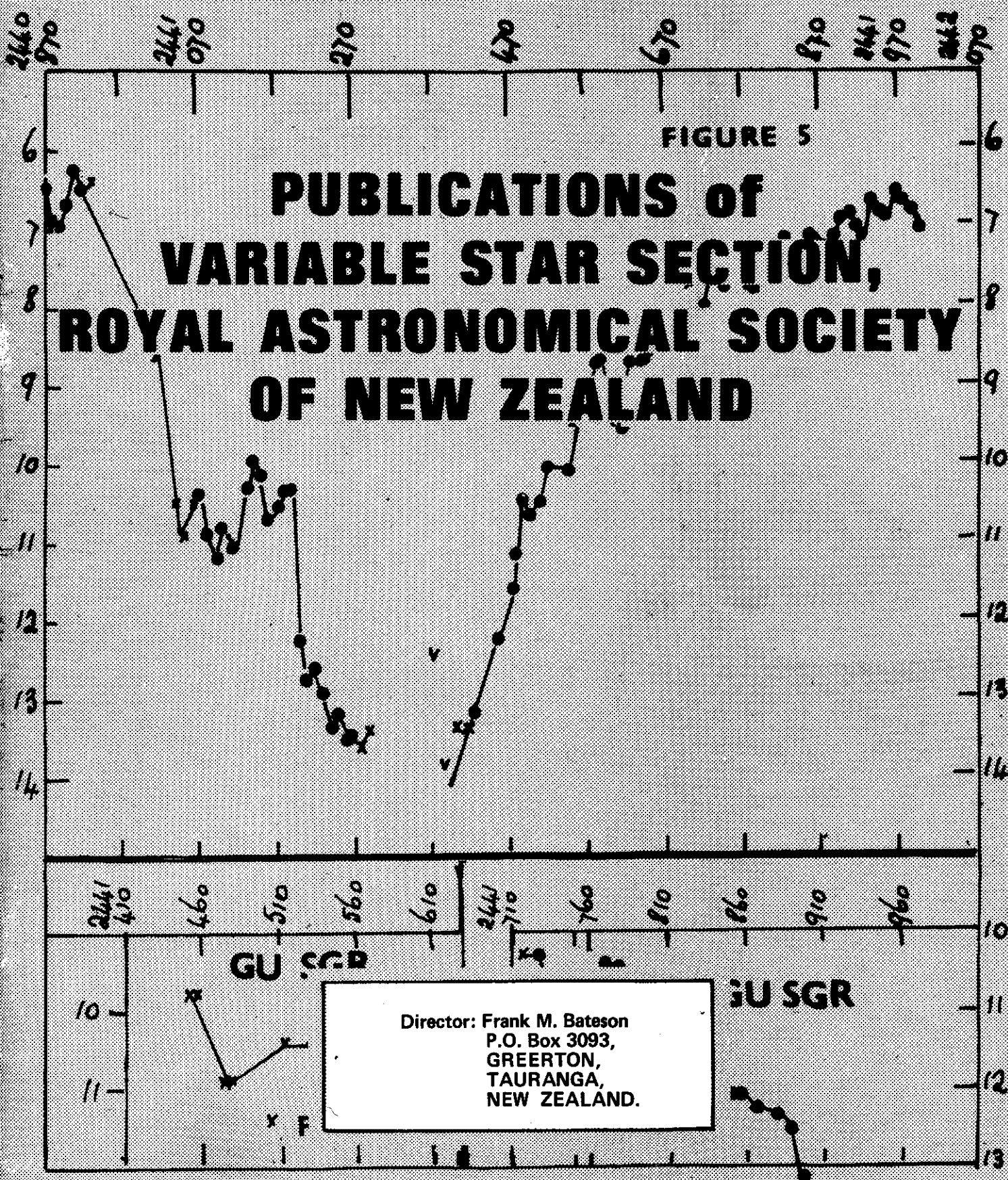




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1979 October 15

THE DWARF NOVA---WW CETI

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and

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SUMMARY: Visual observations between J.D. 2,440,066 and 2,443,722 show that WW Cet is of U Gem type with a mean cycle of 31.2. Observed outbursts are listed and divided into wide, narrow and minor peaks. Wide maxima are brighter and of longer duration than narrow maxima, whilst the minor peaks have a mean width of 1.5 at 13^m.0 and a mean maximum one magnitude fainter than those of narrow maxima.

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1. INTRODUCTION

Herbig (1962) stated that the spectrum of WW Cet (HV 8002) is very similar at minimum to that of SS Cyg. The star was subject to rapid light fluctuations on a time scale of 5-15 minutes with a range in V of about 0^m.3. Herbig gave mean values from three long runs as: V= 14.09; B-V +0.13; U-B= -1.00. He concluded that WW Cet belonged to SS Cyg class but might not be a normal member.

Burley (1962) reported magnitude from 570 Harvard plates from 1888-1955 plus 28 plates taken since July 9, 1962. She found the range was from a maximum of 11^m.10 on August 31, 1896 to a minimum of >16^m.30 on November 7, 1944. Most of the estimates are between 13^m.5 and 14^m.0 but no periodicity was found.

2. PHOTOELECTRIC OBSERVATIONS

B. Marino and W.S.G. Walker, Auckland Observatory, communicated the following three colour observations:-

<u>G.J.D.</u>	<u>V</u>	<u>B-V</u>	<u>U-B</u>
2,443,396.042882	14.60	+0.02	-1.13
.044421	14.57	+0.17	-1.27
.059688	14.17	+0.48	-1.17
.076342	14.54	-0.16	-1.27
.084109	14.67	-0.08	-1.27
.103738	14.59	-0.07	-1.18
.105275	14.65	-0.02	-1.14
.111574	14.81	+0.31	-1.52
.113160	14.46	+0.21	-1.16
430.83	12.78	-0.07	-0.78
.85	12.80	+0.08	-0.82
436.00	13.45	+0.04	-0.97
.02	13.42	+0.37	-1.08
.05	13.67	+0.30	-1.02

3. VISUAL OBSERVATIONS

A total of 697 observations were made between GJD 2,440,066 (1968 July 28) and 2,443,722 (1978 August 1). A.F. Jones made 667 observations with the remainder being distributed amongst 13 observers, who contributed only from 1976 August 29. The observing season is from late April through to the end of January.

4. CHARTS AND SEQUENCE

Charts 324 and 325 (Bateson, et al 1976) identified four comparison stars by the letters "a", "b", "c" and "d". B.F. Marino has communicated preliminary three colour values for these four stars together with values for three brighter stars. This provides the following tentative visual sequence:

<u>COMPARISON STAR</u>	<u>M_v</u>	<u>Jones' Sequence Letter.</u>	<u>REMARKS</u>
A	8.3		45mmW & 56mmS of WW Cet chart 325
B	9.8		5mmE & 45mmS of WW Cet " "
D	10.9	.1..	9mmE & 3mm N of "a" " "
a	12.4	r	Shown on chart 325
b	13.2	u	" " " "
c	13.8	x	" " " "
d	13.4	s	" " " "

A. Jones used a number of other comparison stars for which very approximate visual magnitudes were determined from step estimates and the above tentative sequence. His other sequence stars are:-

<u>JONES' LETTER</u>	<u>M_v</u>	<u>REMARKS</u>
f	10.1	34mm West & 94mm North of WW Cet chart 325
h	10.5	47mm West & 57mm North of WW Cet " "
n	11.4	48mm West & 34mm North of WW Cet " "
p	11.9	6mm East & 47mm North of WW Cet " "
q	12.2	18mm East & 44mm South of WW Cet " "
t	13.3	10mm East & 17mm South of WW Cet " "
y	14.2	2mm West of "c" chart 325.

All the above tentative values have been used to reduce the observations. This may mean that the magnitudes stated in the discussion below are in error. However, as this paper is intended to report on the gross behaviour of the variable the values given are sufficient for the purpose.

5. DISCUSSION.

The observed maxima are shown in Table 1. Notes on these maxima are given at the end of the table. The maxima are numbered successively but this does not imply that they are successive except for those intervals in column five that are not enclosed in brackets.

The mean interval between maxima that are clearly successive is 31.2^d and these intervals range from 11 to 43 days.

Maxima have been divided into four types dependent on their widths at magnitude 13.0 and on their magnitude at maximum. These are:

- W1 = Wide. Width 7^d or more.
- W2 = Wide. Width 7^d or more, but with a distinct pause of 4 days on the decline at 11.0 following a rapid fall from a maximum brighter than normal.^m
- N = Narrow. Width less than 6^d.
- P = Minor peaks. Very short duration. Maximum magnitude fainter than for other types.

Magnitudes at maximum for those maxima whose brightness was well determined are summarised below:

MAXIMA MAGNITUDES

<u>TYPE</u>	<u>MEAN</u> <u>m_v</u>	<u>MEAN</u> <u>Dev.</u>	<u>No.</u>	<u>EXTREMES.</u>
W1	10.95	$\pm 0.^m17$	6	$10.^m7 - 11.^m4$
W2	10.47	0.16	3	$10.3 - 10.7$
N	11.30	0.30	6	$10.9 - 12.0$
P	12.30	0.27	3	$11.9 - 12.5$

The widths at $13.^m0$ and $12.^m0$, when well determined, are:

WIDTHS OF MAXIMA.

<u>TYPE</u>	$13.^m0$ <u>MEAN</u> <u>WIDTH</u>	$13.^m0$ <u>MEAN</u> <u>DEV.</u>	<u>EXTREMES</u>	$12.^m0$ <u>MEAN</u> <u>WIDTH</u>	$12.^m0$ <u>MEAN</u> <u>DEV.</u>	<u>EXTREMES</u>	<u>No.</u>
W1	9^d	± 1.33	$7^d - 11^d$	6^d	± 1.0	$4^d - 9^d$	6
W2	10	0.7	$9 - 11$	7.3	0.43	7 - 8	3
N	4.3	1.19	$2 - 6$	2.7	0.9	1 - 4	7
P	1.5	0.5	$1 - 2$	...	...	. .	4

6. CONCLUSIONS

WW Cet has a mean cycle of $31.^d2$ from the observed maxima that are clearly successive. About half of the observed maxima were well observed so that their widths and maximum brightness were certain. These indicate that wide maxima have a width at magnitude $13.^m0$ of 9 to 10 days on the average and a mean brightness at maximum of $10.^m95$ for Type W1 and $10.^m47$ for W2. Narrow maxima have a mean width at $13.^m0$ of $4.^d3$ and a mean maximum magnitude of 11.30. In addition it appears that minor peaks occur with a width of $1.^d5$ and a mean maximum magnitude of $12.^m30$.

The limited number of photoelectric observations suggest that WW Cet is subject to rapid light fluctuations of about $0.^m4$ in V. There is no evidence to show the behaviour of the variable below $14.^m0$ as this was the limit of the instruments used.

REFERENCES

- Bateson, F.M., Morel, M. & Winnett, R. 1976. "Charts for Southern Variables" Series 8. Published by F.M. Bateson, Tauranga, N.Z.
- Burley, J. 1962. H.C.O. Announcement Card 1576.
- Herbig, G.H. 1962. H.C.O. Announcement Card 1576.

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TABLE 1.

OBSERVED MAXIMA OF WW CETI.

No.	TYPE	J.D. MAXIMA	m_V	INT	$Z=13^m.0$		$13^m.0$ WIDTH	$Z=12^m.0$		$12^m.0$ WIDTH	No. OBS.
					R.	F.		R.	F.		
1	W1	2440089	10.7	... ^d	(086)	097	11 ^d	087	096	9 ^d	11
2	N	160	10.9	(71)	158	164	6	159	163	4	4
3	N	192	11.5	32	192	195	3	192	194	2	3
4	P	230	12.5	38	229	231	2	...	...	..	4
5	W1	383	11.0	(153)	(379)	388	9	381	386	5	5
6	W1	422	10.9	39	419	429	10	420	426	6	5
7	W2	528	10.4	(106)	526	(537)	11	527	535	8	9
8	W1	561	11.4	33	537	564	7	559	563	4	6
9	?	590	10.6	29	...	...	...	586	...	..	5
10	N	721	10.6?	(131)	720	724	4	720	723	3	5
11	?	766?	11.4?	(45)	...	...	...	...	...	..	3
12	W2	842	10.3	(76)	840	850	10	841	848	7	5
13	P	865	12.4?	23	865	866	1	...	...	..	3
14	P	906	11.9	(41)	906	908	2	...	...	..	3
15	W1	2441096	10.9	(190)	094	101	7	094	100	6	8
16	N	133	11.0?	(37)	132	136	4	132	136	4	4
17	P	178	12.5	(45)	177	178	1	...	...	..	2
18	?	207	12.0	29	(207)	210	3	...	...	..	6
19	W2	249	10.7	42	(247)	256	9	248	255	7	8
20	N	286	11.2	37	286	288	2	286	287	1	5
21	?	348?	11.3?	(62)	...	...	...	...	...	..	1
22	?	455?	12.5?	(107)	...	...	...	...	...	..	2
23	N	493	10.9	38	492	498	6	493	496	3	7
24	?	536	11.5	43	534	...	...	535	...	..	5
25	W1	577	10.8	41	576	586	10	576	582	6	7
26	N	668	11.3	(91)	666	670	4	667	669	2	4
27	?	829?	11.5?	(161)	...	832	...	...	830	..	3
28	?	895	11.0	(66)	...	898	...	...	897	..	4
29	N	931	11.5?	36	(931)	936	5	(931)	933	2	4
30	?	995	11.0	(64)	...	998	...	...	996	..	3
31	?	2442018	10.9	23	...	...	...	...	...	..	2
32	?	051?	11.3?	33	...	...	...	...	...	..	1
33	?	201	11.2	(150)	...	...	...	...	...	..	2
34	W1?	322	10.2?	(121)	...	332	...	319	328	9	5
35	?	714	11.0	(392)	(712)	...	...	(713)	...	..	3
36	?	2443416	12.0?	(702)	...	420	...	...	...	..	3
37	?	426	12.0?	10	...	434	...	...	...	..	11
38	N	446	12.0	20	445	451	6	...	...	..	6

REMARKS

- No. 1 Beginning of rise uncertain.
 3 Maximum & fall not adequately observed.
 5 Rise not adequately observed.
 6 Fall not adequately observed.
 7 Rise not adequately observed; 5^d standstill at 11^m.0 on decline.
 8 Fall below 12^m.0 not adequately observed.
 9 Fall not adequately observed; slow rise to 11^m.5. Possibly an anomalous maximum.
 10 Maximum not well observed; Maximum magnitude may have been fainter.
 11 Poorly observed; probably narrow.
 12 On decline 4^d standstill at 11^m.2.
 15 Flat maximum.
 15-16. Possible maximum between Nos. 15 & 16.
 16 Bottom of rise and fall defined by negative observations.
 16-17. Possible maximum around 158.
 18 Rise not observed; probably narrow.
 19 Rise not adequately observed; standstill 4^d at 11^m.1 on decline.

REMARKS TO TABLE 1 (cont)

- No. 21 A single observation of $11.^m3$ indicate a maximum around 348.
 22 Part of fall only observed.
 24 Probably narrow; fall not observed.
 27 Rise not observed.
 27-28. An observation of $13.^m2$ on 866 with negative observations four days before and after indicates that a narrow maximum may have occurred about this date.
 28 Rise not observed.
 29 Maximum not adequately observed.
 30 Probably narrow; not adequately observed.
 31 Not adequately observed.
 32 Dependent on a single observation at $11.^m3$.
 33 Observations at maximum only.
 33-34. A maximum probable around 230; large gaps in records between Nos. 33 & 34.
 34 Maximum not adequately observed; possibly type W1 but this uncertain.
 34-35 Many gaps in observations between these maxima. Possible maxima around 410; 600; 636 and 658.
 35 Rise and fall not adequately observed.
 36 Rise not observed; probably narrow.
 37 Rise not adequately observed.

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DOES TU MENSAE TURN OFF OR IS IT OF Z CAM TYPE?

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SUMMARY: Visual observations from JD 2,438,181 to 2,443,874 are discussed. Outbursts are either brighter than $12.^m5v$, or have a maximum brightness fainter than $13.^m5v$. The normal mean cycle is about 54 days, but TU Men has intervals of comparative inactivity suggesting that it may be of Z Cam type, remaining at an intermediate magnitude for many cycles at a brightness below the threshold of the instruments used. If this suggestion is incorrect then TU Men may "turn off" at times.

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1. INTRODUCTION

TU Men=S6732 was discovered by Hoffmeister (1963), who gave a range of 11-17p, and noted a maximum on 1959 Aug. 29. Kukarkin, et al (1970) classified TU Men as of U Gem type with a range of 11.4-17p and a mean cycle of 413 days. Bateson (1979) drew attention to its much shorter mean cycle and placed it at 21.29 days.

2. CHARTS AND SEQUENCE

An identification chart was published by Hoffmeister (1963). Bateson et al (1977) published charts with comparison stars identified by letters for a sequence originally selected by A.F. Jones. No reliable magnitudes are available for any of these stars. Based on step estimates between the comparison stars made by A.F. Jones arbitrary magnitudes have been assigned to them on the basis that "n" = $13.^m0v$ and "t" = $13.^m9v$. The scale adopted may be in error, especially at the brighter end and the magnitudes quoted in

this paper may be incorrect. However, the arbitrarily fixed values suffice to enable the gross behaviour of TU Men to be discussed.

3. OBSERVATIONS

Between JD 2,438,181 (1963 May 31) and 2,443,874 (1978 December 31) observations were contributed by:

Cragg, T.A.	5	Pleever, N.	3
Freeth, G.	5	Rowe, G.	74
Hull, O.R.	133	Sumner, B.	12
Jones, A.F.	2,134	Taylor, (Dr) N.W.	26
Marino, B.F.	9	TOTAL	2,401

The observations covered 2,493 nights. Except 1963 the observations were evenly distributed throughout each month. All estimates prior to 1976 October 21 were made by A.F. Jones, whose observations also dominated the following years. Thus there are available uniform observations by a highly skilled observer over the entire interval, supplemented in the last two years by other first class records.

4. DISCUSSION

Outbursts are either bright, when TU Men attains a magnitude brighter than 12.5v, or faint peaks with a maximum magnitude close to, or just above, the threshold of the instruments used. A preliminary tabulation of all outbursts suggests that TU Men is much more active during some intervals than during others. This poses the question whether this is merely an apparent effect caused by gaps in the observations or whether it is real.

Before considering the types of individual outbursts they were divided into bright and faint. Complete intervals each of 1000 days from the date of the first observation were taken and the number of nights in each interval on which observations were made tabulated. The results are shown in Table 1.

TABLE 1.
NIGHTS OBSERVED.

<u>J.D.</u>	<u>NIGHTS</u>	<u>OBSERVED MAXIMA</u>	
		<u>BRIGHT</u>	<u>FAINT</u>
2,438,181 - 2,439,180	402	6	18
2,439,181 - 2,440,180	363	5	9
2,440,181 - 2,441,180	403	1	10
2,441,181 - 2,442,180	411	6	18
2,442,181 - 2,443,180	280	5	1

The figures suggest that in the third interval bright outbursts were much below the normal. In the final incomplete interval of 694 days from JD 2,443,181 to 2,443,874 there were three bright and two faint maxima.

To ascertain whether the apparent lack of bright outbursts in the third interval were related to gaps in the records, the observations were divided into years. A comparison was then made between the number of nights covered and the occasions on which gaps exceeding 5 days occurred. If such a gap occurred immediately prior to, or immediately following, an outburst it was disregarded because a maximum had been observed and therefore these gaps had no effect on the frequency of maxima. Normally gaps rarely exceeded 10 days, except in 1976, when the longest gaps of 29 and 23 days occurred.

The results are shown in Table 2.

TABLE 2.

YEARLY TOTALS OF NIGHTS OBSERVED.

YEAR	NIGHTS	GAPS of MORE THAN 5 ^d .	OBSERVED MAXIMA		REMARKS
	OBSERVED		BRIGHT	FAINT	
1963	86	9	2	7	May 31-Dec.31
4	151	8	2	7	
5	149	8	2	4	
6	112	15	2	1	
7	134	14	2	2	
8	155	7	1	6	
9	146	8	0	2	
1970	136	14	0	2	
1	164	9	2	8	
2	170	6	2	10	
3	126	16	2	6	
4	127	14	2	0	
5	107	19	1	1	
6	86	18	3	0	
7	140	13	1	1	
8	204	8	2	1	
	2193	186	26	58	

Ignoring 1963 because observations only commenced in mid-year, it appears that two bright maxima can be expected each year. Exceptions are 1968-1970 with no bright maxima in 1969 or 1970 and one in 1968. There was one in both 1975 and 1977 but 1976 had three.

The years 1968-70 did not have a disproportionate number of gaps nor were the number of nights covered below average. It appears that the activity of TU Men, as far as bright maxima, was lower than usual in these years.

Faint maxima are much more sensitive to the frequency of observations, because of their faintness and short duration. Generally the fewer the gaps in any one year the greater the number of faint maxima recorded which is what one would expect. Minor activity does not appear to have been affected by any "turning off" of bright maxima.

5. FREQUENCY OF BRIGHT OUTBURSTS

The observed bright maxima are listed in Table 3. The numbers of each maximum in the first column run successively with those for the faint maxima given in Table 4. In the fourth column of Table 3 the interval shown is that between successive observed bright maxima, whilst the fifth column shows the interval between successive maxima of any type. The duration given in days in the sixth column is the time that TU Men was brighter than 14.^m0v.

Bateson (1979) termed all bright maxima as supermaxima. It is uncertain as to where best to draw the line between wide maxima and supermaxima as the difference is not as clear cut as for some other dwarf novae. Therefore in Table 3 the bright maxima have been shown either as wide, with a width of 6 days, or longer, or as narrow, having a width of 5 days or less. No. 74 (S?) is probably a true supermaximum, whilst Nos. 20 and 25 may be so.

The mean maximum magnitude of maxima listed in Table 3 is 11.98v, omitting the four maxima marked ">" for which the decline only was observed. The mean cycle from the individual intervals in the fourth column of Table 3, omitting maximum No. 48, is 193.^d6 with a wide variation from 123 to 343 days.

TABLE 3.

OBSERVED BRIGHT MAXIMA OF TU MENSAE.

No.	J.D. MAXIMUM	m_v	INTERVAL		DURATION	TYPE	REMARKS
			d	d	d		
1	2,438,190?	>12.8	...	...	>6	W?	Decline only seen.
8	356	12.2	166	28	5	N?	Maximum only seen.
14	487	12.1	131	10	10	W	Gap 4d before.
17	635?	12.3	148	48	>5	W?	Gap 4d before & 3d after.
20	832	11.3	197	26	10	W	Gap 3d before.
22	976	12.0	144	85	6	W	Gap 12d after.
25	2,439,238	11.5	262	138	10	W	
26	376?	12.3?	138	138	?	?	Gap 19d before & 2d after.
30	593	12.0	217	16	8	W	Gap 3d before & 3d after.
31	842	12.0	249	249	10?	W	Gap 7d before.
37	2,440,083	>12.9	241	49	?	?	Gap 8d before; 3d after.
48	2,441,077	11.9	994	27	8	W	Gap 6d before.
52	256	12.2	179	18	7	W	
58	469	12.0	213	25	8	W	Maximum & fall only observed.
64	658	11.5	189	82	9?	W	Rise not seen.
68	844	12.0	186	21	4	N	Rise not seen.
71	979?	>12.8	135	62	>3	?	Fall only seen. Gap 7d before.
73	2,442,130	12.0	151	100	8	W	
74	369	11.8	239	239	20	S?	
76	686?	12.3?	317	124	?	?	Single observation; Gap 2d before & 5d after.
77	831	12.2	145	145	8	W	Rise not seen.
78	954	12.3	123	123	8	W	Rise not seen.
79	2,443,129?	12.2	175	175	?	?	Maximum only seen; gap 14d before & 6d after.
81	472	11.9	343	74	8	W	Rise 0.8 days.
82	682?	>12.8	210	210	?	?	Single observation; gap 9d before & 2d after.
84	831	11.6	149	82	4	N	

6. FREQUENCY OF FAINT PEAKS

One has first to decide whether the faint peaks are real. A number were recorded as "Trace" without it being possible to make a definite estimate, whilst the remainder were recorded from 13.^m₅ to 14.^m_{3v}. Probably some that are preceded, or followed, by gaps in the observations are really part of a brighter maximum but the observations were insufficient to show this. Most dwarf novae, if not all, show faint peaks. There is no apparent reason why TU Men should be an exception.

It is important to note that the records are mainly due to A.F. Jones who is certainly our most experienced and skilled visual observer. He is unlikely to record anything that he did not see. I have, therefore, accepted the faint peaks as real and that they range in maximum brightness from 13.5 to 14.3_v and hence are either just above or at the threshold of the instruments used.

A total of 58 faint peaks were recorded after ruling out some doubtful cases where Jones indicated he was uncertain. The number in the intervals of 1000 days vary from 1 to 18. The interval that had only one was that in which the nights covered was well below the average. Taken in years the number observed are

related to the gaps in the records in the sense that the fewer the gaps the more peaks that were observed. That is what one would expect.

The frequency of observed peaks depends strongly on how well the star was monitored. For those that are probably successive there is approximately one every 37 days but this cycle varies within wide limits. The observed faint peaks are listed in Table 4 in which the numbers in the first column run successively with the numbers given to the bright maxima in Table 3. Intervals in the third column of Table 4 are those between observed maxima, irrespective of whether these were bright or faint.

TABLE 4

OBSERVED FAINT PEAKS OF TU MENSAL.

<u>No.</u>	<u>JD MAXIMUM</u>	<u>m_v</u>	<u>INT_d</u>	<u>DURATION</u>	<u>REMARKS.</u>
				<u>d</u>	
2	2,438,216?	13.5	26	2	Decline only seen.
3	238	13.8	22	1	Single observation.
4	254	14.3	16	1	Single observation.
5	285	13.8?	31	2?	Gaps of 2d on either side of 285.
6	298	13.8?	13	?	May have been start of rise; was followed by gap of 8d.
7	328	14.0	30	?	Gaps of 8d on either side of 328.
9	382	14.0?	26	1?	Gaps of 2d on either side of 382.
10	403	14.2?	21	1	
11	421	13.5	18	2?	Gap of 3d before 421.
12	440	13.8?	19	?	Gap of 5d before & 3d after 440.
13	477	14.0	37	1	
15	552	13.6?	65	1	Gap of 2d before 552.
16	587	14.2?	35	1?	Gap of 3d after 587.
18	733	14.2	98	1	
19	806	14.0?	73	1	
21	891	14.2?	59	1	
23	2,439,048	14.2?	72	?	Gap of 4d after 048.
24	100	13.6?	52	?	Gaps of 4d on either side of 100.
27	489	14.0?	113	?	Gaps 9d before & after 489.
28	548	13.8	59	1	
29	577	13.9	29	3	
32	890	14.2?	48	1?	Gaps of 2d before & after 890.
33	908	13.8	18	1	
34	946	14.2?	38	?	Gaps 3d before & 7d after 946.
35	2,440,000	13.9	54	1	
36	034	14.0?	34	4?	
38	172	14.2	89	1	
39	302	13.9	130	?	Gap 7d before 302.
40	382	13.9	80	1	
41	619	13.8	237	?	Gaps 5d before & 2d after 619.
42	923	13.9	304	1	
43	960	14.2?	37	?	Gap 10d before 960.
44	991	14.2?	31	1	
45	2,441,019	14.2?	28	?	Gap 7d before 019.
46	032	13.6	13	1	
47	050	13.9	18	?	Gap 3d before 050.
49	177	14.2?	100	1?	Gap 2d before 177.
50	196	13.9	19	1	
51	238	14.1	42	1	
53	319	13.8?	63	?	Gap 5d before 319.
54	383	14.2?	64	?	Gap 5d after 383.
55	398	14.3	15	1	
56	410	14.2	12	1	
57	444	14.0	34	1	
59	500	13.8	31	1	
60	513	14.2?	13	?	Possibly two maxima 6d apart or the start & finish of a bright maximum.

TABLE 4 (cont)

No.	JD MAXIMUM	m_v	INT. d	DURATION. d	REMARKS.
61	2,441,526	13.6	13	2	
62	549	14.1	23	?	Gaps 3d before & 2d after 549.
63	576	14.2?	27	?	Gaps 3d before & 2d after 576.
65	695	13.9	37	?	Gaps 8d before & 6d after 695.
66	758	13.8?	63	?	Gap 6d before 758.
67	823	13.8	65	2?	Gap 6d before; may have been a bright maximum of which bottom of fall only observed.
69	855	13.8?	11	1	
70	917	13.8?	62	?	Gap of 3d after 917.
72	2,442,030	14.2?	51	?	Gap 8d after 030.
75	562	13.8?	193	?	Gap 6d before & 10d after 562.
80	2,443,398	13.8?	269	?	Gap 6d after 398.
83	749	14.2	67	1	

7. CONCLUSIONS

TU Men has maxima brighter than $12^m.5_v$, which are either wide with widths of 6 days, or longer, or narrow, with widths of 5 days or less. Some of the wide maxima may be supermaxima of long duration. There are no anomalous maxima with slow rises. The rise is always rapid. There are also faint peaks with a maximum brightness of $13^m.5_v$, or fainter. They have an average duration of one day. Some recorded faint peaks may be portions of bright maxima which have only been partially observed.

The mean interval between successive bright maxima is 193.6 days. That between successive faint peaks is approximately 37 days. The mean cycle between successive maxima of all types is 68 days with a marked difference in the mean cycle in different years.

For the years to December 31, 1967, the mean cycle is 55 days; for the years 1971-74, inclusive, it is 53 days; for 1968-70 it is 98 days and for 1975-77 it is 158 days. This last interval was poorly observed and its mean cycle reflects this. TU Men appears to have been less active in 1968-70 although it was assiduously monitored in those years. It is concluded that the normal mean cycle of TU Men is about 54 days and that it has intervals of comparative inactivity.

This suggests that TU Men may be of the Z Cam class since it is possible that it remains at some magnitude intermediate between maximum and minimum for many cycles. Unfortunately no evidence can be offered on this because there are a very limited number of observations when it has been observed at from about $14^m.7_v$ to $16^m.2$, or invisible and fainter than $16^m.2$. If TU Men is not of the Z Cam type then it appears that it "turns off" for long intervals.

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A VARIABLE IN THE FIELD OF RW CARINAE

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SUMMARY: Observations of a newly discovered variable in the field of 091868 RW Car are given in ten day means, and plotted in a light curve. An identification chart is published.

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1. POSITION:

The approximate position of the newly discovered variable is:

(1900): 9h 16m 19.5s $-68^{\circ} 10.7'$

It does not appear to be listed in the CPD or CoD. The star appears in the Union Observatory's reproduction of the Franklin Adams charts in area -70° No.28 centred at 9h 00m -70° (1875). It also appears a series of photos held by F.M. Bateson, which include Harvard plate D13294; plate 310 by I. Stranson and the chart from Auckland Observatory No. AO 13, 1969 February. Its position is shown on Chart 73 (Bateson et al 1966). Figure 1 is a tracing from Chart 73, scale $20''=1\text{mm}$ on which the star has been marked "Variable".

2. OBSERVATIONS

The variability of the star was first suspected by Venimore on JD 2,441,066 (1971 April 24) and observations from that date to JD 2,443,995 are published as ten day means in Table 1. All of the 289 observations were made visually by Venimore using the comparison stars on Chart 73.

3. LIGHT CURVE.

The light curve from the ten day means is plotted in Figures 2 and 3. Where the means are dependent on only one observation these are plotted as crosses; two or three observations are indicated by dots and four or more by open circles. The discontinuity of the curve is due mainly to the star being unfavourably placed for the observer in the latter months of each year.

4 DISCUSSION

The mean range is $10^{\text{m}}.00\text{v}$ to $11^{\text{m}}.33\text{v}$. Maxima range from $9^{\text{m}}.9\text{v}$ to $10^{\text{m}}.1\text{v}$ and minima from $11^{\text{m}}.0$ to $11^{\text{m}}.6\text{v}$. Generally the minima are short and sharp and follow a fall that is much steeper than the rise. Parts of the curve that have been dashed are purely surmise and cover those times when no observations were made.

As all the observations are from one observer, it is not possible to establish how precise the disparities from one cycle to the next really are. The observer's errors and systematic deviations may influence the shape of the curve. At some points there is some small degree of scatter. It is obvious that before an accurate mean curve can be drawn the variable needs the attention of more observers.

Table 2 lists the observed dates of maxima and minima. These give a mean period of 365.4 , with maxima giving a period of 355.8 and minima 375 days. $M-m$ is 0.62P .

Bateson (private communication) writes "Without a spectrum of this star I am inclined to consider from its small range and type of variations that it belongs to the semi-regular class."

5. ACKNOWLEDGEMENT

My thanks to Frank M. Bateson for his interest and advice in the preparation of this paper.

REFERENCE

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TABLE 1.

TEN DAY MEANS OF VARIABLE IN FIELD OF RW CARINAE.

<u>MEAN</u> <u>J.D.</u>	<u>MEAN</u> <u>MAG_v</u>	<u>No.</u> <u>OBS</u>	<u>MEAN</u> <u>J.D.</u>	<u>MEAN</u> <u>MAG_v</u>	<u>No.</u> <u>OBS</u>	<u>MEAN</u> <u>J.D.</u>	<u>MEAN</u> <u>MAG_v</u>	<u>No.</u> <u>OBS</u>	<u>MEAN</u> <u>J.D.</u>	<u>MEAN</u> <u>MAG_v</u>	<u>No.</u> <u>OBS</u>
2441000+			2442000+			2442000+			2443000+		
069.9	10.46	5	030.9	10.0	1	592.1	10.67	3	330.8	10.4	1
100.8	10.50	1	039.6	10.02	4	601.8	10.55	2	338.8	10.4	1
120.8	10.45	2	045.9	10.1	1	744.4	10.35	2	357.8	10.4	1
144.8	10.4	1	059.9	9.90	2	751.4	10.27	4	365.4	10.45	4
150.3	10.45	2	071.3	9.92	5	778.9	10.15	2	373.4	10.25	2
156.8	10.6	1	076.4	10.00	2	797.9	10.2	1	394.8	10.20	2
184.8	10.7	1	098.9	10.2	1	831.6	10.15	4	403.8	10.2	1
202.8	10.3	1	120.3	10.32	6	839.8	10.44	5	454.9	10.10	2
212.8	10.8	1	131.3	10.32	6	859.3	10.65	2	487.6	10.33	3
293.6	10.10	3	136.3	10.30	2	872.2	11.03	3	508.9	10.10	2
308.9	10.1	1	148.8	10.6	1	888.8	11.45	2	514.9	10.1	1
362.9	10.20	2	162.8	10.6	1				537.9	10.3	1
392.3	10.60	2	166.8	11.2	1	902.2	11.53	3	543.9	10.45	2
399.9	10.7	1	181.6	11.33	7	919.2	11.07	3	597.9	10.5	1
426.9	11.0	1	187.3	11.50	2	926.8	10.9	1	603.4	10.60	2
442.8	11.4	1	195.8	11.6	1	944.8	10.9	1	637.8	10.70	2
473.8	10.7	1	208.8	11.4	1	951.8	10.60	2	655.8	10.6	1
498.8	10.55	2	221.6	11.30	5	958.9	10.6	1	661.8	10.7	1
506.8	11.4	1	242.3	11.50	2				693.4	11.20	2
648.9	10.4	1	246.8	11.6	1	2443000+			723.9	10.90	3
660.9	10.10	2	393.4	10.35	2				874.9	10.1	1
681.7	9.96	5	399.3	10.20	5	004.8	10.4	1	894.9	10.33	3
690.2	10.00	3	414.9	10.2	1	010.8	10.4	1	903.8	10.0	1
708.4	10.30	2	419.4	10.10	2	123.9	10.00	3	924.1	10.10	4
739.9	10.36	5	428.4	10.15	2	128.9	10.0	1	935.9	10.30	1
769.6	10.48	5	452.4	9.95	2	138.9	10.3	1	956.9	10.7	1
777.8	10.50	2	459.4	10.00	2	157.9	10.4	1	965.9	11.0	1
798.3	10.90	4	473.9	10.10	2	165.9	10.4	1	985.8	11.00	2
810.8	11.1	1	484.4	10.65	2	170.9	10.3	1	993.9	11.10	2
828.3	11.40	2	508.4	10.68	5	185.6	10.35	4			
838.3	11.20	2	518.3	10.75	4	215.9	10.13	3			
860.3	11.00	2	533.8	10.9	1	223.4	10.40	2			
882.8	10.63	3	539.8	11.05	2	243.9	10.86	3			
889.3	10.65	2	544.4	11.00	2	252.9	10.9	1			
			548.8	11.07	3	273.4	10.95	2			
			561.8	11.0	1	285.3	10.90	2			
			570.0	10.80	5	306.3	10.75	2			
			575.9	10.9	1	316.9	10.8	1			

TABLE 2

OBSERVED MAXIMA AND MINIMA OF VARIABLE IN FIELD OF RW CARINAE.

<u>J.D.</u>	<u>MAXIMA</u> <u>MAG.</u> _v	<u>INT</u>	<u>J.D.</u>	<u>MINIMA</u> <u>MAG.</u> _v	<u>INT</u>
2,441,328	10.1	... ^d	2,441,445	11.6	... ^d
685	10.0	357	840	11.4	395
2,442,057	9.9	372	2,442,198	11.6	358
453	9.9	396	545	11.0	347
801	10.1	348	900	11.5	355
2,443,100?	9.9?	299	2,443,268	11.0	368
463	10.1	363	695?	11.2	427

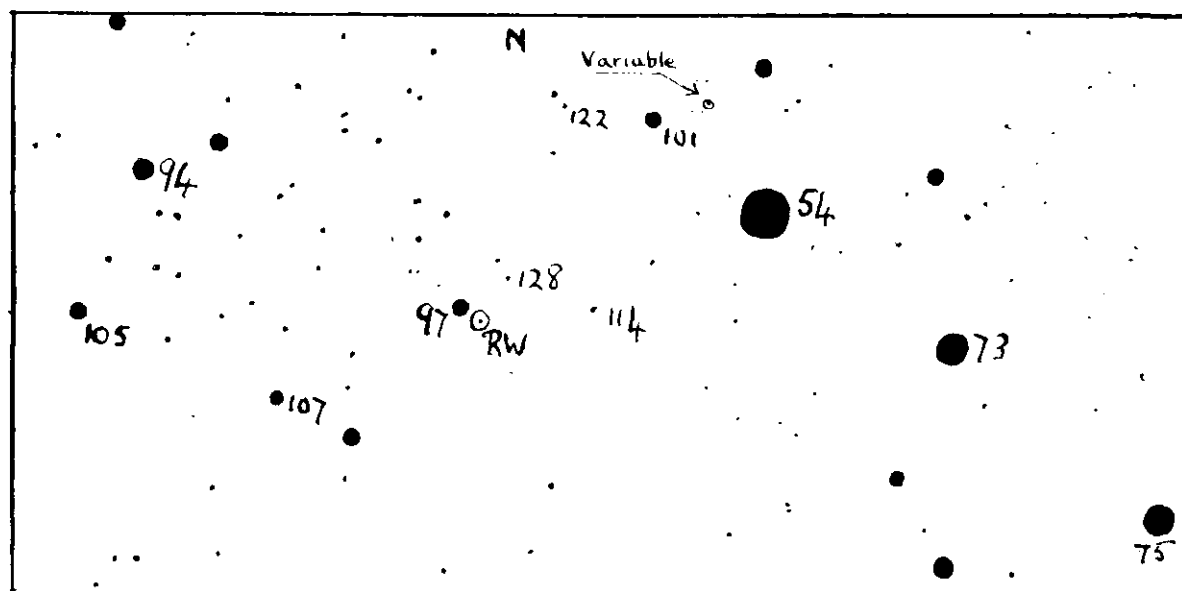


Figure 1 - Identification chart of a variable in the field of RW Carinae.

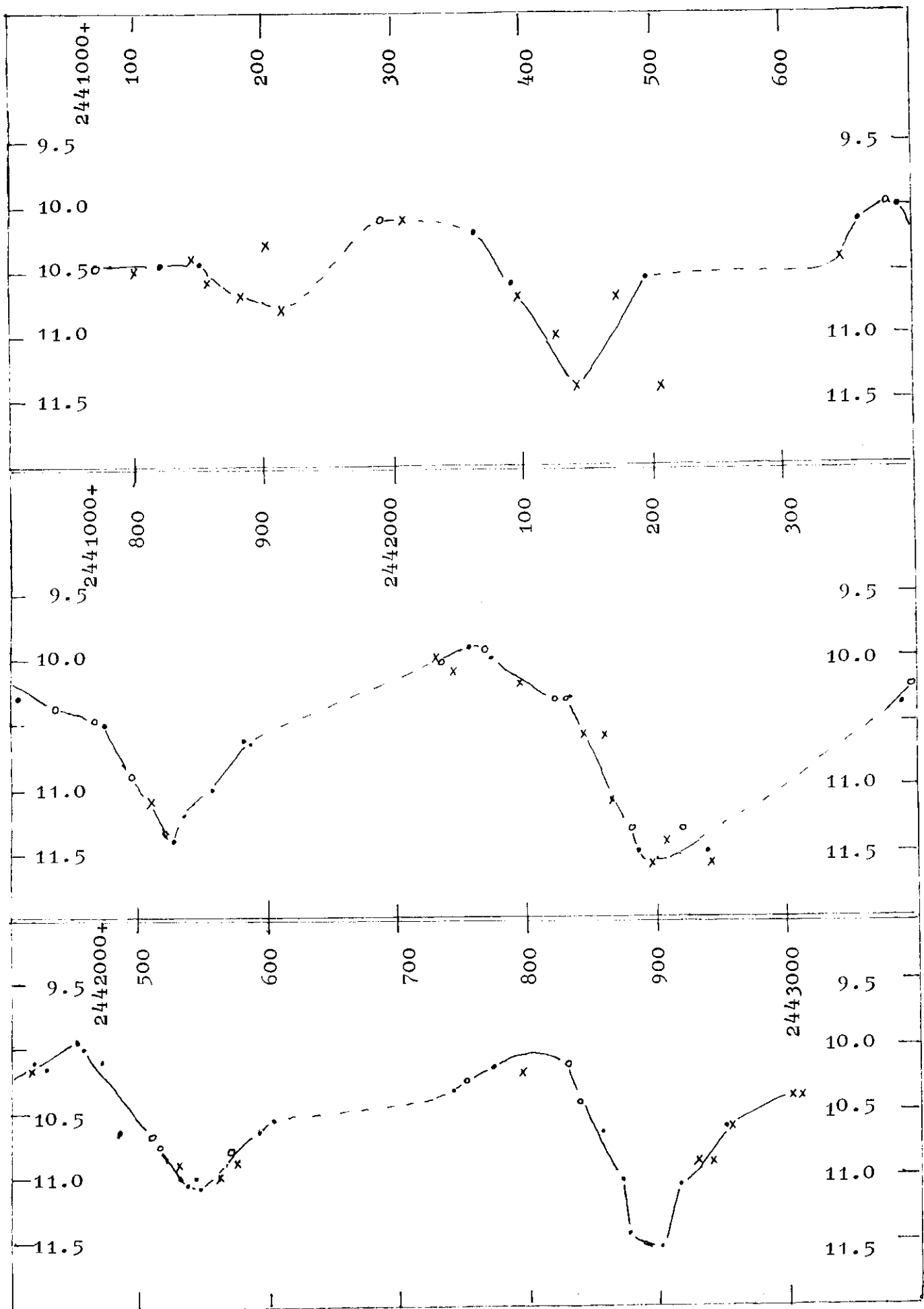


Fig re 2. Light Curve of Variable in field of RW Car.

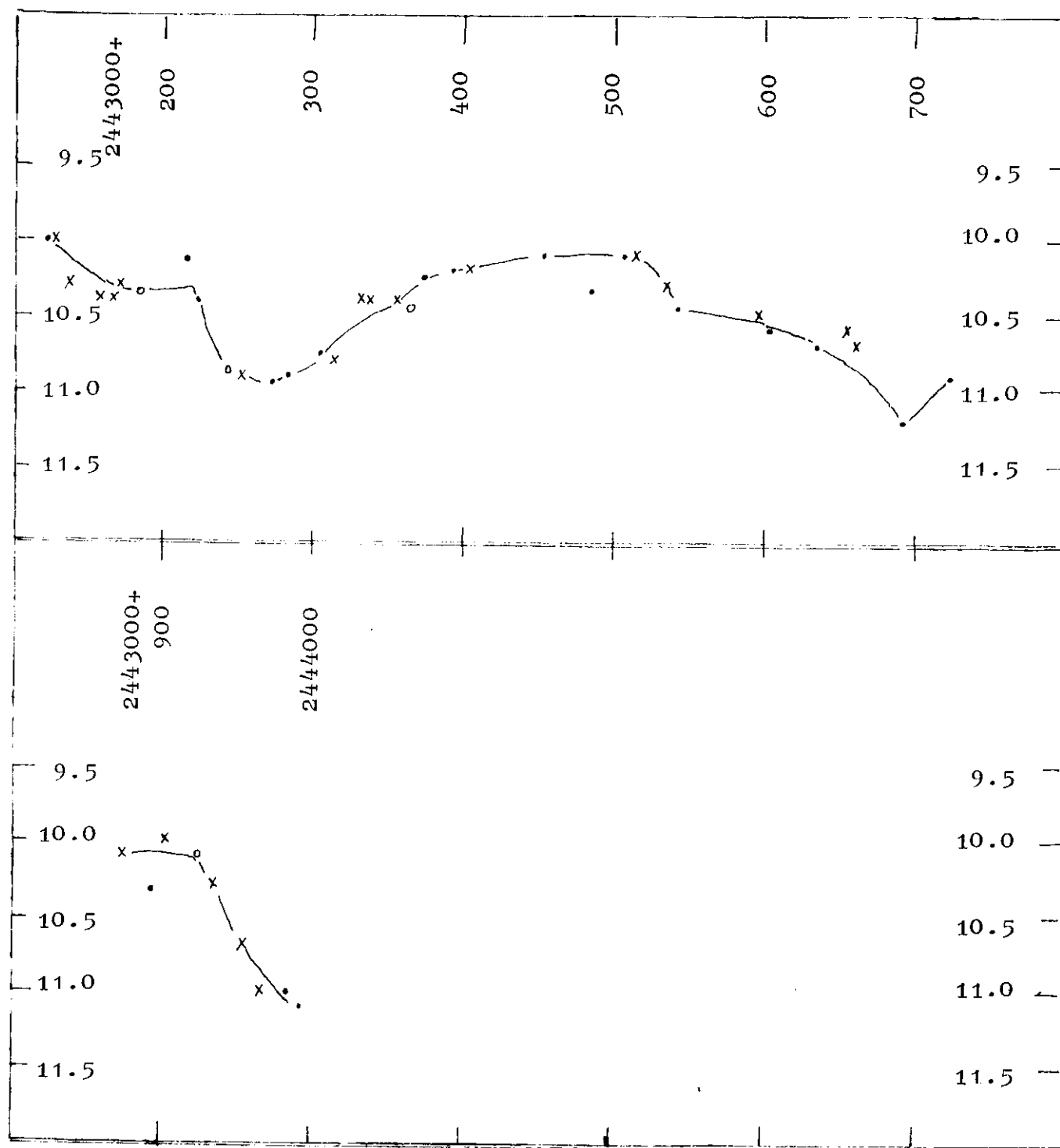


Figure 3. Light Curve of Variable in field of RW Car (cont).

THE DWARF NOVA--CZ ORIONIS

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SUMMARY: A total of 121 observed maxima of CZ Ori are listed for the interval JD 2,434,767 to 2,443,387. The extreme range is 11.8^v to 15.6^v with a mean cycle of 25.73 days. A preliminary comparison is made with visual observations published elsewhere. It is shown that, because of gaps in monitoring, a more meaningful discussion of CZ Ori would be possible if all observations were collected and discussed by one central organization.

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1. INTRODUCTION

CZ Ori is classified as U Gem type with a range of 11.8 to 16.2^p and a mean cycle of 26.6 days (Kukarkin et al 1970). Isles (1976) published observations by the B.A.A. from 1930 to 1969. A.A.V.S.O. (1958-1972) have also published observations.

2. CHARTS AND SEQUENCES

Charts 441 and 442 (Bateson et al 1979) show the same photovisual sequence as appears on the charts used by the B.A.A. and A.A.V.S.O. This sequence was published by Mitchell and Wirtanen (1939) and was used by our observers prior to the publication of charts 441 and 442.

3. OBSERVATIONS

Observations from JD 2,434,767 (1954 Jan. 23) to 2,443,870 (1978 Dec.27) were contributed by:

A.F. JONES	1,105	
M.V. JONES	202	
V.L. MATCHETT	94	
Six Observers	<u>84</u>	1,485.

The majority of the observations were negative. Those to 2440652 were published in the Circulars of the Section as daily means. The observing season is from August to April and, with few exceptions, all observations are confined to these nine months each year.

CZ Ori has not been monitored nearly as closely as the southern dwarf novae because of its less favourable position.

4. DISCUSSION

The observed maxima are listed in Table 1 in which the first column gives a serial number to each maximum. In the second column long (L) maxima are those with a width at 13.0^m longer than 6 days; shorts (S) those with widths less than 5 days. Maximum No. 24 is of the anomalous (A) type and No. 104 probably of this type.

Because of the fragmentary nature of the observations so that generally only part of the curve was observed there is an uncertainty of a day or so in most of the dates of observed maxima. Negative observations have often helped in determining the slope of the light curve.

No two maxima can be clearly stated as being successive. Those separated by less than 42 days have been regarded as probably successive. These give a mean cycle of 28.1^d from 68 maxima with intervals ranging from 10 to 42 days.

From 7 maxima considered to be well determined longs have a mean

maximum magnitude of 12.09 (extremes $11^m.9$ to $12^m.3$) and a mean width of 8.25 days. The corresponding figures for shorts are: mean $12^m.19$ (extremes 11.8 to 12.6); width 2.8 days, from eight maxima.

A limited number of observations at minimum show that CZ Ori is then around $15^m.6$. This is somewhat fainter than $14^m.4$ - $14^m.8$ given by Isles (1976). Our observers also tend to record the maximum brightness fainter than the B.A.A. by about $0^m.2$.

A comparison with the B.A.A. results show a difference of several days in the date of observed maxima in several instances. One must expect marginal differences of a day or so because it is difficult to be precise when dealing with fragmentary observations. Additionally there will always be a slightly different interpretation placed on the observations by different investigators.

On completion of Table 1 a comparison was made of the observed dates of maxima with those that could be derived from the records published by the A.A.V.S.O. (1958-72). There was close agreement between the two sets of records, although naturally there were maxima recorded by one or other organization and not by the other because of gaps in their records. Combining both sets of records there are 60 maxima which appear to be consecutive. These give a mean cycle of $25^d.73$ which is considered to be close to the true value. The intervals between these successive maxima range from 6 to 46 days. There is also evidence that CZ Ori has minor peaks which would make the mean cycle somewhat shorter. The A.A.V.S.O. magnitudes at maxima are slightly brighter than those recorded by our observers.

5. CONCLUSIONS

CZ Ori has a mean cycle of $25^d.73$ and an extreme range of 11.8^v to 15.6^v . Outbursts show an occasional anomalous maximum and also long maxima with widths of 6 days, or longer and short maxima with widths less than 5 days. There is strong evidence that it also has minor peaks when maximum brightness is around $13^m.0$ - $13^m.5$.

It is obvious that all records from the three organizations quoted in this paper are fragmentary. It would be much more meaningful if all the observations were directed to one central organization as this would enable them to be combined and a better understanding of the behaviour of CZ Ori determined. To aid such a discussion the records of the V.S.S., R.A.S.N.Z. are being placed at the disposal of the B.A.A.

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IX, pt. V, p. 74.

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TABLE 1.

OBSERVED MAXIMA OF CZ ORIONIS

SERIAL No.	TYPE	MAXIMUM JD 24..	mv	INT. d	CZ=13 ^m Q RISING	FALLING	WIDTH d	No. Obs	NOTES
1	L	34767?	12.1	...	...	...	...	3	(1)
2	..	34798	12.8	31?	...	800.5	...	2	
3	S	34829	12.7	31	828	...	...	2	
4	..	34864	12.3	35	...	...	...	1	
5	..	34990	12.0	..	...	...	...	4	
6	..	35013	12.8	23	...	016	...	2	
7	..	35044	13.2	31	043	...	...	1	
8	..	35096	13.1	..	...	...	...	1	
9	S	35152	12.0	..	150	154	4	4	
10	L?	35176	12.5	24	...	182	...	2	
11	S?	35371	13.1	..	...	...	...	3	
12	S?	35423	12.1	..	...	426.5	...	3	
13	..	35481	12.8	..	...	...	...	3	
14	..	35517	12.5	36	...	...	...	2	
15	S	35548	12.5	31	547	550	3	4	
16	..	35715	12.8	..	...	718	...	2	
17	S	35762	12.8	..	760	764	4	4	
18	S?	35799	13.1	37	...	801	...	3	
19	..	35821	12.5	22	...	...	...	1	
20	..	35932	12.2	..	...	...	...	3	
21	..	36119	13.1	..	117	...	...	1	(2)
22	..	36141	12.4	22	...	...	...	1	
23	S?	36200?	13.0	..	...	...	...	1	
24	A	36225	12.0	25	217	...	...	4	
25	..	36267	12.6	42	...	270	...	2	
26	..	36319	12.5	..	...	...	...	2	
27	S	36498	12.1	..	...	499.5	...	4	
28	..	36528	12.1	30	...	...	...	2	
29	S	36587	12.1	..	586	589	3	4	
30	S?	36604	12.7	17	...	607	...	3	
31	L	36631	12.2	27	629	640.5	11.5	6	
32	..	36665	12.4	34	...	...	...	1	
33	..	36810	12.3	..	...	...	...	2	
34	S?	36842	12.3	32	...	845	...	4	
35	..	36902	12.2	..	900	...	...	3	
36	..	36976	12.4	..	...	...	...	1	
37	..	36986	12.2	10	...	...	...	3	
38	..	37168	12.1	..	...	...	...	3	
39	..	37240	12.8	..	...	...	...	1	
40	S?	37256	12.5	16	...	259	...	3	
41	L	37283	12.1	27	278.5	287.5	9	5	(3)
42	..	37386	12.0	..	...	...	..	4	
43	S?	37525	12.8	..	...	...	..	2	
44	..	37563	12.6	38	...	...	..	4	
45	..	37587	12.1	24	...	...	..	3	
46	..	37625	12.6	38	...	...	..	1	
47	..	37649	12.3	24	...	...	..	2	
48	..	37669	12.8	20	...	674	..	4	
49	..	37695	12.1	26	...	...	..	4	
50	..	37746	12.4	..	...	...	..	1	
51	..	37950	12.5	..	...	...	..	1	
52	S?	38011	12.9	..	...	...	..	3	
53	L	38050	12.0	39	048	055	7	7	
54	S?	38088	12.8	38	...	...	..	2	
55	L	38120	12.5	32	117.5	124	6.5	3	
56	S?	38355	12.4	..	...	357	..	3	

TABLE 1 (cont.).

SERIAL No.	TYPE	MAXIMUM JD 24..	mv	INT d	CZ=13 ^m .0		WIDTH d	NO. OBS.	NOTES
					RISING	FALLING			
57	..	38401	<u>12.2</u>	..	...	...	..	3	
58	..	38772	<u>12.7</u>	..	...	...	..	1	
59	S	38796	<u>12.8</u>	24	...	797	..	4	
60	S	38824	<u>12.8</u>	28	...	827	..	2	(4)
61	L	38854	<u>12.3</u>	30	851.5	858	6.5	4	(5)
62	..	39026	<u>12.6</u>	..	...	...	..	1	
63	..	39123	<u>12.7</u>	..	...	...	..	1	
64	..	39149	<u>12.4</u>	26	...	...	..	3	
65	S	39205	<u>12.7</u>	..	...	208	..	3	
66	L	39523	<u>12.4</u>	..	521	531	10	11	(6)
67	S	39563	<u>12.0</u>	40	563	565	2	6	(7)
68	..	39772	<u>12.8</u>	..	...	...	..	1	(8)
69	L	39810	<u>13.3</u>	38	...	820	..	1	(9)
70	L?	39850	<u>12.0</u>	40	...	856	..	3	(10)
71	S	39904	<u>12.5</u>	..	903.5	905	1.5	4	(11)
72	L?	39935	<u>12.4</u>	31	...	940	..	5	(12)
73	..	39968	<u>12.5</u>	33	...	...	..	1	
74	..	40118	<u>12.0</u>	..	...	123	..	5	(13)
75	..	40154	<u>12.9</u>	36	...	...	..	1	
76	..	40192	<u>12.4</u>	38	...	...	..	1	
77	..	40317	<u>12.2</u>	..	...	320	..	3	(14)
78	L	40504	<u>11.9</u>	..	502.5	511	8.5	6	(15)
79	S?	40531	<u>12.8</u>	27	...	...	..	2	
80	..	40575	<u>12.4</u>	..	...	...	..	1	
81	..	40667	<u>12.3</u>	..	...	...	..	1	
82	..	40856	<u>12.4</u>	..	...	...	..	1	
83	..	40890	<u>13.1</u>	34	...	...	..	1	
84	S	40918	<u>12.5</u>	28	...	920	..	3	
85	..	40949	<u>11.9</u>	31	...	...	..	4	
86	S	41665	<u>12.9</u>	..	...	667	..	2	
87	S	41687	<u>12.4</u>	22	686.5	690.5	4	4	
88	L	41711	<u>12.0</u>	24	710	717	7	8	
89	S	41738	<u>12.4</u>	27	...	739	..	3	
90	S	41759	<u>12.3</u>	21	...	...	..	1	
91	S	41781.5	<u>11.8</u>	22.5	780.8	783	2.2	8	
92	L	41806	<u>12.0</u>	24.5	802	809	7	8	
93	..	42006	<u>12.0</u>	..	...	009	..	2	
94	..	42044	<u>12.5</u>	38	044	...	..	3	
95	S	42063	<u>13.0</u>	19	063	065	2	3	
96	S	42090	<u>12.6</u>	27	089.7	091	1.3	5	
97	..	42107	<u>12.7</u>	17	...	...	..	1	
98	..	42135	<u>12.0</u>	28	132	...	..	9	
99	..	42160	<u>12.3</u>	25	...	163	..	4	
100	..	42375	<u>12.1</u>	..	369	...	..	3	
101	S	42403	<u>12.3</u>	28	402.5	405.5	3	6	
102	S	42428	<u>12.6</u>	25	427	430	3	5	
103	S	42450	<u>12.5</u>	22	449	454	5	8	
104	A?	42482	<u>11.9</u>	32	473	485	12	14	
105	..	42543	<u>12.0</u>	..	...	...	..	2	
106	..	42758	<u>12.6</u>	..	...	...	..	1	
107	..	42776	<u>12.0</u>	18	...	...	..	2	
108	..	42806	<u>13.3</u>	30	...	...	..	1	
109	..	42824	<u>13.0</u>	18	...	...	..	1	
110	..	42874	<u>12.2</u>	..	...	...	..	4	
111	..	43100	<u>12.1</u>	..	...	102	..	4	
112	..	43133	<u>13.1</u>	33	...	...	..	2	
113	..	43163	<u>12.9</u>	30	...	...	..	1	
114	..	43195	<u>13.1</u>	32	...	...	..	2	
115	..	43220	<u>11.8</u>	25	...	229	..	6	

TABLE 1 (cont).

SERIAL No.	TYPE	MAXIMUM JD 24..	mv	INT d	CZ = 13 ^m .0		WIDTH d	NO. OBS.	NOTES
					RISING	FALLING			
116	.S	43513	12.3	..	512	515	3	5	
117	..	43533	13.0	20	...	...	..	1	
118	..	43552	12.3	19	...	...	..	3	
119	..	43577	11.7	25	...	...	..	4	
120	..	43602	12.8	25	...	...	..	1	
121	..	43869	12.5	..	...	...	..	2	

Notes to Table 1

- (1). Observations commenced 34767. Maximum may have been a day or two earlier.
- (2). CZ Ori faded to fainter than 13^m.0 between Nos. 36 & 37.
- (3). This maximum 9 days after B.A.A. No. 21.
- (4). B.A.A. No. 22 on 818 when our observations placed CZ Ori as fainter than 13^m.6.
- (5). Maximum 61. B.A.A. have 38849.2 11^m.6 with CZ rising 8^h4; falling 851.6 from 6 observations. N.Z. 847.6 fainter than 13^m.3 with positive observations. 12^m.4 on 851.89; 12^m.3 on 853.90; 12^m.4 on 854.84; 12^m.5 on 856.90 and (12^m.2 on 858.88. It appears that a second outburst occurred immediately after that recorded by the B.A.A./
- (6). BAA 39528 11^m.8. N.Z. 528 12^m.5 on decline. Our observations give 523 as maximum at 12^m.0.
- (7). Agrees with BAA No. 26.
- (8). BAA 771.
- (9). Combined with B.A.A. No. 28 gives a width of 11 days.
- (10). Agrees with B.A.A./ No 29.
- (11). Agrees with B.A.A. No. 31.
- (12). Agrees with B.A.A. No. 32 except for difference of 1^d for CZ falling at 13^m.0.
- (13). Differs from B.A.A. No. 33 by 1.3. N.Z. recorded CZ still rising on 116.7.
- (14). Agrees with B.A.A. No. 34.
- (15). 5 days earlier than B.A.A. No. 35.

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THE DWARF NOVA---UU AQUILAE

Frank M. Bateson

SUMMARY: Twenty three observed maxima of UU Aql are tabulated. A mean cycle of 49.5 is found, Maxima are either wide or narrow and no supermaxima or anomalous maxima were observed. All maxima have very rapid rises and smooth, steep declines. The extreme range is 10.9v to fainter than 15.0v.

...

1. INTRODUCTION

UU Aql (Kukarkin et al 1969) is classified as U Gem type with a range of 11.0 to 16.8p with a mean cycle of 56 days.

2. CHARTS AND SEQUENCE.

Bateson et al (1976) published chart 329 for use by members. The sequence shown thereon is the same as that in use by the B.A.A. and A.A.V.S.O.

3. OBSERVATIONS

Infrequent observations were made by A.F. Jones in 1959-62, all of which were negative. UU Aql then was not observed until 1969, when regular monitoring commenced. This paper discusses the observations from JD 2,440,440 (1969 Aug. 5) to 2,443,815 (1978 Nov. 2). Observations were contributed by:

JONES, A.F.	64	
JONES, M.V.	273	
McMILLAN, S.	32	
MATCHETT, (Dr) V.L.	84	
TAYLOR, (Dr). N.	50	
WILLIAMS, P.	24	
Seven observers	<u>35</u>	562

4. DISCUSSION

The observed maxima are listed in Table 1, which is arranged in the usual manner. Types of maxima given in the second column are either wide (W) or narrow (N) in accordance with the details given below. In column four the magnitudes underlined refer to those when the star was not actually observed at maximum brightness.

All maxima appeared to fall into two types and were either wide, when the width at $13^m.5$ was 7 days, or longer, or narrow, with widths of less than 5 days. No supermaxima or anomalous maxima were observed. All maxima had very rapid rises requiring less than one day to increase from invisibility below $15^m.0$ to maximum brightness. The limited number of well observed maxima all showed an abrupt change in the rate of decline after UU Aql had faded $0^m.5$ below maximum brightness. Then the rate of decline was smooth and steep and varied very little from one maximum to another. The five best observed maxima averaged 1.2^d per magnitude decline. This rate was the same between $12^m.0$ and $13^m.0$ and from $13^m.0$ to $14^m.0$. Applying the relationship suggested by Bailey (1975) this decline rate suggested an orbital period of about 0.13^d .

There were 11 maxima that appeared to be clearly successive. The mean interval between these is 49.5^d .

UU Aql was invisible in most instruments used when it was at minimum. A few positive observations recorded it at $15^m.0$ or fainter.

5. CONCLUSIONS

For the interval covered by the observations UU Aql had a mean cycle of 49.5^d and an extreme range of 10.9^d to fainter than $15^m.0^v$. Maxima are either wide or narrow and all have very steep rises of less than one day. Once the star has fallen $0^m.5$ below maximum brightness the decline is very smooth and steep at an average rate of 1.2^d per magnitude. This suggests an orbital period of around 0.13^d .

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 Bateson, F.M., Morel, M. & Winnett, R. 1976. CHARTS FOR SOUTHERN VARIABLES. Series 8. Publ. by F.M. Bateson, N.Z.
 Kukarkin, B.V. et al. 1969. General Catalogue of Variable Stars 3rd ed. Vol. 1. Moscow.

TABLE 1.

OBSERVED MAXIMA OF UU AQUILAE.

SERIAL No.	TYPE	MAXIMUM JD 24..	mv	INT. d	UU=13. ^m 5		WIDTH d	No. OBS	NOTES
					RISING	FALLING			
1	W?	40493	12.2	..	...	494	...	2	(1)
2	..	41074	11.0	..	...	...	...	1	(2)
3	W?	41197	12.2	..	...	202	...	3	(3)
4	..	41242	12.8	45	...	...	...	1	(4)
5	W	41564	11.2	..	563.5	572.5	9	5	
6	N?	41623	12.3	59	...	624	...	3	(5)
7	..	41663	11.8	40	...	...	...	2	(6)
8	N	41811	12.1	..	...	814	...	5	(7)
9	..	41865	10.9	54	...	...	...	2	
10	W	42002	11.1	..	001.5	011	9.5	12	
11	N	42163	12.4	..	...	...	...	3	
12	W	42244	11.4	..	243	252	9	12	
13	..	42291	12.2	47	...	...	...	1	(8)
14	..	42337	11.3	46	...	...	...	4	(9)
15	N?	42393	12.0	56	...	...	...	1	
16	..	42578	12.2	..	...	...	...	1	(10)
17	N	42628	12.4	50	627?	631	4	5	
18	W?	43371	12.0	..	...	375.5	...	7	
19	W?	43420	11.2	49	...	424	...	6	(11)
20	..	43469	13.3	49	...	...	...	1	
21	..	43606	12.4	..	...	...	...	1	
22	..	43717	12.3	..	...	720	...	5	
23	..	43768	11.8	51	...	...	...	4	

NOTES TO TABLE 1.

- (1) B.A.A. 'No.4 40488 11.^m5 with another maximum on 40550.
 (2) Large gaps in observations on either side of this single observation.
 (3) Decline only observed.
 (4) Gap for 9 days before this observation; was fainter than 14.^m7 on 243.9.
 (5) Gap in observations for 16 days before this date.
 (6) Gap in observations for 10 days after this maximum.
 (7) Decline only observed but rise defined by negative observations.
 (8) Gap in observations for 11 days before this date.
 (9) Maximum only observed.
 (10) Large gaps on either side of this single observation.
 (11) Gap in observations for 16 days before this maximum.

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Mati Morel

Variable Star Section, R.A.S.N.Z.

SUMMARY: Attention is directed to the bright Cepheid, U Car, by the publication of a chart and sequence. A light curve from visual observations between JD 2,443,610 and 2,443,747 has been used to produce a mean light curve.

...

1. INTRODUCTION

T.A.Cragg (1971) outlined the Classical Cepheid Programme, the primary aim of which is to monitor a number of bright Cepheids so as to correlate any change in period with any evolutionary developments in the star concerned.

Cragg gives the parameters for a suitable programme object as:

(1) A period of at least 10 days (the longer the better).

(2) A range of at least 1.0^m .

(3) Maximum brighter than 12.0^m .

As Cragg points out, many of the bright and potentially suitable programme objects lie well south of the equator and have, therefore, not been observed visually, nor have charts and sequences been prepared. This is a situation I would like to see rectified.

2. ELEMENTS

The 1950 position of U Car is: $10^h55^m46^s -59^\circ27'.8$. Its range is 5.72V to 6.94V; period 38.7681 (Kukarkin et al 1974). The period is known to vary; e.g. observations 1891-1945 were satisfied by the period 38.750. The spectral type varies between F61b and G7.

U Car is ideal for amateur observations because of its long period and brightness.

3. SEQUENCE

In April 1978 I prepared a sequence of stars with accurately determined V magnitudes. This sequence was used to make frequent observations of U Car between JD 2,443,610 and 2,443,747 to check the feasibility of the visual method.

A further search of the literature in January 1979 revealed additional photometric data, and the complete sequence is given in Table 1, where the final column gives the adopted magnitude, to tenths, to be used by visual observers.

HD 93695 and HD 95880 are suspected variables, and for the latter the spread of determined V magnitudes is larger than for any other star in the table. HD 94491 may not be a satisfactory comparison star due to its close proximity to U Car, which is some $2\frac{1}{2}$ magnitudes brighter.

The position of U Car relative to its comparison stars is shown on chart 452. This chart shows most field stars down to 10.0^m , and also all other variables reaching 13.0^m at maximum. Of these variables separate charts have already been published for Eta and B0 Car. The important SD type variable, AG Car should be observed visually and the additional chart 453 is reproduced for this purpose. The Cepheids, WZ and XZ Car can also be observed visually.

4 MEAN LIGHT CURVE

Between JD 2,443,610 and 2,443,747 I used two pairs of tripod mounted binoculars (20 x 65mm and 10 x 50mm) to make careful observations of U Car, following strictly the instructions given by Bateson (1973). A total of 51 observations were made. Most observations were made with 20 x 65mm binoculars, the 10 x 50mm

being used when the star became brighter than $6^m.0$. Figure 2 is a plot of the observations of individual cycles. All observations were sorted according to phase (assuming $P = 38.7681$), then plotted again to yield a mean light curve, which is shown in Figure 3.

5/DISCUSSION

Because of the small number of cycles observed, and also the fact that on only one cycle was the ascending branch adequately observed (bad weather interfered at this phase on the other cycles), I can only indicate in a general way the salient features of the mean light curve. Perhaps the most striking feature is the relatively rapid rise from minimum to maximum in about 5 days. As a fraction of the period this parameter ($M-m$) on the visual light curve is 0.13. Kukarkin et al (1974) give 0.24, from photoelectric observations. This difference is a little disconcerting, but the reason is partly due to the difficulty of determining accurately the main points of the visual light curve. I suspect that an even more important reason is the difference between visual and V magnitudes. Many more observations are required before an accurate and reliable $M-m(\text{visual})$ can be determined.

The magnitude range of my visual light curve agrees basically with the range in V, with the visual maxima and minima being at times slightly on the bright side.

The only maximum that could be determined even approximately from direct observations was the one on about JD 2,443,720. The elements by Kukarkin et al (1974) predict a maximum at JD 2,443,716.8. Here, again, it would be premature to read too deeply into this deviation, when so few observations are involved. Thorough observation of a number of maxima over successive apparitions are required.

6 CONCLUSIONS

U Car has been observed over a very small number of cycles, too few to draw any definite conclusions about its present period. The main purpose of this paper is to draw attention to this star, which is very suitable for visual observation. Given a few years of regular observation it should be possible to make some judgement on the period of this interesting star.

Observers are reminded that observations should be sent to Headquarters at the end of each month as is done with other variables. At the end of each observing season a copy of all observations should be sent to the Section's Cepheid Recorder: T.A. Cragg, Anglo Australian Observatory, Private Bag No. 4, Coonabarabran, N.S.W. 2857, Australia.

REFERENCES

- Bateson, F.M. 1973. "The Observation of Variable Stars (Revised Ed.). Published by F.M. Bateson.
 Cragg, T.A. 1971. Circ. 179, V.S.S. R.A.S.N.Z.
 Cragg, T.A. 1978. Publ. V.S.S., R.A.S.N.Z. 6 (C78), p. 84
 Kukarkin, B.V/ et al. 1974. Second Suppl. to General Catalogue of Variable Stars, 3rd ed. (Moscow; Nauka).

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TABLE 1.

SEQUENCE OF COMPARISON STARS FOR 105359 U CARINAE.

STAR	R.A. (1950)	Dec. (1950)	SPECTRUM	V	B-V	REF.	ADOPTED MAGNITUDE
HD 93502	10 ^h 44 ^m 21 ^s	-60° 20.4	A0 IV	6.25	+0.03	2	6.3
93695	10 45 47	-59 36.7	B3 V	6.49	-0.11	4	6.5
				6.47	-0.13	2	
93737	10 46 08	-59 39.3	A0 Ia/ab	6.03	+0.28	7	6.0
				6.00	+0.28	6	
				5.96	+0.27	2	
93843	10 46 40	-59 57.6	O5f	7.28	-0.03	5	7.3
				7.33	-0.05	4	
93943	10 47 25	-59 03.5	B9.5IV/V	5.84	+0.01	2	5.8
94144	10 48 43	-61 00.2	B4 III	6.84	-0.01	6	6.9
				6.86	-0.01	2	
94173	10 49 00	-59 41.5	B8/9 IV	6.79	-0.04	2	6.8
94230	10 49 21	-59 28.7	B1 Iab	7.80	+0.37	7	7.8
94491	10 51 20	-58 37.6	B3 IV/V	6.24	-0.10	2	6.3
				6.27	-0.11	4	
94493	10 51 16	-60 32.9	B0.5	7.31	-0.02	4	7.3
			Iab/b	7.25	+0.02	2	
94683	10 52 31	-61 33.6	K4 III	5.93	+1.76	1	5.9
95324	10 57 13	-61 03.1	B8 IV	6.19	-0.08	2	6.2
95880	11 00 41	-59 28.3	B3 Ib/II	6.87	+0.32	7	6.9
				6.96	+0.34	6	
96248	11 02 52	-59 35.3	B1 Iab	6.55	+0.16	4	6.6
				6.56	+0.23	6	
96261	11 02 57	-59 26.6	B1 Ib/II	7.78	+0.14	4	7.8
96919	11 06 30	-61 40.0	B9.5 Ia	5.12	+0.24	6	5.1
				5.14	+0.21	4	

NOTES: HD 93695 = SVS 101161

HD 95880 = SVS 102657

HD 96919 = z² Car.

All spectral types extracted from the Michigan Spectral Catalogue, Vol. 1; (Univ. of Michigan, Ann Arbor, Mich., 1975).

REFERENCES TO TABLE 1.

1. Bok, B.J., Bok, P.F. and Miller, E.W. 1972 *Astron.J.* 77, 733.
2. Deutschman, Wm.A., Davis, R.J. and Schild, R.E. 1976. *Astrophys. J. Suppl.* 30, 97.
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6. Kennedy, P.M. and Buscombe, W. 1974. 'MK Spectral Classifications' (Northwestern University, Evanston, Illinois).
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Additional magnitudes shown on charts 452 & 453 came from:

Buscombe, W. 1977. 'MK Spectral Classifications, Third Gen. Catalogue', (Northwestern Univ., Evanston).

Lynga, G. and Wrandemark, S. 1973. *Astron. Astrophys. Suppl.* 12, 365

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F.M.B. May 31, 1979

105259 AG CARINAE

(1900): 10h 52m 10s -59° 55.2

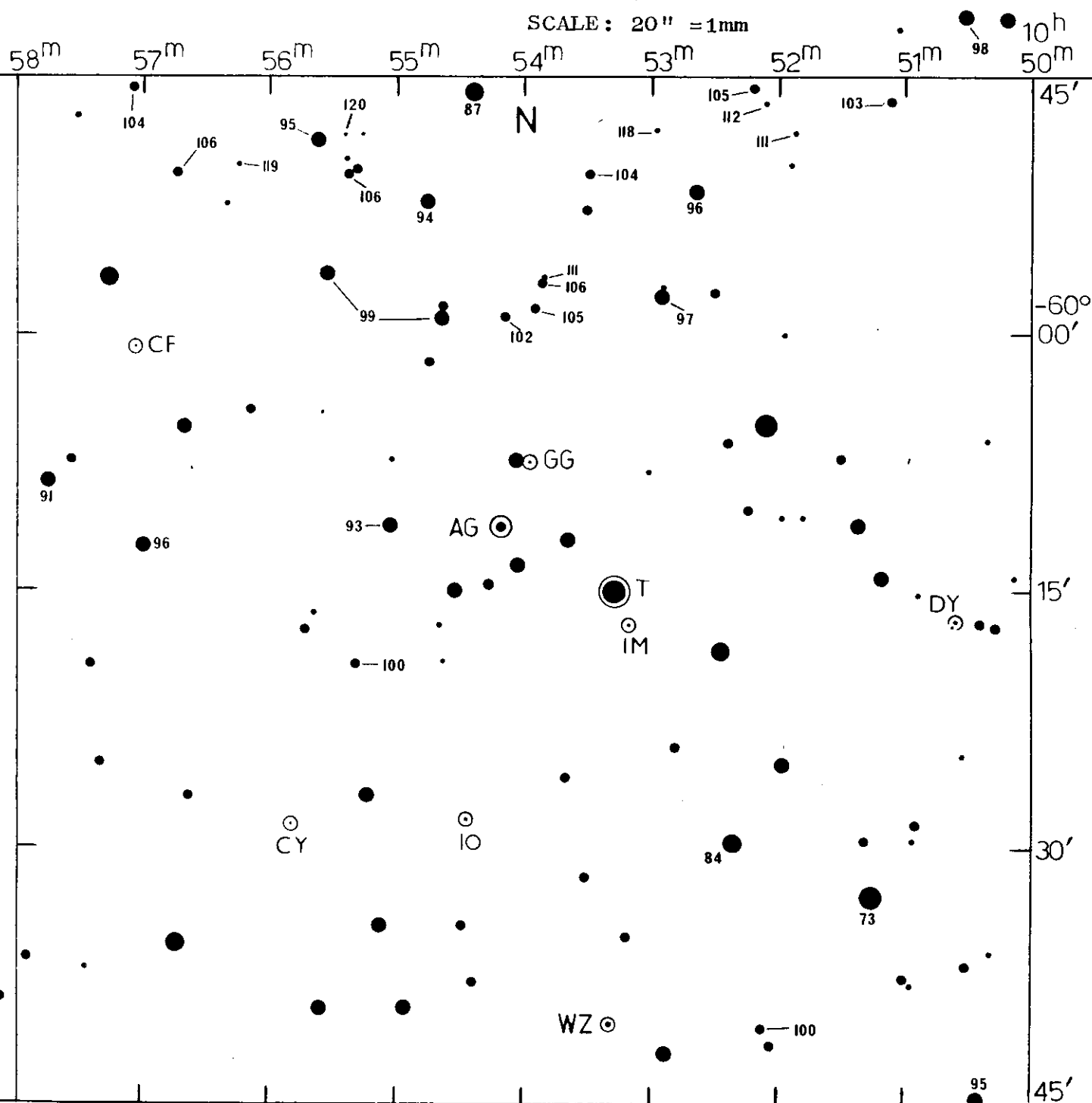
(1950): 10 54 10 -60 11.2

SEE ALSO CHART 452

SD. 7.1-9.0p. B01-A2eq

ALSO SHOWN: T Car; WZ; CF; CY; DY; GG; IM; IO

SCALE: 20" = 1mm



Plotted by M.M. from SAO and CoD.

EPOCH: 1950

MAGNITUDES: V from sources listed in Publ 7 (1979) V.S.S., R.A.S.N.Z.

F.M.B. 1979 May 31, 1979

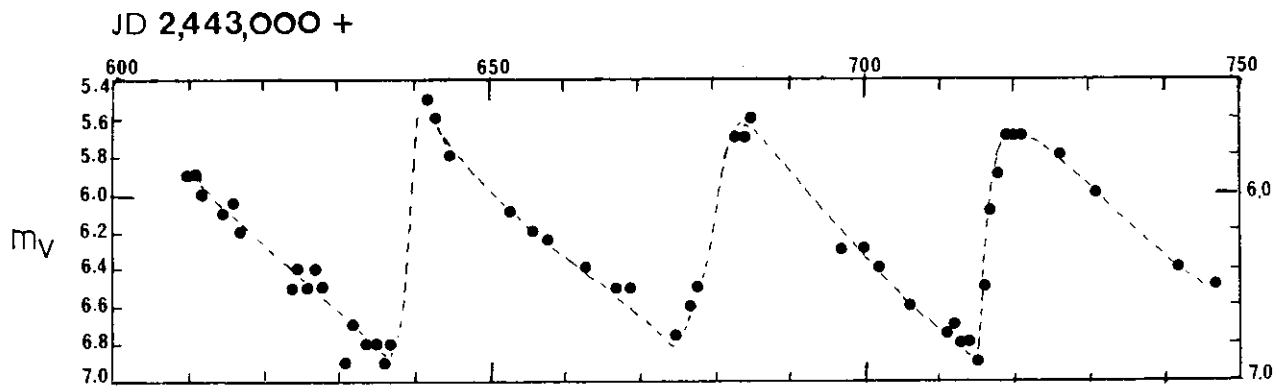


FIG. 2: VISUAL LIGHT CURVE OF **U CAR.**

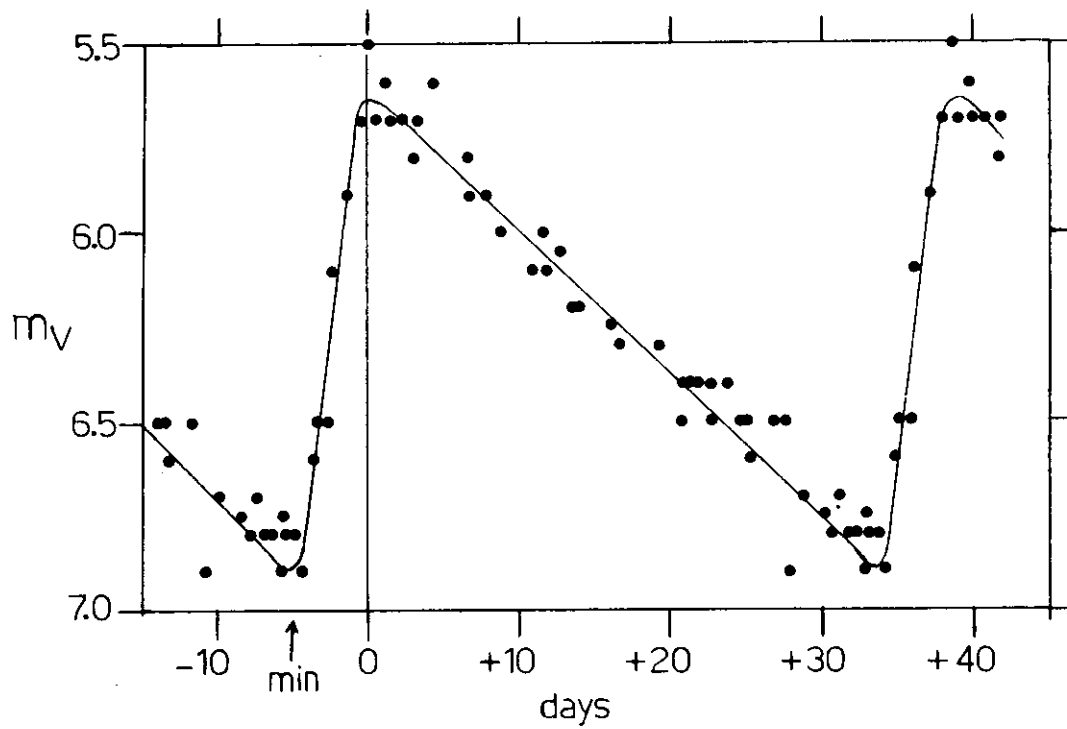


FIG. 3: MEAN LIGHT CURVE, JD 2,443,610 — 2,443,747.

CN ORIONIS--A Z CAM TYPE VARIABLE

Frank M. Bateson

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and Director, Variable Star Section, R.A.S.N.Z.

SUMMARY: A total of 442 outbursts of CN Ori are tabulated for the interval 1950 Oct. 7 to 1979 Jan. 16. Maxima are divided into four types and the mean cycle found is 15.85 days.

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1. INTRODUCTION

CN Ori is classified as Z Cam type with a visual range of $11^m.5$ to $14^m.8$, and a mean cycle of $18^d.4$ (Kukarkin et al 1971). It is observed by most Variable Star organisations.

2. CHARTS & SEQUENCES

Charts have been published by several organisations. The V.S.S., R.A.S.N.Z. use Charts 439 and 440 (Bateson, et al 1979), which show the photo-visual sequence by Mitchell & Wirtanen (1939). Prior to the publication of these charts the same sequence was used, except in the initial interval from J.D. 2,433,562 (1950 Oct. 7) to 2,434,766 (1954 Jan. 23), when the sequence by Hagen et al (1934) was in use.

All observations have been reduced to the sequence by Mitchell & Wirtanen which also appears on the charts used by the A.A.V.S.O. Bailey & Howarth (1979) have investigated the reliability of this, and other Leander McCormick sequences. The results of this investigation have been disregarded in the present paper so that the results now published can be compared to those from the A.A.V.S.O.

The charts issued by the B.A.A. also show the same sequence, but they finally adopted revised magnitudes (Howarth 1978) so that their results at the fainter end of the sequence differ from those of the V.S.S., R.A.S.N.Z. and A.A.V.S.O.

3. OBSERVATIONS

Observations discussed cover the interval J.D. 2,433,562 (1950 Oct 7) to 2,443,890 (1979 Jan. 16). These were contributed by:

JONES, A.F.	2,176	
JONES, M.V.	195	
MATCHETT, (Dr)V.L.	139	
SUMNER, B.	70	
OVERBEEK, M.D.	62	
BATESON, F.M.	59	
WINNETT, R.	22	
Three observers	27	TOTAL 2,750

The observing season is September to April inclusive, but in most years a limited number of observations have been made during the remaining three months.

Means of the observations have been published in the Circulars of the V.S.S., R.A.S.N.Z. up to the end of 1970.

4. OUTBURSTS

The observed outbursts have been divided into types according to their widths when CN Ori was brighter than $13^m.0$. These are:

PEAKS (P)	Width $3^d.0$ or less.
NARROW (N)	" $3^d.1$ to $6^d.0$.
WIDE (W)	" greater than $6^d.1$.
ANOMALOUS (A)	Those outbursts for which the rise from $13^m.0$ to maximum brightness exceeded 4^d .

Details for those maxima of the first three types for which the widths could be reliably determined are given in Table 1.

TABLE 1.

WIDTHS AT 13^m.0 OF OUTBURSTS OF CN ORI.

<u>TYPE</u>	<u>MEAN WIDTH</u>	<u>S.D.</u>	<u>EXTREMES.</u>	<u>No.</u>
P	2.22	$\pm 0.d49$	$0.d7 - 3.d0$	14
N	4.57	± 0.67	3.1 - 6.0	47
W	8.31	± 1.15	6.2 - 11.5	59

The division between the types is quite arbitrary and other investigators might regard type P as extreme forms of type N, although type P do appear to form a distinct type with very rapid rises and declines. Contrary to Howarth (1978) there appears to be no gap in the range 5.5 to 7.0. It is therefore a matter of opinion as to where the division between narrow and wide types should be made.

Anomalous maxima are usually considered to be those with abnormally slow rises. Most dwarf novae rise to maximum brightness in a day, or two, and any rise exceeding 2 days can be considered anomalous. CN Ori displays a wide variety of curves, especially as it often behaves in an erratic manner. Therefore only rises exceeding four days have been termed anomalous. Two definite and four probable examples of anomalous maxima have been observed.

Table 2 shows the magnitudes at maxima for those outbursts that were definitely observed at maximum brightness.

TABLE 2.

MAGNITUDES AT MAXIMA OF CN ORI.

<u>TYPE</u>	<u>MEAN MAXIMUM</u> <u>MAGNITUDE</u>	<u>S.D.</u>	<u>EXTREMES.</u>	<u>No.</u>
P	12. ^m 44	$\pm 0.m27$	$11.m9 - 12.m9$	9
N	12.09	± 0.28	11.5 - 12.6	27
W	12.16	± 0.24	11.6 - 12.7	38

The number of maxima observed in successive intervals of 1,000^d ranges from 34 to 53, reflecting the attention given to CN Ori at the time. The mean is 43.5 outbursts per thousand days.

The observed outbursts are listed in the usual form in Table 3. Underlined magnitudes in the fourth column indicate those outbursts not observed at maximum brightness.

An outburst was considered to have taken place if CN Ori was seen at 13.^m0 or brighter. Naturally there are many dates for maxima that must be considered uncertain because of lack of observations. Published A.A.V.S.O. (1953-66) observations were also plotted to obtain reliable dates of outbursts.

Our plots were also compared to A.A.V.S.O. (1972) light curves, and with the B.A.A. (Howarth 1978) results. Included in the notes that follow Table 3 are references to the inter-comparison with the results from our sister organisations. A much more complete investigation of CN Ori would be possible if all observations were pooled at the one centre.

5. DISCUSSION

There is clear evidence that CN Ori does have the occasional anomalous maximum. In Table 3 it is certain that maxima Nos. 12 and 217 are of this type. Our observations alone would have been insufficient to show this, but when combined with those from the A.A.V.S.O. their true nature is established. Maxima Nos. 115, 310, 347 and 392 are all probably anomalous.

There are 158 maxima that are clearly successive and for which the dates of maxima are definitely established. The mean cycle from these maxima is 15.^d85 and the range is from 2 to 23 days.

There is a slight tendency for wide and narrow maxima to alternate, but this sequence is often broken by successive pairs of either wide or narrow maxima. The ratio between alternating wide and narrow maxima compared to successive maxima of the same type is roughly 3:2.

CN Ori has intervals of erratic behaviour during which maxima succeed one another in rapid succession without the star returning to minimum. At times maxima tend to occur in pairs, when CN Ori having attained maximum brightness declines to around $13^m.0$ and then immediately rises again to a second maximum.

The rate of decline derived from 24 outbursts has a mean value of $2.52 \pm 0.88 \text{ d m}^{-1}$. The rates range from 0.6 to 4.2 d m^{-1} . According to the formula suggested by Bailey (1975) this indicates an orbital period of around 6.5 hours.

At minimum CN Ori fluctuates around a mean of $14^m.21 \pm 0^m.29$ with a range of $13^m.7$ to $14^m.9$. There is no evidence for any lengthy standstill characteristic of the Z Cam class although there are a few gaps in the observations where this may have happened. However, it appears that erratic behaviour is more characteristic of CN Ori than standstills.

Maxima brighter than $12^m.0$ tend to be followed by a marginally longer interval before the succeeding maximum. This tendency is statistically insignificant, and it is concluded that there is no definite relationship between amplitude of outbursts and the widths of either the preceding or following maxima, nor the intervals at which they occur.

6. CONCLUSIONS

CN Ori has an extreme range of $11^m.1$ to $14^m.9$ with a mean cycle of $15^d.85$. Maxima are either wide, narrow, peaks or the occasional anomalous outburst. It has intervals of erratic behaviour but there is no evidence for any prolonged standstills at an intermediate magnitude. There are no supermaxima. CN Ori differs in its behaviour from the normal dwarf nova of short mean cycle, and is therefore correctly classified as of Z Cam type.

Better use could be made of the observations of CN Ori if all organisations pooled their results at one centre.

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TABLE 3.

OBSERVED OUTBURSTS OF CN ORIONIS.

No.	TYPE	MAXIMUM JD24...	M _v	INTERVAL d	CN = 13 ^m .0		WIDTH d	No. of OBS.
					RISING	FALLING		
1	W	33,570	11.6	...	568.8	576	7.2	7
2	N	592	11.7	22	591.9	597	5.1	5
3	W	611	11.7	19	610.5	617.5	7.0	5
4	W?	628	11.7	17	627	...	...	7
5	N	646	11.8	18	645.3	648.5	3.2	5
6	W	662	12.1	16	...	668.5	...	3
7	P	681	12.5	19	680.4	682	1.6	7
8	W	696	11.5	15	693.6	705	11.4	6
9	N	712.8	11.9	16.8	711.5	715	3.5	6
10	N	717	12.0	4.2	715.8	719.7	3.9	6
11	W?	733.5	11.5	16.5	...	737.6	...	7
12	A	751	12.0	17.5	...	...	...	5
13	..	767?	12.0	16?	...	...	...	1
14	..	780?	12.3	13?	...	...	...	1
15	N?	828.5	12.5	...	...	...	...	3
16	..	859	11.5	...	857.3	...	...	2
17	..	884	11.5	...	...	...	...	1
18	W?	898	11.5	14	...	...	...	4
19	N	921	11.5	...	919	923	4.0	3
20	..	958	12.0	...	951	...	...	3
21	N	980	12.4	...	...	982	...	5
22	..	993?	13.0	13?	...	...	...	2
23	N	34,013.5	11.7	20.5	011	014.3	3.3	4
24	W	029	11.8	15.5	027.6	035	7.4	6
25	..	049	12.5	20	047.5	...	...	2
26	..	060?	12.4	11?	...	...	...	1
27	..	083?	11.8	...	...	...	...	1
28	W?	096	11.6	13	...	101	...	3
29	..	118?	12.7	22?	...	...	...	1
30	..	197	12.0	...	...	...	...	1
31	W?	212?	12.5	15	...	216.5	...	4
32	..	246	11.7	...	...	251	...	5
33	..	274	11.5	...	...	...	...	7
34	..	284?	12.8	10?	...	...	...	2
35	..	309?	12.0	...	...	312	...	3
36	..	339	11.1	...	...	...	...	2
37	P	358.5	12.9	19.5	358.3	359	0.7	4
38	N	370	11.7	11.5	...	371	...	2
39	N	372	11.8	2	371.2	374.6	3.4	3
40	W	389	11.9	17	385	394	9.0	9
41	..	404	12.0	15	...	...	...	1
42	P	419?	12.7	15?	418	420.5	2.5	5
43	..	430	11.7	11?	...	...	...	3
44	N	447	12.0	17	445	449.5	4.5	4
45	..	461	12.0	14	...	...	...	1
46	..	480	11.7	19	...	483	...	3
47	..	563?	12.0	...	...	...	...	2
48	..	597?	12.0	...	...	...	...	2
49	..	610?	12.2	13?	...	...	...	4
50	W?	628	12.0	18?	...	631	...	5
51	..	641	12.2	13	...	...	...	4
52	P	654	12.7	13	653.5	655	1.5	3
53	W	685	12.0	...	...	...	...	4
54	..	692	12.0	7	...	697	...	5
55	..	709?	12.0	17?	...	...	...	3
56	..	722?	12.5	13?	...	...	...	3
57	..	738?	12.5	16?	...	...	...	3

TABLE 3 (cont)

No.	TYPE	MAXIMUM JD24...	M _v	INTERVAL d	CN=13 ^m .0		WIDTH d	No. of OBS.
					RISING	FALLING		
58	..	34,754	11.5	16?	...	...	...	4
59	..	772?	12.4	18?	...	...	...	3
60	N	801.5	12.0	...	799.8	805.5	5.7	6
61	N?	815?	12.9	13.5	...	...	...	1
62	W	829.5	12.0	14.5?	827.3	835.5	8.2	9
63	..	862?	12.6	...	...	...	...	2
64	P?	891?	12.6	...	...	...	...	2
65	..	936	12.7	...	934.5	...	...	4
66	..	966	11.9	...	...	...	...	3
67	P?	981?	12.7	...	...	982	...	5
68	W?	995	11.9	14?	994	...	...	5
69	W	35,016	12.1	21	015	022	7.0	6
70	..	044?	12.4	..	041	...	...	4
71	W	062	12.9	18	061	068.5	7.5	6
72	..	080	12.4	18	077.4	...	...	5
73	W	094	12.1	14	091.3	101	9.7	7
74	..	112	12.7	18	...	...	...	4
75	N	127.5	12.2	15.5	125.5	129.5	4.0	8
76	..	142?	12.6	14.5?	...	...	...	1
77	N	149.5	11.8	7.5?	...	151	...	4
78	N	158.8	12.5	9.3	157.5	161	3.5	7
79	W?	172?	12.6	13.2?	...	176	...	2
80	N	185.5	12.6	13.5	185.3	189.6	4.3	6
81	..	205	12.1	19.5	...	209.4	...	5
82	W?	222	12.2	17	221.3	...	...	4
83	..	243?	12.5	21?	239.3	...	...	3
84	..	310?	12.5	...	...	314	...	4
85	..	342?	12.5	...	...	...	...	1
86	..	360?	12.8	18?	...	361	...	2
87	P	363	12.8	3?	362.3	364	1.7	4
88	W?	379.2	12.5	16.2	376	...	...	5
89	Wor A?	396	12.8	16.8	390	401	11.0	3
90	..	415	12.7	...	...	417.7	...	3
91	..	434	12.1	19	...	435.2	...	5
92	N	448.7	11.7	14.7	447	451	4.0	4
93	..	467	12.4	18.3	465	...	...	3
94	N?	473?	12.7	6?	...	...	...	1
95	N	483	12.6	10?	481.4	486.3	4.9	9
96	W	497	12.1	14	...	505	...	6
97	N	514.5	12.6	17.5	512.5	517	4.5	6
98	W?	530	12.1	15.5	...	534	...	6
99	N	546	11.8	16	544.1	549.8	5.7	9
100	..	563.5	12.4	17.5	561	...	...	7
101	..	585?	12.9	...	...	...	...	1
102	..	609?	12.4	...	...	...	...	2
103	..	661?	12.8	...	...	...	...	1
104	..	685?	12.8	...	...	...	...	2
105	W?	696	12.4	11?	...	701.5	...	4
106	N?	716	12.7	20	...	718	...	3
107	W	732	12.3	16	730.3	738.5	8.2	6
108	..	754	12.5	..	...	...	...	3
109	W?	766?	12.7	12?	...	...	...	4
110	N	785.5	12.0	19.5	784.7	787.8	3.1	3
111	..	802?	12.8	...	...	...	...	3
112	..	817?	12.4	15?	815.5	...	...	4
113	N	838	12.1	21?	836.5	840.5	4.0	9
114	..	855?	12.5	17?	...	860	...	3
115	A?	872	12.6	17?	867	877.5	10.5	7

TABLE 3 (cont).

No.	TYPE	MAXIMUM JD24...	M _v	INTERVAL d	CN=13 ^m O		WIDTH d	No. of OBS.
					RISING	FALLING		
116	N	35,890.5	12.3	18.5	889.5	895	5.5	7
117	P	904.5	12.5	14	902.8	905.3	2.5	6
118	..	919	<u>12.0</u>	14.5	916	...	...	7
119	..	924.5	<u>12.3</u>	5.5	...	926.5	...	4
120	..	934	<u>12.3</u>	9.5	...	...	...	3
121	..	986	<u>12.4</u>	...	...	...	...	2
122	..	36,017	<u>12.6</u>	...	...	...	...	1
123	W?	050	<u>12.0</u>	...	...	053	...	6
124	N	081	<u>12.7</u>	...	079.5	084	4.5	6
125	..	102?	<u>12.8</u>	...	...	...	...	1
126	W	115	<u>12.0</u>	13?	111.5	123	11.5	5
127	..	133?	<u>12.5</u>	18?	...	...	...	4
128	..	148?	<u>12.7</u>	15?	...	...	...	1
129	W	168?	<u>12.2</u>	20?	164	171	7.0	6
130	..	183?	<u>12.4</u>	15?	...	187	...	4
131	W	200	<u>12.3</u>	17?	197	203.8	6.8	8
132	W	214.5	<u>12.0</u>	14.5	212.8	219.7	6.9	9
133	..	232?	<u>12.7</u>	17.5?	...	...	...	2
134	W	248	<u>12.1</u>	16?	244	252.3	8.3	5
135	..	263?	<u>12.7</u>	15?	261	...	...	3
136	..	283?	<u>12.4</u>	20?	...	...	...	2
137	..	301	<u>12.6</u>	18?	299.6	...	...	2
138	..	317	<u>12.4</u>	16	...	321.5	...	7
139	..	335?	<u>12.1</u>	18?	...	...	...	1
140	..	349?	<u>12.3</u>	14?	...	...	...	2
141	..	384	<u>12.4</u>	...	382	...	...	3
142	..	431.5	<u>12.4</u>	...	429.8	...	...	3
143	..	450?	<u>12.8</u>	18.5?	...	...	...	2
144	..	468?	<u>12.4</u>	18?	...	471.5	...	4
145	N	498	<u>12.0</u>	...	497	501	4.0	5
146	N	516	<u>12.2</u>	18	515.3	519.6	4.3	5
147	N	547	<u>12.2</u>	...	546.2	549.6	3.4	3
148	..	557?	<u>12.7</u>	10?	...	...	...	3
149	..	564?	<u>12.5</u>	7?	...	...	...	1
150	P	577	11.9	13?	576	578.5	2.5	7
151	N?	590.5	12.0	13.5	...	...	...	4
152	W	608	12.6	17.5	606.5	612.7	6.2	4
153	W	635	12.1	...	633.6	641.6	8.0	13
154	..	665	<u>11.8</u>	...	662.5	...	...	5
155	..	682?	<u>12.8</u>	17?	...	...	...	2
156	..	704?	<u>12.1</u>	22?	...	...	...	1
157	..	714?	<u>12.8</u>	10?	...	...	...	2
158	..	750?	<u>12.7</u>	...	...	...	...	1
159	..	766?	<u>12.4</u>	16?	...	...	...	4
160	..	783	<u>12.4</u>	...	...	...	...	2
161	..	815	<u>12.3</u>	...	...	819.2	...	6
162	..	846	<u>12.0</u>	...	845	...	...	5
163	..	865?	<u>12.8</u>	19?	...	...	...	2
164	..	881?	<u>12.1</u>	16?	...	...	...	4
165	..	895?	<u>12.7</u>	14?	...	...	...	2
166	..	908	<u>11.7</u>	13?	906.8	...	...	2
167	N	927.5	<u>12.6</u>	19.5	927	931.5	4.5	6
168	..	940?	<u>12.8</u>	12.5?	...	...	...	2
169	..	956	<u>12.3</u>	16?	...	958.5	...	7
170	P?	971?	<u>12.6</u>	15?	...	...	...	2

TABLE 3 (cont.).

No.	TYPE	MAXIMUM JD24....	M _v	INTERVAL d	CN=13 ^m 0		WIDTH d	No. of OBS.
					RISING	FALLING		
171	..	36,988?	12.7	17?	986.4	...	...	5
172	..	37,000?	12.7	12?	...	...	...	3
173	..	020.5	12.6	20.5?	...	...	...	5
174	..	038	12.3	17.5	...	...	...	2
175	..	121	12.8	...	...	...	...	2
176	..	141	12.4	20	...	...	...	2
177	..	175	12.2	...	173.6	...	...	4
178	..	198	12.7	...	...	...	...	2
179	..	229?	12.4	...	...	...	...	2
180	W	253	12.5	24?	250	256	6.0	8
181	..	286	12.4	...	...	289	...	7
182	..	301?	12.8	15?	...	...	...	2
183	W?	316	12.2	15	314	...	...	5
184	N	337	12.5	21	336	339	3.0	7
185	..	345?	12.5	8?	...	...	...	4
186	..	351?	12.4	6?	350.2	...	...	3
187	..	368	12.3	17?	...	372.5	...	5
188	N	385	12.0	17	383.8	389	5.2	5
189	P	390.5	12.4	5.5	389.6	391.8	2.2	3
190	..	405?	12.4	14.5?	...	...	...	1
191	..	490?	12.7	...	...	...	...	3
192	..	506?	12.7	16?	...	...	...	1
193	N	523	12.7	17?	522	527	5.0	5
194	W?	558	12.3	...	...	564	...	8
195	N	576.4	12.3	18.4	575.6	581	5.4	5
196	..	591	12.8	14.6	589.5	...	...	4
197	..	610?	12.8	19?	...	...	...	4
198	..	624?	12.8	14?	...	...	...	1
199	W	643	12.1	19?	640.6	649	8.4	6
200	N	661	11.7	18	658.5	663	4.5	4
201	..	676?	12.4	15?	...	...	...	2
202	N	697.7	12.1	...	695	699.8	4.8	5
203	..	730	12.3	...	...	...	...	3
204	..	748?	12.6	18?	...	...	...	2
205	..	762	12.4	14?	...	...	...	2
206	..	778?	12.7	16?	...	...	...	2
207	..	794	12.2	16?	...	...	...	3
208	..	849	12.7	...	...	...	...	5
209	..	883?	12.4	...	...	...	...	3
210	..	912?	12.7	...	...	...	...	4
211	..	926	11.5	14?	...	...	...	2
212	..	940	12.9	14	...	...	...	3
213	..	970	12.1	...	...	...	...	2
214	N?	988	12.3	18	...	...	...	2
215	W	38,017	12.0	...	015.3	026	10.7	8
216	..	040?	12.8	23?	...	...	...	2
217	A	059	12.7	19?	053	...	...	4
218	..	073?	12.1	14?	...	...	...	2
219	..	112	12.8	...	...	...	...	2
220	..	133?	12.6	21?	...	...	...	1
221	..	168?	12.8	...	...	...	...	2
222	..	240?	12.4	...	238.5	...	...	4
223	..	298?	12.7	...	...	...	...	1
224	..	320?	12.7	...	...	...	...	1
225	..	370?	12.1	...	...	...	...	1
226	W?	392?	12.1	22?	...	403	...	3
227	..	425?	12.8	...	...	...	...	2
228	..	492?	12.8	...	...	...	...	1
229	..	645?	12.4	...	...	...	...	3

TABLE 3 (cont)

No.	TYPE.	MAXIMUM JD24...	M _v	INTERVAL d	CN=13 ^m O		WIDTH d	No. of OBS.
					RISING	FALLING		
230	..	38.666?	<u>12.8</u>	21?	...	...	...	2
231	..	684?	<u>12.7</u>	18?	...	...	...	1
232	..	703?	<u>12.8</u>	19?	...	...	...	2
233	..	716	<u>12.0</u>	13?	...	...	...	1
234	W	736	<u>12.2</u>	20	734	740	6.0	6
235	..	752?	<u>12.8</u>	16?	...	...	...	3
236	..	769?	<u>12.4</u>	17?	...	...	...	5
237	W	787	<u>12.7</u>	18?	785	792	7.0	5
238	W	808	<u>12.6</u>	21	804.6	811.5	6.9	8
239	..	823	<u>12.8</u>	15	...	...	...	2
240	N	842	<u>12.1</u>	19	839.4	844.5	5.1	3
241	..	857.5	<u>12.2</u>	15.5	857	...	...	3
242	..	873?	<u>12.7</u>	15.5?	...	...	...	1
243	..	897?	<u>12.7</u>	24?	...	...	...	1
244	..	972?	<u>12.4</u>	...	...	...	...	2
245	..	39.003	<u>11.8</u>	...	...	006	...	4
246	..	041?	<u>12.8</u>	...	...	...	...	2
247	..	072?	<u>12.8</u>	...	...	...	...	3
248	..	103?	<u>12.7</u>	...	...	...	...	2
249	..	120?	<u>12.8</u>	...	...	...	...	1
250	..	135	<u>12.7</u>	15	...	140.4	...	4
251	..	157?	<u>12.6</u>	22?	...	...	...	3
252	..	167?	<u>12.6</u>	10?	...	172.5	...	3
253	..	202	<u>12.7</u>	...	...	205.3	...	4
254	W	234	<u>12.1</u>	32	230.3	240	9.7	6
255	..	264?	<u>12.6</u>	...	...	...	...	1
256	..	355?	<u>12.7</u>	...	...	...	...	3
257	..	393?	<u>12.8</u>	...	...	...	...	1
258	..	405	<u>12.3</u>	12	...	...	...	3
259	W?	422	<u>12.7</u>	17	418	...	...	4
260	..	453?	<u>12.8</u>	...	...	...	...	2
261	..	468	<u>12.4</u>	15?	...	...	...	2
262	..	485?	<u>12.8</u>	17?	...	...	...	1
263	W	506	<u>12.4</u>	21	503.5	510.5	7.0	6
264	W	522	<u>12.7</u>	16	519.6	526.9	7.3	8
265	N	537	<u>12.6</u>	15	535	539	4.0	3
266	N	553	<u>12.7</u>	16	552	...	...	3
267	W	570	<u>12.7</u>	17	567.5	577	9.5	7
268	..	592	<u>12.6</u>	22	...	596.5	...	7
269	..	606	<u>12.6</u>	14	...	...	...	2
270	..	626?	<u>12.6</u>	20?	...	77.	...	3
271	..	714?	<u>12.4</u>	...	...	...	...	2
272	..	732?	<u>12.6</u>	18?	...	...	...	3
273	..	766?	<u>12.8</u>	...	...	...	...	3
274	..	790?	<u>12.9</u>	...	...	...	...	2
275	..	808	<u>12.3</u>	18?	...	...	...	3
276	..	829?	<u>12.8</u>	21?	...	...	...	3
277	N?	850?	<u>12.6</u>	21?	...	...	...	2
278	..	870?	<u>12.8</u>	20?	...	...	...	1
279	..	889	<u>12.6</u>	29?	...	892	...	2
280	W	906	<u>12.7</u>	17	904	910.3	6.3	7
281	N	926?	<u>12.7</u>	20?	...	...	...	2
282	N.	944	<u>12.5</u>	18?	941	946.7	5.7	4
283	..	965	<u>12.7</u>	21	...	...	...	3
284	..	981?	<u>12.7</u>	16?	...	...	...	1
285	..	40,066	<u>12.6</u>	...	...	...	...	2
286	..	104?	<u>12.8</u>	...	...	...	...	1
287	W	124	<u>12.0</u>	20?	...	130.3	...	4

TABLE 3 (cont.).

No.	TYPE	MAXIMUM JD24...	M _v	INTERVAL d	CN=13 ^m O		WIDTH d	No. of OBS.
					RISING	FALLING		
288	..	40,145?	12.8	21?	...	...	...	2
289	N?	171?	12.8	...	...	...	...	1
290	..	184	12.7	13?	...	190	...	5
291	W	204.9	11.8	20.9	202.4	209.3	6.9	7
292	N	227?	13.0	22.1?	...	...	...	2
293	..	240	12.7	13?	...	...	...	4
294	..	258	12.7	18	...	...	...	2
295	W	271	12.6	13	269	277	8.0	7
296	..	287	12.7	16	...	...	...	4
297	..	305	12.6	18	...	...	...	3
298	W	321	12.4	16	317	324	7.0	6
299	..	340?	12.5	19?	...	...	...	1
300	..	421	12.8	...	...	...	...	2
301	..	443	12.5	22	...	447	...	3
302	..	457?	12.7	14?	...	...	...	1
303	..	478?	12.9	21?	...	...	...	1
304	W	510	11.8	...	506.7	513.8	7.1	6
305	..	528?	12.8	18?	...	...	...	1
306	N	540	12.7	12?	...	...	...	2
307	..	558?	12.9	18?	...	...	...	3
308	..	572	12.7	14?	...	...	...	2
309	W	587	12.7	15	584	590	6.0	4
310	A?	606	12.6	19	600.3	...	...	3
311	W	616?	12.8	10?	615	622.5	7.5	4
312	W	635	12.7	19?	632.5	639.5	7.0	5
313	N	650	12.8	15	...	...	...	2
314	..	665	12.5	15	663	...	...	2
315	..	674?	12.9	9?	...	...	...	1
316	N?	682	12.5	8?	681.2	686	4.8	4
317	..	694	12.9	12	...	...	...	1
318	..	723?	12.4	29?	...	...	...	1
319	..	779	12.1	...	...	784	...	2
320	N	799	12.7	20	795.5	801	5.5	3
321	..	831?	12.6	...	...	...	...	1
322	..	898?	12.7	...	...	...	...	1
323	..	913	12.8	15?	...	...	...	4
324	..	948	12.0	...	...	...	...	4
325	P	969	12.1	21	968	970.5	2.5	4
326	..	986	12.6	17	...	...	...	2
327	W?	41,001	12.6	15	999.3	...	...	6
328	..	020?	12.2	19	...	...	...	1
329	N	036	12.5	16	035	039.6	4.6	3
330	..	058?	12.7	22?	...	...	...	2
331	..	090?	12.4	...	...	...	...	2
332	..	178?	12.7	...	...	...	...	1
333	N	195	12.0	17?	192	196.8	4.8	3
334	N	213	12.7	18	...	...	...	2
335	N	216	12.6	3	...	...	...	3
336	..	235	12.8	19	...	238	...	2
337	P	250	12.6	15	...	...	...	2
338	..	266	12.5	16	...	268	...	3
339	..	279	12.0	13	278	...	...	3
340	P	284	12.7	5	...	285.6	...	5
341	W	300	12.6	16	296.4	302.4	6.0	9
342	..	318	12.7	18	...	320.7	...	3
343	..	333	12.6	15	329	...	...	7
344	..	340	12.4	7	...	...	...	1
345	N	349	12.7	9	347.8	352.3	4.5	3

TABLE 3 (cont.).

No.	TYPE	MAXIMUM JD24...	M _v	INTERVAL d	CN=13 ^m O		WIDTH d	No. of OBS.
					RISING	FALLING		
346	P	41,363.5	12.7	14.5	363	365.3	2.3	3
347	A?	382	12.7	18.5	...	388.7	...	5
348	P?	397	12.8	15	...	...	...	2
349	..	409?	12.8	12?	...	...	...	2
350	..	417?	12.7	8?	...	...	...	1
351	..	445?	12.8	28?	...	...	...	1
352	..	459?	12.8	14?	...	...	...	1
353	..	509?	12.8	...	...	...	...	2
354	..	523	12.7	14?	521	...	...	4
355	W	570	12.0	...	...	576	...	5
356	..	591?	12.9	21?	590	...	...	2
357	W?	605	12.1	14?	...	608	...	3
358	..	619	11.9	14	618	...	...	2
359	..	650	12.8	...	...	654.5	...	2
360	W	670	12.3	20	668	675.7	7.7	9
361	N	687	12.4	17	686	690.2	4.2	7
362	..	702?	12.9	15	...	...	...	1
363	W	715	12.7	13?	712	719	7.0	8
364	..	728	12.8	13	...	...	...	1
365	W	740	12.3	12	737.3	746	8.7	10
366	N?	753	12.4	13	751.5	...	...	2
367	W	765	12.4	12	761	770	9.0	8
368	N?	779	12.3	14	778.5	...	...	4
369	W	792.5	12.2	13.5	789	798.3	9.3	7
370	P	806	12.6	13.5	805.5	808.4	2.9	4
371	..	819	12.3	13	...	...	...	2
372	..	895?	12.8	...	...	...	...	1
373	..	971?	12.8	...	...	...	...	1
374	..	981	12.8	10?	...	983	...	2
375	W	42,002	12.0	21	998?	009	11?	11
376	..	025?	12.7	23?	...	...	...	1
377	..	038	12.2	13?	...	...	...	2
378	..	060?	12.7	22	...	061.5	...	3
379	W	076	12.1	16?	072.5	080	7.5	6
380	W	093	12.4	17	090.5	099	8.5	8
381	N	110	12.7	17	108	112	4.0	3
382	W	127	12.3	17	124.5	133	8.5	7
383	..	159	12.4	...	...	164	...	5
384	..	178	12.4	19	...	...	...	2
385	..	227	12.6	...	...	...	...	1
386	..	259	11.9	...	256	...	...	2
387	..	277?	12.6	18?	...	...	...	1
388	..	290	12.0	13?	...	...	...	1
389	..	313?	12.6	23?	...	...	...	1
390	..	340?	12.8	27?	...	...	...	1
391	..	361	12.6	21?	...	365.6	...	3
392	A?	395	12.7	...	390.8	398.5	7.7	10
393	..	411?	13.0	16?	...	413	...	4
394	W	425	12.5	14?	423	431	8.0	10
395	W	445	12.3	20	442	449	7.0	9
396	N	458	12.6	13	457.2	461.2	4.0	7
397	W?	472	12.4	14	...	480	...	5
398	W	490	12.3	18	487.3	495	7.7	7
399	W	504	12.1	14	503	511	8.0	10
400	..	519?	12.7	15?	...	521.5	...	2
401	..	661?	12.0	...	...	...	...	1
402	..	715?	12.6	...	713	...	...	2

TABLE 3 (cont).

No.	TYPE	MAXIMUM JD24...	M _v	INTERVAL d	CN=13 ^m .0		WIDTH d	No. of OBS
					RISING	FALLING		
403	..	42,740?	12.7	...	...	...	...	1
404	N	754	12.0	14?	753	758	5.0	8
405	W	770.3	12.0	16.3	768.5	776	7.5	11
406	..	787	12.5	16.7	784	...	...	5
407	..	796?	12.7	9?	...	...	...	1
408	W	804	12.2	8?	800.3	810.7	10.4	12
409	W	821	12.4	17	817.2	827	9.8	8
410	..	834	12.4	13	832	...	...	4
411	..	839	12.3	5	...	844	...	8
412	W	856	12.5	17	851.8	859.8	8.0	11
413	W	873	12.0	17	869	876	7.0	13
414	..	888	12.4	15	887	...	...	3
415	..	894	12.0	6	...	895	...	7
416	..	914?	12.7	20?	...	...	...	1
417	..	998	11.7	...	...	...	...	1
418	..	43,099	12.2	...	...	102	...	7
419	W	131.3	11.8	...	130	138.4	8.4	10
420	..	152	12.1	20.7	...	156	...	6
421	P	166	12.1	14	165	168	3.0	5
422	W	182	12.3	16	180	189.6	9.6	9
423	..	200?	12.6	18?	198.5	...	...	2
424	W	220	12.1	20?	216.5	225.7	9.2	7
425	..	241?	12.9	21?	...	...	...	1
426	..	255?	12.0	14?	...	259	...	3
427	P	272	12.6	17?	271	273.2	2.2	3
428	..	442?	12.9	...	...	...	...	1
429	..	456?	12.2	14?	...	...	...	1
430	..	488	12.5	...	486.6	...	...	3
431	N	510	12.6	22	...	511	...	4
432	N	522?	12.8	12?	521	525	4.0	5
433	N	527?	12.4	5?	525	530	5.0	3
434	W	544	12.2	17?	539.4	548.6	9.2	10
435	N?	560?	12.9	16?	...	...	...	2
436	W	575	12.0	15?	572	582.4	10.4	9
437	W	608	11.9	...	605.3	616.5	11.2	7
438	..	628?	12.5	20?	...	...	...	3
439	..	818	12.1	...	...	819.2	...	2
440	..	832?	12.7	14?	...	833	...	2
441	W	863	11.8	...	861.9	871.8	9.9	12
442	..	882?	12.5	19?	...	...	...	2

NOTES TO TABLE 3.

Nos. 9 & 10. Double maxima.

11. Probable decrease of 0.^m.7 after initial rise.12. Rise from 12.^m.7 in 6 days.

38 & 39. Double maxima.

49. Possibly a double maxima 5 days apart.

50. Possibly anomalous.

60. Possibly double maxima 5.^d.5 apart.

62. Possibly followed by maximum 5 days later.

86. Probably earlier than 360? but immediately followed by peak No. 87.

91. Possibly double maxima 4 days apart.

92. Followed by erratic variations for 4 days.

115. Apparently an anomalous maximum.

118 & 119. Double maxima.

138. Possibly a double maxima 5 days apart.

153. Possibly a maximum around 630 but observations discordant.

NOTES TO TABLE 3 (cont).

- Nos. 184-186. Erratic behaviour.
 188 & 189. Double maxima.
 217. Combined with A.A.V.S.O. results this maximum is definitely anomalous.
 261. =B.A.A. No. 2.
 264. B.A.A. No. 3 on 527 at 11.9 when N.Z. observations made CN Ori 13^m.1.
 266. =B.A.A. No. 4.
 276. B.A.A. No. 5 on 823 & No. 6 on 832.
 279. =B.A.A. No. 7.
 287. B.A.A. No. 8 on 128.
 290. =B.A.A. No. 9.
 293. =B.A.A. No. 10.
 296. B.A.A. No. 11 on 286.
 306. B.A.A. No. 12 on 541.
 307. B.A.A. No. 13 on 560.
 308. B.A.A. No. 14 on 571.
 309. B.A.A. No. 15 on 590.
 310. B.A.A. No. 16 on 599.
 311. B.A.A. No. 17 on 623.
 312. B.A.A. No. 18 on 632.
 313. =B.A.A. No. 19.
 322. B.A.A. No. 22 on 896.
 323. =B.A.A. No. 23.
 324. B.A.A. No. 24 on 951.
 325. B.A.A. No. 26 on 971.
 326. =B.A.A. No. 27.
 327. B.A.A. No. 29 001.5
 329. B.A.A. No. 29 on 038.
 330. B.A.A. No. 30 on 053.
 334 & 335. Double maxima. B.A.A. Nos. 31 & 32 on 212 & 218.
 337. =B.A.A. No. 33.
 338. =B.A.A. No. 34.
 339. =B.A.A. No. 35.
 341. B.A.A. No. 36 on 301.
 343 & 344. Appears to be double with CN Ori declining to 13^m.0 between the two maxima. B.A.A. No. 37 on 337.
 346. B.A.A. No. 38 on 356. Only N.Z. observation 13^m.2 on 357 followed by three negative observations at fainter than 13^m.6 before rise commenced to maximum No. 346.
 347. Rise not observed. B.A.A. No. 39 on 382.4. Accepting their date of 376 for CN Ori rising at 13^m.0 there was a rise of 6 days making this an anomalous maximum.
 348. B.A.A. No. 40 on 396.
 349 & 350. Possibly the same wide maximum. B.A.A. No. 41 on 412.
 357. =B.A.A. No. 42.
 358. B.A.A. No. 43 614.
 359. = B.A.A. No. 45.
 361. B.A.A. No. 46 on 694 probably forms double maxima with our No. 361.
 363. = B.A.A. No. 47 with difference of 1 day in width.
 364. =B.A.A. No. 48.
 365. =B.A.A. No. 49 with difference of 0^d.8 in width.
 366. =B.A.A. No. 50.
 367. =B.A.A. No. 51.
 368. =B.A.A. No. 52.
 374. =B.A.A. No. 54.
 375. B.A.A. No. 55 on 004.
 376. B.A.A. No. 56 on 022.
 377. =B.A.A. No. 57.
 378. B.A.A. No. 58 on 058.
 379. =B.A.A. No. 59 with difference of 1^d in width.
 380. B.A.A. No. 60 on 092.

NOTES TO TABLE 3 (cont).

- No. 381. =B.A.A. No.61.
 382. =B.A.A. No.62.
 389. This single observation may be part of B.A.A. No. 64 on 307 but if so disagrees with their 312.5 for CN Ori falling at 13^m.0.
 391. =B.A.A. No. 65.
 392. B.A.A. No. 67 on 392.
 394. =B.A.A. No. 68.
 395. B.A.A. No. 69 on 443 with difference of 1^d.5 in width.
 396. B.A.A. No. 70 on 457.
 397. =B.A.A. No. 71.
 398. =B.A.A. No. 72.
 399. B.A.A. No. 73 on 505. May have been double maxima with second maximum of 12.4 on 508.
 402. B.A.A. No. 75 on 717.
 404. B.A.A. No. 76 on 753.
 405. B.A.A. No. 77 on 772.
 410 & 411. Double maxima with CN Ori declining to minimum between the two maxima.
 414 & 415. Double maxima with CN Ori declining to minimum between the two maxima.
 432 & 433. Double maxima with CN Ori declining to 13^m.0 between the two maxima.

The B.A.A. results referred to are in J. Brit. astron. Assoc. 88, 3, 292 (Howarth, I.D. 1978).

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THE DWARF NOVA---AT ARAE

Frank M. Bateson.

SUMMARY: Observed maxima are listed. Maxima are divided into four types amongst which anomalous and wide maxima predominant and occur in almost equal numbers. The mean cycle is about 65 days.

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1. INTRODUCTION

AT Ara was discussed by Bateson (1978), who published a list of observed maxima for the interval J.D. 2,436,260 to 2,442,958. This list is now continued to J.D. 2,443,910 (1979 Feb. 5).

2. OBSERVATIONS

Since the previous publication observations have been contributed by:

WILLIAMS, P.	88	
TAYLOR, (Dr). N.	68	
ROWE, G.	60	
HULL, O.	57	
JONES, A.F.	54	
ADCOCK, B.	27	
MATCHETT, (Dr).V.L.	24	
MARINO, B.	14	
SEVEN OBSERVERS	<u>10</u>	402.

The majority of the observations were negative with AT Ara being invisible and fainter than 14^m.0.

3. DISCUSSION

The observed maxima between J.D. 2,442,959 and 2,443,910 are given in the usual form in Table 1. Maxima have been divided into the following types:

- ANOMALOUS (A). Rise from 14^m.0 to maximum brightness exceeding 5 days.
 WIDE (W). Width at 14^m.0 ten days, or longer, but rise of 5 days or less.
 NARROW (N). Width at 14^m.0 less than 10 days.
 PEAKS (P). Maximum brightness fainter than 13^m.5.

TABLE 1.

OBSERVED MAXIMA OF AT ARAE.

No.	TYPE	MAXIMUM JD24...	M _v	INTERVAL d	AT = 14 ^m .0		WIDTH d	No. of OBS.
					RISING	FALLING		
64	..	42,967	12.6	86	...	...	...	2
65	N	43,043	11.5	76	041.5	048.4	6.9	13
66	A	264	12.3	(221)	257	270.3	13.3	9
67	W	351	12.2	87	348	358	10.0	6
68	P?	397?	14.0	46?	...	...	...	1
69	P?	437?	14.3	40?	...	...	...	1
70	..	573?	12.8	(136)	...	...	...	1
71	P?	629	14.4	56	...	...	...	1
72	W	721.5	12.0	92.5	718.5	729	10.5	24

NOTES TO TABLE 1.

- No. 64. Gaps in observations 6^d before and 5^d after the 2 positive observations on 967 & 968.
 68. Negative observations show that this was a peak with a duration of no longer than 2 days.
 69. Possibly reached a brighter magnitude as gap of 1^d before and 6^d after 437.
 70. Gaps 22^d before and 6^d after 573 so the single positive observation indicates that maximum was bright, and occurred around this date.
 71. Negative observations indicate duration about 1^d.

Of the maxima previously published (Bateson 1978) 36 could not be assigned to any definite type. The remainder could be assigned as under with certainty:

- ANOMALOUS Nos. 3; 8; 16; 18; 30; 33; 38; 51; 54, while Nos. 6, 20, 28 and 32 were probably anomalous.
 WIDE. Nos. 19; 26; 27; 46; 49; 50; 55; 56, with No. 40 probably wide.
 NARROW. Nos. 14 and 48.
 PEAKS. Nos. 52; 57 and 58.

For those maxima for which the parameters could be reliably determined a comparison of widths is shown in Table 2 and of maximum brightness in Table 3. No corresponding details can be given for the Peaks. The sample in Tables 2 and 3 is small mainly because this star has not been monitored closely. There is an indication that possibly the narrower the maximum the brighter is the outburst. However, many more outbursts need to be observed to prove whether this is true.

Anomalous and wide maxima differ in their mean widths and mean rise times. The mean rise times are Anomalous 10.3 ± 2.3 ; Wide 3.80 ± 0.6 . The decline times differ little--Anomalous 8.93 ± 2.27 ; Wide 9.05 ± 2.16 .

TABLE 2.WIDTHS OF MAXIMA OF AT ARAE.

<u>TYPE</u>	<u>MEAN</u>	<u>S.D.</u>	<u>EXTREMES.</u>	<u>No.</u>
A	19. ^d 23	$\pm$ 3. ^d 61	13. ^d 3 - 25. ^d	10
W	12.55	2.50	10 18	10
N	7.45	0.55	6.9 8	2

TABLE 3.MAGNITUDES AT MAXIMA OF AT ARAE.

<u>TYPE</u>	<u>MEAN</u>	<u>S.D.</u>	<u>EXTREMES</u>	<u>No.</u>
A	12. ^m 53	$\pm$ 0. ^m 34	11. ^m 5 - 13. ^m 1	10
W	12.30	0.23	12.0 - 12.7	7
N	11.90	0.40	11.5 - 12.5	3

The rate of decline derived from the six best observed outbursts has a mean value of $3.1 \pm 0.65 \text{ d m}^{-1}$. The rates range from 2.0 to 4.0 d m^{-1} . According to the formula suggested by Bailey (1975) this indicates an orbital period around 8 hours. The inclusion of a number of less well observed maxima results in a somewhat longer period of about 12 hours. .

Gaps in the observations make it impossible to state with certainty that any two maxima are successive, but it appears from those that are probably consecutive that the mean cycle is around 65 days.

4. CONCLUSIONS

Anomalous and wide maxima are the main features of the outbursts of AT Arae. They occur in almost equal numbers but do not alternate. Narrow maxima and minor faint peaks also have been observed, both of which have been poorly observed mainly because this star has not been closely monitored.

It is possible that the narrowest maxima are the brightest. However, more evidence is required to show whether this is true.

No information is available of the behaviour at minimum as the star is then well below the thresholds of the instruments used.

The mean cycle appears to be approximately 65 days.

REFERENCES

- Bailey, J. 1975. J. Brit. astron. Assoc., 86, 1, 30.
 Bateson, F.M. 1978. Publ. V.S.S., R.A.S.N.Z. 6, 1.

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THE 1979 OUTBURST OF THE RECURRENT NOVA, U SCORPII.

Frank M. Bateson

SUMMARY: Visual observations of the 1979 outburst of U Sco are given. The rate of fall for the first four magnitudes below maximum brightness was one magnitude per 2.35 days. Then the decline rate slowed. A comparison is made with the outbursts of 1863 and 1936.

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1. INTRODUCTION

Observations to J.D. 2,440,885 (1970 October 25) were discussed by Bateson et al (1971). That paper also contained V magnitudes for the comparison stars shown on chart No. 100 (Bateson et al 1966). From JD 2,440,986 (1971 February 3) to 2,444,113 (1979 August 27, a total of 1,093 visual observations were made by:-

FREETH, G.	178	
JONES, M.V.	158	
JONES, A.F.	109	
HULL, O.R.	105	
MENZIES, B.	93	
TAYLOR, (Dr). N.W.	87	
WALKER, W.S.G.	69	
ROWE, G.	53	
McMILLAN, S.C.	40	
MATCHETT, (Dr). V.L.	39	
MARINO, B.F.	29	
CROMPTON, A.	25	
18 OBSERVERS	<u>108</u>	1,093.

The main observing season each year is March to September, inclusive. October observations are few and confined to the early evening. No observations are possible in November and December on account of proximity to the Sun. January and February observations are few and confined to the morning hours.

The distribution of observations varied from year to year with the best coverage in 1973, when the star was monitored on 144 nights, whereas in 1977 observations were made on only 48 nights. Except for those made during the 1979 outburst all observations were negative with U Sco being at minimum and fainter than 15^m.0.

2. THE 1979 OUTBURST

This outburst was detected by Hiroaki Narumi on 1979 June 23.560 U.T. at magnitude 8.7 (IAU Circ. 3373). The latest observations prior to this date by members of the V.S.S., R.A.S.N.Z., were on June 17.36 U.T. when A.F. Jones and O.R. Hull both found U Sco invisible and fainter than 12^m.8. Probably the star was still at minimum on that date.

The means of observations during the outburst are given in Table 1. All observations have been reduced using the V magnitudes determined by Menzies (Bateson et al, 1971). Curve "A" in Fig. 1 shows the decline branch of the 1979 outburst plotted from the means given in Table 1.

TABLE 1.

MEANS OF OBSERVATIONS OF U SCORPII.

<u>MEAN J.D.</u> 2,444,000+	<u>MEAN M_v</u>	<u>No.OBS.</u>	<u>MEAN J.D.</u> 2,444,000+	<u>MEAN M_v</u>	<u>No. OBS.</u>
038.9	(13.7	1	058.0	13.0?	1*
041.86	(12.8	1	.05	(12.6	1
049.0	9.4	1	.9	13.2?	1*
.9	9.7	1	.92	(12.8	2
050.86	10.20	3	059.77	13.2	1
051.83	10.90	2	.93	(12.6	1
052.00	10.67	3	060.31	(11.5	1
053.03	11.20	2	065.9	14.0	1
054.01	11.40	3	066.0	(12.8	1
.14	11.75	2	.9	14.0	1
.98	11.35	2	067.8	(14.0	1
056.91	12.70	5	100.0	15.7	1
057.84	13.30	2			
.93	(12.6	1			

The two values followed by a question mark were class 3 observations.

The magnitude on 100.0 is approximate.

Between 067 and 100 there were no positive observations and negative observations showed that U Sco was fainter than 14.^m0.

3. DISCUSSIONS

No observations were made on the rise but this was obviously very steep, and probably occurred in a day or two. The decline was smooth, despite some minor apparent fluctuations. U Sco declined at the mean rate of one magnitude in 2.35 days until 12.^m7 was reached. It then took 5.5 to fall a further magnitude and 37.^d2 to decline from 13.^m7 to about 15.^m7.

These rates compare to those given by Gaposchkin (1957) of three magnitudes in 6.^d7 and five magnitudes in 10.^d6 for the means of the maxima of 1863 and 1936.

According to Thomas (1940) details of previous outbursts were:

1863 May 20 2,401,646 9.^m1v. Declined to 12.^m4v in 8 days.
 1906 May 12 2,417,342 8.8ptg.
 1936 June 22 2,428,342 8.79ptg. Rose from 10.^m96 to 8.^m99 in 2 hrs 58 minutes. Declined from maximum of 8.79 to 9.^m82 in 8hrs 43 minutes. Declined to 10.^m36 in 3 days and to 15.^m22 in 30 days.

In Figure 1 curve "B" shows the decline from the maximum of 1863 and "C" the decline from the 1936 outburst, plotted from the data given by Thomas (1940). There appears to be little information on the 1906 outburst. The 1979 outburst duplicates the decline of 1863, and apart from the initial sharp decline appears to be very similar to the 1936 decline curve.

The mean interval between the observed outbursts is 14,134 days. It is a strange coincidence that all observed outbursts have occurred in May or June. No other recurrent novae show such a coincidence. These months fall in the middle of the observing season for U Sco.

The maximum time during which U Sco has been brighter than 14.^m0 is 18 days. One wonders whether other outbursts have occurred but been missed.

The distribution in time of the plates examined by Thomas (1940) and of the visual observations (Bateson et al, 1971) and in the present paper show that there are many gaps in the observations of sufficient length for outbursts, if they occurred, to have gone unnoticed. One such possibility was discussed by Bateson et al (1971) but it was concluded that the observations possibly were of a faint star that is north and immediately preceding U Sco. This implied that this star might be variable.

O.R. Hull reported an outburst on 1979 March 23 (IAU Circ. 3341), but this was almost certainly a case of misidentification as observations made the same night at the Anglo Australian Observatory showed U Sco still at minimum. U Sco would have had to have a short lived flare of five magnitudes which appears unlikely from its known behaviour.

4. CONCLUSION

The decline of U Sco from its 1979 outburst was similar to the falls from previous outbursts, with the exception that the steep initial fall of 1936 was not repeated.

REFERENCES

- Bateson, F.M., Jones, A.F. & Stranson, I. 1966. "Charts for Southern Variables" Series 3. Publ. by F.M. Bateson.
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 Payne-Gaposchkin, C. 1957. "The Galactic Novae" p.190. North-Holland Publishing Co., Amsterdam.
 Thomas, H.L. 1940. Harvard Bull. 912.

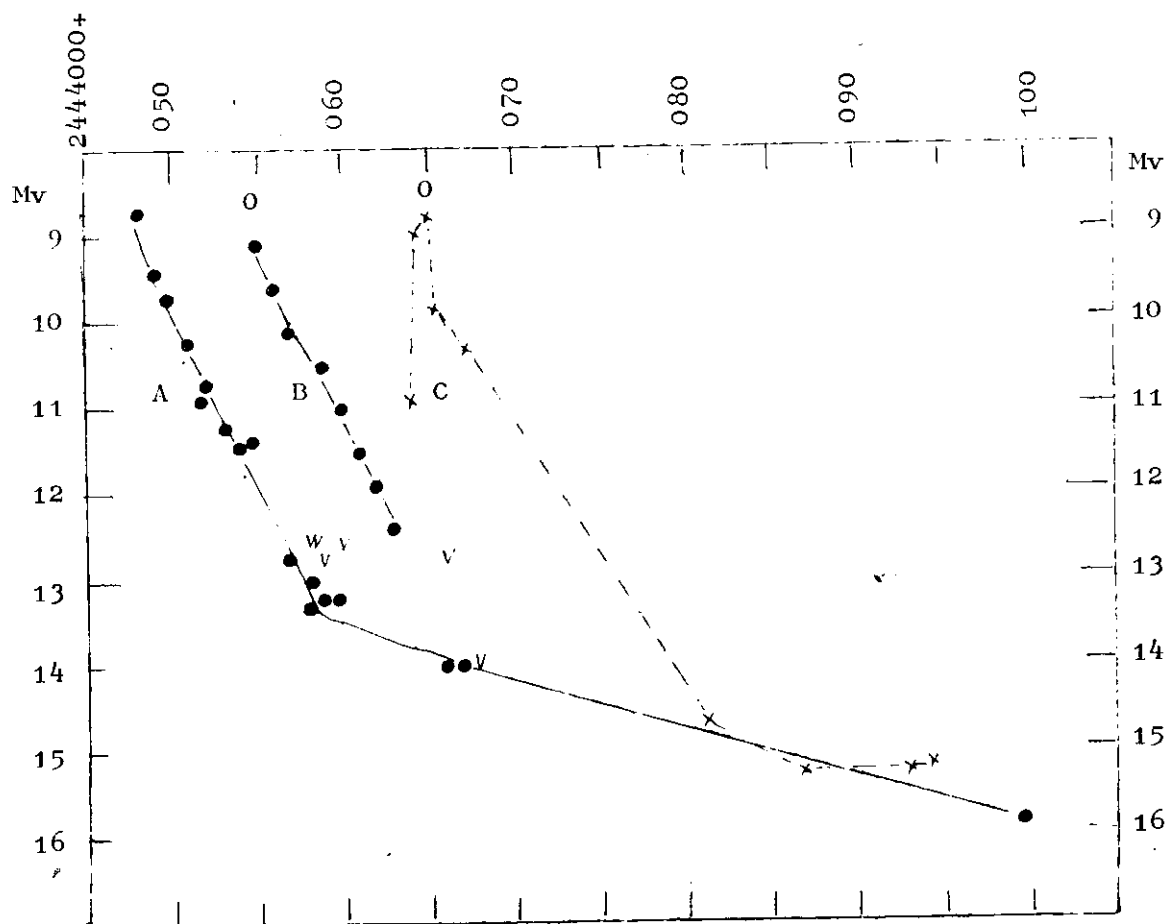


Figure 1. Light curves U Scorpii.

A=1979 outburst; B=1863 outburst; C=1936 outburst. Curves B and C are plotted with dates of maxima as zero and other points at times before or after maxima. For clarity B and C are displaced by 5 and 15 days respectively from A.

THE DWARF NOVA -- V485 CENTAURI

Frank M. Bateson

SUMMARY. A limited number of visual observations of V485 Cen, mainly in the years 1972 to 1977, suggest that its maxima are around magnitude 14.0, or fainter. A list of the few positive observations are given.

...

1. INTRODUCTION

V485 Cen is classified in the General Catalogue of Variable Stars, 3rd Edition, as of U Gem class with a range of 12.9 to fainter than 16.5ptg. The mean cycle is given as 12: days.

2. CHARTS & SEQUENCE

V485 Cen is shown on Charts 483 and 484 in Series 11 of CHARTS for Southern Variables (Bateson et al 1979). The V magnitudes shown on these charts is from the three colour sequence published by Vogt (1977). This sequence has been used for the observations discussed in this paper.

3. OBSERVATIONS

Albert Jones observed V485 Cen from 1959 March 6 to July 28. Apart from suspecting the variable on a few occasions his observations were negative. The star was then not observed until 1972 April 7 when M.V. Jones commenced observation using his own chart, which identified the comparison stars for which Vogt (1977) subsequently determined the magnitudes.

Observations to 1978 March 27 have been made by:

Matchett, (Dr). V.L.	158	
Jones, M.V.	142	
Freeth, G.	78	
McMillan, S.	45	
Jones, A.F.	43	
Seven observers	<u>19</u>	485.

Most observations have been negative with the variable noted as invisible and fainter than 14.^m0 and often fainter than 14.^m8.

Observations have been mainly confined to the months January to August inclusive in each year. V485 Cen has not been observed as frequently as other dwarf nova with the result that the number of observations have varied from 137 in 1973 to 15 in 1977.

4. DISCUSSION

Table 1 lists the positive observations that have been made together with the negative observations preceding and following the positive observations.

It is obvious from this Table that little can be stated concerning the mean cycle. However, it does appear that maxima are not as bright as the catalogued details suggest. Although it is discouraging to observers to repeatedly record only negative observations those with adequate instrumental means are asked to monitor this star more closely because if the mean cycle is short it is possible that many maxima have gone unobserved due to the infrequency of the observations to date.

TABLE 1.

OBSERVATIONS OF V485 CENTAURI.

<u>J.D.</u>	<u>MAG_v</u>	<u>OBSERVER</u>	<u>J.D.</u>	<u>M_v</u>	<u>OBSERVER</u>
2,441,437.91	(13.0	Jn	2,442,079.0	(14.5	Ft
452.07	14.0	Mt	080.0	(14.5	Ft
.90	14.3	Jn	081.11	15.0	Ft
453.90	14.3	Jn	083.0	(13.5	Ft
.97	(14.0	Mt	132.0	(14.5	Ft
454.90	14.0	Jn	.97	14.0	Mt
455.02	14.0	Mt	137.0	(14.0	Mt
456.05	(14.0	Mt	245.88	(14.8	Jn
772.94	(14.0	Jn	246.88	14.8	Jn
.96	14.0	Mt	247.88	13.7	Jn
773.04	(14.0	Mt	248.89	13.6	Jn
775.02	(14.0	Mt	249.89	13.7	Jn
.95	14.0	Mt	250.87	13.9	Jn
778.00	14.0	Mt	251.93	14.1	Jn
.92	14.0	Mt	255.90	(12.9	Mt
779.03	(14.8	Mm	257.92	(12.9	Mt
.92	14.0?	Mt	264.87	(14.8	Jn
.94	(14.8	Jn	432.10	(14.0	Jn
800.8	(14.5	Cj	434.06	12.9	Mt
.88	15.5	Ft	.22	(14.0	Jn
801.9	(15.0	Ft	623.89	(14.8	Mm
807.0	(14.5	Ft	625.94	14.3	Mt
.06	14.8	Mt	629.95	(13.9	Mm
.13	(14.0	Mm	630.87	(14.8	Mm
.91	(14.0	Jn	.92	14.0	Mt
.93	14.8	Mt	634.94	(13.0	Mt
808.0	(14.5	Ft	636.88	(14.8	Mm
.87	(14.0	Jn	867.94	(14.0	Mt
.95	(14.8	Mm	870.93	14.0	Mt
810.0	(14.0	Ft	872.9	(13.5	Ft
.95	14.8?	Mt	873.03	14.0	Mt
.99	(14.8	Mm	875.01	14.0	Mt
			.91	(13.5	Mt

Some of the positive observations in Table 1 must be regarded with caution because they represent records made at the limit of the instruments used. No conclusions can be drawn from these observations.

Two outbursts have been reported in the Monthly Circulars, of the Section during 1979, namely: 2,443,932 and 2,444,081 at 14.^m1 and 14.^m0 respectively.

REFERENCES

- Bateson, F.M., Morel, M., Sumner, B. & Winnett, R. 1979. CHARTS FOR SOUTHERN VARIABLES, Series 11. Publ. by Astronomical Research Ltd., Tauranga, N.Z.
- Vogt, N. 1977. Publ. 5, V.S.S., R.A.S.N.Z.

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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	1	1	LEE, D.	98	24
ADCOCK, B.S.	88	17	LESLIE, (Mrs).A.	488	15
BARRETT, A.	11	6	LUMLEY, E.	1142	39
BELL, S	5	3	MARINO, A.	133	16
BEUNING, J.	3	2	MARINO, B.	135	32
BIRD, R.	5	4	MARSHALL, G.	18	8
BLANE, D.	22	6	MATCHETT, (Dr).V.L.	200	47
BLOW, G.	23	18	MENZIES, B.	982	114
BOLTON, R.	4	2	MOREL, M.	334	30
BROWN, N.	135	74	MOYLES, (Miss) K.	46	14
BRYANT, K.	59	8	MUNDT, F.	2	2
CAMPOS, J.	83	18	McKENZIE, T.	22	11
CARTER, B.	135	23	PATERSON, (Mrs) D.	106	53
CLEMENTS, S.	3	2	Pleaver, N.	91	41
CRAGG, T.A.	1277	391	PROSSER, G.	50	27
CROSSLEY, G.	3	3	PYCROFT, R.	11	2
CURNICK, (Dr) C.L.	181	54	RIGBY, M.	10	4
DIETERS, S.	204	32	ROWE, G.	1718	55
DODSON, A.	235	68	SALISBURY, J.V.	9	6
DORAN, A.	5	3	SHINKFIELD, R.C.	251	32
EVANS, R.	106	17	SMITH, K.	51	8
GILLER, R.	135	62	STEPHENSON, S.	314	56
HALL, R.	187	31	SUNNER, B.	1048	193
HARRIES-HARRIS, E.	763	63	TAYLOR, K.	2	1
HERDMAN, G.	175	10	TAYLOR, (Dr). N.	1634	129
HERS, J.	476	131	TRAINER, J.	1	1
HICKEY, D.	55	8	TREGASKIS, T.B.	792	232
HULL, (Mrs) O.A.	10	5	VENIMORE, (Rev).C.W.	930	69
HULL, O.R.	2672	112	VINCENT, J.	189*	31
JACKSON, M.G.	954*	117	WALKER, W.S.G.	134	22
JONES, A.F.	3698	107	WALKER, S.	99	13
KENT, (Mrs).K.	69	12	WALMSLEY, M.	18	5
KILBEY, P.	70	4	WILLIAMS, P.	751	60
KISSLING, W.	230	16	WINNETT, R.D.	219	69
KOMOROUS, M.	578*	23	WILSON, A.	165	36
KOPINSKY, M.*	8*	3	WOODGER, A.	2	2

*= Results also communicated to AAVSO

TOTAL OBSERVATIONS 24,863

There was a substantial increase in the number of observations compared to the previous year. The contribution from T.A. Cragg represents only those observations of southern variables made for the Section. In addition he communicated many other observations to the A.A.V.S.O. of stars not on our programme.

The seven observers, who each contributed in excess of a thousand observations, accounted for over fifty percent of the total.

PUBLICATIONS: Issues during the year consisted of:

Monthly Circulars Nos. M77/9-M77/12; M78/1-M78/8.

Publications No. 6 (C78).

Memoir No.3. Z Cha.

Numerous notes in the Society's Newsletter.

GENERAL: The main programme has been the close monitoring of as many southern dwarf novae as possible. These stars are currently the subject of considerable professional interest because of their interesting observational and theoretical problems. The value of

visual observations of dwarf novae lies in the survey of their gross behaviour, which is best done visually. This enables the most interesting to be selected for intensive study by other methods.

R CrB and other unusual variables have received close attention. More observations are needed of Mira and semi-regular variables, many of which have not received the attention required because most of our experienced observers have devoted their time to dwarf novae. More observers are needed to provide adequate coverage of all the southern variables on our programme.

IAU COLLOQUIUM No. 46: A considerable portion of the Director's time was devoted to the organisation of this Colloquium to be held at the University of Waikato later this year. This will provide members with the opportunity of hearing distinguished overseas astronomers discussing many facets of variable star research. It will also provide ample time for members to discuss programmes with our visitors. This will greatly aid the work of the Section. All members have been given the opportunity of attending this meeting and it is hoped that the majority will accept this opportunity.

PUBLICATIONS: An enlarged edition (No.6) of the Publications was issued this year to mark the Golden Jubilee of the Section. The support of the Carter Observatory Board enabled papers on several dwarf novae to be published, providing the results of the Section's monitoring of AT Ara; FQ Sco; and UZ Ser. The results of photo-electric observations of WX Hyi and VW Hyi at the Auckland Observatory were presented in papers by B.F. Marino and W.S.G. Walker. These were a most valuable contribution to knowledge of these two stars.

A.J. Baldwin and P.J. Thomson presented the first paper from the computer programme on Mira variables. They provided a periodgram analysis of the Section's observations of S Car over an interval of 45 years, broken only during the war years. Mati Morel provided up dated visual sequence for the stars Eta, RT and BO Car with charts. T.A. Cragg, our Cepheid Recorder, discussed 1,300 visual observations of the bright Cepheid, ϵ Car.

These, and other papers, in Publications 6, provided an indication of the wide scope of the observational work of the Section.

MONTHLY CIRCULARS: These continued to be issued monthly, giving preliminary information of the behaviour of eruptive and other important variables. They also served as a medium through which observers were kept informed on current programmes and special requests for observations.

MEMOIR: Memoir No. 3 on Z Cha was published by the Royal Astronomical Society, London. This included the valuable results obtained, mainly by N. Taylor, on the timing of the eclipses and their relation to the outburst light curve. A limited number of reprints are available on request to the Director.

CHARTS: It was not possible to issue a further Series of Charts because the Director could not complete the checking due to the pressure of work with IAU Colloquium No. 46. M. Morel and R.D. Winnett have continued to produce fresh charts with the result that there are sufficient available for Series 10.

RECORDER: Gordon Smith has continued to occupy the position of Recorder. His work has involved the checking and entering of all observations on to the permanent sheets. In addition he lists and prepares the data on Mira variables that is sent to the A.A.V.S.O. quarterly for use in their predictions and light curves. This contribution greatly aids the A.A.V.S.O. in their work and the Section is indebted to Gordon for the care and attention with which he handles the work of recorder.

CEPHEID RECORDER: T.A. Cragg, who has had a long interest in the classical Cepheids, has kindly offered to discuss observations of these stars.

COMPUTER PROGRAMMES: A.J. Baldwin and P.J. Thomson have continued their programmes on S and R Car, with the result that their first paper appeared in Publications 6.

P.R. Wood has provided computer results on U Tuc and R Hor from fifty years of observations by the Section. He has also provided preliminary programmes for use with the computer at the University of Waikato. This will be discussed with him during the forthcoming IAU Colloquium. However, already the Director has prepared data on several more Mira stars and these have been run through the computer. This programme will be extended to cover all Mira stars in our programmes.

INTERNATIONAL COOPERATION: Many requests were received for visual light curves, mainly of dwarf novae, for use with results obtained from artificial satellites. All requests were responded to with complete light curves for the intervals requested.

Light curves were also supplied for a number of dwarf novae for use with photoelectric and spectral observations. In all a total of just over 150 sets of data were supplied to overseas investigators during the year.

During the visit of J.A.J. Whelan to Headquarters it was arranged to cooperate by supplying visual light curves for dwarf novae to be observed by him and his colleagues at the A.A.T.

Good progress has been made with the identification of stars for the Atlas of Identification of Dwarf Novae to be published under the joint authorship of N. Vogt, E.S.O. and the Director. This is intended for professional use, but will also ultimately provide reliable sequences and the chart material necessary to provide charts for use by our members. We are indebted to the Director, Perth Observatory, for undertaking to provide plates on some of these stars, and to B. Sumner for notifying Perth Observatory when an outburst is detected so that the necessary plate can be taken.

Discussions have proceeded with the Director (I. Howarth), of the Variable Star Section, B.A.A. concerning the pooling of records of eruptive variables commonly observed by both them and our own Section. It makes more sense to combine these results and the only point to be resolved is at what declination the division will be made. Close cooperation has continued with the B.A.A. over the exchange of other information.

The Director is indebted to J. Hers, Director, A.S.S.A., Variable Star Section, and his colleagues for supplying copies of all their observations. This has enabled the interval in which stars can be closely monitored to be extended because of the greater spread of observing sites in longitude. We, in turn, have been able to assist in the encouragement of observations from South Africa.

It is pleasing to note that the instructional manual "THE Observation of variable stars" is now used in some Australian Colleges of Advanced Education as a manual for the practical instruction of students in observational astronomy.

We have continued to freely exchange data with the A.A.V.S.O. through their Director, J.A. Mattei.

A number of professional papers have appeared during the past year in which use has been made of the Section's results.

R CORONAE BOREALIS TYPE VARIABLES: Th declines of RY Sgr and UW Cen were well observed. Results for 12 R CrB stars appeared in Publications 6, in continuation of the light curves previously published. A monograph published in Russia by A.F. Pugach and his colleagues drew extensively on our results of R CrB stars.

NOVAE: The novae discovered during the past year were closely followed by our members and the preliminary results published promptly in the Monthly Circulars. The wide spread of our observers in latitude is obvious from the coverage that the more northern members were able to give to Nova Cyg 1978.

FINANCE: The Director is indebted to the support of the Carter Observatory Board, which enabled many of the results of dwarf novae to be published. It was possible to hold subscription rates steady despite inflation. This has been mainly due to the continued support of a number of overseas institutions. Additional finance was made available by grants from the Low Estate and a family trust.

ACKNOWLEDGEMENTS: The skill and care of our more experienced observers is reflected in the accuracy of their results. Their practical encouragement to new observers has also been a great help. To these members I am deeply grateful not only for their observations but also for their support in so many other ways. I am also indebted to the less experienced observers for their results and for their desire to attain the standard set by the senior members. The Section can only be as good as its observers.

The leaders of the various local groups have continued to both encourage new observers and to carefully check results from their members. This has saved a considerable amount of work of a routine nature.

The continued support from individual astronomers and observatories through subscriptions has greatly helped the Section. Allied with this has been a keen interest in our activities and the desire to use our results.

This year I do not propose to mention all who have assisted in various ways by name but do desire to record my sincere thanks to all who have helped either by observations, finance or in so many other ways. The reason for this is that I wish to conclude by referring to the future.

OUTLOOK: The year that commences on 1st October 1978 promises to be the highlight of the Section's history. Firstly, the IAU have honoured New Zealand by sponsoring IAU Colloquium No. 46 on "The Changing Trends in Variable Star Research." We are most fortunate to have the cooperation of the University of Waikato in providing the venue for this meeting. It will provide a great stimulus to the Section and its members, benefiting their work and understanding by affording the opportunity for discussions with professional colleagues. I expect that many programmes will result from such discussions which should also materially assist the fine work that is being done at the Auckland Observatory.

Secondly an added stimulus will be provided by the lecture tour that has been arranged for B. Warner. This will supply an additional opportunity for discussion of problems of variable stars.

Once these events are over more attention can be paid to producing the results of the Section. Unfortunately it is a fact of life that we all must grow old. Having founded and directed the Section since its inception the time is approaching when I must step down and pass over its affairs to younger, and hopefully more qualified people. With this end in view steps will be taken in 1979 to provide for the future so that in a few years time an orderly handing over of the reins can be made. The methods and financial provisions that will be made will be to a great extent dependent on discussions that will be held over the next few months.

1978 October 10

Frank M. Bateson
Director.

REPORT OF SECTION FOR YEAR ENDED 30th SEPTEMBER 1979.

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>
ADCOCK, B.S.	22	10	KOMOROUS, M.	399*	25
ASHDOWN, M.	38	10	LEE, D.	6	6
BACON, I.	16	7	LESLIE, (Mrs). A.	410	12
BALL, W.	1	1	LUMLEY, E.	922	42
BARRETT, A.	6	6	MARINO, A.	265	36
BEUNING, J.	23	10	MARINO, B.F.	2,152	108
BLANE, D.	19	4	MATCHETT, (Dr) V.	21	15
BROWN, N.	843	223	MENZIES, B.	758	33
BRYANT, K.	31	4	MOREL, M.	218	23
CAMPOS, J.	217*	32	MURRAY, A.	235	30
CARTER, B.	64	18	McNAMARA, G.	3	3
CLARK, M.	53	29	PAGE, A.	1	1
CORKIN, J.	209	8	PARKINSON, M.	1,713	59
CRAGG, T.A.	1,626+	426	PATERSON (Mrs) D.	54	26
DIETERS, S.	447	61	PROSSER, G.	358*	83
DODSON, A.W.	167	46	ROWE, G.	599	44
DOUGLAS, W.	15	4	St. GEORGE, L.	23	2
FRANKPITT, B.	8	8	SALISBURY, J.	23	5
GARRETT, M.	1	1	SHINKFIELD, R.	83	19
GILLER, R.	77	31	SUMNER, B.	2,435	157
HARRIES, HARRIS, E.	384	59	TAYLOR, (Dr) N.	1,656	113
HAYWARD, G.	62	14	TREGASKIS, B.	504	221
HERDMAN, G.	1,230	78	VENIMORE, (Rev) C.	837	67
HERS, J.	135*	38	VINCENT, J.	123*	23
HICKEY, D.	83	12	WALKER, W.S.G.	4	3
HULL, O.R.	2,483	127	WINNETT, R.	53	27
JACKSON, M.	1,725	147	WILLIAMS, Peter	734	86
JONES, A.F.	3,448	91	WILLIAMS, Paul	5	5
KENT, (Mrs) K.	49	13	WILSON, A.	26	15
KILBEY, P.	467	26			

+ = Total observations for VSS, RASNZ and is additional to observations for A.A.V.S.O.

* = Results also communicated to A.A.V.S.O.

TOTAL OBSERVATIONS 28,569

Once again it is pleasing to note that there was a substantial increase in the number of observations compared to the previous year. Almost all local groups shared in this increase. The nine observers who made more than one thousand observations accounted for 64% of the total observations.

PUBLICATIONS: Twelve issues of the Monthly Circulars were issued. Nos. M78/9-12 and M79/1-8. Publications No.7 (C79) is in the hands of the printer. "Charts for Southern Variables" Series 10 was published. Series 11 is almost completed and will be published in October. Numerous notes have been published in the Society's Newsletter.

The Director was co-editor, with J. Smak and I.H. Urch of the Proceedings of IAU Colloquium No. 46 on "Changing Trends in Variable Star Research", published early in 1979 by the University of Waikato. All orders for copies are handled, on behalf of the Local Organizing Committee, by the Director.

IAU COLLOQUIUM No. 46. The year's highlight was the holding of this Colloquium at the University of Waikato from 1978 Nov.27 to Dec. 1. This provided those members, who were able to attend, with the rare opportunity of meeting professional colleagues. The stimulus so provided is reflected in the increased observations and greater general interest in the Section. The outstanding benefits to members were:

- (a) Learning from professionals why visual observations are so important, and, of the high regard in which the Section's work is held. Whilst this only reinforces what I have stated on so many occasions it probably carried greater weight coming from our professional colleagues.
- (b) Even greater participation by visual observers in cooperative programmes.
- (c) Enabling photoelectric groups, such as that in Auckland, to establish personal contacts, discuss methods and programmes and to arrange participation in various programmes.

Naturally the tremendous burden of organization, and the subsequent editing and distribution of the Proceedings of this meeting, caused some delay at Headquarters on other activities.

GENERAL: The main observational programmes have been concerned with the close monitoring of dwarf novae, R CrB and other unusual variables. Novae discovered during the year were also closely observed. Mira and semi-regular variables, although not neglected, still need more attention. Preference had to be given to the monitoring of dwarf novae because of the current professional requirements. More observers are still needed and in this regard I am grateful for the efforts made by the various local groups to foster interest in variable star observing.

CHARTS: I am indebted to M. Morel, B. Sumner and R.D. Winnett for their careful production of charts. Series 10 has been published; Series 11 is in the hands of the printer and will be distributed in late October 1979. Some charts have already been completed for Series 12.

N. Vogt, European Southern Observatory, and the Director are cooperating on the production of an Atlas of Dwarf Novae. This is intended purely for professional use and is based on certain identification either by visual observation at outburst for the brighter stars; photoelectric and photographic observations at outburst; photoelectric observations at minimum or spectroscopic observation. For a number of stars confirmation has been obtained by all these methods.

We are grateful to the Director, Perth Observatory for allowing his staff to take astrographic plates of some stars when advice was given that these were at outburst. We also appreciate the cooperation of B. Sumner and N. Brown for informing Perth when they found a dwarf nova at maximum. We have also been assisted by A.C. Gilmore and P.M. Kilmartin in taking plates for our use. All identifications have been made on E.S.O. or Palomar Sky Survey prints.

In the course of this work several stars catalogued as dwarf novae have been found to belong to other types. AC Sco was found to be a Mira variable on the basis of visual observations by A.F. Jones and F.M. Bateson. EQ Mon; V591 Cen; AG Ser; AA Cnc and TU Oph from their spectra are not dwarf novae. The final proofs of this Atlas are due shortly.

SEQUENCES: The value of Series 10, CHARTS FOR SOUTHERN VARIABLES, was greatly enhanced by publication of a number of photoelectric sequences, mainly from B. Menzies and his assistants. Their

help was much appreciated.

It was expected that a number of three colour sequences would be available for PUBLICATIONS No. 7. However more data has been secured than was expected with the result that reductions could not be completed in time for the dead-line. These sequences will now appear in PUBLICATIONS No.8. They are being determined by N. Vogt.

A number of other sequences are being determined elsewhere and will be published when available. R.F. Webbink has kindly supplied extensive three colour magnitudes for the fields of several recurrent novae. These will be published with the detailed charts.

Good use has been made of already determined V magnitudes. These have been drawn from a wide variety of sources as can be seen from the acknowledgments in Series 11, Charts for Southern Variables. M. Morel has performed a sterling service in searching the literature and we are grateful for the assistance given to him by the Directors and staff at Mt. Stromlo and Sydney Observatories. It is also a pleasure to acknowledge the help of W. Buscombe in forwarding his catalogues of MK Spectral Classifications.

OBSERVATIONS: During the first 18 years of the Section's activities, 1927 to 1953, a total of 128,120 observations were made by a small group of observers. This interval included the war years when most members were on active service and little observing was possible. It is a measure of the increased activity of the Section that in the past five years observations have totalled 131,648 from a greatly expanded band of observers. These figures provide some measure of the volume of records that are handled at Headquarters.

That remarkable observer, Albert Jones, has made 238,661 observations. Such a record is outstanding not only for its sheer number but because of the very high standard of accuracy that Albert maintains.

RECORDER: The figures in the foregoing section give some idea of the amount of work that Gordon Smith, our Recorder, gets through. He checks and enters every observation after the preliminary data has been extracted at Headquarters for the Monthly Circulars. His ledger sheets for each star are a model of clarity that make them a pleasure to handle.

Not only does Gordon keep these records up to date but he also prepares the quarterly lists of observations of Mira variables. These are sent to the A.A.V.S.O. for use in their predictions and light curves. The value of pooling results of this nature is acknowledged by J.A. Mattei, Director A.A.V.S.O. who states "We appreciate these observations. They are indispensable in predicting the maxima and minima dates of southern variables."

SPECIAL REQUESTS: A total of 59 requests were received during the year for light curves and observations. Several of these were for a number of light curves, whilst others only require data for a single star. Some requests were for light curves covering the past four years and others only required information for a short interval. These requests came from professionals requiring the information on the optical behaviour of variables to interpret observations at other wave lengths made from satellites or for use with spectroscopic or photoelectric observations. The types of variables for which information was required included many dwarf novae; three SD variables; nine Mira variables; three irregular variables; the X-ray source V818 Sco and several novae and recurrent novae.

PROGRAMMES: Members contributed observations to a number of special cooperative programmes during the year mainly on dwarf novae.

Some cooperative programmes for 1980 have already been announced in Circ. M79/9. Announcements of other programmes will be made in subsequent Monthly Circulars. Particular attention will be given to members of the SU UMA sub class of dwarf novae.

COMPUTER PROGRAMMES. During IAU Colloquium No. 46 it was possible for P.R. Wood to have discussions with the Computer Centre at the University of Waikato. As a result he kindly supplied a set of instructions and a revised programme for the handling of the observations of Mira Variables.

It has been only possible to send C.J. Potter the results for one additional star over an interval of 50 years for this programme. This is the one programme that has suffered a delay due to the Director's other work. It is hoped that the results can be speeded up during 1980. I am grateful to Chris Potter for his assistance on this programme and thank the University of Waikato for making computer time available.

A.J. Baldwin has continued his computer programme on which assistance has been given by P.D. Cain and R.D. Austin, in preparing the data.

FINANCE: All finances of the Section are now handled by ASTRONOMICAL RESEARCH LIMITED in order that the ultimate transfer of the Section to a successor when the Director finally retires will be easier. This also has the double advantage of being better able to spread the work load through the engagement of students from time to time and of securing grants to further the work of the Section.

The recent heavy increases in postal rates has made it necessary to increase the price of the Monthly Circulars. Whilst this is regretted it is unavoidable especially as the increased postal rates are allied with an ever increasing cost of printing.

ACKNOWLEDGEMENTS: I am most grateful to all members for their contributions throughout the year and for their cooperation. It is the observations that alone make the work of the Section possible.

I appreciate the encouragement given by the more experienced observers to new observers. The leaders of the various local groups have continued to check the results from their members, which eases the burden at Headquarters. A very pleasing feature of this year's activities has been the assistance given by a number of non observing members to the "desk work".

It is also a pleasure to record the assistance given by some many professionals to the Section, both by way of subscriptions and donations, as well as in practical help with the programmes. Fortunately this has been a two way operation since the Section in its turn has been able to supply results that these good people have requested.

It is impossible in the Annual Report to thank individually all who have helped in some way or other. If one was to do so the report would exceed the space that can be provided. I trust therefore that all those who have contributed in some way to the Section, be it by observations or otherwise, will accept my most sincere thanks for their support.

1979 October 15

Frank M. Bateson

Director.