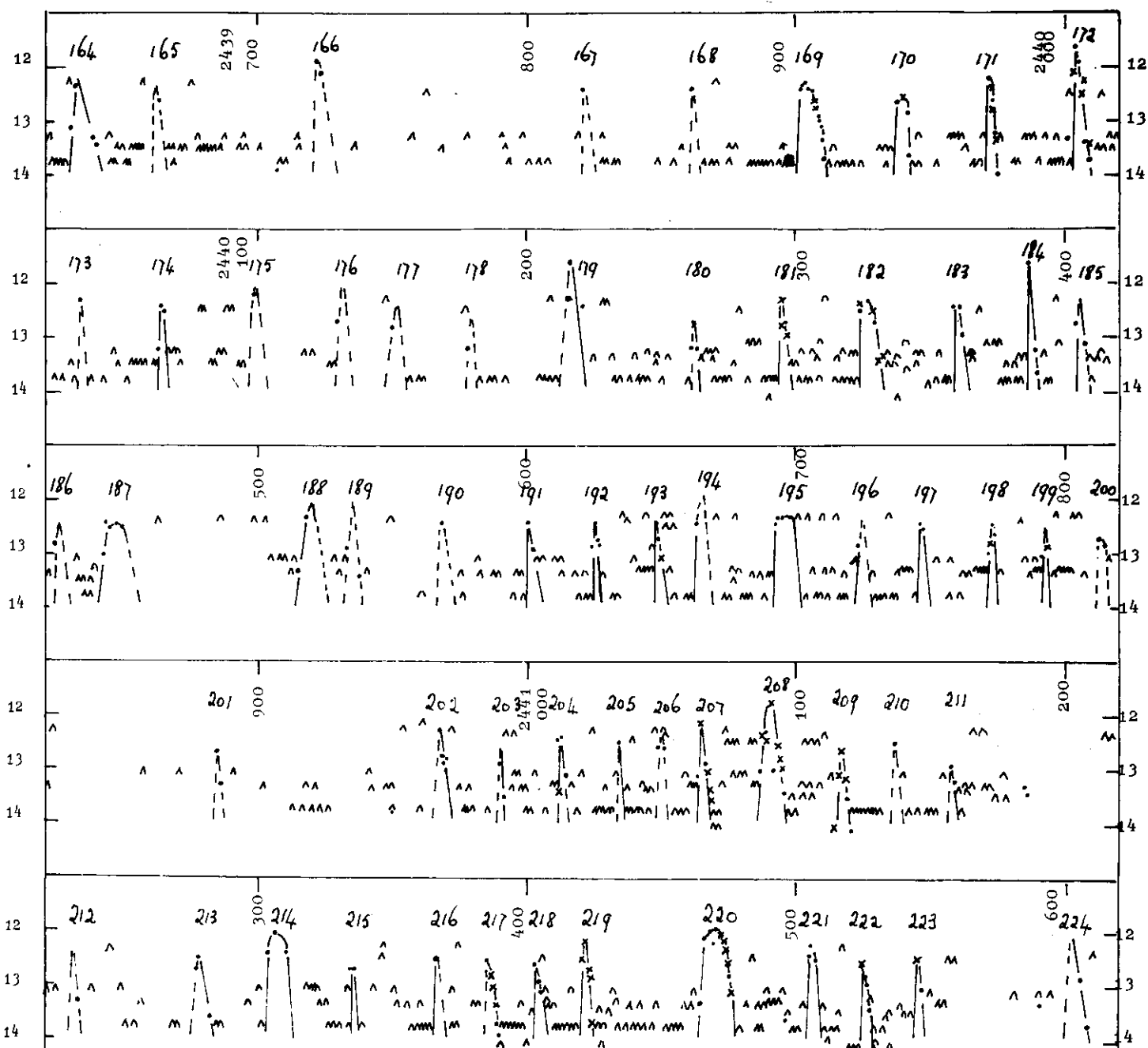


FIGURE 1c. V442 Centauri. Light Curve. 2,439,620 to 2,441,620.

Dots single observations

Crosses Means from 2 or more observations.

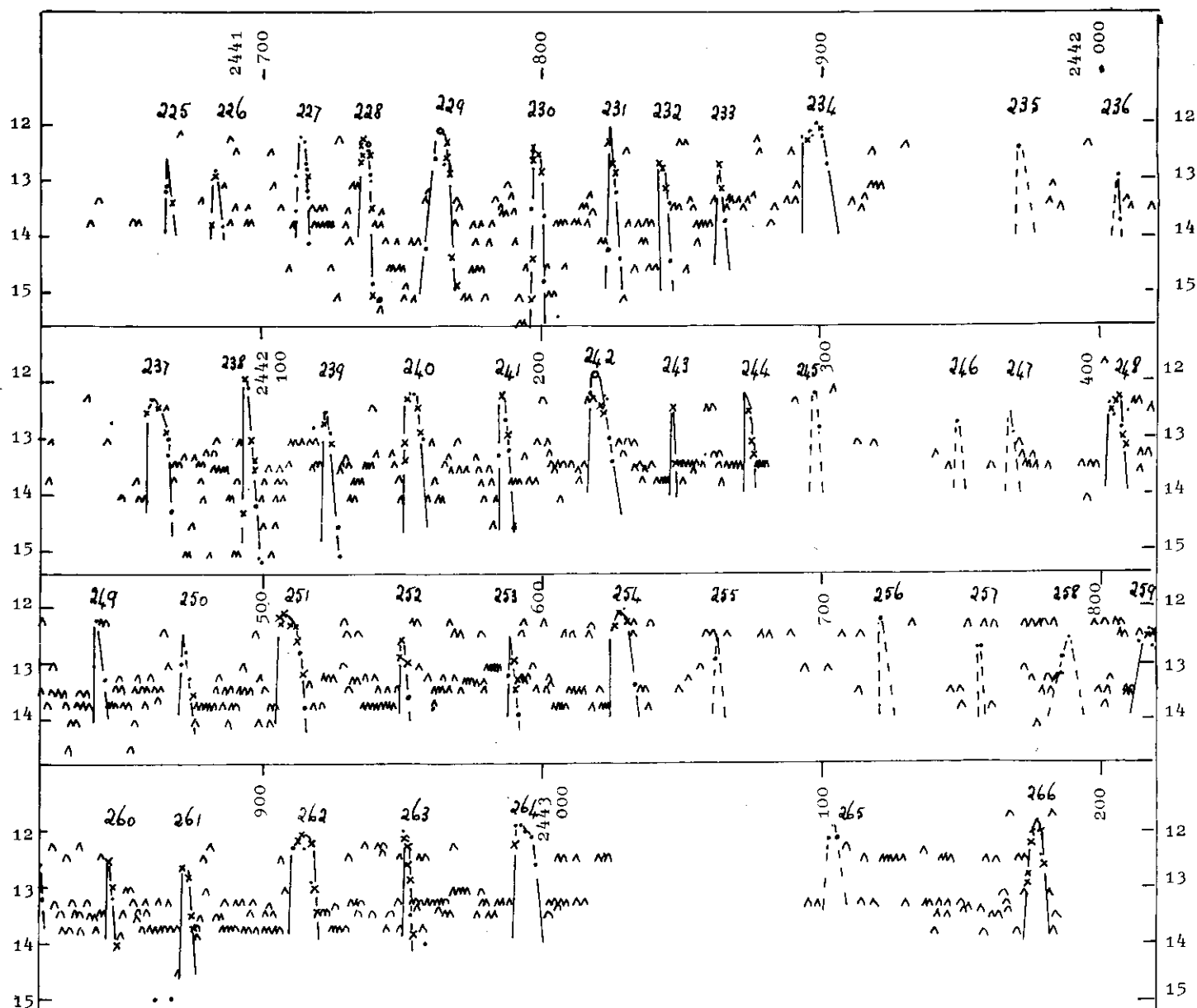


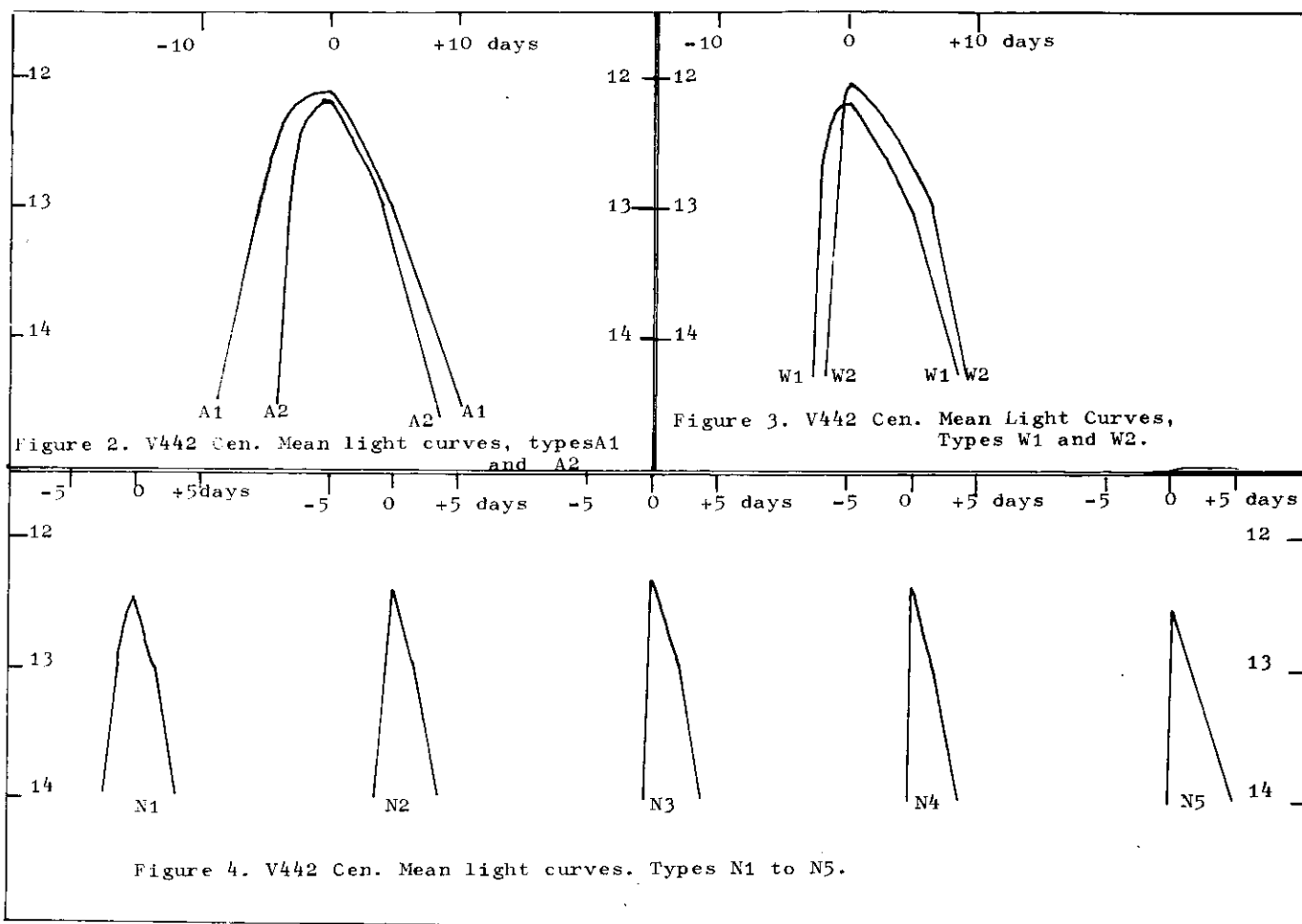
FIGURE 1d. V442 CENTAURI. Light Curve 2,441,620 to 2,443, 184.

Dots single observations.

Crosses Means from 2 to 5 observations

Open Circles Means from 5, or more, observations

In Figures 1a to 1d the numbers above maxima refer to the corresponding numbers in Table 2. Dashed lines indicate maxima for which the possible slope of the curve is subject to considerable uncertainty, because of the lack of observations. In these the form may be different to that outlined. Maxima, with points connected by solid lines are considered to be definite as to slope and type, especially on the large scale plots. Some detail is lost in the small scale plots reproduced.



SEQUENCE FOR SY SCULPTORIS

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Refer Chart 337, Series 8. Standard star HD 562. $V=7.65$. $B-V=+0.14$
 $U-B=+0.04$. Sp. A5

CHART LETTER	V	B-V	ADOPTED	CoD	CHART LETTER	V	B-V	ADOPTED	CoD
a	7.04	+0.45	7.0	-26° 8	n	12.12	+0.69	12.1	-26° 11
b	9.53	1.37	9.5	-26° 5	q	12.55	0.59	12.6	—
f	10.31	1.02	10.3	-26° 1	q ¹	12.96	0.59	13.0	—
d	10.32	0.42	10.3	-25° 2	r	12.98	0.58	13.0	—
h	10.35	1.53	10.4	-26° 7	s	13.17	0.58	13.2	—
k	11.26	0.90	11.3	-26° 14	u	13.63	0.73	13.6	—
l	11.37	0.53	11.4	-26° 3	t	(Measured variation 13.5 to 14.1)			
m	11.53	0.51	11.5	-26° 16 909					
o	12.08	1.00	12.1	—					

Visual observers should use adopted values.

Photoelectric UBV Sequences

for Seventeen Southern Dwarf Novae

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La Silla, Chile.

SUMMARY: Photoelectric UBV magnitudes for a total of 121 stars in 17 fields of southern dwarf novae are given. The limiting magnitudes range from $13^m.0$ to $16^m.5$ in V. There are one certain and two suspected variables among the sequence stars.

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Photoelectric sequences are essential for the reduction of visual and photographic observations of dwarf novae. Many of these observations have been gathered by members of the Royal Astronomical Society of New Zealand during the past years. The reduction and publication of these observations will clear up the general behaviour of the dwarf novae giving valuable hints to the observing astronomer for further detailed studies. In order to reduce said data F. M. Bateson requested some of the sequences presented here. Others belong to dwarf novae which were selected by the author for photoelectric studies.

All observations were carried out at the 1 m telescope of the European Southern Observatory in La Silla, Chile between April 1975 and May 1977. A single-channel photometer was used equipped with an EMI 6256 multiplier and dry ice cooling. As standards E region stars were used (Cousins and Stoy, 1962). The data were reduced to the standard UBV system in the usual way, taking into account first and second order extinction as well as a linear colour transformation. The adaption of the instrumental system to the standard UBV system was very good revealing transformation coefficients with absolute values of less than 0.05 in all colours.

The internal error is less than $\pm 0^m.02$ for all stars brighter than 14^m and increases up to $\pm 0^m.05$ for the faintest stars. - The measurement of the UBV standard stars fit to the standard system with typical rms deviations of $\pm 0^m.01$. Five stars of Table 1 and four other stars in the fields of CU Vel, EX Hya and V 436 Cen (not published here) coincide with Warner (1976). The two independent photometries show excellent agreement with insignificant systematic differences of less than 0.01 in all three colours, and rms deviations of $\pm 0^m.02$. - The errors of the stars in the field of V 1830 Sgr may be slightly larger because of less certain sky background measurements in this extremely crowded field.

The results of the photoelectric photometry and the number N of individual measurements for each star are given in Table 1. The identifications with letters refer always to the stars as identified in the finding charts of Bateson et.al. (1967; 1970; 1976; 1977). All stars with number identifications have been added by the author. - The finding charts (Fig. 1) have been plotted based on the ESO Sky Survey or -for the most northern fields- on the Palomar Observatory Sky Survey. They show all stars with $m_B \leq 16^m$.

Some of the stars included in field BX Pup were observed with the Bochum 61 cm telescope in La Silla, Chile in the course of a photoelectric study of the open star cluster NGC 2482 (Moffat and Vogt, 1975).

Star S in the field of MU Cen is variable with an amplitude of 0.^m1 in a time scale of a few days.

ACKNOWLEDGMENT.

I am indebted to F.M. Bateson for providing me with finding charts and further information prior to publication.

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TABLE 1.

<u>Field</u>	<u>No.</u>	<u>V</u>	<u>B-V</u>	<u>U-B</u>	<u>N</u>
<u>020763</u>					
WX Hyi	F	10.24	0.42	-0.01	9
	N	11.54	0.56	0.05	1
	T	13.05	0.87	0.39	1
	U	13.67	0.81	0.31	1
<u>041813</u>					
AH Eri	A	10.93	1.17	1.07	2
	B	11.64	0.52	0.06	1
	C	12.18	0.63	0.13	1
	D	12.56	0.65	0.12	1
	E	13.09	0.59	0.04	1
	F	13.50	0.02	-0.52	1
	H	16.47	0.92	0.3	1
<u>074423</u>					
BV Pup	1	12.06	0.39	-0.02	5
	2	14.08	0.97	0.66	1
	3	14.10	0.43	0.08	1
	4	14.43	0.56	0.00	1
<u>075024</u>					
BX Pup	1	8.02	1.23	1.12	1
	2	8.93	1.68	1.76	3
	3	10.28	1.06	0.85	1
	4	10.58	0.09	0.07	1
	5	11.41	-0.02	-0.18	1
	6	11.50	0.12	0.11	1
	7	11.70	0.19	-0.26	17
	8	11.87	1.00	0.59	2
	9	12.12	1.12	0.94	1
	10	12.63	0.34	0.15	1
	11	13.00	0.69	0.11	1
<u>111935</u>					
V 442 Cen	1	11.66	0.78	0.32	7
	2	12.18	0.56	0.07	30
	3	13.20	0.64	0.01	1
	4	14.37	0.95	0.4	1

TABLE 1 (cont).

Field	No.	V	B-V	U-B	N	
<u>120743</u>						
MU Cen	L	12.26	1.14	1.00	1	
	N	12.23	1.18	1.18	1	
	P	12.91	0.60	0.04	1	
	R	13.31	0.74	0.20	2	
	S	13.26	0.65	0.06	12	
	1	~~12.20~~	0.79	0.40	16	var
		11.20				= C ₀ D - 43° 7534 (10)
<u>122045</u>						
V 373 Cen	1	12.03	0.55	0.02	9	
	2	13.41	0.58	0.03	1	
	3	14.03	0.53	0.08	1	
	4	14.31	0.57	-0.03	4	var?
	5	14.36	0.73	0.16	1	
<u>125132</u>						
V 485 Cen	A	10.00	1.07	0.85	4	
	B	10.81	1.34	1.43	2	
	C	11.08	1.06	0.86	2	
	D	12.06	0.59	-0.02	2	
	E	12.39	1.23	1.20	2	
	F	12.82	0.51	0.02	2	
	G	12.86	0.45	-0.01	2	
	M	13.94	0.90	0.39	3	
	N	14.02	0.85	0.40	2	
	P	14.76	0.58	-0.1	3	
<u>130760</u>						
NN Cen	1	11.34	0.53	0.28	2	
	2	13.53	0.69	0.13	1	
	3	13.54	1.25	0.97	1	
	4	13.71	0.64	0.37	1	
	5	13.86	0.84	0.28	1	
<u>152940</u>						
BR Lup	H	13.24	0.50	0.06	2	
	K	13.39	1.04	0.8	2	
	L	13.76	0.73	0.20	2	
	M	13.70	0.41	0.31	3	
	N	13.60	1.53	1.8	2	
	O	14.43	0.61	0.0	2	
	P	14.43	1.19	1.1	2	
	Q	14.72	1.00	0.5	2	
	R	15.6	1.2	0.4	1	
	1	10.33	0.43	0.00	5	
<u>154242</u>						
AB Nor	1	10.90	0.64	0.08	1	
	2	11.39	1.58	1.78	1	
	3	12.15	1.39	1.5	1	
	4	13.70	0.67	0.15	1	
<u>161254</u>						
HP Nor	1	7.59	0.30	0.09	17	
	2	11.67	0.28	0.10	1	
	3	11.71	0.40	0.43	7	
	4	~~12.00~~	0.88	0.41	1	
	5	12.91	0.72	0.28	1	
	6	12.98	1.71	2.1	1	
	7	14.81	0.78	0.2	2	
	8	15.71	0.75	0.1	1	
	9	15.74	1.02	0.4	1	

Typo: should be 13.00

TABLE 1 (cont).

<u>Field</u>	<u>No.</u>	<u>V</u>	<u>B-V</u>	<u>U-B</u>	<u>N</u>
161755 IK Nor	A	11.95	1.55	1.61	3
	B	12.65	1.30	0.9	2
	D	13.62	0.75	0.2	2
	E	14.5	1.1	0.4	2
	Z	13.07	0.55	0.39	1
	1	12.34	0.44	0.21	1
170132 FQ Sco	A	10.24	0.48	0.01	4
	F	12.10	1.31	1.03	1
	G	13.10	0.82	0.32	1
	H	13.48	0.71	0.18	1
	K	13.39	1.44	1.34	2
	M	14.16	1.10	0.51	2
	N	13.83	1.79	0.9	1
	P	14.26	1.90	2.0:	2
172342 MM Sco	C	10.70	1.50	1.53	1
	D	11.32	1.11	0.79	2
	E	12.44	0.51	0.34	1
	F	12.93	0.49	0.19	1
	G	13.37	0.67	0.34	1
	H	13.56	1.49	1.5	1
	K	14.02	0.69	0.04	2
	L	13.95	1.56	1.4	1
	M	14.25	0.69	0.01	1
	N	13.51	0.88	0.50	2
	1	8.61	0.26	0.30	5
	2	13.95	1.52	1.4	1
	3	14.59	1.03	0.5	1
172346 AT Ara	E	11.71	0.30	0.20	5
	F	11.46	1.71	2.0	1
	H	12.02	1.65	1.6	2
	K	12.59	1.25	1.01	2
	M	13.61	0.55	0.01	2
	N	14.19	1.34	1.5:	1
	1	12.96	0.73	0.29	3
	2	13.37	0.91	0.52	1
	3	13.46	1.29	1.3	1
	4	14.62	1.77	1.9	1
180727 V 1830 Sgr	1	10.31	0.01	-0.38	5
	2	12.03	1.62	1.24	1
	3	14.36	0.79	0.37	1
	4	14.37	1.20	2.2:	1
	5	15.58	0.70	0.5	1

var?

Wrongly marked on chart.

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NOTE TO OBSERVERS: In no case has the positions of the variables been inserted on the charts in Fig. 1, because of many uncertainties. These charts can be used with N. Vogt's sequences in conjunction with the charts that have already been issued for WX Hyi; AH Eri; V442 Cen; MU Cen; V373 Cen; NN Cen; AB Nor; AT Ara. For the remaining stars charts will be issued when the identification of the variables can be made with certainty. As space prevents additional comments here, these will appear in Circular M77/8.

F.M.B.

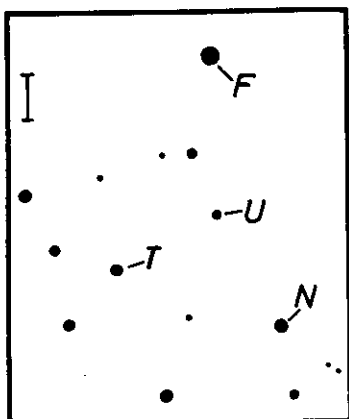
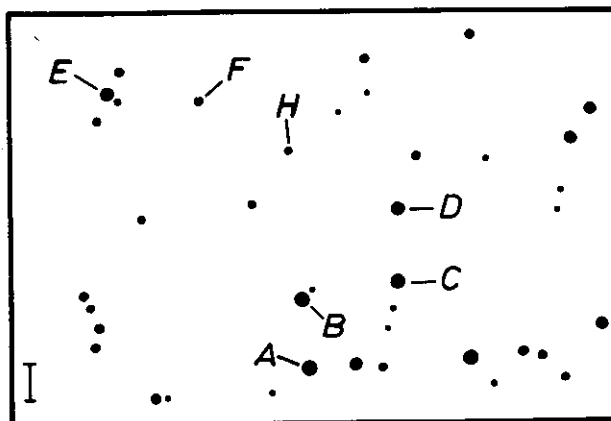
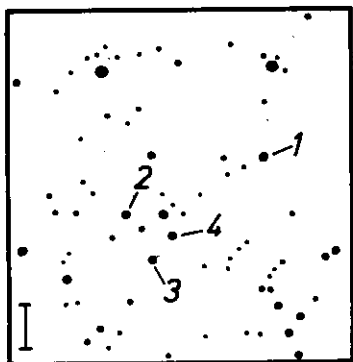
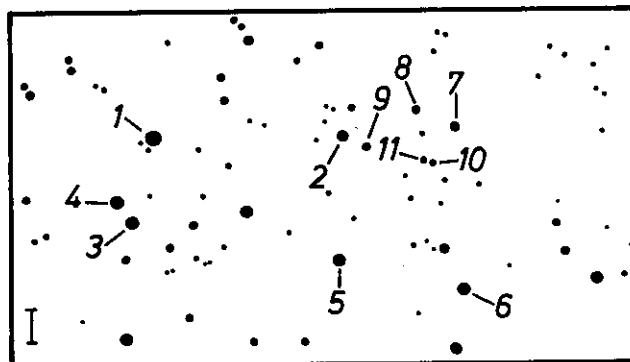
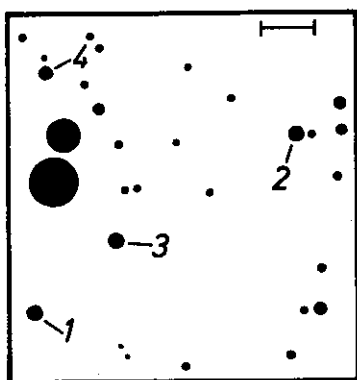
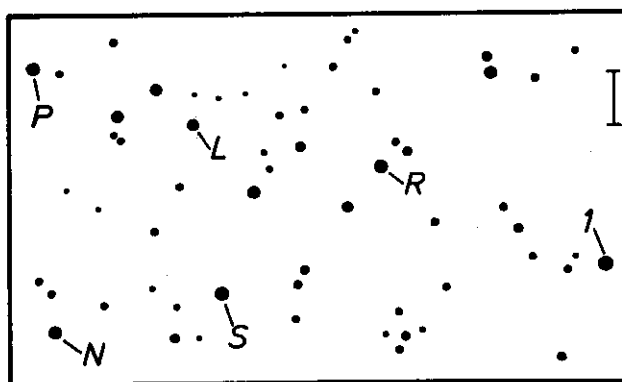
WX Hyi*AH Eri**BV Pup**BX Pup**V 442 Cen**MU Cen*

Figure 1a. Identification charts of the photoelectric sequences. North is top, east is left. The bar corresponds to the size of one minute of arc.

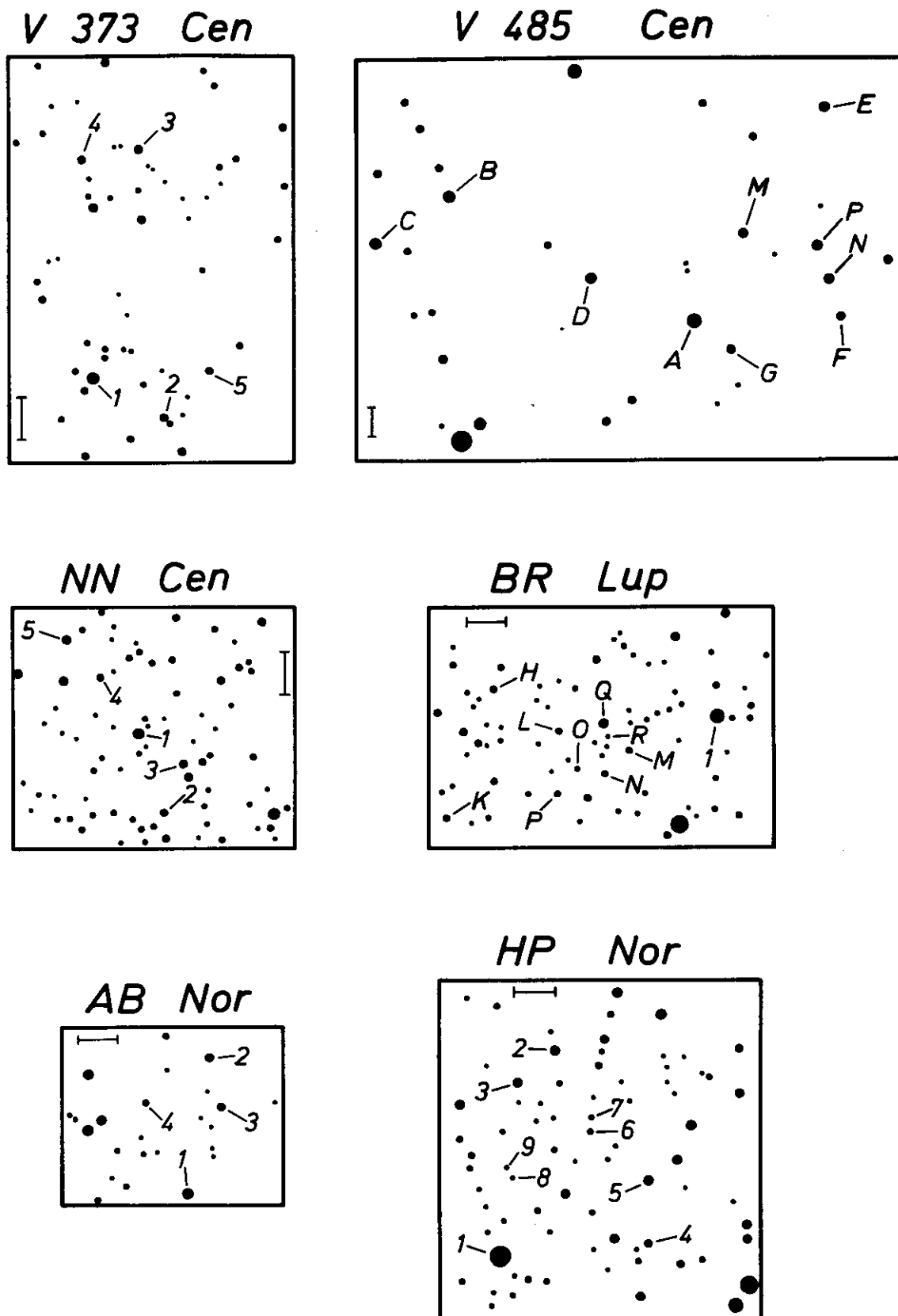
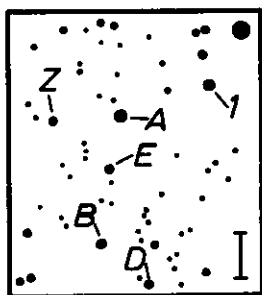
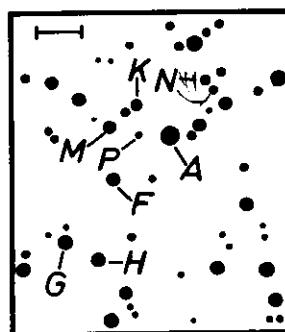


Figure 1b. Identification charts of the photoelectric sequences. North is top, east is left. The bar corresponds to the size of one minute of arc.

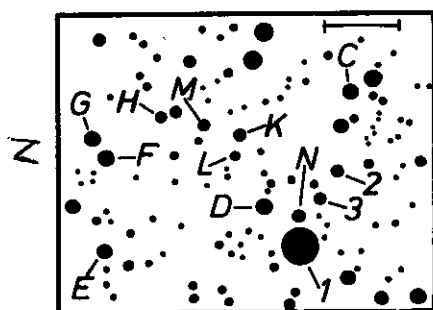
IK Nor



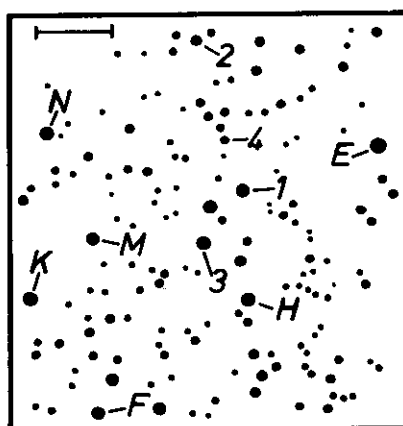
FQ Sco



MM Sco



AT Ara



V 1830 Sgr

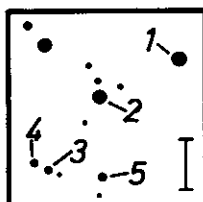


Figure 1c. Identification charts of the photoelectric sequences. North is top, east is left. The bar corresponds to the size of one minute of arc.

OBSERVATIONS: The following visual observations have been received since the last report:

<u>OBSERVER</u>	<u>No. of OBS.</u>	<u>No. of STARS.</u>	<u>OBSERVER</u>	<u>No. of OBS.</u>	<u>No. of Stars</u>
Adams, M.	54	13	Matchett, (Dr). V.L.	689	43
Adcock, B.S.	748	30	Menzies, B.	96	63
Ashley, M.	119	34	Morel, M.	579	41
Baldwin, A.J.	62	14	Morton, J.G.	3	3
Beuning, J.	2	1	Mundt, F.	7	3
Beuning, L.	2	1	Nikolau, B.	97	35
Bird, R.	2	2	Oliver, W.	22	5
Blow, G.L.	143	47	Overbeek, M.D.	3766*	205
Bryant, K.	22	3	Page, A.A.	4	2
Clements, S.	19	13	Paterson, (Mrs). D.	836	107
Cragg, T.	398*	184	Petrovic, J.F.	9	4
Curnick, (Dr).C.L.	519	61	Plever, N.	402	55
Dodson, A.W.	62	10	Powell, H.C.T.	10	2
Doran, B.	15	4	Pycroft, R.	7	3
Dowle, G.	11	4	Robinson, I.	59	10
Dukes, M.	16	8	Rodrigues, C.	1	1
Ellims, M.	3	3	Rowe, G.	1007	94
Evans, R.W.	32	5	Schenk, S.	20	6
Freeth, G.	463	31	Salisbury, J.V.	10	7
Giller, R.H.	513	68	Shinkfield, R.C.	313	29
Goodman, D.	45	12	Sims, (Dr). B.	12	4
Granc, (Rev).A.A.	96	25	Stephenson, S.M.	1269	38
Grimmett, M.J.	17	11	Stewart, M.	156	15
Hall, R.F.	5	3	Sumner, B.	441	174
Harries-Harris, E.	595	43	Taylor, (Dr). N.	1558	130
Hayward, G.	186	16	Thomas, (Dr). M.	64	55
Heath, D.	43	11	Thompson, G.	7	1
Heather, A.	6	1	Trainer, J.B.	21	2
Hull, O.R.	1709	96	Tregaskis, T.B.	892	162
Jones, A.F.	4625	141	Tripp, H.	74	11
Kent, (Mrs). K.	68	9	Venimore, (Rev). C.W.	922	67
La Teef, A.	1	1	Walker, W.S.G.	74	12
Lee, D.	77	7	Wallace, R.L.	8	5
Lee, S.	50	8	Walmsley, J.	7	4
Leggett, A.A.G.	5	2	Walmsley, M.	14	4
Leslie, (Mrs) A.	704	14	Williams, P.	652	35
Lumley, E.	524	20	Wilson, A.G.	17	7
Marino, B.F.	6	5	Winnett, R.D.	220	67

* = Results also communicated to AAVSO

TOTAL OBSERVATIONS 26,312.

PUBLICATIONS: Issues during the year consisted of:
Monthly Circulars Nos. M75/9-M75/12; M76/1-M76/8
Publications Nos 3 (C75) and 4 (C76)
Charts: Series 7 and 8.

GENERAL: Particular attention was given to dwarf novae during the past year, both by encouraging observers to monitor these closely, and in reducing the results for publication. The latter was made possible by a grant from the Carter Observatory Board, and by the sequences established by B. Warner as well as those established by B. Menzies and his assistants at the Auckland Observatory. This resulted in the completion of Memoir No. 2 on VW Hyi, which has been accepted for publication in the 1977 March issue of the N.Z. Journal of Science. Papers on WX Hyi; MU Cen; EK TrA were published during the year.

Close visual monitoring of southern dwarf novae provides valuable information to astronomers on the general behaviour of these stars.

Cabled advice is sent to a number of observers on the outbursts of dwarf novae, which enables programmes on large instruments to be arranged. We have continued to supply predictions on supermaxima and these have also been used in conjunction with various satellites.

MONTHLY CIRCULARS: These continue to provide regular and prompt advice on the behaviour of eruptive and other important variables. They also provide observers with observational information and predictions.

It was with regret that the price for the Circulars had to be increased slightly during the year on account of increased postage rates and paper prices. It is hoped to be able to hold prices at the present level during the coming year. Circulation of these Circulars continues to expand.

PUBLICATIONS: The two issues during the year enabled a large volume of observations to be published and discussed. It is hoped to steadily expand the Publications, although inflation will ultimately force some readjustment of the price. Several contributors from overseas enhanced the Publications in papers based on the published results of the Section.

CHARTS: M. Morel and R. Winnett have continued their excellent work on charts. Two issues were published during the year, and Series 9 is well advanced. It will be issued in the New Year. A number of charts have also been approved for Series 10.

The basic work of assembling data for the production of these charts has continued at Headquarters with the result that there is now ready a large file of such material. R. Winnett is producing a number of Binocular Charts for use by those who have no other instrumental means.

SEQUENCES: B. Warner kindly measured the sequences for seven dwarf novae, which were published in Publ. 4 (C76). B. Menzies and his assistants have continued to determine two colour sequences for a number of southern fields. Some of these have been published with the charts; others appeared in Pub. 3 (C75). It is hoped to publish the remainder of the completed sequences during 1977.

N. Vogt has undertaken to provide three colour sequences for a number of dwarf novae, which have been under observation by members for some years. These sequences should be available in 1977.

CEPHEIDS: All observations of the classical long period Cepheid ϵ Car have been turned over to T. Cragg, who will produce a paper on the results as part of his work on Classical Cepheids.

RECURRENT NOVAE: All observations of recurrent novae have been supplied to R.F. Webbink for use in his investigations of these stars. He has investigated all past records of recurrent novae, and, as a result a composite chart for T Pyx has been supplied and checked. A request has been made to B. Menzies to obtain photoelectric magnitudes for those stars in this field not yet determined. He has also been asked to check on a number of suspected variables, found photographically in this field by A.A. Page and I. Stranson. This work will enable all past records to be reduced to the same system.

D. Hoffleit has undertaken to supply accurate identification charts for a number of suspected variables for which their positions are doubtful. This will enable the charts on objects HS Sgr; V441 Sgr, V999 Sgr, FM Sgr to be updated and published in Series 10 of Charts for Southern Variables.

Novae. A number of old nova have been kept under observation. Our

northernmost observers were able to observe the bright Nova Cygni, 1975. Their observations appeared in Circ. M75/9. Amongst the many independent discoverers of this nova was Donald Wallace, Bundaberg Astronomical Society, Queensland, who reported his discovery to V.L. Matchett.

R CORONAE BOREALIS TYPE VARIABLES: Observers have continued monitoring these important variables. The results for 13 stars of this type were discussed in Publ. No. 3 (C75).

S Aps declined to a deep minimum, which was very well observed. O.R. Hull was the first to detect the fade which commenced in 1976 February. Details appeared in Circ. M76/2; M76/3; the latter including a preliminary light curve of the declining branch. A more detailed light curve will appear after the star has recovered.

RED VARIABLES: Observations of Mira Cet, irregular and semi-regular variables have continued. Regular three monthly reports are compiled by G. Smith of those stars in which the AAVSO are interested. These are used by them in their plots to assist their predictions. These predictions are distributed to our observers via the Monthly Circulars.

As soon as the results on dwarf novae and R CrB stars are all published the published results on other variables will appear.

COMPUTER PROGRAMME: P.D. Cain completed the listing of all observations of S Car for the computer programme. A.J. Baldwin has processed these and produced a computer drawn light curve covering the results for the past 50 years. Discussions are proceeding on how best to extend this programme so that the systematic deviations of observers can also be obtained.

P.D. Cain is now preparing the results for R Car for the computer, with the same objectives as applied to S Car.

OBSERVERS: The transfer of D. Overbeek to U.S.A. means that his valuable contribution will be sadly missed. During recent years he has paid particular attention to many stars on our programme. His position as Director, A.S.S.A./, Variable Star Section, has been taken over by J. Hers, with whom close cooperation has already been established.

The loss of D. Overbeek will, however, be offset by T. Cragg, who moves south to Australia. He has contributed results to us in the past from Mt. Wilson, and his new location will provide us with another very experienced observer.

INTERNATIONAL COOPERATION: Requests for our observations and help on particular programmes have continued. Such requests have been too numerous to list individually. They are the best possible tribute to the observational skills of our observers. We, for our part, are also indebted to the many astronomers who have helped us during the past year.

Close cooperation with our sister organisations --AAVSO, BAA., in particular--has continued to the mutual advantage of all through the free exchange of observations, charts, sequences and publications.

FINANCE: The continual effect of inflation, especially in postal charges, has been a matter of considerable concern to the Director. Late in 1977 a system of postcards will be introduced in order to keep the rising cost of postage under control. These will replace much of the present correspondence with observers at a considerable saving.

The Monthly Circulars continue to be self supporting, but should postal charges be again increased this will no longer be so. It is desirable that the Publications be again expanded, which will call for some increase in charges in the near future. The production of many of the results have been due to a grant from the Carter Observatory Board. However, the overall activities of the Section

have been maintained through subsidies from the Low Estate and a family trust. For this assistance we are deeply grateful.

JUBILEE 1977: As reported in the previous report the Golden Jubilee of the Section falls in 1977. This will coincide with the Annual Conference of the Society to be held at the University of Waikato in November 1977. It will also be marked by an International Colloquium on the "Changing Trends in Variable Star Research" to be held at the same University in 1978. Originally this meeting was planned also to be held in 1977, but at the request of the IAU was postponed for one year in order not to clash with the Bamberg Colloquium in 1977.

It has been suggested that the Jubilee be marked by the establishment of a Trust Fund aimed at providing an endowment to help finance the activities of the Section. This will require the appointment of Trustees and the support and endorsement of members. Your Director would welcome comments on this suggestion, which has been proposed by several members.

ACKNOWLEDGMENTS:

The success, or otherwise, of the Section depends entirely on the contributions of the observers. I am deeply indebted to them all for their observations. In particular, the skill and accuracy of these are due to the work of the more experienced observers, and the guidance and advice which they have given to new members.

Gordon Smith has continued the task of collating the records and entering them on the permanent sheets. A task which calls for painstaking attention to detail and, which he carries out so well. His work, and mine, have been made easier by the leaders of the various local groups, who have collected and checked the records of their members.

The production of charts has been made possible in the first place through the co-operation of many Observatories in providing photographs and other data on which the charts are based. This help would, however, be lost without the practical skill that both Mati Morel and Bob Winnett bring to the accurate drawing of the charts.

The Director and staff of the Carter Observatory have assisted the Section in some many ways. For this I am grateful. In particular the grant from the Carter Observatory Board is making possible the reduction and publication of all the results on dwarf novae.

We are indebted to the Trustees, Auckland Observatory for allocating telescope time to Barry Menzies and his assistants on the sequence programme.

The continued, and increased, support from individual astronomers and observatories through subscriptions has greatly helped in making the PUBLICATIONS and MONTHLY CIRCULARS recognised as reliable sources for data on southern variable stars.

This report by no means covers the entire activities of the Section. Space limitations precludes mention of all those who have helped the Section either through observations; guiding and leading groups; assisting with the "desk" routine or by providing data or exchanging records. I do not therefore intend to follow my previous reports by naming so many individually. Instead I thank them all for their support and help. The flourishing state of the Section is the best tribute to their work.

1976 October 31

Frank M. Bateson
Director.

NOTICE TO CONTRIBUTORS.

Papers are invited for publication on all aspects of research on Variable Stars, as well as articles of general interest to variable star observers.

STYLE:

(a) TEXT. All contributions should be typewritten on one side of the paper only, double spaced and with a left hand margin of at least 3 cm. The original and one copy, including figures and tables, are required.

There is no limit on length, but papers under 5000 words in length are preferred. Each paper should have a short summary indicating the scope of the paper and giving the principal results.

(b) TABLES. Tabular matter should be so arranged that it can be reproduced upright and should fit the page size of these Publications. Tables should be typed with a carbon ribbon and laid out to the correct format so that they can be reproduced direct. Each table should have a title and be numbered.

(c) FIGURES. These should be drawn in Indian Ink on white mat paper, or tracing paper. Figures should include accurate and clear lettering. They should be of a size that can be reproduced direct on a whole page, or part thereof, without reduction. Figures drawn to a larger size for photographic reduction involve additional costs and are to be avoided if possible. If, however, these are approved by the Editor they should not exceed twice the page size.

(d) REFERENCES. References in the text should give the name of the author and the year of publication, e.g. J. Smith (1973). Only the name of the first author should be quoted in the text (followed by et al.), when reference is made to a paper having three or more authors.

References should also be in alphabetical order at the end of the article. If several references to a single author are given they should appear in chronological order. Contributors are requested to follow the style used in these publications in listing references. Standard abbreviations should be those given in Transactions of the International Astronomical Union, Vol. XLVB (1971) or XLIC (1966).

(e) FORMULAE. All mathematical formulae should be written by hand in Indian Ink so that they can be reproduced direct.

REFEREEING. All research papers are submitted to a referee. This can cause some delay in publication since most papers have to be sent overseas.

ISSUES. At present Publications appear twice a year. The object is to distribute one issue about August and the other in December. The actual dates depend on the amount of material available, and the time required for refereeing.

All contributions should be sent to the Editor, Variable Star Section, R.A.S.N.Z., C/o 18 Pooles Road, Greerton, Tauranga, New Zealand.

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