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PUBLICATIONS OF THE

VARIABLE STAR SECTION

ROYAL ASTRONOMICAL SOCIETY OF NEW ZEALAND

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1997 February 20th

V854 CENTAURI - THE FIRST 3000 DAYS

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SUMMARY:

V854 Cen is the third brightest representative of the rare R Coronae Borealis class of variable stars. It was only recognised as such around 1987 which is somewhat surprising considering at maximum light this star attains a visual magnitude of 7.5.

Visual observations during the 3000 day interval 1986 July through 1994 October show this a particularly active member of the RCB class.

1. INTRODUCTION: THE RCB PHENOMENON

The RCB variable stars are evolved F or G type supergiants whose atmospheres are rich in carbon and deficient in hydrogen, yet with other elements at near solar abundances. Distribution and radial velocity data suggest they belong to the old disk and possibly also the galactic bulge population. Absolute magnitudes appear to lie within the range –3 to –5 and may be related to the evolutionary state of the star.

The visual light curve is typified by deep minima of amplitude up to 8 magnitudes and which occur at essentially irregular intervals but the time of decline onset appears linked to maximum light phase of the star's pulsation period, as has been demonstrated for RY Sgr (1) and V854 Cen (2). The decline is generally much steeper than the return to maximum while both amplitude and duration of each event can vary considerably in character.

At maximum the RCB stars tend to show small amplitude variations, possibly due to radial pulsations, with periods typically near 40 days but ranging from 20 to 230 days. Photometric data on V854 Cen has shown a probable period of 43.2 days (2).

All of the currently recognised RCB stars have been shown to exhibit a large infrared excess, apparently due to the presence of a dust shell which has condensed from material expelled by the star, or which may indicate the presence of an old hydrogen envelope. IUE satellite spectra indicate dust formation occurs at maximum phase of the 43.2 day pulsation cycle (3). Temperatures of these shells are of the order of 500K to 900K. In the case of R Coronae Borealis, surrounding this is an extensive dust cloud whose temperature throughout is a nearly uniform 25K to 30K and which has been shown by IRAS data to be some 8pc in diameter.

The RCB stars are comparatively rare objects which suggests this stage of a star's evolution is a relatively short lived phenomenon. Only 26 of these stars are presently recognised as listed in Table 1. Included also in this list are the three so-called "Hot RCB Stars" DY Cen, V348 Sgr and MV Sgr. These appear similara to the classic RCB stars but show a considerably higher photospheric temperature and may represent an early stage in the development towards the RCB stage.

Also related to the RCB stars are the hydrogen deficient carbon stars (HdC stars). These have a spectrum similar to the RCB variables but show no evidence of circumstellar dust nor marked variations in brightness, though the latter may merely reflect a lack of close monitoring over the long term. The presence of strong hydrogen lines in HD148839 (NSV 7820) and V854 Cen, plus weak hydrogen lines in some other HdC stars has given support to the suggestion that these two groups of stars are in fact closely related and should perhaps no longer be classified as independent groups.

The mechanism responsible for the deep minima observed in the RCB stars is still unclear and this class of variable are currently the subject of close study by a number of professional groups. Amateur astronomers can provide valuable assistance here by regular long term monitoring of these stars and promptly reporting the onset of deep declines, such information being critical in allowing professional study of these events.

Multi-band photometry shows the light at longer wavelengths of JH-K-L is less affected during the deep minima than is the visual. At L there is only minimal variation. This has been interpreted by suggesting the light from U through J bands has as its source the central stellar object but at L the light originates almost solely from the circulstellar shell and surrounding dust cloud.

During decline, the observed spectra changes from that of absorption to one with pronounced emission lines. This is believed to occur as the photosphere of the star becomes totally obscured by the expanding cloud, leaving the chromosphere as the primary light source. In the case of V854 Cen this has been shown to occur some 5 or 6 magnitudes below maximum brightness.

The rates of early decline and photometric colour changes have been discussed by Lawson (4) who described both "blue" and "red" events which have been interpreted as resulting from different levels of obscuration of the star's photosphere during the ejection process.

A "blue" decline occurs when the photosphere is only partially obscured during the initial stages of decline, where (U-B) and (B-V) colours are observed to become considerably bluer prior to finally reddening. This has also been tentatively linked to a "fast" rate of initial decline and where the cloud has been ejected from the star at a relatively low angle.

A "red" decline results from the ejected material totally obscuring the photosphere plus much of the chromosphere at the time of cloud condensation. This has been associated with a large angle of ejection and a "slow" rate of early decline.

2. DISCOVERY & OBSERVATION.

V854 Cen has the dubious distinction of having been discovered three times prior to being recognised as the important and interesting star it is.

It was first noted during a 1964 photographic survey for variable stars conducted by the Remeis Observatory, Bamberg, receiving the preliminary designation BV520 and catalogued as a faint variable of small amplitude. This led to its inclusion in the New Catalogue of Suspected Variable Stars (NSV) as NSV6708 (5). No follow-up observations were obtained.

Attention was again directed towards this star in 1971 when New Zealand amateur Ron Welch noted it but again no follow-up observations came.

Its third discovery was on July 6, 1986 when Australian amateur Glenn Dawes

(6) noted it as a magnitude 7 object on patrol photographs. By this time, however, another Australian amateur, Mati Morel, had established a service through the Variable Star Section, RASNZ, whereby he produced and distributed preliminary charts for newly discovered and/or transient stellar objects. Such a service allowed for prompt and continuous follow-up observation.

Robert H. McNaught (6) of Siding Spring Observatory investigated survey plates and determined a magnitude range of 7 to 15 for this star and indicated its tendency to remain faint for extended periods of time. He also noted this star had previously been misidentified as the 11th magnitude CPD-39 9021 which lies only 33 arcsec to south of the variable. An accurate position determined by McNaught is (1950) 14h 31m 41s.54 –39 20' 13".2.

Early spectra obtained at Mount Stromlo Observatory indicated an F type star with strong hydrogen lines.

The long periods of faintness and its close proximity to the nearby CPD-39 9021 apparently contributed to its only recent 'discovery'. No doubt its location some 20 degrees from the galactic plane also aided its non detection for so many years, despite its maximum brightness and the regular photographic nova patrols which tend to concentrate closer to the Milky Way.

NSV6708 later appeared on VSS, RASNZ charts 885 and 886 (7) plus 932 and 933 (8) with a lettered sequence of comparison stars. V-magnitudes were later determined at Mount John University Observatory (9). These V-magnitudes have been used in the preparation of the light curve included in this paper.

In 1989 NSV6708 was assigned the official variable star designation V854 Cen.

The first major decline observed was that commencing in July 1987 as reported in IAUC 4419. Subsequent early declines were also reported in various IAU Circulars, including IAUC 4650 (1988), 4879 (1989) and 5203 (1991).

3. THE VISUAL LIGHT CURVE.

The light curve presented here is based on observations by the author, with the exception of a few estimates where the variable was either inaccessible from the author's observing site or when long periods of cloud prohibited observation. These additional observations have been gleaned from the various Monthly Circulars of the VSS, RASNZ.

All observations have been obtained using standard methods as described by Bateson (10) for the visual observer. Binoculars have been used to record the variable when near maximum light while a variety of telescopes used when it faded below 8.5 magnitude. The general observing season is from March through early October, though predawn observations can commence as early as December, thus allowing for a near continuous record of the star's behaviour. Conjunction with the sun occurs in November.

Figure 1 is the visual light curve of the first 3000 days since regular observation commenced. This covers the interval JD 2446600 to 2449600 (1986 July through 1994 October) and is based observations by the author (solid dots) as 5-day means when the variable is near maximum or as individual estimates when it is varying rapidly. These have been supplemented by observations from the Monthly Circulars of the VSS, RASNZ (open circles).

Perhaps the most striking feature of the light curve is the number of deep minima observed, one of which was still in progress at the end of the period under discussion. Clearly, V854 Cen is a very active member of the RCB class with 8 major declines, plus several distinct but brief fadings, occurring in only 8 years. Also, this star has spent close to 50% of this interval fainter than 8.0 magnitude.

The frequency of declines over this 8 year interval is compared to other well observed southern RCB variables in Table 2.

When at maximum light V854 Cen shows small variations between magnitudes 7.3 and 7.8 with occasional well defined but brief dips to the 8th magnitude or a little fainter. Such dips can be seen on the light curve near JDs 2446815, 2447585 and 2447725.

The 8 major declines observed thus far show a wide range in both amplitude and duration, as is typical for this class of variable. Minimum brightness recorded is near magnitude 14.5v but there appears to be some "scatter" in the visual results, possibly due to the faintness of the star when at minimum and the lack of comparison stars with reliable V-magnitudes at this level. The faintest currently designated comparison has V = 13.5.

Table 3 lists details of the 8 major events observed, including the pronounced but shallow fade which occurred during July/September 1993 (JD 2449200).

Column 1 gives the event number as indicated on the light curve for easy identification. Columns 2 and 3 list the dates of decline onset and initial minimum. Column 4 (DELTA-m) gives the amplitude of the initial decline and Column 5 (t/2) the time in days for the star to fade half its brightness to that prior to decline onset. Column 6 (T) gives the time in days for the fall from magnitude 8.0 to minimum light, clearly showing the generally rapid decrease following the initial onset phase. The segmented nature of events 5 and 6 are clearly evident here. Column 7 gives the total duration in days the star remained below magnitude 8.0.

The dates given here are subject to the usual accuracy associated with a visual light curve but are sufficient for the purposes of this paper.

With the exception of events 3 and 4, V854 Cen has shown a tendency to produce declines of initial gradual decrease in brightness, comparable to the " slow" declines referred to by Lawson in his study of R Coronae Borealis. V854 Cen would appear to be a good candidate star, because of its regular activity, for photometric monitoring to further test Lawson's relation between pulsation period and the onset of decline events, plus the relation between "red" and "blue" colours and rates of initial decline.

5. CONCLUSION

V854 Cen has been shown through visual monitoring over the first eight years of regular observation to be a very active member of the RCB class of variable stars and is thus ideal for detailed photometric and spectroscopic study. It also clearly warrants close attention by amateur observers to ensure a complete and detailed history of its variations are obtained.

6. NOTE ON AVAILABILITY OF DATA.

Observations of any variable star on the observing programme of the Variable Star Section, RASNZ are available on request. These can be supplied as computer printouts, light curves or on

disks. A small charge is made to cover costs. All requests should be sent to the Director: Dr. Frank M. Bateson,
P.O. Box 3093, Greerton,
TAURANGA, N. Z.

7. ACKNOWLEDGEMENTS. The auhor wishes to thank Frank Bateson for his interest and guidance in the preparation of this paper. He also wishes to thank the referees for their input and assistance with additional and updated information on the RCB and related stars.

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TABLE 1

RCB and Related Stars.

STAR	RA (2000) DEC	MAX vis	MIN vis	RASNZ CHART	NOTES
XX Cam	040839+532139	7.3	9.0	-	HdC (?)
HV 5637	051132-675600	14.8	?	966/967	LMC
W Men	052624-711118	13.9	?	443/444	LMC
HV 12842	054503-642424	13.7	<15	968/969	LMC
SU Tau	054906+190400	9.7	16.9	-	
UX Ant	105708-372339	12.2	<14	1006/1007	
UW Cen	124317-543141	9.1	15	919/920	
Y Mus	130548-653048	10.4	?	602/603	
DY Cen	132534-541447	12.5	<15	610/611	Hot RCB (?)
V854 Cen	143448-393319	7.3	15.0	932/933	
S Aps	150925-720345	9.6	15.2	no.num	
R CrB	154834+280924	5.8	14.8	-	
RT Nor	162419-592042	10.2	14.0	934/936	
RZ Nor	163242-531709	11.2	14.0	351/352	
V517 Oph	171520-290526	11.5	<14.5	645/647	
WX CrA	180850-371946	11.4	15	380/381	
V3795 Sgr	181324-254724	12.0	14.2	578/580	
VZ Sgr	181509-294224	11.2	15	612/614	
RS Tel	181851-463254	9.8	<14	376/377	
GU Sgr	182416-241529	10.1	<14	110/111	
V348 Sgr	184020-225429	11.7	<15	401/402	Hot RCB (?)
MV Sgr	184432-205716	12.7	<15	450/451	Hot RCB (?)
FH Sct	184515-092549	12.1	<15	-	
V CrA	184732-380931	8.3	14	473/474	
SV Sge	190812+173742	10.4	<15	-	
RY Sgr	191633-333118	6.2	14	no.num	
V482 Cyg	195944+335830	12.1	<15	-	
U Aqr	220320-163740	11.0	14	586/587	Galactic Halo?
UV Cas	230213+593642	10.6	<15	-	

Hydrogen Deficient Carbon Stars (HdC Stars)

HD137613	152748-251011	7.5	7.6	-	NSV7085
HD148839	163546-670737	8.3	8.4	-	NSV7820
HD173409	184627-312034	9.5		-	
HD175893	185847-293917	9.3		-	
HD182040	192310-104210	7.0	7.1	-	NSV11960

Table 1.
Currently recognised RCB and related stars plus hydrogen deficient carbon stars (HdC stars). (Adapted from Kilkenny 1992).

TABLE 2

STAR	OBSERVED FADES	STAR	OBSERVED FADES
V854 Cen	8	WX CrA	4
UX Ant	1	V3795 Sgr	2
UW Cen	3	VZ Sgr	2
Y Mus	nil	RS Tel	1
S Aps	3	GU Sgr	1
R CrB	2	V CrA	4
RT Nor	1	RY Sgr	2
RZ Nor	4	U Aqr	1
V517 Oph	3		

Table 2.
Frequency of major fades detected in well observed southern RCB stars, 1986 through 1994, compared to V854 Cen. R CrB is also included for comparison.

TABLE 3

EVENT	DECLINE ONSET	INITIAL MINIMUM	DELTA-m (vis)	t/2 DAYS	T DAYS	DURATION DAYS <8.0	
1	6968	6995	4.4	26	13	141	
2	7396	7422	6.5	22	9	144	
3	7786	7799	2.6	13	10	21	
4	7878	7901	6.9	16	9	279	
5	8310	8358	3.7	16	35	230	(1)
6	8621	8766	6.9	76	139	428	
7	9127	9221	1.1	30	17	86	(2)
8	9415	9447	7.1	24	18	(?)	(3)

Notes for Table 3:
(1) Initial decline of 3.7 magnitudes in 21 days, followed by 18 day standstill near magnitude 11.0 then declined further 4.5 magnitudes in 14 days.
(2) Shallow but well defined fade.
(3) Fade in progress at end of period under discussion.

Table 3.
List of observed declines of V854 Cen, 1986 through 1994.

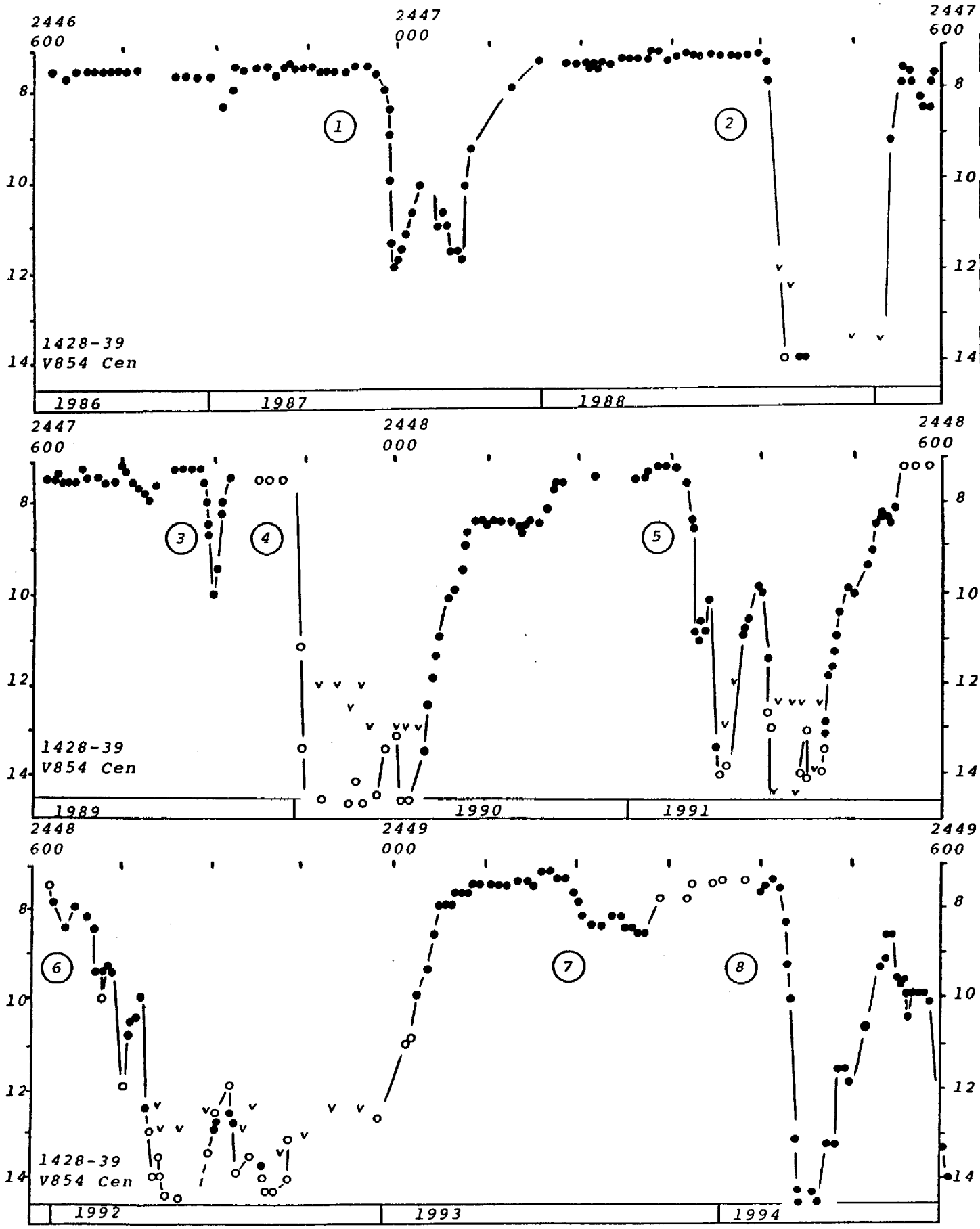

Figure 1. Visual light curve of V854 Cen covering the interval 1986 July to 1994 October.

V2051 OPHIUCHI NEEDS CLOSER ATTENTION

Frank M. Bateson
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SUMMARY: **A table of outbursts and flickering activity of the dwarf nova, V2051 Oph, is presented. Complete observations of one outburst are reproduced to show that observers can make reliable observations of the eclipses of this system provided they have a large enough telescope. The observations are discussed and it is shown that V2051 Oph requires close monitoring.**

. . . . . .

1. INTRODUCTION:

V2051 Oph has been classified as an AM Her star, Nova like (Nl), a dwarf nova possibly of U Gem type. Kholopov (1) terms it UG + EA with a range of 13.0 to 17.5V. However, he points out that it is usually around magnitude 15.0 whilst the depth of the eclipses is 2.5 magnitudes. Warner & Cropper (2) state there are considerable variations in the eclipse profiles and at times there is flickering on time scales of tens of seconds and longer, the longer having larger amplitudes of up to 0.4 mag. in 5 minutes. A detailed study of the spectrum of the system was published by Watts, Bailey et al (3).

V2051 Oph is in many respects similar to Z Cha and OY Car but there appears to be no evidence that it belongs to the SU Uma type of dwarf nova as might be expected from it being below the period gap.

The ephemeris of the eclipses is:
Min. HJD = 2,444,787.321141 +
0. 062427860^d E (Kato) (4)

2. OBSERVATIONS

V2051 Oph is shown on charts 575/6/7 (5) with a sequence of comparison stars with V magnitudes. All observations were made visually using these charts and their sequence. There appears to be no possibility of an observer misidentifying the variable.

Almost all the possible outbursts and times of flickering listed in Table 1 are due to Danie Overbeek and Bill Goltz. The former had a threshold of about mag. 13.8 so that most of his observations were negative as he could only see the brighter outbursts. Bill Goltz had a threshold of around mag. 15.0 and the flickerings listed are due to him. I asked Rod Stubbings to pay close attention to faint dwarf nova in recent years and outbursts 51 to 54 inclusive are due to his observations supplemented by results from Peter Nelson. Both used telescopes with thresholds around 15.0 mag.

The main observing season is March through October with usually a few observations in February and November. There are large gaps in the data despite the efforts of the two main observers, Goltz and Overbeek.

3. DISCUSSION

It is obvious from Table 1 that V2051 Oph has outbursts with a peak brightness

between mags. 13.0 and 13.7. These probably have durations exceeding 5 days. The mean maximum magnitude from the ten bright outbursts in Table 1 is 13.40. It is impossible to state the mean cycle for these due to the gaps in the records. The cycle is probably long.

There was a problem in deciding whether the fainter peaks in Table 1 were merely due to flickering or were faint outbursts for which only one or two positive observations had been made. The remarks to Table 1 show that in other cases there were positive observations around the date shown which may be flickering or part of an outburst.

The excellent records of outburst No. 54 clearly demonstrates that outbursts of around mag. 14.2 do occur. I therefore suggest that it is possible, but not certain, that the maxima between mags. 14.0 and 14.5 are outbursts and fainter peaks are due to flickering.

I suggested to Rod Stubbings that he made very frequent observations of V2051 Oph and of SU UMa dwarf novae during outbursts, because I knew that he was an exceptionally skilled observer. The results for observation of outburst No. 54 are given in Table 2, which includes preceding and following negative observations as well as those from other observers.

The respective columns of Table 2 give:

(1) GJD of observation accurately timed.
(2) Magnitude. If preceded by a minus sign it means V2051 Oph was invisible and fainter than mag shown.
(3) Code for observer as given in footnote.
(4) Sky conditions on scale of 1 to 3: 1 = good; 2 = inferior; 3 = very poor.
(5) The degree of reliability the observer attaches to his result on scale of 1 to 3.
1 = reliable;
2 = not so good due to hindrance to seeing conditions;
3 = not reliable.

The variations strongly resemble those in a normal outburst of Z Cha and OY Car. Two eclipses were observed. The difference between the points taken as the mid-eclipses gives an eclipse period of 0.0624^d - a remarkable achievement for visual observing.

No information can be given on the depth of the deep minima as these are well below the thresholds of the instruments used.

4. CONCLUSIONS

V2051 Oph has bright outbursts at long intervals with a mean maximum magnitude of 13.40. There are probably shorter and more frequent outbursts with peak brightness around 14.4. Flickering appears to occur rising to 0.2 to 0.3 mags. above the normal minimum brightness of 15.0.

Eclipses occur with V2051 Oph becoming invisible and fainter than mag. 14.7. It is presumed that during eclipse the magnitude falls to the reported minimum of 17.5 but no evidence can be given on this. The duration of the eclipses appears to be about nine minutes and the observations give the eclipse period as 0.0624^d.

V2051 Oph requires much closer monitoring. Observers with telescopes with thresholds of mag. 15.0, or fainter, are requested to make observations as frequently as possible and, when an outburst is seen to observe every few minutes until the outburst ends.

I conclude that a skilled visual observer, provided they can observe to at least mag. 15.0, can make very accurate observations of the eclipses and flickering.

V2051 Oph may be a SU UMA dwarf nova with superoutbursts but this can only be proved, or disproved, by very close monitoring. The data to date is insufficient to decide this question one way or the other.

ACKNOWLEDGEMENTS

I thank all observers for their data, especially Bill Goltz and Danie Overbeek for their efforts over such a long time. Rod Stubbings has demonstrated how accurate visual observing can be and, without his contribution in recent years, this paper could not have been written.

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REMARKS TO TABLE 1

3 Doubtful
5 "
6 "
7 Possibly a wide maximum as also 14.3 on 267.
8 Was 14.7 on 290
11 Fading 14.8 on 529.01; 15.0 on 529.263.
13 Fading 14.5 on 617.128; 14.7 on 617.935; 14.7 on 622.025.
14 14.7 on 693.95 & 701.928; 15.0 on 702.949 & 706.930.
Possibly a brighter & wide maxima between these dates was not seen.
15 Also 14.8 on 025; 14.3 on 029; 14.8 on 030. Possibly a wide maxima with peak not seen.
18 14.8 on 710 & 712; 14.7 on 714.
20 Possibly a slow rise of 10 days.
24 Rise 5^d. At Max 2^d. Fall 6^d.
53 Rise 1^d. At Max 2^d. Fall 2^d.

TABLE 1

V2051 OPH - POSSIBLE OUTBURSTS & INTERVALS OF FLICKERING

No.	JD Max 24	Max $_{mv}$	Int. $_d$	Type	No. Obs.	
1	44,487	13.7	-	?	1	
2	45,076	13.0	(589)	?	1	
3	198?	14.0	122	?	1	
4	523	13.3	325	4^d?	2	
5	557?	13.0	34	?	1	*
6	577?	13.2	20	?	1	*
7	46,260	14.3	(683)	W?	2	*
8	287	14.4	27	?	2	*
9	316	14.7	29	?	1	
10	340	14.5	24	?	1	
11	529	14.8	189	?	2	*
12	562	14.8	33	?	1	
13	617	14.5	55	?	3	*
14	694	14.7	77	W?	4	*
15	47,019	14.8	(325)	?	4	*
16	056	14.8	37	W?	6	
17	078	14.8	22	W	3	
18	703	14.5	(625)	?	3	*
19	732	14.8	29	?	2	
20	747	14.5	15	W 12^d	5	*
21	776	14.7	29	N	2	
22	787	14.7	11	W 6^d	6	
23	802	14.7	15	?	1	
24	950	13.2	148	W 13^d	9	
25	975	14.8	25	W 8^d	4	
26	48,016	14.0	41	N?	5	
27	031	14.5	15	?	1	
28	046	14.0	15	?	1	
29	069	14.4	23	?	2	
30	098	14.5	29	?	2	
31	114	14.5	16	?	3	
32	130	13.4	16	W 5^d	7	
33	152	14.5	22	N?	2	
34	180	14.7	28	N?	4	
35	312	14.5	132	?	1	

TABLE 1 (Cont.)

No.	JD Max 25	Max $_{mv}$	Int. $_d$	Type	No. Obs.
36	48,332	14.3	20	N?	2
37	361	13.7	29	?	2
38	391	14.4	30	?	2
39	442	14.8	51	?	1
40	478	14.7	36	?	1
41	499	14.7	21	?	2
42	667	14.5	168	?	1
43	719	14.5	52	?	1
44	749	14.7	30	?	2
45	771	14.5	22	?	1
46	803	14.4	32	?	1
47	832	14.4	29	?	1
48	852	14.4	20	?	2
49	884	14.3	32	?	1
50	49,065	14.7	181	?	1
51	50,529	13.0	(464)	W?	3
52	627	13.8	98	N	5
53	668	13.7	41	W 5^d	
54	716	14.2	48	N 4^d	84

TABLE 2
V2051 OPH - OBSERVATIONS OF OUTBURST No. 54

G.J.D.	Mag.	Obs.	Sky	Class
2450693.2000	-13.80	Ov		
693.8965	-14.50	SX	1	1
695.2000	-13.80	Ov		
695.9201	-14.80	SX	1	1
696.3000	-13.50	Hz		
696.9174	-14.30	SX	1	1
697.0007	-14.50	Nl	1	1
698.9514	-14.50	SX	2	1
699.9800	-15.00	Cj		
700.9764	-13.80	SX	2	1
703.9278	-13.80	SX	2	1
705.0076	-13.80	SX	2	1
707.9104	-13.80	SX	2	1
708.8972	-14.00	SX	2	1
709.8951	-14.50	SX	1	1
711.9313	-14.50	SX	1	1
711.9600	-15.00	Cj		
712.2000	-13.80	Ov		
713.9292	-14.30	SX	1	1

G.J.D.	Mag.	Obs.	Sky	Class
2450714.2000	-13.40	Ov		
714.9431	-14.30	SX	1	1
714.9875	-14.50	Nl	1	2
715.9236	14.30	SX	1	1
715.9264	14.20	SX	1	1
715.9285	14.30	SX	1	1
715.9313	14.30	SX	1	1
715.9354	14.30	SX	1	1
715.9382	14.30	SX	1	1
715.9389	14.30	SX	1	1
715.9431	14.20	SX	1	1
715.9458	14.30	SX	1	1
715.9500	14.20	SX	1	1
715.9528	14.20	SX	1	1
715.9563	14.20	SX	1	1
715.9590	14.20	SX	1	1
715.9611	14.20	SX	1	1
715.9639	14.20	SX	1	1
715.9660	14.30	SX	1	1
715.9674	14.40	SX	1	1

TABLE 2
V2051 OPH - OBSERVATIONS OF OUTBURST No. 54 (Cont.)

G.J.D.	Mag.	Obs.	Sky	Class
2450715.9681	14,50	SX	1	1
715.9694	-14.70	SX	1	1
715.9701	-14.70	SX	1	1
715.9708	-14.70	SX	1	1
715.9715	-14.70	SX	1	1
715.9722	-14.70	SX	1	1
715.9729	-14.70	SX	1	1
715.9736	-14.70	SX	1	1
715.9743	14.70	SX	1	1
715.9750	14.50	SX	1	1
715.9757	14.30	SX	1	1
715.9764	14.30	SX	1	1
715.9771	14.30	SX	1	1
715.9778	14.30	SX	1	1
716.2000	-13.40	Ov		
716.9236	14.20	SX	1	1
716.9310	14.00	Cj		
716.9313	14.20	SX	1	1
716.9347	14.20	SX	1	1
716.9382	14.20	SX	1	1
716.9417	14.20	SX	1	1
716.9458	14.20	SX	1	1
716.9493	14.20	SX	1	1
716.9528	14.20	SX	1	1
716.9563	14.20	SX	1	1
716.9590	14.20	SX	1	1
716.9611	14.20	SX	1	1
716.9618	13.90	Nl	1	2
716.9625	14.00	Nl	1	2
716.9632	14.00	Nl	1	2
716.9632	14.20	SX	1	1
716.9639	14.10	Nl	1	2
716.9646	14.00	Nl	1	2
716.9646	14.20	SX	1	1
716.9653	14.10	Nl	1	2
716.9660	14.10	Nl	1	2
716.9660	14.20	SX	1	1
716.9667	14.40	Nl	1	2
716.9674	14.30	SX	1	1
716.9674	14.40	Nl	1	2
716.9681	14.30	Nl	1	2
716.9681	14.30	SX	1	1
716.9688	14.40	Nl	1	2

G.J.D.	Mag.	Obs.	Sky	Class
716.9688	14.70	SX	1	1
716.9694	14.70	Nl	1	2
716.9694	-14.70	SX	1	1
716.9701	14.70	Nl	1	2
716.9701	-14.70	SX	1	1
716.9708	-14.50	Nl	1	2
716.9708	-14.70	SX	1	1
716.9715	-14.50	Nl	1	2
716.9715	-14.70	SX	1	1
716.9722	14.40	Nl	1	2
716.9722	-14.70	SX	1	1
716.9729	14.40	Nl	1	2
716.9729	14.70	SX	1	1
716.9736	14.40	Nl	1	2
716.9736	14.50	SX	1	1
716.9743	14.30	Nl	1	2
716.9743	14.40	SX	1	1
716.9750	14.30	Nl	1	2
716.9750	14.40	SX	1	1
716.9757	14.10	Nl	1	2
716.9757	14.30	SX	1	1
716.9764	14.10	Nl	1	2
716.9764	14.30	SX	1	1
716.9771	14.20	Nl	1	2
716.9771	14.30	SX	1	1
716.9778	14.10	Nl	1	2
716.9778	14.30	SX	1	1
716.9785	14.10	Nl	1	2
716.9785	14.30	SX	1	1
716.9792	14.10	Nl	1	2
716.9792	14.20	SX	1	1
716.9799	14.10	Nl	1	2
716.9875	14.20	SX	1	1
717.9580	14.50	Cj		
718.2000	-13.40	Ov		
718.9240	15.30	Cj		
719.2000	-13.40	Ov		
719.9868	-14.50	SX	1	1
719.9972	-14.50	SX	1	1
720.9271	-14.50	SX	1	1
720.9290	-15.60	Cj		
721.3000	-13.50	Hz		
721.9465	-14.50	SX	1	1

OBSERVER'S CODES: Cj = T. CRAGG Nl = P. NELSON SX = R. STUBBINGS
Hz = J. HERS Ov = D. OVERBEEK

CW MONOCEROTIS REQUIRES CLOSER MONITORING

Rod Stubbings & Ranald McIntosh
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SUMMARY: Outbursts of the dwarf nova, CW Mon, between J.D. 2,448,408 & 2,450,721 are listed. These add little to previous papers because of gaps in the data. It is essential that CW Mon is monitored more closely.

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1. INTRODUCTION

Bateson (1) discussed the results of visual observations of CW Mon showing it had two types of maxima. He concluded that its cycle of outbursts was about 160 days, but because coverage was poor many outbursts had been missed. He also gave details of charts and the V sequence.
CW Mon is type UG with a range of 11.9 to 16.3p and an outburst cycle of 121.7 days (2).

2. OBSERVATIONS

The observations discussed here cover the interval J.D. 2,448,408 to 2,450,721. The main observing season is September through May. There are large gaps in the records when it is impossible to observe CW Mon. These are shown in Table 1.

There are frequent gaps of several days during the main observing season. A total of 1,976 visual estimates were made during the interval reviewed here. Most were negative. The seven outbursts are shown in Table 2. The field around CW Mon is crowded. Two supposed outbursts were rejected as it was apparent that in each case the single positive estimate of 12.7 was that of a nearby comparison star. Negative observations on the same dates by very experienced observers showed that the variable was invisible and not at outburst.

3. DISCUSSION

Bateson (1) stated it was difficult to determine the outburst cycle precisely because of the gaps in the observations and the large intervals between outbursts. He selected nine intervals between outbursts from the 35 he listed. These intervals ranged from 74 to 206 days giving a mean cycle of 151.6 days. He added that if larger intervals were included the mean cycle was possibly around 160 days.

Seven outbursts are shown in Table 2 with intervals between them ranging from 182 to 589 days making it unlikely that any two were consecutive.

Table 1 lists the large gaps in the records when CW Mon is unobservable or badly placed. We tested Bateson's statement that it was impossible to accurately determine a mean cycle due to gaps in the observations. We selected for this purpose the smallest intervals in Table 2, i.e. 186 days between outburst 35 in Bateson's paper and our 36 and the 182 days between outbursts 39 and 40.

The former interval included 10 gaps of 2 days; 3 of 3 days; 2 of 4 days and 1 each of 8, 11 and 67 days.

The gaps in the second interval were 7 of 2 days; 2 of 3 days; 1 of 5 days; 3 of 6 days and 1 each of 10 and 79 days.

It is obvious that at least one outburst probably occurred during the very large gaps of 67 and 79 days. Gaps of 2 to 4 days are scattered throughout each interval. It seems unlikely that at least part of any outburst in these gaps would be observed. Gaps exceeding 4 days either immediately precede or follow the 67 and 79 gaps.

We made two assumptions based on the above details, i.e.

(1) That at least one outburst in each cycle has passed unobserved;

(2) That the length of individual cycles varies widely from one cycle to the next as is common with many UG stars.

The mean outburst cycle may possibly be around 151 days if assumption '1' is correct but much shorter if more than one outburst has not been observed in each cycle.

4. CONCLUSIONS

CW Mon is a typical UG dwarf nova with wide and narrow outbursts. The former are on the average half a magnitude brighter than the latter. Gaps in the observations make it impossible to be definite about the mean outburst cycle, which may be possibly about 150 days if only one outburst has been missed in each cycle. The mean cycle may be much shorter if two, or more, outbursts were unobserved in each cycle. Closer monitoring is required outside of the interval each year when CW Mon cannot be observed.

ACKNOWLEDGEMENTS

We are indebted to Frank Bateson for guidance and suggestions without which this paper could not have been written.

Observers are thanked for their estimates.

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TABLE 1

CW MON – LARGE GAPS IN OBSERVATIONS

48,403 - 48,469 = 67 days
48,774 - 48,840` = 67 days

49,129 - 49,213 = 85 days
49,499 - 49,571 = 73 days
49,847 - 49,936 = 90 days

50,227 - 50,293 = 67 days
50,602 - 50,663 = 62 days

TABLE 2

CW MON - OBSERVED OUTBURSTS

No.	JD Max 24	Max_{mv}	$Int._d$	$Width_d$	Type	No. Obs.	
36	48,488	12.1	186	?	?	2	*
37	729	13.3	241	?	?	2	
38	49,111	12.8	382	?	?	2	*
39	430	12.3	319	10	W	16	
40	612	12.2	182	5?	N?	5	
41	50,201	12.4	(589)	8	W	5	*
42	655	12.8	354	11	W	20	

VISUAL OBSERVATIONS OF THE 1995 ECLIPSE OF OW GEMINORUM

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SUMMARY: Visual observations of the 1995 eclipse of OW Gem are presented as daily means. These indicate the date of mid eclipse was 1995 Feb 12.7UT (GJD 2,449,761.1 +/- 0.1).

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1. INTRODUCTION

Variability of OW Gem (BD +17 1281, CVS102512, HD258878, SAO 095781) was first suspected in 1952 by Hill & Scholt (1). This led to its inclusion in the New Catalogue of Suspected Variable Stars (NSV) as NSV3005 (2). The authors of the NSV, however, considered this star as probably non variable. Its position for epoch 1950.0 from the NSV is RA 06h 28m 48s Dec +17deg 07'.2.

In 1988 American amateur nova search Daniel Kaiser (3) noted it as one magnitude fainter than usual on photographs taken on 21 March 1988UT when compared to previous patrol photographs. Prompt follow-up observations by Kaiser, M. Baldwin and D. Williams indicated variability consistent with an Algol type eclipsing system.

A subsequent search of the Harvard plate collection by Kaiser revealed 5 previously unreported eclipses between 1902 and 1933, suggesting a probable period near 3.4458 years (1258.56 days).

Based on this period, the first predicted eclipse was of 2nd September 1991 when the variable was poorly positioned with respect to morning twilight and bright moon. Successful photometry and visual results were reported by Hanzl et. al (4) and Bembrick (5). Dates of mid eclipse were determined as JD 2,448,502.58 and 2,448,502.1, respectively. Williams (6), using the same visual data as Bembrick but presented as daily means, determined the date of mid eclipse as 2,448,502.3. The average of these three values is 2,448,502.33.

An investigation into the physical properties of OW Gem by Griffin (7) revealed an interesting binary system consisting of an F2Ib-II giant of 5.9 solar masses with a giant G8IIb companion of 4.0 solar masses and respective rotation periods of 163 and 122 days. The orbital eccentricity is 0.52 and inclination only 1 degree from our line of sight.

A pairing of such stars poses interesting astrophysical problems making OW Gem an interesting star to follow over a number of cycles.

2. CHART AND OBSERVATIONS

All observations presented here were obtained visually using the comparison stars of V-magnitude given by Kaiser (3). These are shown on the chart produced here as Figure 1 in which the V-magnitudes have been rounded to the nearest 0.1 magnitude for use by visual observers.

A total of 168 observations were obtained by 17 observers. These are listed in Table 1 as daily means.

3. DISCUSSION

The daily means are plotted in Figure 2, in which the large dots represent original mean values, open circles represent single observations and small dots are points generated by a mirror image plot. This method assumes a symmetrical shape for the light curve.

These observations suggest a uniform rate of decline and recovery with mid eclipse occurring on 1995 February 12.7UT (GJD 2,449,761.2 +/- 0.1). This is 1258.87 days since the mean date given above for the previous eclipse.

This eclipse commenced on 1995 February 4.7UT (GJD 2,449,753.2) and ended on 1995 February 20.7UT (GJD 2,449,769.2), indicating a total duration of 16.0 days.

Mean minimum magnitude observed was 9.76v but as this was not at mid eclipse the true value is probably a little fainter than this.

Based on these observations the next eclipse of OW Gem will be centred on 1998 July 25 when it will be poorly placed with respect to the sun. Thus, the next favourable eclipse of OW Gem will not occur until 3rd January 2002.

4. CONCLUSION

The observations presented here indicate the date of mid eclipse was 1995 February 12.7UT (GJD 2,449,761.2 +/- 0.1), an interval of 1258.87 days since the previous event.

5. ACKNOWLEDGEMENTS

The author would like to thank the observers for their interest in this programme and to Frank Bateson for his guidance.

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TABLE 1 - OW GEMINORUM

Table 1. Daily mean magnitudes.

GJD 2440000+	MEAN MAG.	No.Obs	GJD 2440000+	MEAN MAG.	No.Obs
9740	8.1	1	9760	9.56	9
9741	8.2	1	9761	9.76	8
9742	8.25	2	9762	9.58	5
9744	8.20	2	9763	9.10	11
9747	8.22	5	9764	8.89	7
9748	8.20	2	9765	8.93	3
9749	8.21	7	9766	8.57	7
9750	8.34	8	9767	8.38	8
9751	8.5	1	9768	8.29	5
9752	8.28	10	9769	8.23	8
9753	8.23	4	9770	8.32	5
9754	8.30	2	9771	8.1	1
9755	8.34	9	9772	8.17	3
9756	8.47	6	9773	8.25	5
9758	8.67	6	9774	8.30	2
9758	8.93	7	9775	8.1	1
9759	9.09	7			

FIGURE 1 - OW GEMINORUM

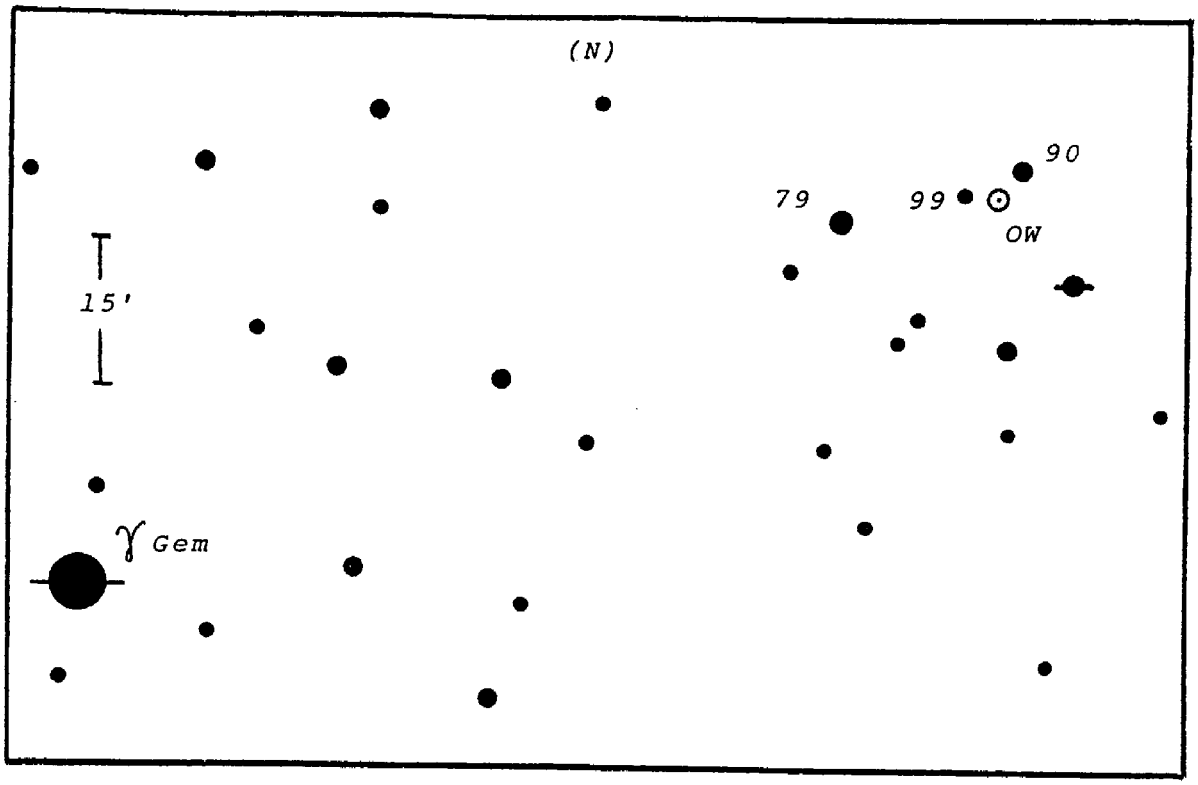

Figure 1. Identification chart for OW Geminorum.

FIGURE 2 - OW GEMINORUM

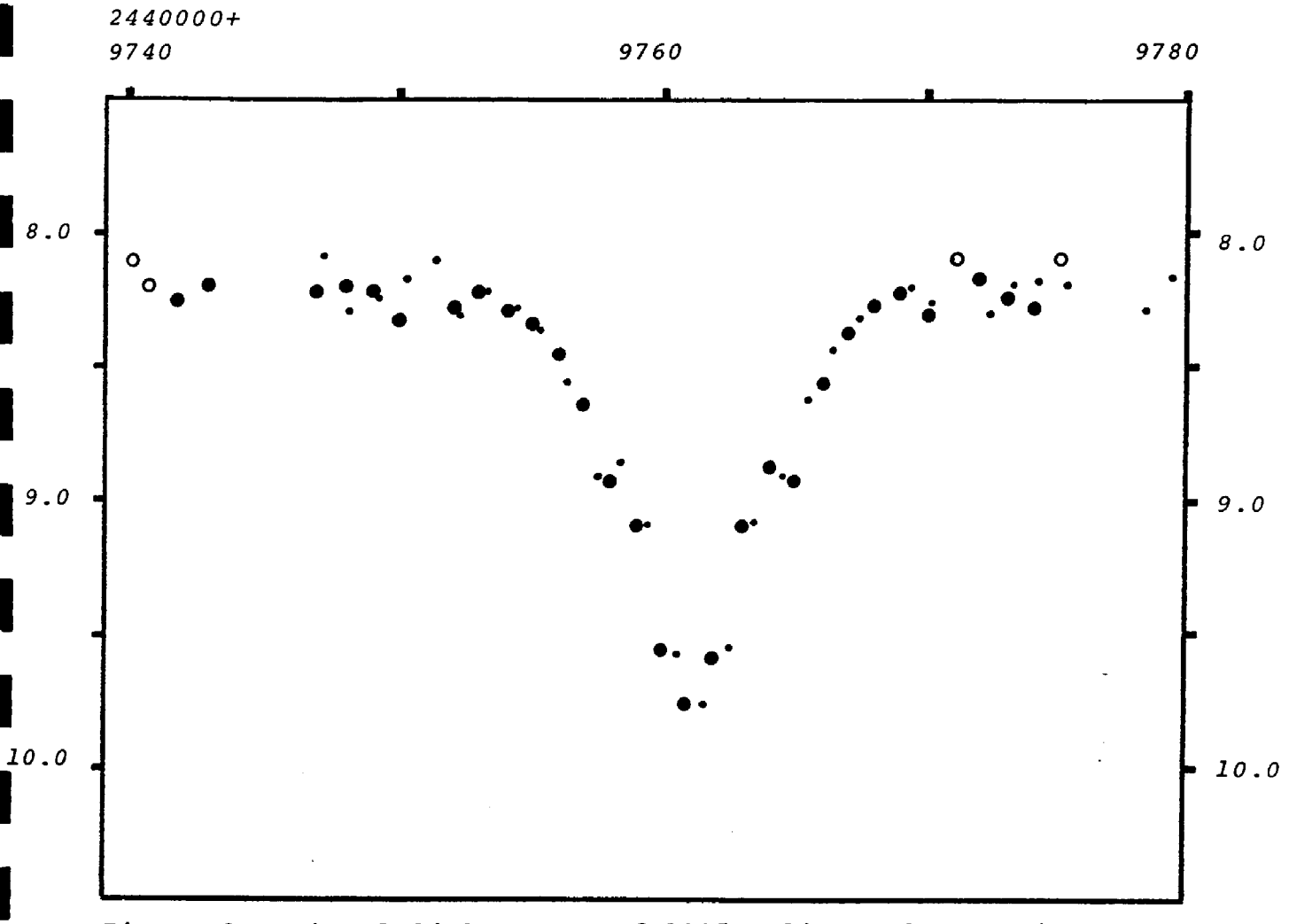

Figure 2. Visual light curve of 1995 eclipse of OW Geminorum.

THE MEAN CYCLE OF IK NORMAE

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SUMMARY: Observed outbursts of the dwarf nova IK Nor from decades of visual monitoring are tabulated. The mean maximum magnitude is 13.41. The mean cycle is about 260 days.

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1. INTRODUCTION

IK Nor is classified as a UG dwarf nova with a range of 12.9p to 16.3p with a possible cycle of 30 days (1).

Bateson (2) published a corrected position for IK Nor based on a photo taken by B.M. Lewis, Carter Observatory, during an outburst. Charts 542; 545 & 546 (3) have a V sequence by N. Vogt (4).

2. OBSERVATIONS

Observations to J.D. 2,445,915 were discussed by Bateson (5;6). The present paper continues the observations from J.D. 2,445,916 to 2,450,721. All observations were made visually by members of the Variable Star Section, R.A.S.N.Z. using charts 545 and 546 and the V sequence thereon.

IK Nor has been closely monitored especially by Albert Jones and Danie Overbeek. Their estimates were supplemented by regular but less frequent, estimates by other observers. The threshold of the two main observers is 14.0 under the best seeing and usually slightly brighter.

Care is necessary not to misidentify comparison star, magnitude 13.1 as IK Nor in small apertures. This comparison lies slightly N.E. of the variable. We are satisfied that observers have not wrongly identified IK Nor except in two estimates which have been eliminated from the discussion below. IK Nor was not monitored as closely prior to 1987 as it has been in the last ten years during which there are few gaps in the records exceeding 4 days. The exceptions to this occur at yearly intervals when the variable cannot be observed. These large gaps are listed in Table 1. The intervals listed are preceded and followed for about 30 days during which estimates are less numerous.

Table 2 lists the outbursts observed since the previous papers.

3. DISCUSSION

IK Nor has wide and narrow maxima. The duration of the wide maxima exceeds 5 days during which it remains visible brighter than magnitude 14.5. The duration of some outbursts in Table 2 could not be determined and have a question mark in column 5. Negative observations were used to determine the duration wherever possible.

The mean maximum magnitude is 13.41 with a possible tendency for wide maxima to be slightly brighter than narrow outbursts.

The mean cycle is 260 days with intervals between individual outbursts ranging from 98 to 418 days for those intervals reliably determined in Table 2 and in the earlier papers. There is no evidence for a short outburst cycle.

Many dwarf novae with short mean cycles belong to the Z Cam class. There is no evidence that IK Nor is a Z Cam star. UG variables often have faint outbursts peaking at about 1.0 to 1.5 magnitudes fainter than their brighter outbursts. This implies that IK Nor may have faint outbursts with maximum brightest between 14.0 to 15.0. It is surprising that in decades of close visual monitoring not a single example of faint maximum has been observed. There are many estimates by Bill Goltz and Andrew Pearce of negative estimates down to 14.5. Rod Stubbings in recent years has paid close attention to IK Nor to a threshold of 14.5. The only possible explanation from a very careful study of all the observations is that if IK Nor has a short outburst cycle many outbursts must peak around magnitude 15.0.

It appears probable that the visual magnitude at minimum is 17th magnitude, or fainter. There are scattered estimates by Nicholas Brown recording mainly negative observations from 16.0 to 16.8.

4. CONCLUSIONS

We conclude that IK Nor is a UG variable with a mean maximum magnitude of 13.41. The visual data give a mean outburst cycle of 260 days. There is no evidence for a short outburst cycle leading us to conclude that if there is a cycle of about 30 days there must be many outbursts that peak around magnitude 15, or fainter.

Minimum magnitude is probably fainter than 17.0.

ACKNOWLEDGEMENTS

Our appreciation goes to all observers whose observations have made this paper possible.

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TABLE 1

IK NORMAE - LARGE GAPS IN OBSERVATIONS.

J.D. 24 .....

47,113 to 47,178	=	66 days
47,474 to 47,533	=	60 days
47,833 to 47,881	=	49 days
48,204 to 48,269	=	66 days
48,576 to 48,625	=	50 days
48,924 to 48,993	=	70 days
49,305 to 49,358	=	54 days
49,667 to 49,717	=	51 days
50,046 to 50,083	=	38 days
50,403 to 50,452	=	50 days

TABLE 2

IK NORMAE - OBSERVED OUTBURSTS

No.	JD Max 24	Max $_{mv}$	Int. $_d$	Width $_d$	Type	No. Obs.
6	46,201	13.2	333	2	N	3
7	501	13.8	300	3?	N?	2
8	715	13.3	214	?	?	2
9	924	13.5	209	2?	N?	3
10	47,062	13.4	138	4	N	6
11	236	13.8	174	3?	N?	3
12	416	13.7	180	1	N	3
13	685	13.4	269	4?	N?	4
14	48,035	13.4	350	9	W	13
15	365	13.1	330	10	W	18
16	650	13.5	285	5?	?	4
17	879	13.2	229	2	N	3
18	49,046	13.1	167	?	?	2
19	464	13.2	418	3?	N?	4
20	597?	13.0	133?	?	?	1 *
21	874	13.4	277	?	?	1
22	50,241	13.0	367	10	W	12
23	581	13.3	340	7+	W	12

REMARKS TO TABLE 2: No. 20 very doubtful

THE DWARF NOVA BI ORIONIS

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SUMMARY: Observed outbursts of BI Ori are listed for the interval J.D. 2,445,718 to 2,450,721. The mean cycle is 22.1 days. The brighter outbursts have a mean maxima visual magnitude of 13.98; the fainter maxima of 14.54.

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1. INTRODUCTION

BI Ori is classified as a Z Cam dwarf nova by Kholopov (1); as UG by Downes (2). The present paper continues details of outbursts listed by Bateson (3).

2. CHARTS

Charts 464/5/6 published by Bateson et al (4) showed the comparison stars denoted by letters. V magnitudes for these were later circulated to observers and are listed in Table 1 for the benefit of new observers.

TABLE 1
V MAGNITUDES FOR BI ORI COMPARISON STARS

a = 11.7	e = 14.2
b = 11.9	f = 14.5
c = 12.3	g = 14.6
d = 12.1	h = 15.1

star = 13.7 15mm S & 24mm E of 'h' on chart 466

3. OBSERVATIONS

All observations were made visually. Table 2 lists the observed outbursts during the interval J.D. 2,445,718 to 2,450,721. The results must be treated with caution because many maxima depend on a limited number of estimates usually made close to the threshold of the aperture. The position of BI Ori means that there are large gaps in the records when the star was unobservable. The frequency of the observations also depended on when observers with larger apertures were monitoring.

We have combined the previous results by Bateson (3) with those in Table 2. The outbursts we consider to be consecutive have a mean cycle of 22.1 days. There appears to be two types of maxima – wide and narrow, or short. The former are usually but not always brighter than narrow maxima. The brighter maxima have a mean magnitude of 13.98 with a range of 13.2 to 14.2. The remaining maxima have a mean of 14.54 ranging from 14.3 to 14.9 although the true mean is probably fainter because these outbursts depend on very few estimates.

Figures 1 to 4 show :
(a) The large gaps in observations.
(b) That most estimates were negative.
(c) The short duration of outbursts.
No information can be given on minima which were fainter than 16.60.

We are inclined to consider that BI Ori belongs to the Z Cam class of dwarf nova but can offer no firm evidence to support this view because any standstills would occur at around 15.0-16.0 for which there are few observations.

4. DISCUSSION

BI Ori has a mean cycle of 22.1 days. More intensive monitoring with larger apertures is required to decide whether BI Ori is Z Cam or UG star. It has wide and narrow maxima. Many outbursts depend on very few estimates but there appears to be brighter outbursts with a

mean maximum magnitude of 13.98 and fainter ones with a mean of 14.54. Minima are fainter than 16.60.

We stress that our results should be treated with caution because the results depend mainly on when BI Ori was monitored by those with larger telescopes and hence the data is uneven in quality.

ACKNOWLEDGEMENTS
All observers are thanked for their results

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TABLE 2
BI ORIONIS - OBSERVED OUTBURSTS

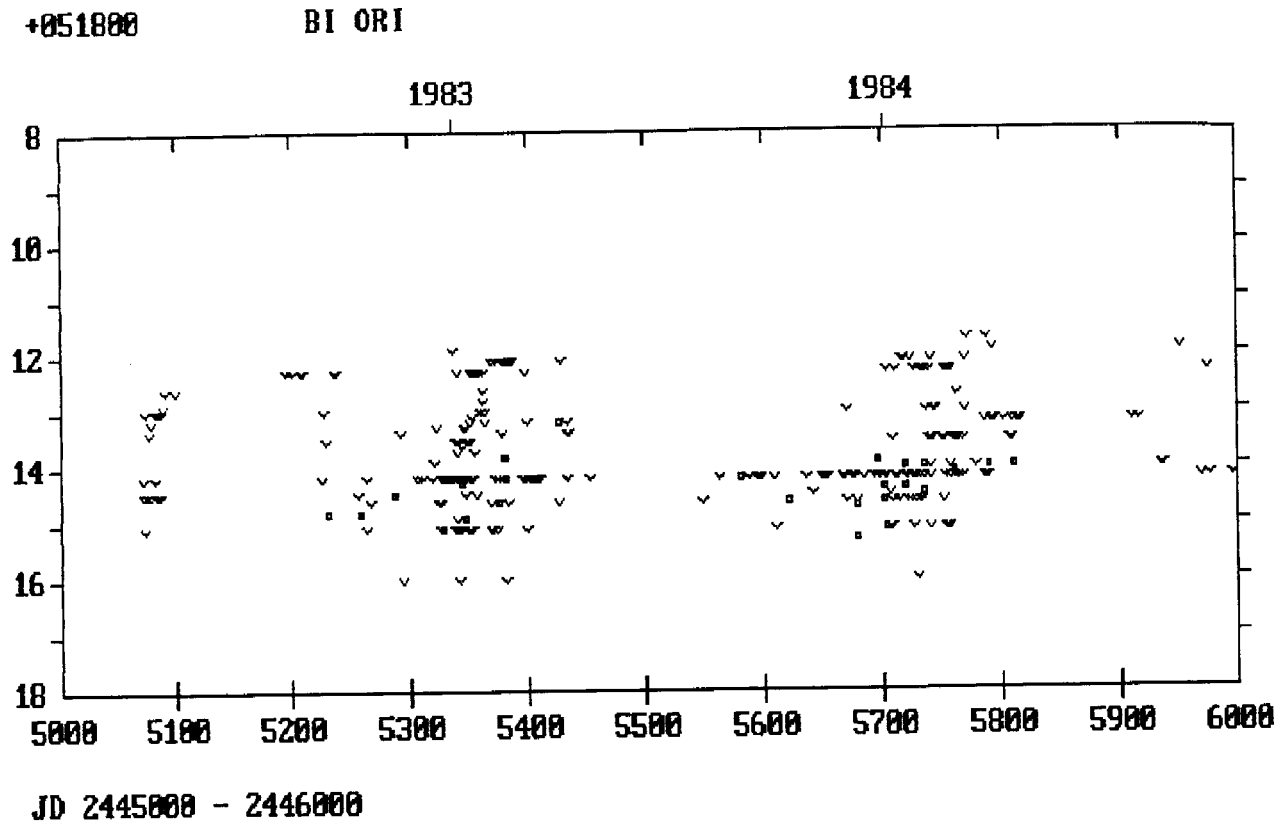
No.	JD Max 24.. ...	Max $_{mv}$	Int.$_d$	Width $_d$	Type	No. Obs.
26	45,719	14.0	23	1	N	2
27	736	14.0	17	1?	N?	2
28	760	14.1	24	2?	N	2
29	811	14.0	51	?	?	1
30	46,031	13.8	(220)	2	N	3
31	063	14.2	32	?	N?	2
32	077	14.3	14	?	N	2
33	105	14.4	28	?	N	1
34	330	14.0	(225)	?	?	1
35	377	14.3	47	?	?	1
36	437	14.1	60	6	W	5
37	469	14.1	32	?	N	2
38	774	14.1	(305)	?	N	2
39	851	14.0	77	?	?	1
40	47,140	14.8?	(289)	?	?	2*
41	183	14.0	43	4	W	10*
42	205	13.8	22	6	W	5*
43	512	14.0	(307)	?	?	1
44	595	14.1	83	?	?	1
45	835	14.6	(240)	?	N	2
46	851	14.6	16	?	?	4*
47	47,864	14.6	13	4	N	3*
48	884	13.8	20	7	W	7*
49	936	14.6	52	?	N	2
50	974	13.9	38	11	W	10*
51	48,162	14.1	(188)	3	N	4
52	236	13.8	74	8	W	9*
53	283	14.6?	47	?	N?	1
54	308	13.9	25	6	W	4
55	342	14.6?	34	?	?	1

TABLE 2 (Cont.)
BI ORIONIS - OBSERVED OUTBURSTS

No.	JD Max 24.. ...	Max $_{mv}$	Int.$_d$	Width $_d$	Type	No. Obs.
56	356	14.6?	14	?	?	1
57	978	13.9	(622)	?	?	2
58	49,042	13.9	64	?	?	2
59	358	13.8	(316)	?	?	1
60	721	14.0	(363)	?	?	1
61	739	13.8	18	?	?	2
62	763	13.2	24	?	?	1
63	805	14.0	42	4	N	3
64	986	14.6	(181)	?	?	1
65	50,038	14.7	52	?	N?	1
66	063	14.2	25	20	W	6*
67	078	14.6	15	1	N	2
68	094	14.6	16	2	N	2
69	110	14.2	16	3	N	3
70	151	14.2	41	3	N	4
71	50,360	14.2	(209)	9	W	15*
72	395	14.6	35	2	W	6
73	417	14.6	22	1	W	6
74	491	14.2	(74)	14	W	15
75	516	13.9	25	3	W	10
76	535	14.3	19	?	N?	1
77	554	14.2	19	2	N	3
78	675	14.2	(121)	1?	N	3

REMARKS TO TABLE 2

No. 40 Outburst probably brighter earlier. Gap of 17 days before 140. BI Ori continued to fade after 140.
41 Rise & fall observed.
42 " " "
46 Fall only seen.
47 Rise & fall observed.
48 " " "
50 " " "
52 " " "
66 A very slow rise & fall.
71 A very slow fall to 15.8.; Max possibly 13.8.



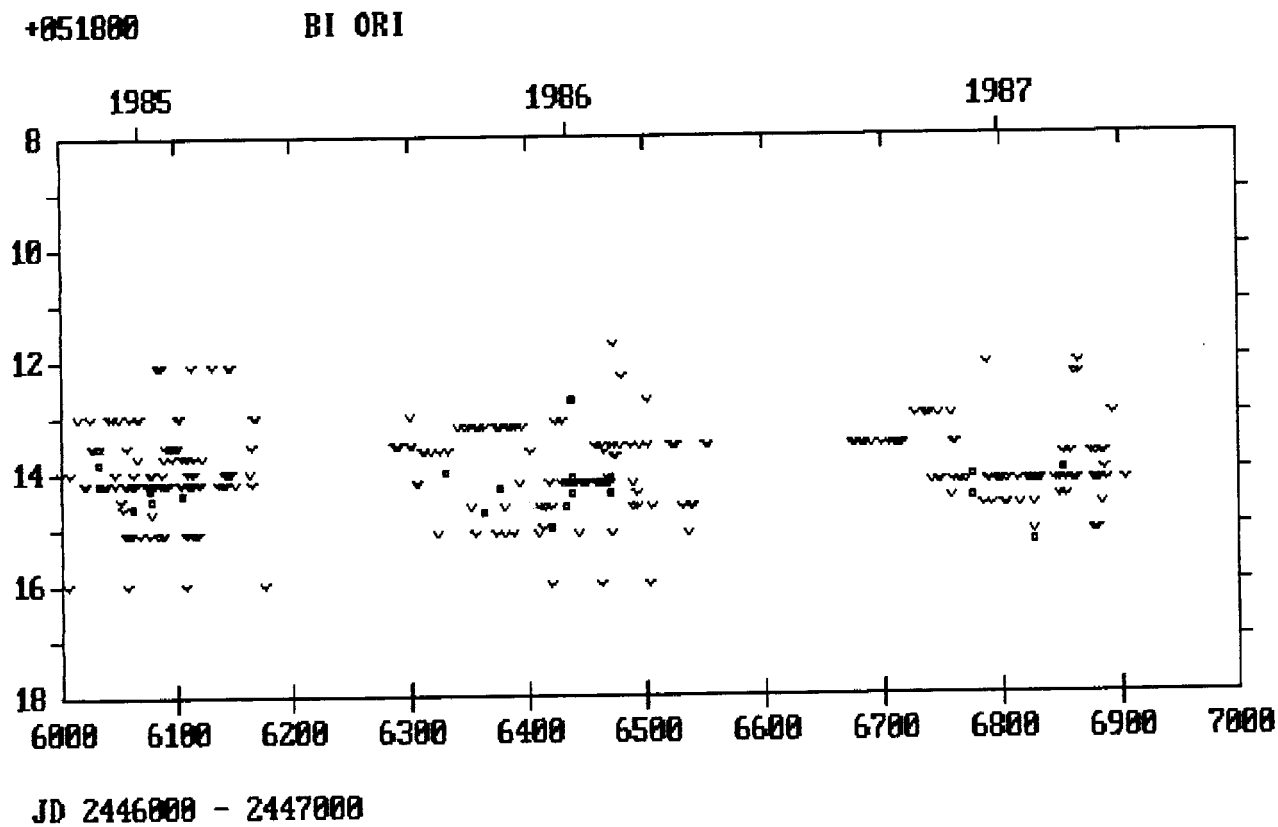
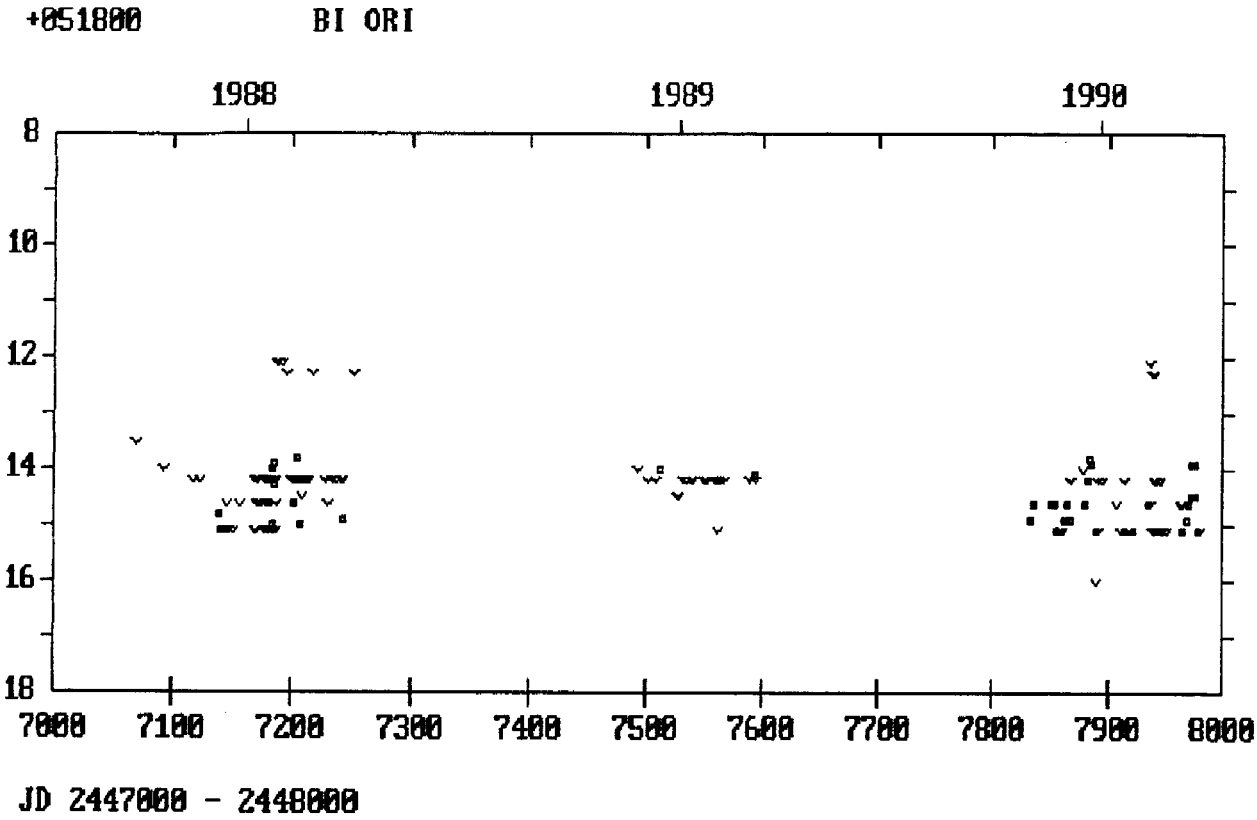


FIGURE 1

LIGHT CURVE FROM INDIVIDUAL OBSERVATIONS
J.D. 2,445,000 - J.D. 2,447,000



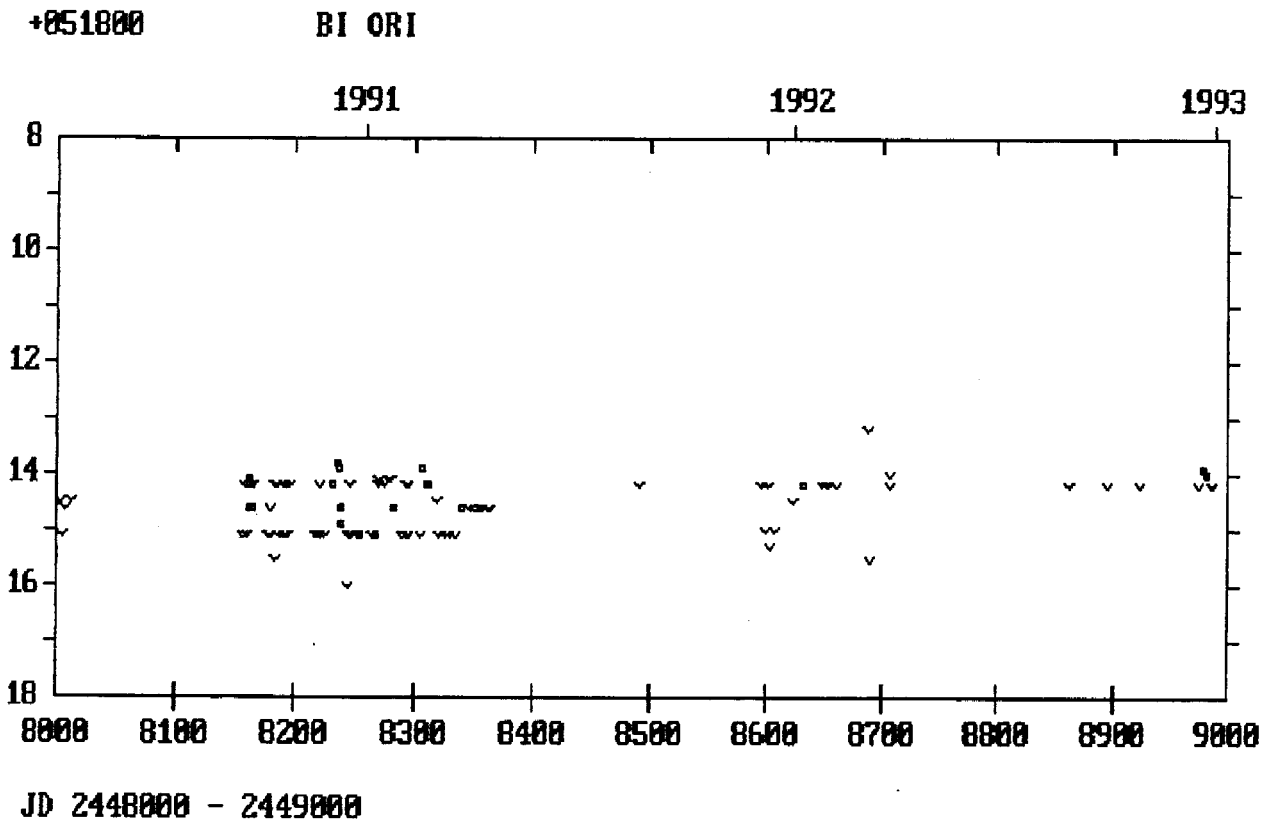
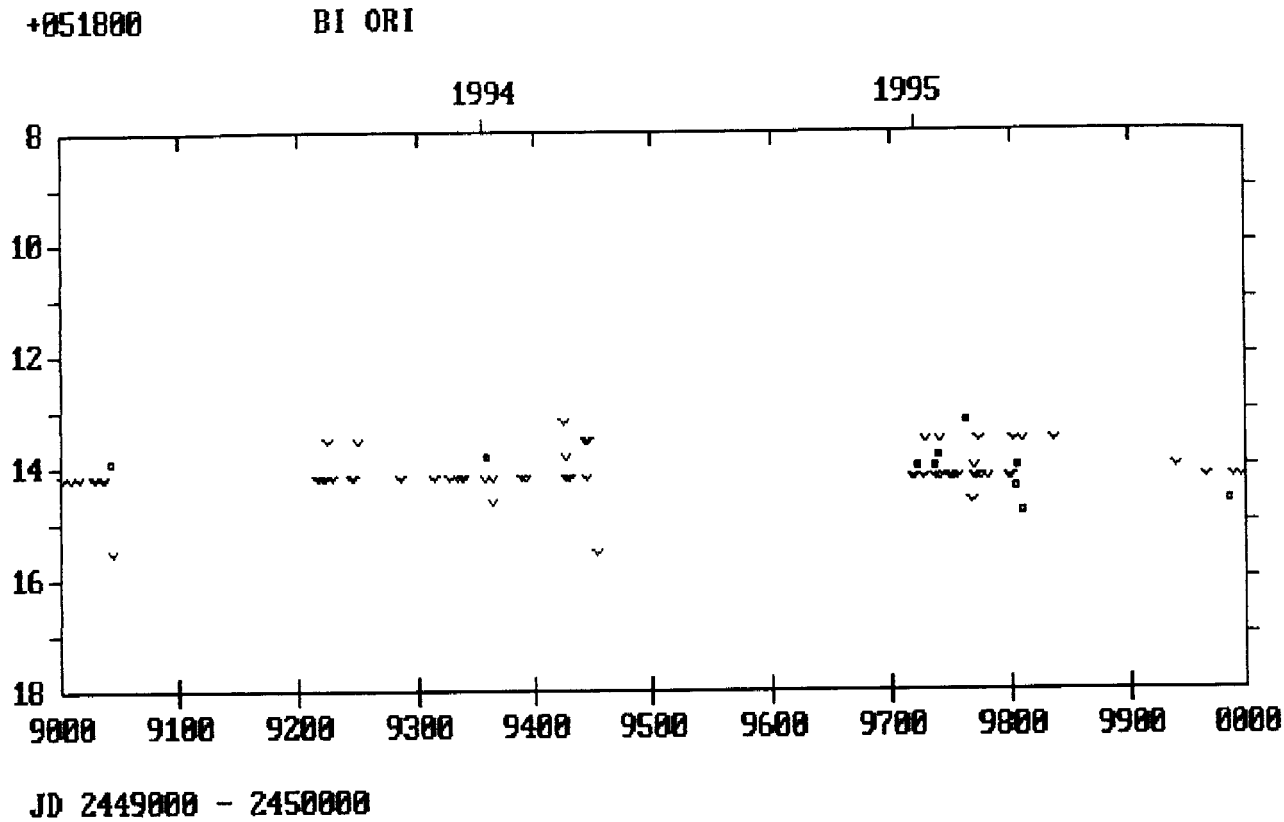


FIGURE 2

LIGHT CURVE FROM INDIVIDUAL OBSERVATIONS
J.D. 2,447,000 - J.D. 2,449,000



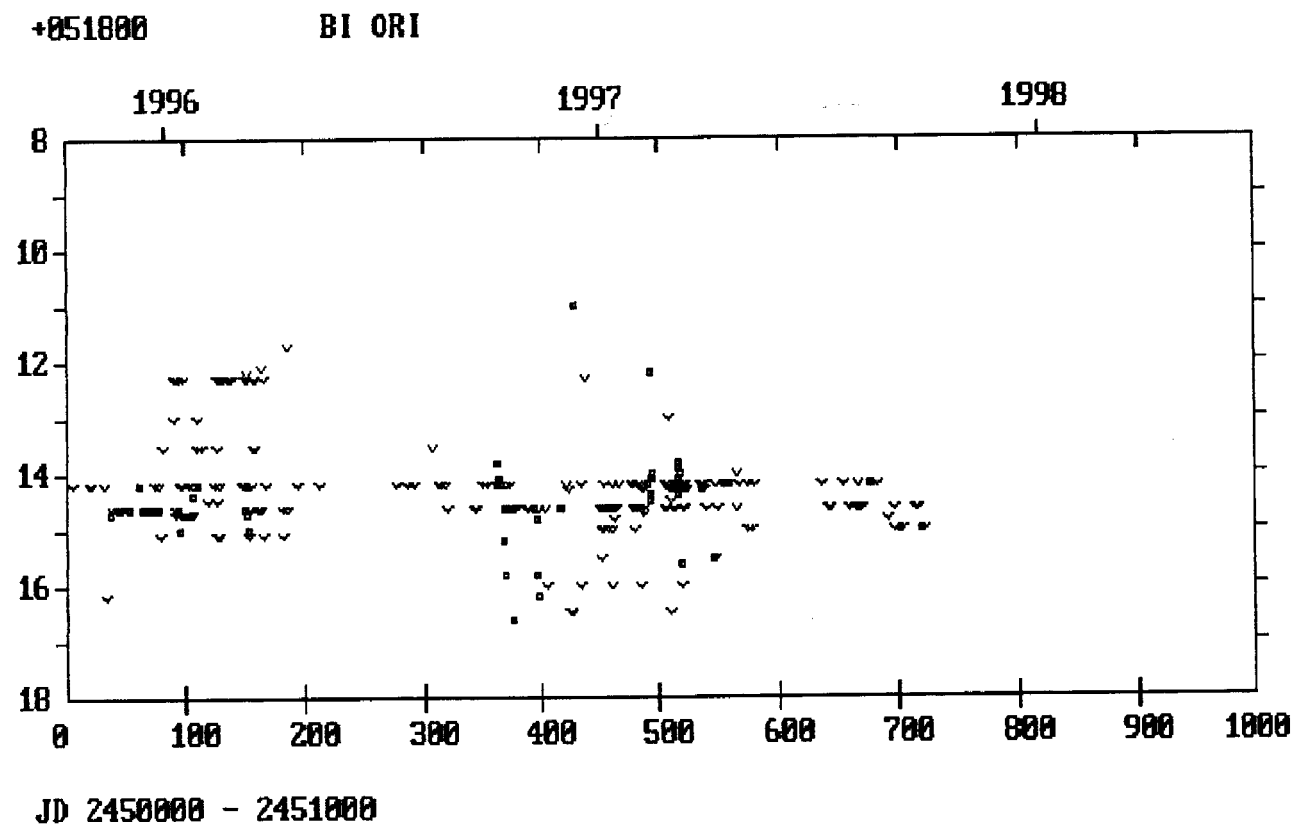


FIGURE 3

LIGHT CURVE FROM INDIVIDUAL OBSERVATIONS
J.D. 2,449,000 - 2,451,000

VISUAL PHASE PLOTS OF SOME BRIGHT CEPHEIDS

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SUMMARY: Phase plots based on visual estimates are presented for the southern Cephids RZ Vel, U Car, R Mus and V Cen. These show that an experienced visual observer can obtain useful data provided there is a good, reliable sequence of comparison stars.

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1. INTRODUCTION

A visual phase plot based on observations by the author (1) showed maxima of the bright southern cepheid U Car were occurring over one week later than predicted by published elements Kholopov (2). This prompted preparation of similar plots for other bright cepheids which were under observation or for which data had been obtained in recent years.

The stars chosen for this programme were those cepheids bright enough to be adequately followed through all of their light cycle from the author's suburban observing location with a pair of hand held 10 x 50mm binoculars i.e: stars brighter than magnitude 8.0v at minimum. This meant such observations could be obtained quickly and easily (usually less than one minute per observation) without absorbing unnecessary time which would otherwise be used on recognised programme stars. Cepheids have been included in the VSS observing programmes since 1930 but have received little attention in recent years. This paper may stimulate interest amongst both visual and photoelectric observers.

In 1971 Cragg (3) gave details of the "Classical Cepheid Programme" wherein he discussed suitable stars for the visual observer. These were described as being brighter than magnitude 12.0v, of at least one magnitude amplitude and with a period of 10 days or longer. Subsequent to this Cragg (4) published results for *l* Carinae in which he showed visual observations from 1970-76 were satisfied by the elements JD 2435619.7 + 35.5412 days, in good agreement with contemporary catalogue values (5) showing O-C residuals of essentially zero.

Two of the stars included here, R Mus and V Cen, do not satisfy the criteria set by Cragg and are dealt with under the separate section 4 (B). It is unlikely the methods employed here are of sufficient accuracy to reveal any period change but an inaccuracy in catalogue data in the order of 0.001 day may be evident after an interval of 30 years since the catalogue epoch.

Preliminary results for U Car were presented by Morel (6) who suggested this star would be well suited to the visual observer.

The accuracy of visual data has been discussed in several recent papers, including those of Lawson (7), Figer (8), Granslo (9) and Williams (10) in which the importance of a reliable V-magnitude comparison sequence of small increment

has been shown to greatly enhance the accuracy of visual magnitude estimates.

Published elements Kholopov (2) for many of the bright southern cepheids are based on data which is in some cases old. Examples include two of the stars in this study, namely RZ Vel whose epoch is JD 2434,845.57 (April 1954) and U Car at JD 2437,320.055 (January 1961). Any inaccuracies within the published period (or changes of pulsation period) will become evident over time where the star has undergone a sufficient number of cycles. This accumulated error will result in the displacement of the observed maxima as shown on a phase plot.

2. CHARTS & OBSERVATION

Few bright cepheids appear within the various Series of "Charts for Southern Variables" as these stars are generally considered unsuitable for visual observation. Of the stars covered here, RZ Vel and U Car appear on dedicated charts and R Mus is plotted on the finder chart for the faint semi regular EG Mus. V Cen lies adjacent to the field of the popular Mira type star R Cen. All of these charts show suitable comparison stars with reliable photoelectric V-magnitudes.

All observations presented here have been obtained by a single observer using hand held 10 x 50mm binoculars and standard methods for the visual observer as outlined by Bateson (11). A single magnitude estimate has been obtained for each star on a nightly basis, weather permitting, during the respective observing season.

Observations of each star have been sorted according to phase based on elements by Kholopov (2). These were then grouped into overlapping bins according to phase and a mean magnitude of each bin derived. The resultant phase plots are shown as Figures 1 - 4.

The observations have been obtained under a variety of observing conditions, including bright moonlight, and should therefore be treated with caution.

No attempt has been made to determine the dates of maxima for individual cycles of these stars.

3. DISCUSSION

Visual data derived for each of the stars discussed is summarised and compared to those of Kholopov (2) in Table 1. It is noted the resultant M-m values, the rise from minimum (m) to maximum (M), are consistently shorter than the corresponding published values. More detailed investigation may determine if this is real or merely demonstrate the difficulty in determining the actual points of 'M' and 'm' in visual data.

(A) LONG PERIOD CEPHEIDS

RZ Vel is plotted on chart 552 (12). Published details of this star are:

Epoch: JD 2434,845.57
Period: 20.398240 days
max: 6.42V min: 7.64V M-m: 0.30p

It is a bright classical cepheid of long period and well suited to visual observation. The phase plot shown as Figure 1 is based on 58 observations obtained during the 1993 observing season. This clearly shows the dates of maximum brightness are, within the limitations of the visual data and method of analysis, co-incident with those predicted by Kholopov (2).

RZ Vel shows a mean visual magnitude range of 6.7 to 7.9 and M-m 0.15p (3.06 days).

U Car is a bright classical cepheid shown on chart 452 (13). Published details are:
Epoch: JD 2437,320.055
Period: 38.7681 days
max: 5.72V min: 7.02V M-m: 0.21p

The phase plot shown as Figure 2 has been derived from 99 estimates obtained during the 1993 observing season. This clearly shows the observed dates of maximum are, at the time of observation, occuring some 0.20p (7.75) days later than predicted by GCVS data.

Similar plots from earlier observing seasons back to 1982 when regular observation commenced show a similar but smaller deviation. A difference in the 0-C dates was also noted by Morel (6) from his 1971 observations. Bateson (14) considered this discrepancy most likely the result of poorly defined catalogue data rather than physical change in the star. Kholopov (2) does, however, indicate a different period (38.753 days) during the earlier epoch JD 2415,000 – 2429,500.

Based on the observations here the mean visual range of U Car is 5.9 – 7.4. It shows a rapid rise to maximum with M-m 0.13p (5.04 days). This M-m is considerably shorter than the GCVS value but in good agreement with that previously obtained by Morel.

U Car would appear to be an ideal star for further study by more accurate methods with the aim of better defining its current period and M-m value.

(B) SHORT PERIOD CEPHEIDS

R Mus. The observations presented here were obtained by the author over a decade ago to test the viability of producing visual phase plots of cepheids. They are very limited in number but the results are now given to allow comparison with a larger series of observations currently underway.

R Mus is plotted on chart 641 (15), the finder chart for the faint semi regular variable EG Mus. The V magnitude sequence shown on this chart was supplemented by an additional comparison star to north west of the chart limits. This was found necessary when R Mus was at maximum. Details of this star are:
HD 107567 (Zeta-1 Mus) V = 5.74
B-V = +1.04 (16).

Published data for R Mus is:
Epoch: JD 2426,496.288
Period: 7.510211 Days
max: 5.93V min: 6.73V M-m: 0.30p

The phase plot shown as Figure 3 is based on 29 magnitude estimates obtained during 1984 June and July. From these, the mean visual range of R Mus is 5.9 to 7.0 with an M-m 0.18p (1.35 days).

V Cen. Current details of V Cen are:
Epoch: JD 2440,308.60
Period: 5.493839 days
max: 6.43V min: 7.21V M-m: 0.26p

Observations of V Cen were obtained at the request of C.S. Bembrick for his personal use in testing a computer programme then under development. This cepheid does not appear on a standard VSS chart but is conveniently located a little north of R Cen for which a suitable V-magnitude sequence is shown on chart 3 (11).

Figure 4 shows a phase plot based on 86 estimates obtained during the 1992 observing season. From these, the mean visual range of V Cen is 6.5 to 7.6 and the M-m 0.19p (1.04 days).

4. CONCLUSION

The visual observation of cepheid variables, while not as accurate as electronic techniques, can be successfully employed to draw attention to stars in need of further detailed study by more accurate methods, particularly in the southern hemisphere where published data dealing with longer period cepheids is in some cases now decades old.

Observations presented here indicate the variations of the bright southern cepheids RZ Vel, R Mus and V Cen are, within the limitations of visual data, in agreement with current GCVS elements. The results for U Car, however, show a clear discrepancy and suggest this would be an ideal star for further investigation.

5. ACKNOWLEDGEMENTS

The author would like to thank E. Budding and W.S.G. Walker for their valuable comments and suggestions and to Frank Bateson for his interest, advice and encouragement without which this paper would not have been published.

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Table 1.

Summary of derived visual data compared to that of Kholopov.

	Max	Min	M-m (days)	M-m (p)
RZ Vel				
GCVS :	6.42V	7.64V	6.12	0.30
VISUAL :	6.7v	7.9v	3.06	0.15
U Car				
GCVS :	5.72V	7.02V	8.14	0.21
VISUAL :	5.9v	7.4v	5.04	0.13
R Mus				
GCVS :	5.93V	6.73V	2.25	0.30
VISUAL :	5.9V	7.0V	1.35	0.18
V Cen				
GCVS :	6.43V	7.21V	1.43	0.26
VISUAL :	6.5v	7.6v	1.04	0.19

FIGURE 1 - RZ VEL

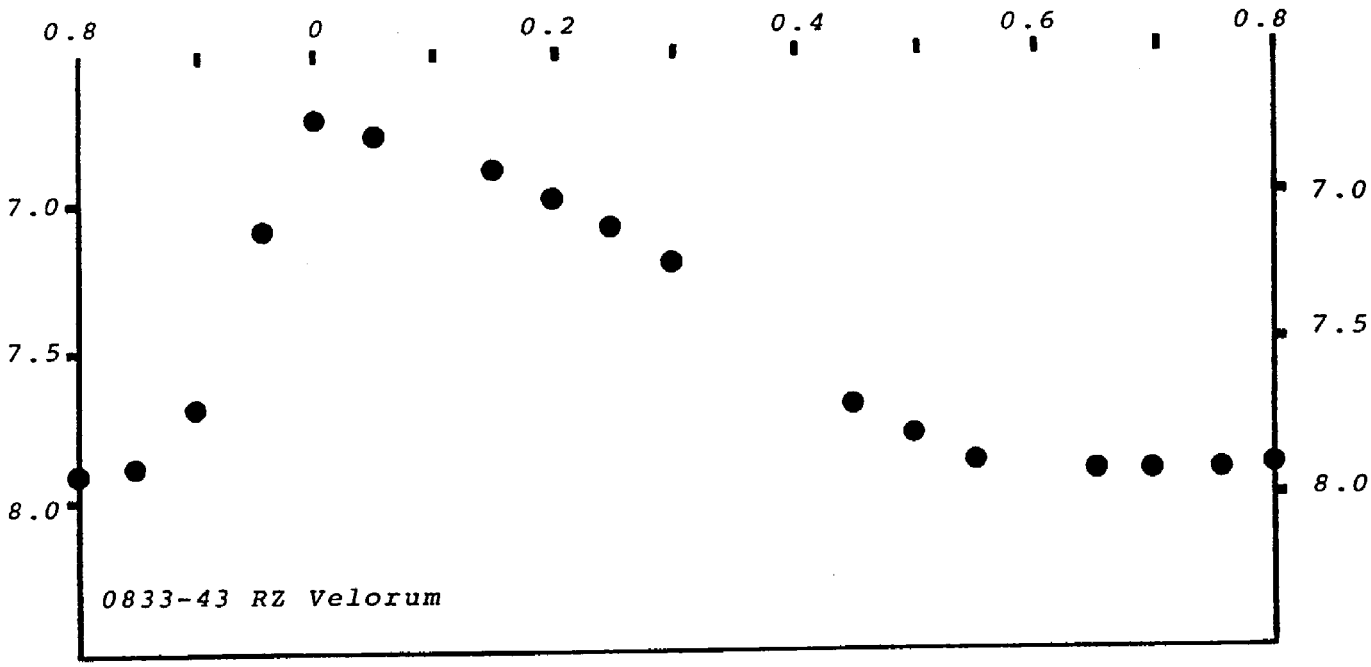

Figure 1. Visual phase plot of RZ Vel. 0.05p bins.

FIGURE 2 - U CAR

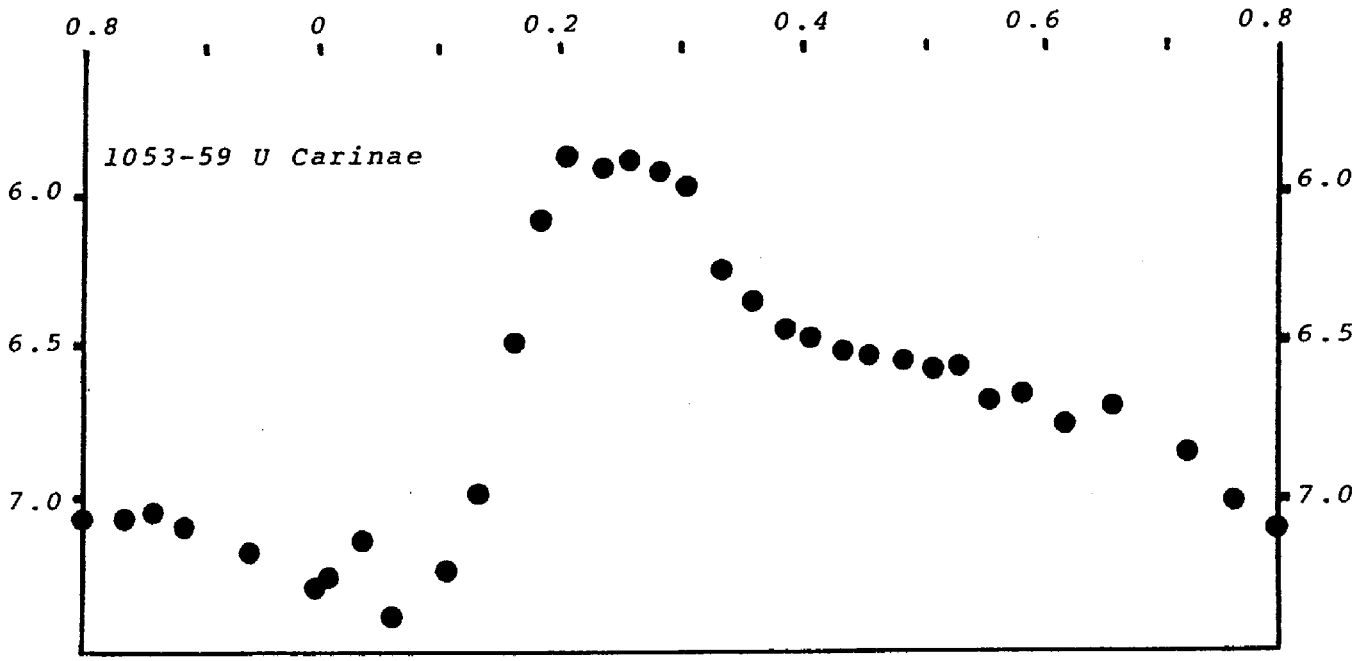

Figure 2. Visual phase plot of U Car. 0.025p bins.

FIGURE 3 - R MUSCAE

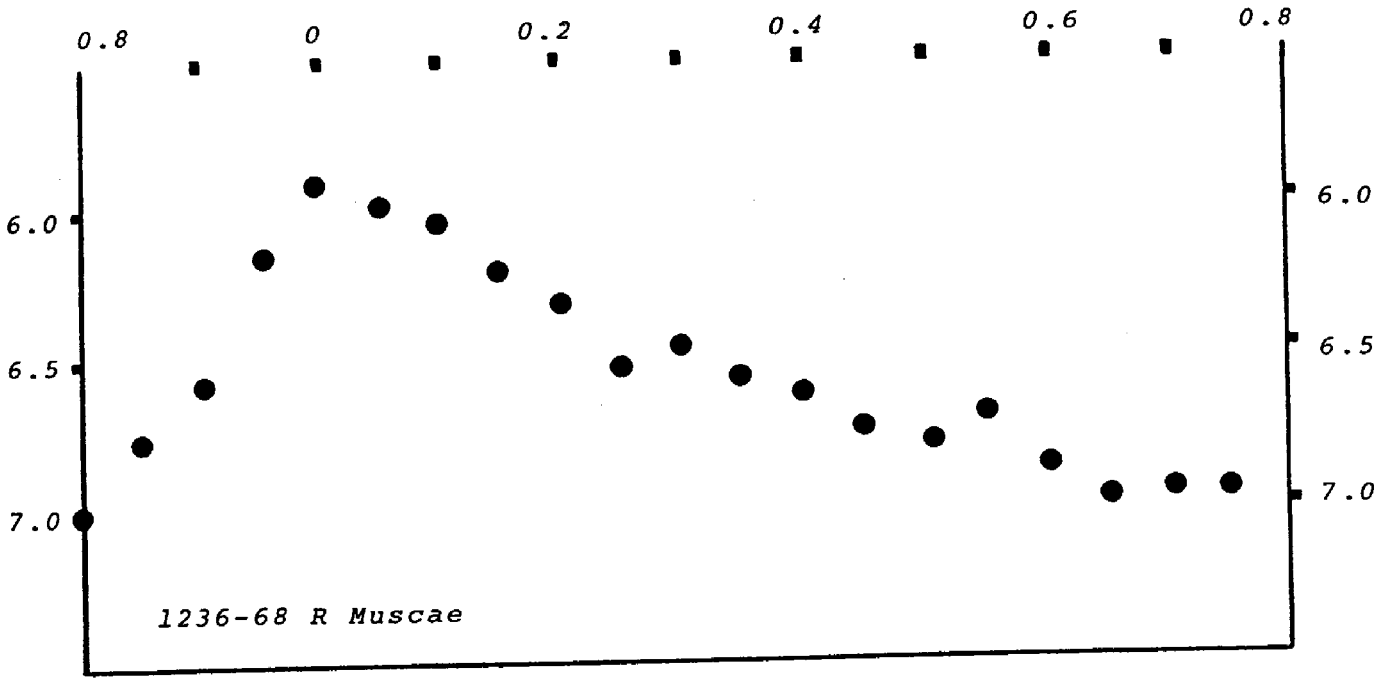

Figure 3. Visual phase plot of R Mus.. 0.05p bins.

FIGURE 4 - V CENTAURI

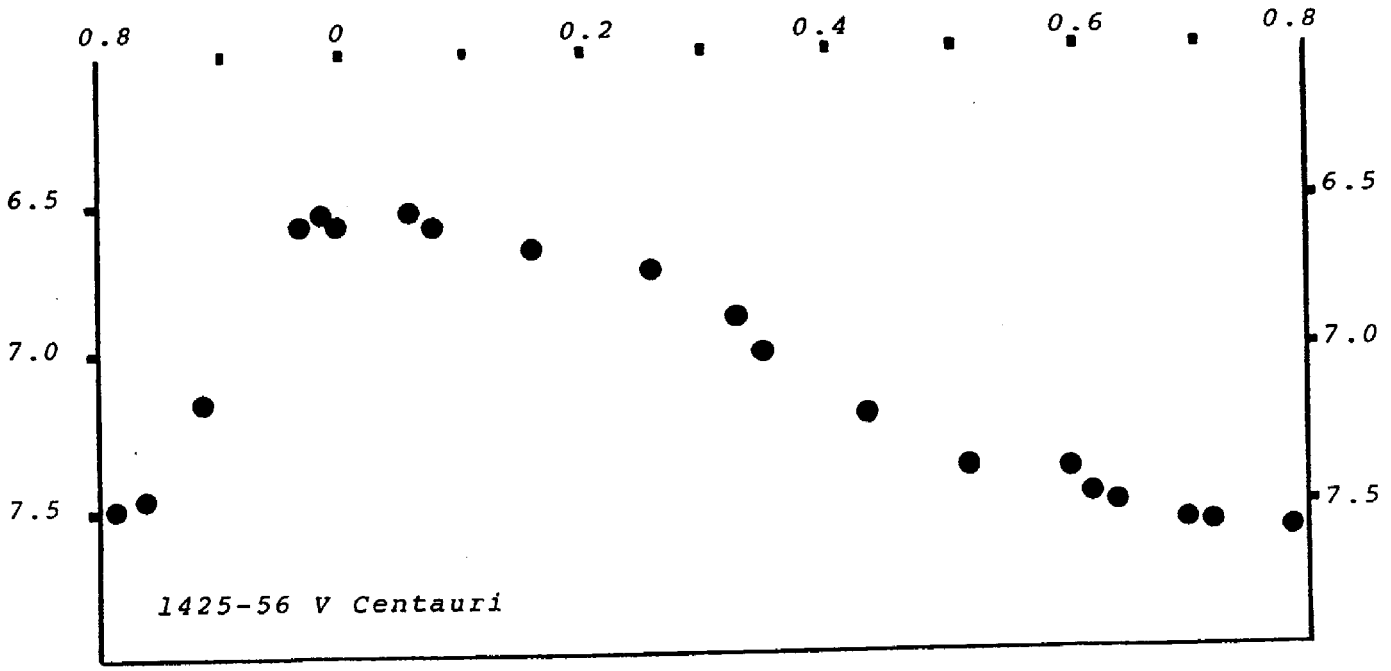

Figure 4. Visual phase plot of V Cen. 0.02p bins.

RESULTS OF MONITORING V1830 SAGITTARII OVER AN INTERVAL OF NEARLY 7,000 DAYS

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

SUMMARY: **Problems in visual observations of V1830 Sgr are discussed. Observed outbursts are listed. The mean maximum magnitude is 11.94. A possible mean cycle of 238 days needs to be treated with caution. The duration of maxima range from 2 to 15 days.**

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1. INTRODUCTION

V1830 Sgr is a dwarf nova of UG type with a range of 11.5p to 17.5p (1). A finder chart, No. 578, and detailed charts, 581 and 582 (2) show V magnitudes for the comparison stars.

2. OBSERVATIONS

Two previous papers (3:4) listed four outbursts of V1830 Sgr. These papers covered the interval J.D. 2,443,998 to 2,445,913 and is extended in the present paper to J.D. 2,450,721. The three papers cover monitoring over a period of 6,723 days during which 3,346 observations were made.

This field is very crowded with a comparison star, magnitude 12.0, just north of V1830 Sgr. The closeness of the two stars to each other means that it is easy to mistake the comparison star for the variable, especially in small telescopes. Each positive estimate has been evaluated in an endeavour to be certain that misidentification has not occurred. Some estimates were rejected because negative observations indicated that an outburst was unlikely. Other estimates were rejected because negative estimates were clearly in error as several observers estimated V1830 Sgr as at maxima on these dates.

Large gaps occur in the observations during the period when V1830 Sgr is unobservable due to conjunction with the sun. The observed outbursts since the previous papers are listed in Table 1. Outbursts 5 - 22 inclusive are mainly dependent on observations by Danie Overbeek, a very experienced observer who has monitored V1830 Sgr very consistently. Occasionally his estimates were supplemented by those from Nicholas Brown, Bill Goltz, Andrew Pearce and Peter Williams. All were in excellent agreement. The last two outbursts in Table 1 are the result of several observers giving closer attention to V1830 Sgr.

3. DISCUSSION

The four outbursts listed previously (3:4) are included in this discussion. A mean maximum magnitude of 11.94 is well established showing a range of 11.5 to 12.5. There are no signs of outbursts at fainter magnitudes as apart from the outbursts listed almost every other estimate was negative.

No information is available on minima. The faintest estimate was 16.80.

Determining the mean cycle was a problem because of the wide spread in

intervals between outbursts. It is almost impossible to be certain which maxima are consecutive. Two large intervals of 701 and 847 days were not included in determining a possible mean cycle because it was probable that these were not consecutive outbursts. Intervals of 31 and 19 days were also not counted because the dates were uncertain, depending on a single positive estimate in each case. The remaining 19 intervals give a mean cycle of 238 days, with intervals ranging from 73 to 436 days. The figure determined for the mean cycle should be treated with caution, because gaps in the observations imply that some outbursts passed unobserved in which case the mean cycle is probably shorter than 238 days.

Maxima are either wide or narrow. The former were usually better observed because of their longer duration resulting in a larger number of positive observations.

4. CONCLUSIONS

It is obvious that V1830 Sgr requires much closer attention with great care taken not to confuse the variable with the 12th magnitude comparison star immediately north of V1830 Sgr.

The mean maximum magnitude of 11.94 is considered accurate, but the mean cycle of 238 days is probably too long and should be treated with caution.

ACKNOWLEGEMENTS

My thanks are due to all observers. In particular it is the consistent monitoring by Danie Overbeek that has made this paper possible. I am also indebted to Ranald McIntosh for the print outs used in this review.

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TABLE 1

V1830 SGR - OBSERVED OUTBURSTS

No.	JD Max 24.. ...	Max $_{mv}$	Int. $_d$	Width $_d$	Type	No. Obs.
5	46,257	12.0	436	1?	N?	2*
6	362	11.7	105	6?	W?	2
7	527	11.8	165	2?	N?	5
8	558?	13.0	31	?	?	1
9	932	12.0	374	15	W	18
10	47,005	12.0	73	7	W	8*
11	098	12.5	93	?	N?	2
12	945?	11.9	847	4?	?	7*
13	48,346	11.6	401	?	N?	1
14	445	11.8	99	2	W	5
15	692	12.0	247	11?	W	11
16	49,039?	12.0	347	?	N?	1
17	175	12.0	136	14	W	12
18	194?	11.7	19	?	?	1
19	502	12.0	308	10	W	9
20	606	12.2	104	10	W	10
21	50,012	12.2	406	7	W	8
22	275	12.2	263	2	N	10
23	581	12.4	306	9?	W	19
24	716	12.0	135	7	W	26

REMARKS TO TABLE 1

5. Rose from <14.0 in 1^d; faded to <14.4 in 2^d.
10. Possibly faded to 13.6 on 007 & then brightened to 12.0.
12. A gap of 113 days before 945.

RESULTS FROM LONG TERM MONITORING OF BB VELORUM

Frank Bateson, Ranald McIntosh & Rod Stubbings
Variable Star Section, R.A.S.N.Z.

SUMMARY: **Decades of visual monitoring of the dwarf nova, BB Vel, are discussed. A mean cycle of 22.0 days was determined. The mean maximum for wide outbursts is 13.48; for narrow 14.25.**

. . . . . .

1. INTRODUCTION

BB Vel has a range of 13.8v to 17.9V and is at (Equinox 2000) 08h 36m 49s -47° 22" 39". Downes et al (1) . Warner (2) published a three colour sequence. Charts 366 & 367. (3) identified the comparison stars by letters. There are a number of faint comparison and field stars very close to BB Vel which in small telescopes could be mistaken for the variable. B. Sumner therefore prepared improved charts Nos. 1172 & 1173 (4). These showed Warner's V magnitudes rounded off to tenths.

2. OBSERVATIONS

Previous papers by Bateson discussed results from J.D. 2,443,183 to 2,448,408 (5;6;7). These are now continued to J.D. 2,450,721. We have combined all data from the previous papers in the discussion below.

The main observing season is December through July with a limited number of observations in other months.

Table 1 lists the outbursts observed from J.D. 2,448,409 to 2,450,721. Three observers consistently monitored BB Vel during this interval. They were Gordon Herdman; Danie Overbeek and Wes Taylor, who were using telescopes with thresholds of around magnitude 14.0 under the best seeing and a few tenths brighter on other nights. They could, therefore, detect only the brighter outbursts. The majority of the fainter outbursts were the result of observations by Bill Goltz whose estimates were made during most of the interval covered in Table 1. His data was supplemented by less frequent observations from Nicholas Brown, Tom Cragg, Jan Hers and Andrew Pearce whilst in the past three years one of us (R.S.) has paid close attention to BB Vel. All the foregoing are experienced and reliable observers well aware of the care needed to avoid confusing the variable with nearby stars. Their estimates were supplemented by infrequent observations from other members who usually did not observe BB Vel for long as they found it too faint.

3. DISCUSSION

Maxima have been termed either wide (W) or narrow (N) as in the earlier papers. Wide maxima are those with a width of 6 days, or longer, between 14.5 on the rise and fall. Narrow maxima have a width of 5 days or less. Naturally outbursts that were fainter at maximum

than 14.5 could not be assigned to a type although we suspect they were narrow. The mean maximum magnitude for wide outbursts is 13.48, ranging from 13.0 to 14.1. The mean maximum magnitude for narrow outbursts is 14.25, range 13.3 to 14.8.

It is obvious that many outbursts passed unobserved. It is difficult to be certain which outbursts were consecutive. We consider that those separated by intervals less than 40 days were probably consecutive. A mean cycle of 22.0 days was determined after omitting some maxima considered doubtful. Individual intervals ranged from 10 to 37 days.

There is some evidence that standstills occasionally occur at magnitudes 15.0 to 15.2 for 10 to 15 days. This would indicate that BB Vel is a Z Cam variable. The observations concerned are almost entirely due to one observer. However, we refrain from stating BB Vel is a Z Cam star until further evidence is obtained.

There is no information on minima because the faintest magnitude recorded is 16.0.

4. CONCLUSIONS

We consider BB Vel as a dwarf nova of U Gem type subject to verification that it has standstills just below magnitude 15.0 which may indicate that it is a Z Cam star.

The mean cycle is 22.0 days. Outbursts are either wide or narrow with mean maximum magnitudes of 13.48 and 14.25 respectively.

ACKNOWLEDGEMENTS

Our appreciation is due to all observers for their results.

REFERENCES:

(1) 1997. Downes, R.A; Webbink, R.F. & Shara, M.M. "A Catalog and Atlas of Cataclysmic Variables" 2nd ed. Pub. Astr. Soc. Pacific. Vol 109, No. 734.
(2) 1976. Warner, B. Publ. 4. Var. Star Sect. R. astr. Soc. N.Z. p.18.
(3) 1977. Bateson, F.M., Morel, M. & Winnett, R. Charts for Southern Variables. Ser. 9. Astronomical Research Ltd., Tauranga, N.Z.
(4) 1997. Bateson, F.M. & Morel, M. Charts for Southern Variables. Ser. 25. Astronomical Research Ltd., Tauranga, N.Z.
(5) 1982. Bateson, F.M. Publ. 9. Var. Star Sect. R.astr. Soc. N.Z. p. 8.
(6) 1985. Bateson, F.M. Publ. 12. Var. Star Sect. R.astr. Soc. N.Z. p.52.
(7) 1991. Bateson, F.M. Publ. 16, Var. Star Sect. R.astr. Soc. N.Z. pp.92-93.

TABLE 1

BB VELORUM - OBSERVED OUTBURSTS

No.	GJD Max 24.. ...	Max $_{mv}$	Width Int. $_d$	14.5 I-D$_d$	Type	No. Obs.
36	48, 546	14.7	(157)	-	N	1
37	586	13.4	40	13	W	8
38	630	14.8	44	-	N	1
39	652	14.8	22	-	N	1
40	694	13.5	42	12	W	6
41	715	14.8	21	-	N	1
42	752	14.4	37	-	N	1
43	766	13.3	14	8	W	16
44	950	13.3	(184)	?	N?	1
45	986	14.8	36	-	N	3
46	49 001	14.7	15	-	N	1
47	049	14.0	48	-	N	1
48	068	14.8	19	-	N	2
49	100	13.3	32	4	N	3
50	157	13.5	57	11	W	8
51	354	13.5	(197)	9	W	9
52	533	13.4	(179)	-	-	9
53	798	13.0	(265)	6	W	5
54	861	13.0	63	?	?	1
55	887	14.0	26	-	?	1
56	50,064	13.4	(177)	16	W	22
57	190	13.5	(126)	9	W	11
58	276	14.2	86	-	?	1
59	350	13.9	74	16	W	5
60	379	14.9	29	-	?	1
61	526	13.7	(147)	14	W	9

THE DWARF NOVA MM SCORPII PROBABLY HAS A SHORT MEAN CYCLE

Frank Bateson, Ranald McIntosh & Rod Stubbings
Variable Star Section, R.A.S.N.Z.

SUMMARY: **Observed outbursts of MM Sco during the interval JD 2,445,601 to 2,450,772 are listed. The mean maximum visual magnitude is 13.60 and the mean cycle 65.7 days but it is probable that the true value is much shorter.**

. . . . . .

1. INTRODUCTION

MM Sco is a dwarf nova of UG type with a range of 13.0B to 18.5B (Downes) (1). Position: (Equinox 2000) 17h 30m 46s – 42° 11' 40". Charts 485/6/7 were published (2) with a V sequence from Vogt (3). The present paper continues those previously published by Bateson (4;5).

2. OBSERVATIONS

A total of 2772 observations were made during the interval JD 2,445,601 to 2,450,722. Most were negative because the apertures used by the most consistent observers permitted estimates to magnitude 14.0 or slightly brighter. These were supplemented by spasmodic estimates from observers with larger apertures with thresholds down to 16.8.

One of us (FB) has recently requested observers with larger apertures to give closer attention to faint dwarf novae, such as MM Sco, in order that their mean cycles can be more accurately determined.

It should be noted that a comparison star, magnitude 13.9, lies very close to MM Sco and in small telescopes could be misidentified for the variable.

3. DISCUSSION

Table 1 lists the observed outbursts during the interval reviewed. We have combined the results in the two previous papers (4;5) with those now presented. The majority of outbursts depend on very few observations but, except for those marked with a question mark, we are satisfied that the estimates are correct.

The mean maximum visual magnitude is 13.60 with a range of 13.2 to 14.4. We conclude that only the brightest maxima have been observed, because most estimates were made with comparatively small apertures. We suspect that fainter outbursts occur but can offer no firm evidence on this due to the infrequent estimates below magnitude 15.0.

There are 12 maxima that may be consecutive although this is uncertain. The mean cycle from these is 65.7 days with individual cycles ranging from 10 to 166 days. The mean cycle may be considerably shorter if MM Sco also has fainter outbursts.

The main observing season is March through October. This is extended if morning observations are made when MM Sco emerges from conjunction with the sun. The very long intervals listed between outbursts indicates long breaks in the observations.

4. CONCLUSIONS

MM Sco belongs to the UG type of dwarf novae with wide and narrow maxima. The mean visual maximum magnitude

is 13.60 and the mean cycle 65.7 days. This cycle is probably shorter than 65.7 days if there are faint outbursts of around 15th magnitude that have not been observed.

ACKNOWLEDGEMENTS

We are indebted to all observers for their estimates. In particular we wish to record our admiration to Gordon Herdman, Barry Menzies and Danie Overbeek for their persistent monitoring of MM Sco.

REFERENCES:

(1) 1997. Downes, R.A., Webbink, R.F. & Shara, M.M. "A Catalog and Atlas of Cataclysmic Variables" 2nd ed. Pub. Astr. Soc. Pacific 109, No. 734.

(2) 1979. Bateson, F.M., Morel, M., Sumner, F. & Winnett, R. Charts for Southern Variables Ser 11. Publ. by Astronomical Research Ltd., Tauranga, N..Z.

(3) 1977. Vogt, N. Pub. Variable Star Sect. R.astr. Soc., N.Z. 5, p.45.

(4) 1982. Bateson, F.M. Pub.10 Var. Star Sect. R.astr. Soc., N.Z. pp.16;17.

(5) 1996. Bateson, F.M. Pub. 12 Var. StarSect. R.astr. Soc., N.Z. p.54.

TABLE 1
OBSERVED OUTBURSTS OF MM SCO

No.	GJD Max 24.. ...	Max $_{mv}$	Int. $_d$	Type	No. Obs.
18	45,600	13.5	166	?	2
19	46,185	12.9?	(585)	?	1
20	282	13.5	97	?	1
21	316	14.4	34	?	1
22	47,382	13.9	(1066)	W?	2
23	410	13.2	28	W	4
24	972	13.4	562	W	10
25	48,499	13.9	(1027)	N	2
26	917	13.9	418	N	3
27	49,565	13.5	648	?	1
28	628	13.4	63	?	1
29	951	14.0	323	N	1
30	50,212	14.0	261	W	4
31	596	13.8	384	W	7
32	712	13.9	116	W	23

VISUAL OBSERVATIONS OF THE 1994 ECLIPSE OF BL TELESCOPII

Peter F. Williams
Variable Star Section, R.Astr. Soc. of N.Z. & Sutherland Astr. Soc.
3 McAuley Close, Heathcote, NSW 2233, AUSTRALIA

SUMMARY: Visual observations of the 1994 eclipse of BL Tel are presented as daily means. The date of mid eclipse is determined as 1994 May 8.5UT (GJD 2,449,481.0) with a minimum magnitude of 10.0v.

1. INTRODUCTION

BL Tel is an Algol type eclipsing system classified as EA/GS+SR (1) of V magnitude 7.09 to 9.41 with small amplitude, semi regular variations (7.09 – 7.26V) of period 65.1 days sometimes evident outside of eclipse. The mean period between consecutive eclipses is given as 778.6 days (1) but the observed interval between eclipses, the amplitude and their duration are known to vary.

Visual results for the eclipses of 1983, 1985, 1987, 1990 and 1992 have been discussed (2, 3, 4). The 1990 eclipse was, however, poorly observed. Thus, the 1994 eclipse is the 5th such event to be successfully observed as part of a long term programme to visually monitor eclipses of BL Tel.

2. OBSERVATIONS

All observations discussed here have been made visually by those listed in Table 1 using the chart and comparison stars shown in (4). The observations are listed as daily means in Table 2.

These are plotted in the light curve shown as Figure 1 in which large dots represent original observations and small dots indicate points generated by a mirror image plot. This method assumes a symmetrical shape for the light curve.

A total of 125 observations were obtained by the 12 contributing observers.

3. DISCUSSION

The available observations indicate BL Tel reached mid eclipse on 1994 May 8.5UT (GJD 2,449,481.0), an interval of 778.0 days since the previous eclipse. The eclipse commenced on 1994 April 4.5UT(GJD 2,449,447.0) and ended on 1994 June 15.5UT (GJD 2,449,515.0), indicating a total duration of 68.0 days. Minimum magnitude attained during this eclipse was 10.0v.

Varying rates of decline and recovery have been previously noted (3 & 4). During the 1994 eclipse, BL Tel showed a gradual decline of 0.5 magnitudes in 10.5 days (0.05 mag/day) before commencing a more rapid decline of 2.5 magnitudes in a further 23.5 days (0.11 mag/day). Similar rates of change occurred during the return to maximum.

Based on the observed date of mid eclipse, the next eclipse of BL Tel is predicted to be centered on 1996 June 24UT when it will be a favourable evening object.

4. CONCLUSION

Visual observations of the 1994 eclipse of BL Tel indicate mid eclipse occurred on 1994 May 8.5UT, an interval of 778.0 days since the previous eclipse.

5. ACKNOWLEDGEMENTS

The author would like to thank the observers for their efforts and continued interest in this long term programme and to Frank Bateson for his guidance.

REFERENCES:

(1) Kholopov P.N. Ed 1987. G.C.V.S. 4th ed. Vol III, Nauka, Moscow.
(2) Williams P.F. 1985. Publ. Var. Star Section, R.astr.Soc. N.Z. No. 12 pp 8-10.
(3) Williams P.F. 1988. Publ. Var. Star Section, R.astr.Soc. N.Z. No. 14 pp 40-43.
(4) Williams P.F. 1992. Publ. Var. Star Section, R.astr.Soc. N.Z. No. 18 pp 11-16.

TABLE 1
LIST OF CONTRIBUTING OBSERVERS

FARRELL, F.	NATION, P.	TILBROOK, J.
GARLAND, B.	NELSON, P.	TREGASKIS, B.
HEARTFIELD, C.	SKILTON, P.	WILLIAMS, P.
MATTIAZZO, M.	STUBBINGS, R.	WILLIAMSON, L.

TABLE 2
DAILY MEAN MAGNITUDES

J D 2449	Mean M_v	No. Obs	JD 2449	Mean M_v	No. Obs
441	7.1	1	478	9.67	4
442	7.00	2	479	9.70	2
446	7.07	3	480	9.2	1
447	7.05	2	482	10.0	1
448	7.3	1	483	9.2	1
449	6.9	1	485	9.47	3
450	7.20	3	486	9.6	1
451	7.20	5	487	9.0	1
452	7.25	2	488	9.6	1
454	7.40	4	489	8.92	4
456	7.50	2	491	9.0	1
457	7.35	2	492	8.6	1
458	7.85	4	497	8.33	3
459	7.76	5	498	8.5	1
460	7.65	2	500	8.0	1
461	7.7	1	502	7.83	4
462	8.5	1	503	7.80	2
463	8.4	1	504	7.3	1
464	8.33	3	505	7.40	2
465	8.35	3	507	7.4	1
466	8.35	4	509	7.2	1
467	8.6	1	510	7.30	2
469	8.70	4	512	7.1	1
470	8.67	3	515	7.05	2
471	8.70	2	516	7.20	2
472	8.88	3	517	7.1	1
473	8.98	5	520	6.9	1
474	9.0	1	523	7.2	1
476	9.40	4	532	7.00	2
477	9.8	1			

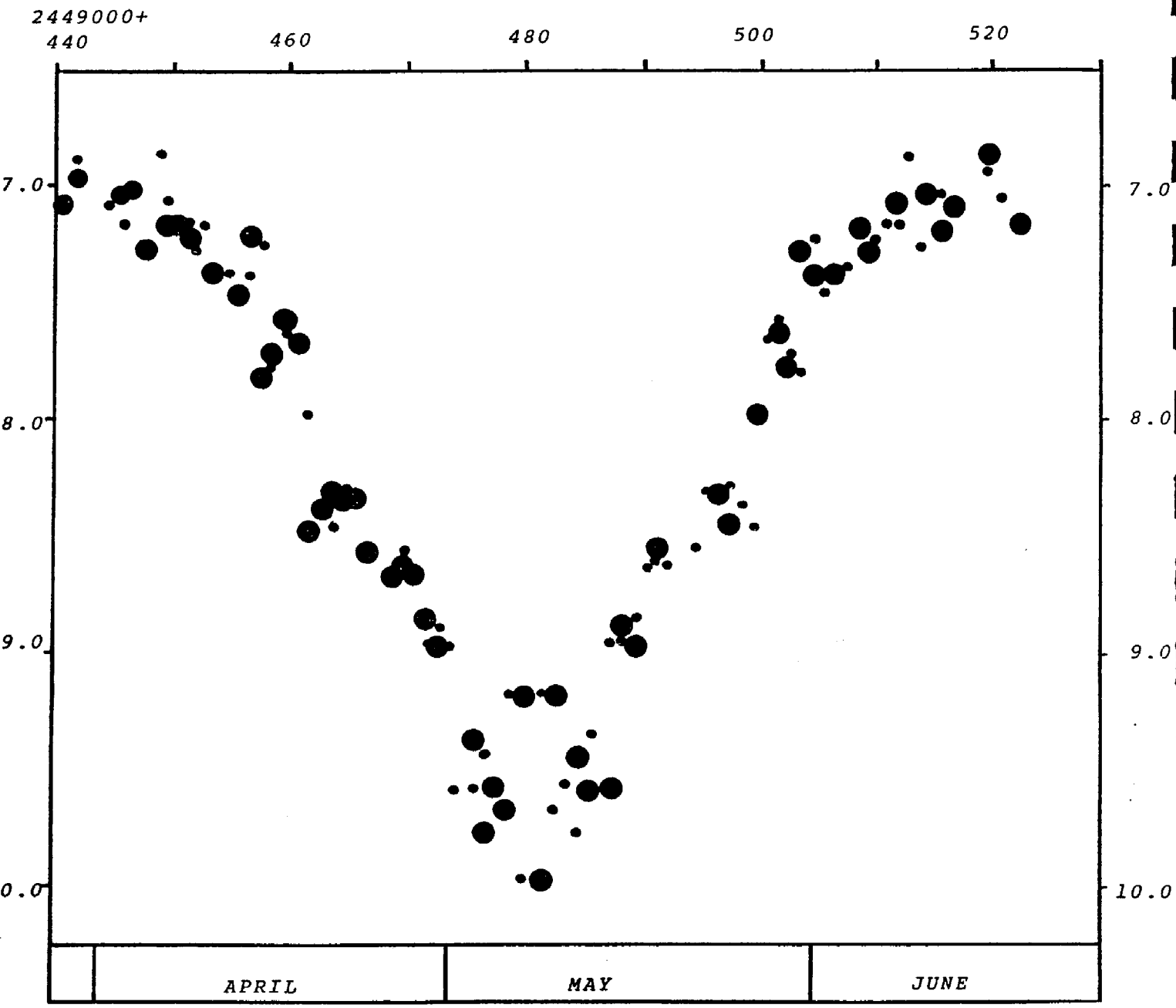


Figure 1. Visual light curve of 1994 eclipse of BL Telescopii.

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

FOR YEARS ENDED 31st DECEMBER 1994 & 1995

This report covers two years because there was no space in Publications for the 1994 report

1. OBSERVATIONS (1994) - 67,516
(1995) - 71,695

These totals are for programme stars. Totals for non-programme stars are not included for the reason given in the 1993 report. Observations from the B.A.A. as part of the co-operative programme with them are also omitted from the totals so that the totals reflect the work of Section members. The contributions from each member are shown in the Tables at the end of this report with diagrams illustrating the monthly totals. All totals are for the years ending on 31st August to provide strict comparison with previous years.

The two senior members, Danie Overbeek and Albert Jones, made their usual outstanding contributions. There was a marked improvement in the monitoring of variables at faint limits, especially in 1995, because several observers obtained larger apertures with thresholds of around magnitude 15. This combined with excellent coverage by younger members accounts for the steady increase in the number of observations.

2. REQUESTS FROM PROFESSIONALS.

Professionals have made extensive use of our data as the following examples demonstrate. These will show observers how valuable their dedicated observing is and how their data is fully used.

All requests from professional colleagues were supplied within a fortnight of receipt. Edited data was supplied on floppy disks or as computer print outs and computer light curves. This prompt service was made possible by the invaluable assistance of Ranald McIntosh.

SY MUS & RR TEL Observations of these two symbiotic variables made after the paper by Scott Kenyon and Frank Bateson were supplied to T. Dumn (Zurich) and Elia M. Leibowitz (Tel Aviv, Israel). The data was required for studies of the small amplitude variations, which are possibly periodic.

BX MON T. Dumn was sent fax messages giving the current magnitudes of this symbiotic star and later the detailed observations and light curve. This was for his spectroscopic observations which resulted in the first detailed spectral analysis of BX Mon.

T PYX. P. Reinhard (Austria) is studying the past outbursts of this recurrent nova. He was supplied with our observations of the 1966 outburst and the paper and light curve which was published in Pub. 17, VSS, RASNZ.

SN 1960F. Brad Schefer (Yale) was supplied with observations by Albert Jones of this supernova. Schefer was under the impression that Jones was the only person to observe SN 1960F but his attention was directed to the paper and light curve published by the Italian amateur-professional group that search for and observe supernovae.

RED VARIABLES. Twice annually disks containing our observations of Mira and semi-regular variables have been sent to AAVSO. These, with similar data from other Variable Star Groups, are used for the annual predictions of maxima and minima which, by agreement, are the responsibility of the AAVSO to publish.

Z CAM VARIABLES. Disks containing observations of all Z Cam stars on our programme were supplied to F. Ringwald (Arizona) for his investigations of standstills and other features of these stars.

RW HYA . A symbiotic variable. T. Dumn (Zurich) obtained our data for his study of this star.

HD 5980. Observations & copies of Pub. 19 VSS RASNZ containing a paper by Bateson & Jones were supplied to P.A. Crowther (University College, London); R. Barba (La Plata) and others.

S DOR VARIABLES. A.M. van Genderen obtained our light curves and publications containing papers on these stars.

This data was required for studies of the cyclic nature of the low amplitude variations.

DWARF NOVAE. There were the usual numerous requests for alert notices of outbursts of many dwarf novae as well as predictions of both probable dates of outbursts and times of minima. Some predictions were correct and others wrong which was to be expected considering the wide range in outburst cycles for some systems. Some of the main programmes are given below.

Z CHA & OY CAR. Tan Billington (Oxford) and Tom Marsh (Southampton) depended on our alert notices of superoutbursts to observe these events with IUE. We also supplied the light curves and detailed observations.

BV CEN; CU VEL; V436 CEN; MU CEN; SY CNC; BD PAV.
C la Dous (European Space Agency) & Barbara Hassall (Keele) relied on our predictions and alerts to observe these stars with IUE when at minima. They were successful in obtaining the IUE data.

WX HYI; VW HYI; BV CEN; OY CAR; HL Cma. Joni Johnson (Wisconsin) requested data on these stars. This was supplied together with our publications containing papers giving details of outbursts.

VW HYI. Predictions and alerts were provided for EUVE and HST.

TU MEN. Observations were supplied to N. Vogt (Germany) who was investigating whether there had been a change in the superhump period following the prolonged outburst reported in Pub. 16 VSS RASNZ.

DWARF NOVAE – LONG TERM PROGRAMMES. Steve Howell (Arizona) received several alert notices for outbursts of the dwarf novae listed in "CHANGING TRENDS" No. 56. After the events he was sent the light curves and print-outs of the individual observations.

ERUPTIVE VARIABLES. John Graham (Carnegie) received light curves and detailed data for T Tau stars in CrA. He required this data for use with his spectral observations made using Carnegie's large telescope in Chile.

AM HER STARS. C. Wetherly (Holland) had three nights on a large telescope at ESO's La Silla Observatory. He sought our help in advice on which of his target stars were active.
Their normal magnitude is 18-19 and they can brighten to around 14-15 magnitude. Fortunately, Peter Nelson using a CCD camera was able to indicate the state of activity.

OTHER LONG TERM PROGRAMMES.
Observers maintained close monitoring of R CrB stars (for SAAO); TV Col & EX Hya (for Coel Hellier, Keele); Recurrent Novae (to detect any outbursts); Long period eclipsing systems (to determine accurate times of minima) and a wide range of unusual variables.

BA.A. The co-operative programme with the B.A.A. on stars in the equatorial zone continued.

HIPPARCOS. This satellite used our observations of long period variables. Those operating this satellite advised:
" The RASNZ observations have been of particular importance due to the large number of southern variables on our program".

FLARES IN DWARF NOVAE.
A short paper by Bateson reporting on the Section's observations of flares was published in the proceedings of IAU Colloquim No. 151.

PUBLICATIONS. Nos. 19 & 20 have been distributed. No 21 has been delayed due to a technical hitch but should be published early in 1996. Papers submitted for No. 22 have all been reviewed by referees and are now ready for typing.

Pub. 20 consisted of an index to all charts published by Astronomical Research Ltd. The Index was prepared by Bruce Sumner to whom we are indebted for this most useful reference work. I wish to thank Grant Christie for editing the publications and for suggesting the new format, which I hope members find an improvement.

CIRCULARS. Each year the usual 12 monthly circulars were published. The Newsletter, "CHANGING TRENDS", appeared quarterly and has proved very popular with observers. A number of special circulars were distributed each year regarding special programmes. Details of these programmes were distributed by fax or phone when they were urgent.

COMPUTER DATA PROCESSING.
Don Brunt has continued processing the archival observations. A total of 556,814 have been processed showing the splendid work done by Don. There still remain an even larger number of observations to be checked and sent to Don.

Ranald McIntosh has maintained the computer database with his usual efficiency. I am deeply grateful for his assistance in so many ways. The satisfactory functioning of the Section depends so much on his work.

FINANCIAL. I commented in the previous report that Astronomical Research Ltd. provided the financial base that enables the Section to function. The changes reported in that report have now been concluded and Astronomical Research is now accepted by the Inland Revenue Dept. as a scientific charity. The changes made involved a considerable sum in legal expenses but will now save a considerable sum each year in Accountancy and other charges.

I am most grateful to the following for their donations during the years under review.

O.R. Hull; B. Menzies; N.W. Taylor;
N.J. Rumsey; G. Herdman; D. Watson;
A. Fujii; D. Brunt; W. Orchiston
W. Albrecht; Dr .H. Duerbeck;
Dr. W. Schmeetz;
Auckland Astronomical Soc.;
Anonymous

HEADQUARTERS

Work has continued on preparing archival records for processing and on the editing of observations. These jobs also involve the rewriting of summaries on the past investigations on individual variables because many of the details date back for 50 years and these have become faded. These jobs have to be fitted in between routine work and the large volume of correspondence.

Members have been encouraged to submit papers for publication. I thank the referees for kindly passing comments on the numerous papers submitted to them. Several boxes of correspondence no longer required were sent to the national archives. This is done periodically under an agreement made with the Alexander Turnbull Library many years ago. They require these records for historical purposes.

Maureen Phizacklea has been employed as part time Secretary and now has the experience to handle many matters which frees me for the many more important – and time consuming problems.

ACKNOWLEDGEMENTS

This report has already acknowledged the wonderful help so freely given by a number of members. Much of the success of the Section is due to the interest in variable star observation by the leaders of associated societies. I wish to thank, in particular, Jan Hers, Director of the Variable Star Section of the Astronomical Society of Southern Africa and the leaders of the various Australian Groups – Fraser Farrell; Sue Dreves; Peter Nelson & Peter Williams.

They are responsible for the recruiting of new members and encouraging observers.

I have often commented that it is each and every observer who makes the Section possible. There would be no section without their dedicated work. My sincere appreciation is extended to all observers, be their contributions limited or numerous.

Mati Morel has continued to produce all the charts required. His work reflects the very high standard of care of detail and skilled draughtmanship that is the hallmark of anything he does.

Alan Gilmour and Pam Kilmartin have provided a number of valuable measures of comparison star sequences. These measures have been published in our Publications.

Dick Hull produced the Julian Date Calendars published in "CHANGING TRENDS".

My personal thanks are extended to Maureen Phizacklea for her most efficient handling of a multitude of tasks as well as for so quietly coping with the vagaries of her Boss.

Finally I wish to thank all members and supporters, both amateur and professional, for their continued assistance and encouragement.

1996 January 31 Frank M. Bateson
DIRECTOR

VARIABLE STAR SECTION OBSERVATIONS 1993/94

Observer's Name	Ob. Code	Obs. Total
Antaw, J	AA	27
Albrecht, W.M.B.	Aj	7807
Allen, W.	Ar	52
Brandie, J.	BD	343
Burns, G.	BE	190
Biggins, L.	BG	1
Baade, W.H.	BH	19
Boattini, A.	BS	51
Blane, D.	Bz	130
Cooper, T.	CH	737
Coghlan, R.D.	CO	42
Cragg, T.A.	Cj	2519
Campas, J.A. da S.	Cv	4
Dreyer, N.J.G.	DA	3
Dreeves, S.	Dx	47
Emmerson, R.	Em	2
Farrell, F.	Fm	1055
Garland, B.	GB	133
Herdman, G.	HA	3907
Hearnshaw, C.	HH	260
Huljak, J.	HJ	291
Harries-Harris, E.	Hi	532
Heartfield, C.	Hk	11
Hull, O.R.	Hl	2794
Hovell, S.	Hv	39
Hers, J.	Hz	775
Ives, F.	Iv	845
JRW	JRW	215
Jooste, J.L.	Jf	24
Jones, R.W.	Jg	1847
Jones, A.F.	Jo	15100
Kent (Mrs.) K.E.	Kn	76
Kay, J.	Ky	25
Kenni, A.	KY	24
Lumley, E.	Lm	198

Observer's Name	Ob. Code	Obs. Total
Murray, A.M.	MG	143
Monard, L.	MIA	922
Mattiazzo, M.	MKA	673
Menzies, B.	Mf	929
Morel, M.	Mv	2
Nicolau, F.C.	Nc	31
Nelson, P.	Nl	1042
Nation, P.	Nn	481
O'Kane, J.	Ok	149
Overbeek, M.D.	Ov	17925
Robinson, N.	RB	121
Richards, T.	Ri	87
Kelly, R.	Rq	14
Stephanopoulos, G.	SK	157
Smit (Dr.) J.A.	SP	1379
Saw, A.D.J.	ST	129
Skilton, P.	SU	3
Stubbing, R.	SX	1293
Stephenson, S.M.	Sy	18
Tucker, P.	TA	105
Turner, D.	Tq	86
Tregaskis, T.B.	Tr	468
Taylor (Dr.) N.W.	Ty	2763
Tilbrook, J.	Tz	796
de Villiers, P.	Vb	104
VnVn	Vn	3
Watson (Mrs.) D.	WJ	415
Walsh, P.	WP	128
Williamson, L.J.	Wm	273
Williams, P.	Wy	3434

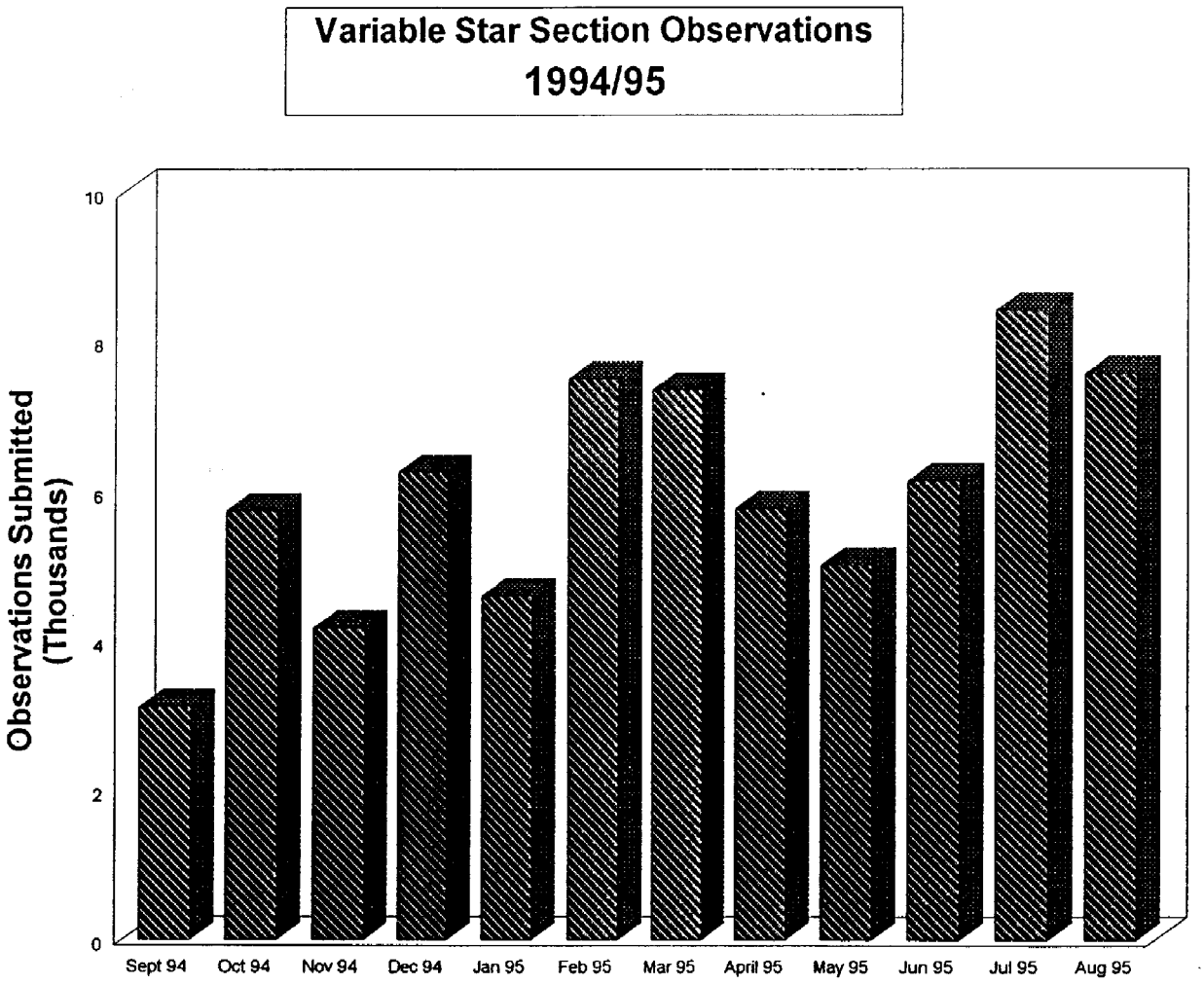
TOTAL: 67,516

VARIABLE STAR SECTION OBSERVATIONS 1994/95

Observer's Name	Ob. Code	Obs. Total
Antaw, J	AA	19
Albrecht, W.M.B.	Aj	7159
Allen, W.	Ar	36
Baade, W.H.	BH	302
Brandie, J.	BD	389
Burns, G.	BE	4
Bailley, P.	BT	1
Burdis, B.	BU	1
Burdis, K.	BV	1
Bryant, K.	Bk	19
Blane, D.	Bz	82
Cooper, T.	CH	39
Cook. J.C.	CJ	465
Coghlan, R.D.	CO	44
Cragg, T.A.	Cj	1495
Crossley, G.	Cy	27
Datt, M.	DC	1
Farrell, F.	Fm	1182
Garland, B.	GB	265
Goltz, W.	Gp	221
Herdman, G.	HA	4577
Hill, M.	Hl	4
Huljak, J.	HJ	130
Harrison, K.	HL	1
Harries-Harris, E.	Hi	905
Heartfield, C.	Hk	11
Hull, O.R.	Hl	1947
Hovell, S.	Hv	793
Hers, J.	Hz	755
Ives, F.	Iv	616
Jooste, J.L.	Jf	2
Jones, R.W.	Jg	2282
Jones, A.F.	Jo	13944
Kinghorn, L	Kc	3
Kent (Mrs.) K.E.	Kn	6
Lumley E.	Lm	75
Lund H.	Lz	64
Murray A.M.	MG	205

Observer's Name	Ob. Code	Obs. Total
Monard, L.	MIA	941
Mattiazzo, M.	MKA	399
Menzies, B.	Mf	1041
Nelson, P.	Nl	765
Nation, P.	Nn	290
Nocanda, X.	Nb	1
O'Brian, M.	Ob	ll
O'Kane, J.	Ok	109
Overbeek, M.D.	Ov	16195
Parry, J.	PB	701
Pow, M.	PD	122
Pitt, B.	PE	7
Robinson, N.	RB	24
Ritchie, M.	Rz	1
Stephanopoulos, G.	SK	740
Smit (Dr.) J.A.	SP	1263
Saw, A.D.J.	ST	83
Skilton, P.	SU	546
Stubbing, R.	SX	3086
Sumner, B.	Sb	15
Skilton, Ros	Sw	13
Tucker, P.	TA	26
Turner, D.	Tq	56
Tregaskis, T.B.	Tr	381
Taylor (Dr.) N.W.	Ty	1850
Tilbrook, J.	Tz	1071
de Villiers, P.	Vb	93
van Aswegen, D.	Vg	2
Vincent, J.C.	Vi	31
Ward, D.	WD	25
Watson (Mrs.) D.	WJ	601
Walsh, P.	WP	375
Williamson, L.J.	Wm	104
Williams, P.	Wy	2655

TOTAL: 71,695


Variable Star Section Observations
1994/95
Observations Submitted
(Thousands)
0
2
4
6
8
10
Sept 94
Oct 94
Nov 94
Dec 94
Jan 95
Feb 95
Mar 95
April 95
May 95
Jun 95
Jul 95
Aug 95