No. 24 (C98)

PUBLICATIONS OF THE

VARIABLE STAR SECTION

ROYAL ASTRONOMICAL SOCIETY OF NEW ZEALAND

Director: Frank M. Bateson
P.O. Box 3093, Greerton,
Tauranga, New Zealand

Telephone: (64)-07-541-0216
Email: varstar@voyager.co.nz

ISSN 0111-736X

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2000 April 7

THE SLOW RISE OF ETA CARINAE

Frank M. Bateson
Director, V.S.S., R.A.S.N.Z.

SUMMARY: The very slow rise in brightness of Eta Carinae is shown in a Table of Monthly Means. The difficulties of observing Eta Car visually are discussed.

1. INTRODUCTION

Eta Car Is a variable of the S Dor type. The literature contains numerous papers on this unusual star with some of the main references given in a previous paper (1). Hereafter this is referred to as Paper 1.

2. OBSERVATIONS

A light curve from ten day means appeared in Paper 1. This covered the interval 1952 April 3 to 1988 August 26 during which Eta Car rose from magnitude 7 to 6. Table 1 of the present paper lists the monthly means from 1973 January to 1999 April. A large number of observations were made each month by members of the variable Star Section, R.A.S.N.Z. Most of the estimates were made using binoculars with a few using small aperature telescopes.

Eta Car has an expanding envelope which contains knots of ejected material and is also surrounded by nebulosity. Obviously the observers are unable to separate these components so their estimates are of the entire Eta Car complex. There is often a marked difference in the mean magnitude derived from different groups of observers.

The means listed in Table 1 were derived from all observations. However, often observers fall into two main groups. Group A have means around 0.4 magnitude brighter than the means from group B. There are also a few observers who record Eta Car at the same magnitude month after month.

I have examined the observations of Eta Car closely to see if there is any reason for the difference between Groups A and B because this is also apparent in the estimates of other S Dor type variables involved in nebulosity. It is obvious that estimates made in moonlight tend to be brighter than those made when the moon is absent. I suggest that Eta Car, and other S Dor stars, should not be observed during moonlight.

Some observers are still using chart No.25 (2) instead of the V sequence shown on charts 460 & 461 (3) as requested in Paper 1.

3. DISCUSSION

Table 1 shows that the mean monthly magnitude of Eta Car rose from 6.40 in January 1973 to 5.52 in April 1999. The rise was not a steady progressive one but showed small increases in some months after which Eta Car faded slightly. No importance can be attached to these slight variations because they are affected by variations in the number of estimates each month from each group mentioned earlier. All that can be stated is that the very slow rise reported in Paper 1 has continued.

THE SLOW RISE OF ETA CARINAE (Cont.)

The largest rise occurred in 1981 when the mean magnitude rose by 0.25 mag. Eta Car faded in the years immediately following. The four months of 1999 the rise in mean magnitude amounted to 0.22 mag.

3. CONCLUSIONS

It is clear that during the years covered in this paper Eta Car increased in mean magnitude from 6.40 to 5.52 in a very slow and erractic manner. There has been a small but progressive rise in mean magnitude in recent months. The future will show whether this is an indication of increased development or merely a temporary brightening to be followed by a fading.

No firm conclusions can be drawn from the observations as the main aim of this paper has been to provide suggestions to observers on ways to increase the accuracy of their estimates of Eta Car by not observing in moonlight and by using the right charts and sequence.

ACKNOWLEDGEMENTS

All observers are thanked for their observations.

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TABLE 1

ETA CAR - MONTHLY MEANS

1973	Jan	6.40
	Feb	6.40
	Mar	6.30
	Apr	6.35
	May	6.40
	June	6.40
	July	6.41
	Aug	6.40
	Sept	6.30
	Oct	6.35
	Nov	6.40
	Dec	6.32
1974	Jan	6.39
	Feb	6.31
	Mar	6.30
	Apr	6.39
	May	6.34
	June	6.29
	July	6.31
	Aug	6.25
	Sept	6.31
	Oct	6.25
	Nov	6.27
	Dec	6.34
1975	Jan	6.26
	Feb	6.30
	Mar	6.31
	Apr	6.31
	May	6.31
	June	6.31
	July	6.30
	Aug	6.30
	Sept	6.30
	Oct	6.30
	Nov	6.23
	Dec	6.20
1976	Jan	6.22
	Feb	6.30
	Mar	6.30
	Apr	6.30
	May	6.26
	June	6.26
	July	6.27
	Aug	6.20
	Sept	6.17
	Oct	6.20
	Nov	6.23
	Dec	6.13
1977	Jan	6.19
	Feb	6.18
	Mar	6.17
	Apr	6.18
	May	6.23
	June	6.12
	July	6.20
	Aug	6.20
	Sept	6.20
	Oct	6.24
	Nov	6.13
	Dec	6.18
1978	Jan	6.22
	Feb	6.23
	Mar	6.27
	Apr	6.27
	May	6.28
	June	6.26
	July	6.24
	Aug	6.23
	Sept	6.30
	Oct	6.16
	Nov	6.24
	Dec	6.10
1979	Jan	6.15
	Feb	6.14
	Mar	6.08
	Apr	6.06
	May	6.07
	June	6.02
	July	5.96
	Aug	6.03
	Sept	6.05
	Oct	6.00
	Nov	5.96
	Dec	6.02
1980	Jan	6.04
	Feb	6.07
	Mar	6.08
	Apr	6.13
	May	6.05
	June	6.04
	July	6.04
	Aug	6.03
	Sept	6.02
	Oct	5.96
	Nov	6.00
	Dec	6.01
1981	Jan	6.07
	Feb	6.13
	Mar	5.89
	Apr	6.00
	May	5.98
	June	5.95
	July	5.93
	Aug	5.95
	Sept	5.96
	Oct	5.75
	Nov	5.86
	Dec	5.82

TABLE 1 (Cont.)

ETA CAR - MONTHLY MEANS

1982	Jan	5.79	1985	Jan	5.98	1988	Jan	5.91
	Feb	5.90		Feb	5.98		Feb	6.00
	Mar	5.80		Mar	5.99		Mar	6.00
	Apr	5.90		Apr	5.95		Apr	6.02
	May	5.87		May	5.90		May	6.02
	June	5.84		June	6.02		June	5.99
	July	5.88		July	5.91		July	6.03
	Aug	5.85		Aug	5.95		Aug	6.03
	Sept	5.84		Sept	5.93		Sept	5.93
	Oct	5.90		Oct	5.90		Oct	5.97
	Nov	5.90		Nov	5.96		Nov	6.03
	Dec	5.89		Dec	6.06		Dec	6.06
1983	Jan	5.87	1986	Jan	5.93	1989	Jan	5.96
	Feb	5.92		Feb	5.98		Feb	5.93
	Mar	6.02		Mar	6.04		Mar	5.99
	Apr	5.88		Apr	5.94		Apr	5.99
	May	5.89		May	5.88		May	5.94
	June	6.06		June	5.90		June	5.97
	July	5.95		July	6.00		July	5.92
	Aug	5.99		Aug	5.97		Aug	5.94
	Sept	5.96		Sept	5.92		Sept	5.92
	Oct	5.87		Oct	5.99		Oct	5.99
	Nov	6.00		Nov	5.95		Nov	5.96
	Dec	5.95		Dec	5.99		Dec	5.93
1984	Jan	6.00	1987	Jan	5.94	1990	Jan	5.96
	Feb	5.96		Feb	5.94		Feb	5.93
	Mar	6.03		Mar	5.85		Mar	5.93
	Apr	6.02		Apr	5.86		Apr	5.89
	May	6.04		May	5.89		May	5.89
	June	5.89		June	5.91		June	5.99
	July	6.04		July	5.88		July	5.90
	Aug	6.00		Aug	5.90		Aug	5.87
	Sept	5.90		Sept	6.05		Sept	5.91
	Oct	5.88		Oct	6.11		Oct	5.93
	Nov	5.96		Nov	6.00		Nov	5.83
	Dec	5.91		Dec	6.01		Dec	5.95

TABLE 1 (cont.)

ETA CAR - MONTHLY MEANS

1991	Jan	5.95
	Feb	5.80
	Mar	5.87
	Apr	5.86
	May	5.87
	June	5.87
	July	5.89
	Aug	5.89
	Sept	5.83
	Oct	5.92
	Nov	5.98
	Dec	5.90
1992	Jan	5.92
	Feb	5.81
	Mar	5.91
	Apr	5.99
	May	5.92
	June	5.85
	July	5.92
	Aug	5.83
	Sept	5.96
	Oct	6.03
	Nov	5.99
	Dec	6.00
1993	Jan	5.94
	Feb	5.89
	Mar	5.85
	Apr	5.81
	May	5.83
	June	5.83
	July	5.79
	Aug	5.90
	Sept	5.89
	Oct	6.01
	Nov	5.91
	Dec	5.86
1994	Jan	5.86
	Feb	5.81
	Mar	5.82
	Apr	5.77
	May	5.77
	June	5.80
	July	5.83
	Aug	5.82
	Sept	5.88
	Oct	6.00
	Nov	5.90
	Dec	5.90
1995	Jan	5.86
	Feb	5.94
	Mar	5.82
	Apr	5.83
	May	5.78
	June	5.85
	July	5.84
	Aug	5.84
	Sept	5.86
	Oct	5.96
	Nov	5.90
	Dec	5.82
1996	Jan	5.93
	Feb	5.85
	Mar	5.84
	Apr	5.86
	May	5.82
	June	5.72
	July	5.85
	Aug	5.85
	Sept	5.88
	Oct	5.85
	Nov	5.88
	Dec	5.87
1997	Jan	5.82
	Feb	5.79
	Mar	5.84
	Apr	5.86
	May	5.64
	June	5.82
	July	5.81
	Aug	5.78
	Sept	5.86
	Oct	5.85
	Nov	5.85
	Dec	5.81
1998	Jan	5.79
	Feb	5.74
	Mar	5.72
	Apr	5.65
	May	5.74
	June	5.72
	July	5.77
	Aug	5.77
	Sept	5.70
	Oct	5.76
	Nov	5.74
	Dec	5.67
1999	Jan	5.70
	Feb	5.66
	Mar	5.61
	Apr	5.52

VISUAL OBSERVATIONS OF THE 1998 ECLIPSE OF BL TELESCOPII

Peter F. Williams
Sutherland Astronomical Society & Variable Star Section, RASNZ

SUMMARY: Visual observations of the 1998 eclipse of BL Tel are presented. These indicate mid eclipse occurred on 1998 August 09.0 UT (GJD 2451034.5) an interval of 778.5 days since the previous eclipse.

1. INTRODUCTION.

The 1998 event was the 7th successfully observed eclipse of BL Tel in the current long term program to monitor eclipses of this star.

Details of this interesting Algol type system have been given previously by Williams (1) and the references therein. That paper also summarised results from the previous eclipses and this summary is extended here.

2. OBSERVATIONS.

A total of 157 visual observations by members of the VSS, RASNZ are summarised in Table 1. These are shown as daily mean magnitudes wherein column 1 gives the GJD, column 2 the mean magnitude and column 3 the number of observations used to derive the mean. Due to the extended nature of eclipses of BL Tel and of the visual data, no heliocentric corrections have been applied.

Table 2 lists 8 CCD observations reported. These were obtained in white light (no filter) through a 14-inch SC telescope and ST8 CCD camera, reduced with commercial MIRA software.

Figure 1 shows a visual light curve based on the daily mean magnitudes. These have been plotted using the "mirror image" method which assumes a symmetrical shape of the light curve. Here, solid circles represent mean magnitudes of 2 or more estimates, open circles are single magnitude estimates and small dots are points generated by the mirror image plot.

3. DISCUSSION.

The available observations indicate this eclipse commenced on 1998 July 12.0 UT (GJD 2451006.5) and ended on 1998 September 06.0 UT (GJD 2451062.5). This indicates a total duration of 56.0 days.

Mid eclipse occurred on 1998 August 09.0 UT (GJD 2451034.5), an interval of 778.5 days since the date of previous mid eclipse.

A mean minimum magnitude of 8.96v was recorded during this eclipse, an amplitude of 1.96 magnitudes.

A uniform rate of both decline and recovery is inferred from the light curve, yielding an average daily variation of 0.07 magnitude per day. This is essentially the same as the previous 1996 eclipse but there is no suggestion of a total eclipse phase as occurred during that event.

Table 3 extends the summary of O-C values given earlier (1) and is based on the elements of Kholopov (2).

VISUAL OBSERVATIONS OF THE 1998 ECLIPSE OF BL TELESCOPII (Cont.)

4. CONCLUSION.

Mid eclipse of the 1998 BL Tel eclipse occurred on 1998 August 9.0 UT (GJD 2451035.5), an interval of 778.5 days since the previous event. Based on this, the next eclipse of this system is expected to be centred near 2000 Sept 25 UT (GJD 2451813.0).

5. ACKNOWLEDGEMENTS.

All observers are thanked for their observations without which this paper could not have been written.

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VISUAL OBSERVATIONS OF THE 1998 ECLIPSE OF BL TELESCOPII

TABLE 1

Daily mean magnitudes of 1998 eclipse of BL Tel.

GJD 2450000+	Mean Mag	No	GJD 2450000+	Mean Mag	No
0997	7.0	1	1039	8.75	2
0998	7.0	1	1040	8.67	3
0999	7.07	3	1041	8.75	2
1001	7.2	1	1042	8.60	2
1002	7.07	3	1043	8.40	2
1003	7.0	1	1044	8.43	4
1005	7.0	1	1045	8.37	3
1006	7.0	1	1048	8.24	5
1007	7.2	1	1049	8.20	4
1009	7.17	3	1050	8.12	6
1010	7.0	1	1051	7.80	4
1011	7.37	4	1052	7.88	5
1012	7.4	1	1053	7.62	4
1013	7.30	2	1054	7.86	5
1014	7.36	4	1055	7.50	3
1016	7.47	3	1056	7.40	2
1017	7.72	4	1057	7.32	4
1018	7.88	6	1058	7.37	3
1019	7.90	2	1059	7.30	2
1020	8.2	1	1060	7.45	2
1022	8.3	1	1061	7.4	1
1023	8.4	1	1063	7.20	2
1024	8.6	1	1064	7.20	2
1025	8.56	3	1065	7.20	2
1026	8.65	2	1066	7.1	1
1029	9.0	1	1067	7.2	1
1031	8.83	3	1069	7.05	2
1032	8.55	2	1070	7.0	1
1033	8.6	1	1072	7.05	2
1034	8.96	3	1074	7.00	2
1035	8.93	3	1077	7.1	1
1036	8.85	2	1082	7.0	1
1037	8.5	1	1085	7.0	1
1038	8.5	1	1087	7.0	1
			1088	7.0	1

VISUAL OBSERVATIONS OF THE 1998 ECLIPSE OF BL TELESCOPII

TABLE 2

CCD white light measurements of BL Tel.

GJD 2450000+	Mag	Precision
0973.9375	7.20	0.001
1029.1125	8.74	0.003
1029.1271	8.59	0.003
1029.1305	8.58	0.003
1035.0993	8.67	0.003
1035.1104	8.75	0.003
1035.1139	8.81	0.003
1035.1166	8.76	0.003

Table 3

O-C and Summary of BL Tel eclipses 1983-1998, from visual data by VSS, RASNZ according to elements JD 2434692 +778.1 days

Year	Observed	Calculated	O-C	Mag (v)	Duration days	Interval days
1983	2445591.5	2445586.0	+4.5	8.60	57.0	-
1985	2446369.5	2446364.1	+5.4	9.60	65.0	778.0
1987	2447144.5	2447142.2	+2.3	9.30	63.0	775.0
1992	2448703.0	2448698.4	+4.6	9.20	58.0	(1558.5)
1994	2449481.0	2449476.5	+4.5	10.10	62.0	778.0
1996	2450256.0	2450254.6	+1.4	8.90	65.0	775.0
1998	2451034.5	2451032.1	+2.4	8.96	56.0	778.5

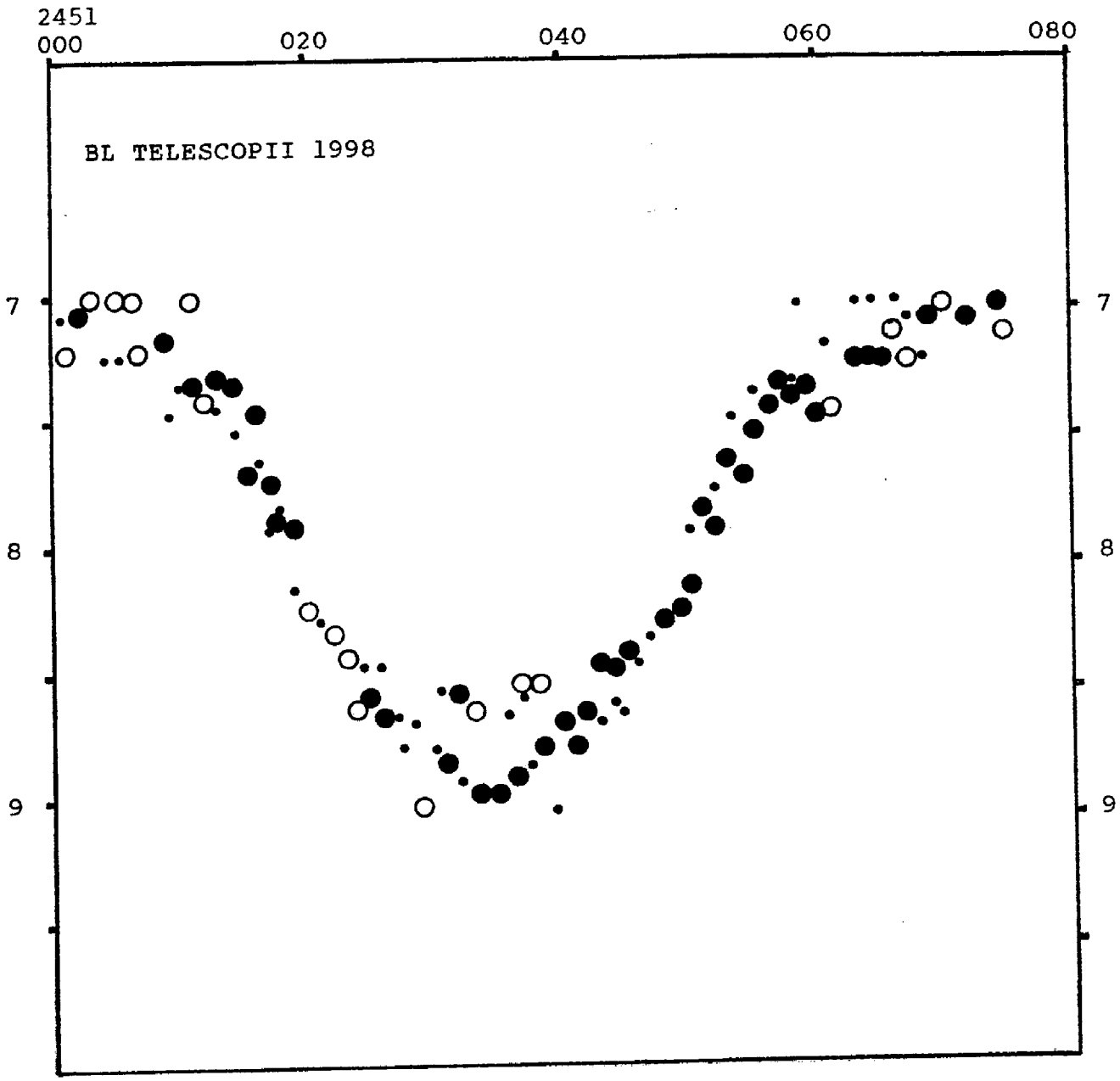

Figure 1. Visual light curve of the 1998 eclipse of BL Tel, based on 157 observations. Date of mid eclipse was GJD 2451034.5, an interval of 778.5 days since the previous event.

Summary of eclipse data :
Eclipse began : GJD 2451006.5 1998 July 12.0 UT
Mid eclipse : GJD 2451034.5 1998 Aug 09.0 UT
Eclipse end : GJD 2451062.5 1998 Sept 06.0 UT
Duration of eclipse : 56.0 days
Interval since previous eclipse : 778.5 days
Predicted date of next eclipse : 2451813.0 (2000 Sept 25 UT)

THE SLOW VARIATIONS OF HDE 269858

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

SUMMARY: Visual observations of the S Dor type variable HDE 269858 are listed as ten day means from JD 2445,661 to 2451,260. Light curves of some segments are reproduced and the results are discussed.

1. INTRODUCTION

HDE 269858 is in the L.M.C. and classified as of the S Dor type with a range of 8.8 to 11.17V (1). It is L.M.C. variable V3600 and is CPD –69°427.

2. OBSERVATIONS

Visual observations are listed in Table 1 as means from J.D. 2445,661 to 2446,751 because during this interval observations were few and spasmodic. Ten day means are listed in Table 1 from J.D. 2446,760 onwards after observations became more numerous. Segments of the light curve are shown in Figs. 1 to 3.

All observations were made visually by members of the Variable Star Section, R.A.S.N.Z. using charts 778/9 (2) and the sequence of V magnitudes thereon. HDE 269858 was at magnitude 10.5 when first observed and apparently rising from minimum. There was a very slow, erratic rise to 8.70 followed by a gradual decline to 9.62.

3. DISCUSSION

HDE 269858 was at magnitude 10.5 when first observed by Peter Williams (Wy) on J.D. 2445,661, remaining at that brightness for the following 56 days before commencing a slow rise. It is presumed that minimum had occurred earlier before observations commenced and was fainter than 10.5.

The rise to a mean magnitude of 8.75 on 2447,790 was erratic. The star then remained 8.8 for some time before very slowly commencing to fade eventually reaching a mean of 9.62 on 2451,260.

The observations were dominated for long intervals by estimates from Albert Jones (Jo) and to a lesser extent by Peter Williams (Wy) despite observations from many other observers.

The estimates from different observers were usually in excellent agreement except for one observer who recorded little change. However whenever the variable was around magnitude 9.1 - 9.2 it was noticeable that Jo was often estimating the variable as 0.4 to 0.5 fainter than Wy with Justin Tilbrook (Tz) agreeing with Wy's estimates and B. Monard with Jo. Other first class observers, such as Rod Stubbings (SX) tended to fall between those from Wy and Jo although closer to Jo's estimates.

Naturally these small differences affected the ten day means according to the number of observations from each observer included in the mean magnitude.

The reason for discussing these differences in estimates as HDE 269858 commences to fade is twofold.

THE SLOW VARIATIONS OF HDE 269858 (Cont.)

Firstly there are intervals in Table 1 which suggest a semi-regular period exists. This may be true but the visual observations are too much dependent on which observers are represented in each ten day mean to give any credence to a semi- regular variation.

Secondly, sites close to large cities may appear to be dark but are not really, so that light pollution at high altitudes tend to make stars, especially those associated with nebulosity, appear brighter than they really are.

4. CONCLUSION

HDE 269858 is a typical S Dor type variable which during the interval covered in this paper varied between mean magnitudes 8.70 to 10.5. The rise and fall were slightly erratic without showing any semi-regular periodicity.

ACKNOWLEDGEMENTS

The many observers who contributed estimates are thanked for their contributions and congratulated on the accuracy of their observations of a difficult object for visual observation.

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Pub. by Astronomical Research, Tauranga, N.Z.

Table 1

HDE 269858 - TEN DAY MEANS

JD	Mean Mv	No Obs
2445,000+		
661	10.5	1
673	10.5	1
689	10.50	2
702	10.4	1
717	10.5	1
730	10.3	1
750	10.3	1
778	9.5	1
789	9.5	1
2446,000+		
015	10.4	1
031	10.00	3
036	9.90	2
052	10.50	2
060	10.35	2
073	10.13	3
078	10.35	2
091	10.35	2
114	10.3	1
121	9.9	1
126	10.0	1
141	10.3	1
356	10.0	1
373	9.8	1
387	9.8	1
408	10.0	1
415	9.4	1
442	9.8	1
467	9.8	1
495	9.7	1

JD	Mean Mv	No Obs
2446,000+		
537	9.5	1
552	9.95	2
560	9.50	2
579	9.45	2
587	9.35	2
597	9.2	1
612	9.2	1
617	9.30	5
627	9.07	3
640	9.23	6
653	9.0	1
660	8.8	1
680	9.37	3
701	9.22	4
718	8.80	2
730	9.25	4
740	9.07	4
751	9.20	3
760	9.31	7
770	9.20	4
780	9.18	5
790	9.33	3
801	9.3	1
813	9.15	2
819	9.03	3
826	9.17	3
840	9.17	3
850	9.00	7
860	9.10	7
870	9.01	7

JD	Mean Mv	No Obs
2446,000+		
880	9.03	9
890	9.00	6
910	8.93	10
920	8.98	8
930	8.93	8
940	8.95	4
950	9.02	8
960	8.90	4
970	8.90	3
980	8.99	8
990	8.95	4
2447,000+		
000	8.97	7
010	8.98	5
020	9.20	8
030	9.17	3
040	-	-
050	9.10	6
060	9.17	10
070	9.11	9
080	9.00	11
090	9.06	11
100	8.87	10
110	8.92	5
120	8.94	7
130	9.12	5
140	9.07	7
150	9.20	3
160	8.99	9
170	9.04	5
180	9.03	9
190	9.06	7

Table 1 (cont.)

HDE 269858 - TEN DAY MEANS

JD	Mean Mv	No Obs	JD	Mean Mv	No Obs	JD	Mean Mv	No Obs
2447,000+			2447,000+			2448.000+		
200	9.05	2	600	8.89	8	000	8.90	5
210	9.02	5	610	8.85	12	010	8.88	6
220	8.96	10	620	8.79	10	020	8.85	2
230	8.98	5	630	8.70	5	030	8.74	5
240	8.98	8	640	8.82	11	040	8.87	6
250	8.90	9	650	8.90	12	050	8.87	3
260	8.95	6	660	8.90	3	060	8.80	4
270	8.94	7	670	8.80	4	070	8.75	4
280	8.85	11	680	8.82	10	080	8.87	3
290	8.78	8	690	8.82	6	090	8.80	5
300	8.73	4	700	8.83	3	100	8.78	4
310	8.79	9	710	8.85	13	110	8.75	2
320	8.80	7	720	8.77	3	120	8.87	6
330	8.73	6	730	8.83	3	130	8.80	1
340	8.89	10	740	8.82	6	140	8.90	4
350	8.76	8	750	8.85	6	150	9.04	8
360	8.72	12	760	8.85	6	160	9.06	7
370	8.70	12	770	8.84	8	170	9.18	5
380	8.75	4	780	8.88	10	180	9.00	7
			790	8.75	6	190	8.99	8
400	8.85	6	800	8.83	6	200	9.12	4
410	8.85	2	810	8.96	5	210	8.97	3
420	8.92	7	820	8.90	7	220	8.93	10
430	8.89	13	830	8.82	5	230	9.12	4
440	8.94	8	840	8.87	3	240	9.18	7
450	8.87	12	850	8.80	5	250	9.07	4
460	8.93	7	860	8.90	8	260	9.08	5
470	8.99	16	870	8.98	6	270	9.20	7
480	8.96	9	880	8.96	9	280	8.84	5
490	8.99	8	890	8.78	6	290	9.00	6
500	9.00	10	900	8.97	3	300	8.98	5
510	8.98	13	910	9.02	11	310	9.14	8
520	8.97	9	920	9.01	8	320	9.12	5
530	8.93	8	930	9.02	4	330	9.09	6
540	8.93	11	940	-	-	340	8.82	5
550	8.96	10	950	-	-	350	9.07	3
560	8.97	15	960	-	-	360	9.00	7
570	8.96	10	970	8.94	5	370	9.03	3
580	8.94	7	980	8.89	8	380	9.10	7
590	8.90	16	990	8.6	1	390	9.23	3

Table 1 (cont.)

HDE 269858 - TEN DAY MEANS

JD	Mean Mv	No Obs	JD	Mean Mv	No Obs	JD	Mean Mv	No Obs
						2449,000+		
24448,000+			2448,000+			200	9.35	2
400	9.10	2	800	8.90	3	210	9.2	1
410	9.17	3	810	-	-	220	9.33	3
420	8.95	4	820	-	-	220	9.3	1
430	8.98	4	830	9.07	3	230	9.5	1
440	8.90	6	840	9.10	3	240	9.47	3
450	8.67	3	850	9.12	4	250	9.1	1
460	8.77	3	860	9.16	5	260	9.45	2
470	8.85	6	870	9.17	3	270	9.35	4
480	9.17	3	880	9.20	2	280	9.45	2
490	8.90	3	890	9.57	3	290	9.35	2
500	9.10	4	900	9.55	2	300	9.23	3
510	9.06	5	910	9.33	3	310	9.5	1
520	9.45	2	920	9.16	5	320	9.30	3
530	9.24	5	930	9.18	5	330	9.35	2
540	9.25	4	940	9.20	2	340	9.53	3
550	9.30	3	950	9.09	7	350	9.40	3
560	9.20	3	960	-	-	360	9.40	5
570	9.22	4	970	9.50	2	370	9.45	4
580	9.17	4	980	9.27	4	380	9.47	6
590	9.28	7	990	9.32	5	390	9.60	2
			2449,000+					
600	9.16	5	000	9.35	4	400	9.40	3
610	9.24	5	010	9.40	3	410	9.35	6
620	9.37	3	020	9.30	4	420	9.12	4
630	9.27	4	030	9.28	5	430	9.17	3
640	9.35	4	040	9.20	7	440	-	-
650	9.15	10	050	9.20	2	450	9.32	6
660	9.43	3	060	9.25	2	460	9.24	5
670	9.22	4	070	9.22	6	470	9.18	5
680	9.12	4	080	9.2	1	480	9.20	4
690	9.27	7	090	9.18	7	490	9.30	5
700	9.13	6	100	9.28	5	500	9.33	3
710	9.32	5	110	-	-	510	9.25	2
720	9.19	6	120	9.12	4	520	9.25	2
730	-	-	130	9.30	5	530	9.4	1
740	9.13	3	140	9.1	1	540	9.25	4
750	9.20	2	150	9.15	2	550	9.25	2
760	9.1	1	160	9.1	1	560	-	-
770	9.10	3	170	9.10	2	570	9.3	1
780	9.07	3	180	-	-	580	9.30	3
790	8.83	3	190	9.00	2	590	9.22	5

Table 1 (cont.)

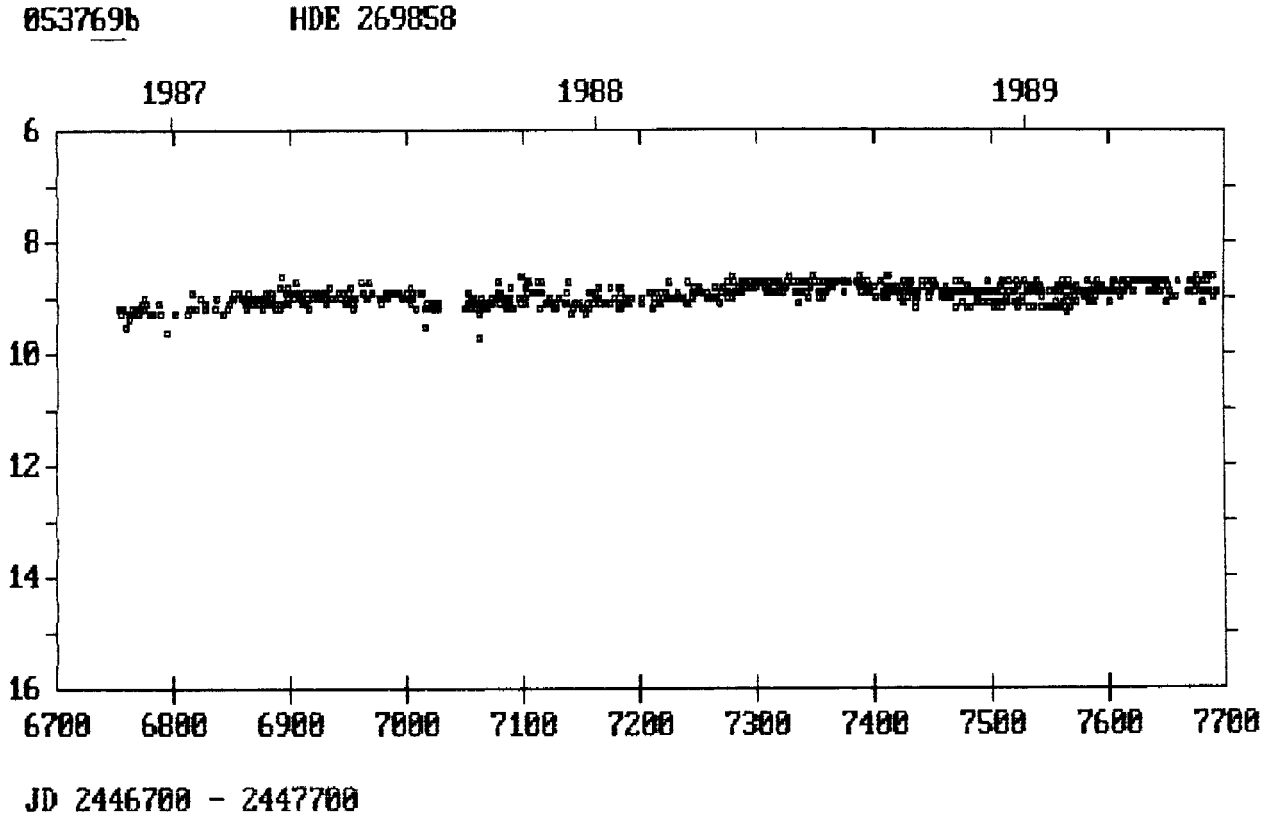
HDE 269858 - TEN DAY MEANS

JD	Mean Mv	No Obs	JD	Mean Mv	No Obs	JD	Mean Mv	No Obs
2449,000+			2450,000+			2450,000+		
600	9.36	3	000	9.46	3	400	9.27	3
610	-	-	010	9.25	4	410	9.03	3
620	9.4	1	020	9.15	2	420	9.43	3
630	9.27	4	030	9.47	3	430	9.17	7
640	9.36	5	040	9.32	9	440	9.25	2
650	9.40	3	050	9.12	5	450	9.17	8
660	9.2	1	060	9.35	2	460	9.21	9
670	9.30	3	070	9.33	3	470	9.50	2
680	9.43	3	080	9.34	7	480	9.17	6
690	9.34	5	090	9.4	1	490	9.10	5
700	9.30	5	100	9.36	7	500	8.7	1
710	9.42	5	110	9.20	7	510	9.33	3
720	9.30	4	120	9.6	1	520	9.35	4
730	9.50	3	130	9.35	9	530	-	-
740	-	-	140	9.38	5	540	9.31	7
750	9.30	6	150	9.32	5	550	9.26	5
760	9.25	4	160	9.40	3	560	-	-
770	9.07	6	170	9.33	3	570	9.29	7
780	9.23	3	180	9.3	1	580	9.25	2
790	9.35	2	190	9.37	8	590	-	-
800	9.3	1	200	9.45	2	600	9.25	2
810	9.14	7	210	9.27	4	610	9.25	2
820	-	-	220	9.50	2	620	9.2	1
830	9.27	4	230	9.37	3	630	9.15	2
840	-	-	240	9.3	1	640	9.10	2
850	9.2	1	250	9.25	2	650	9.0	1
860	9.2	1	260	9.10	1	660	9.20	2
870	9.30	2	270	9.0	1	670	9.17	4
880	9.2	1	280	9.10	2	680	9.35	4
890	9.25	2	290	9.17	3	690	9.23	3
900	9.15	2	300	9.2	1	700	9.53	3
910	-	-	310	9.10	4	710	9.7	1
920	9.20	3	320	9.20	3	720	9.16	5
930	9.2	1	330	9.35	2	730	9.57	3
940	9.25	2	340	9.03	3	740	9.38	5
950	9.40	2	350	9.40	3	750	9.25	4
960	8.9	1	360	9.35	2	760	9.30	4
970	9.5	1	370	9.25	10	770	9.37	4
980	9.46	3	380	9.17	3	780	9.48	6
990	9.33	3	390	9.24	5	790	9.56	5

Table 1 (cont.)

HDE 269858 - TEN DAY MEANS

JD	Mean Mv	No Obs	JD	Mean Mv	No Obs	JD	Mean Mv	No Obs
2450,000+			2451,000+			2451,000+		
800	9.50	3	000	9.30	2	200	9.41	10
810	9.36	5	010	9.26	3	210	-	-
820	9.38	5	020	9.32	5	220	9.25	4
830	9.43	3	030	9.60	4	230	9.33	3
840	9.35	4	040	9.6	1	240	-	-
850	9.60	2	050	9.43	6	250	9.52	6
860	9.36	7	060	9.43	3	260	9.62	5
870	9.37	8	070	9.47	3			
880	9.25	4	080	9.85	2			
890	931	9	090	9.7	1			
900	9.37	4	100	9.55	6			
910	9.30	6	110	9.48	4			
920	9.40	5	120	9.43	3			
930	9.25	8	130	9.45	4			
940	9.27	3	140	9.55	6			
950	9.45	2	150	9.45	2			
960	9.38	6	160	9.36	5			
970	9.4	1	170	9.27	6			
980	9.20	5	180	9.44	7			
990	9.24	5	190	9.36	3			



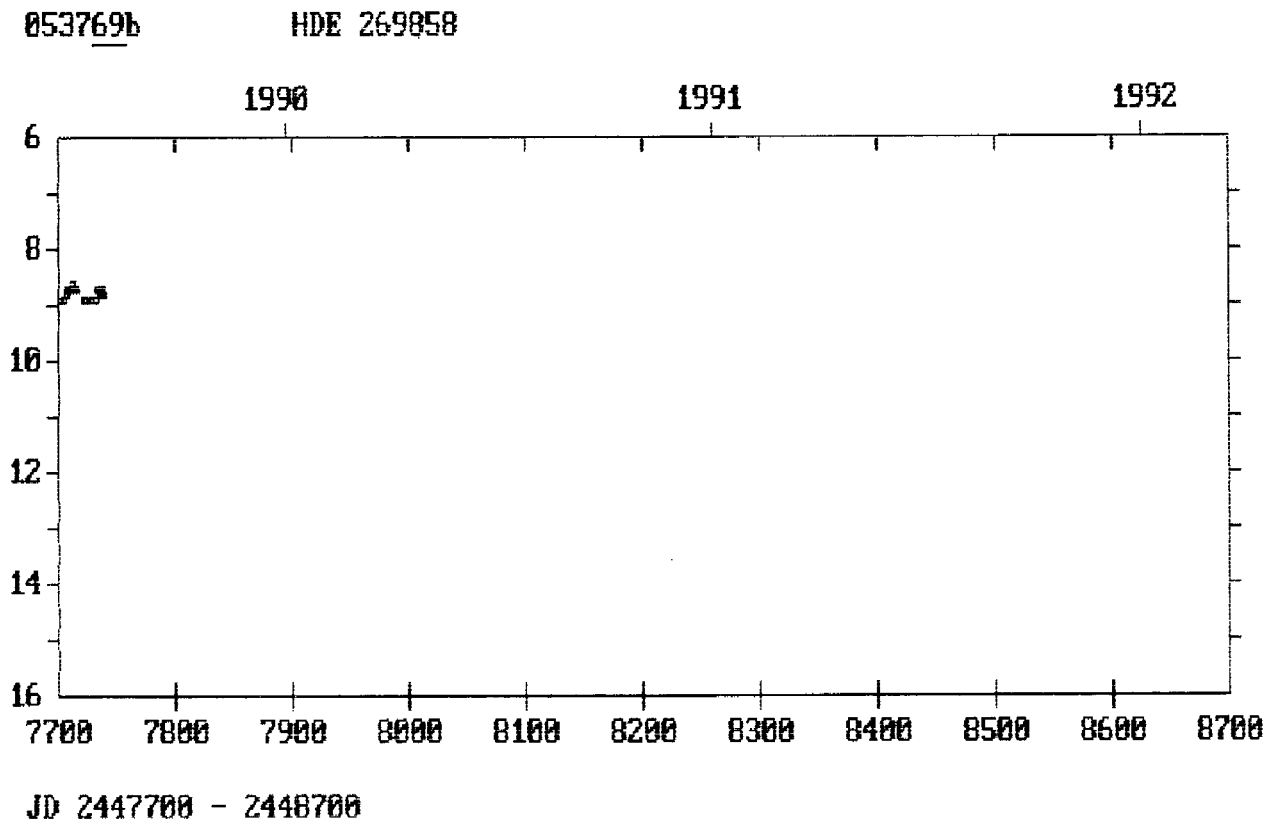


FIGURE 1

JD 2446,700 - 2448,700

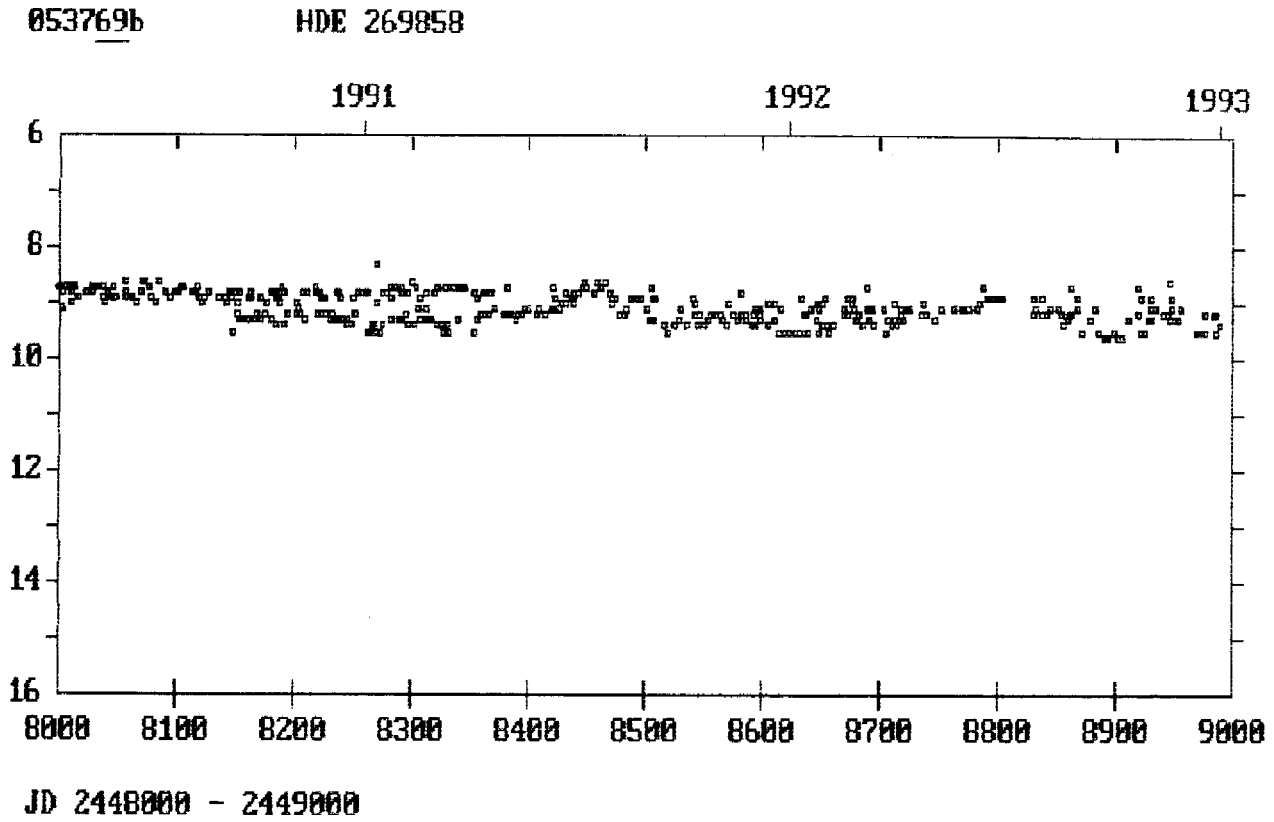
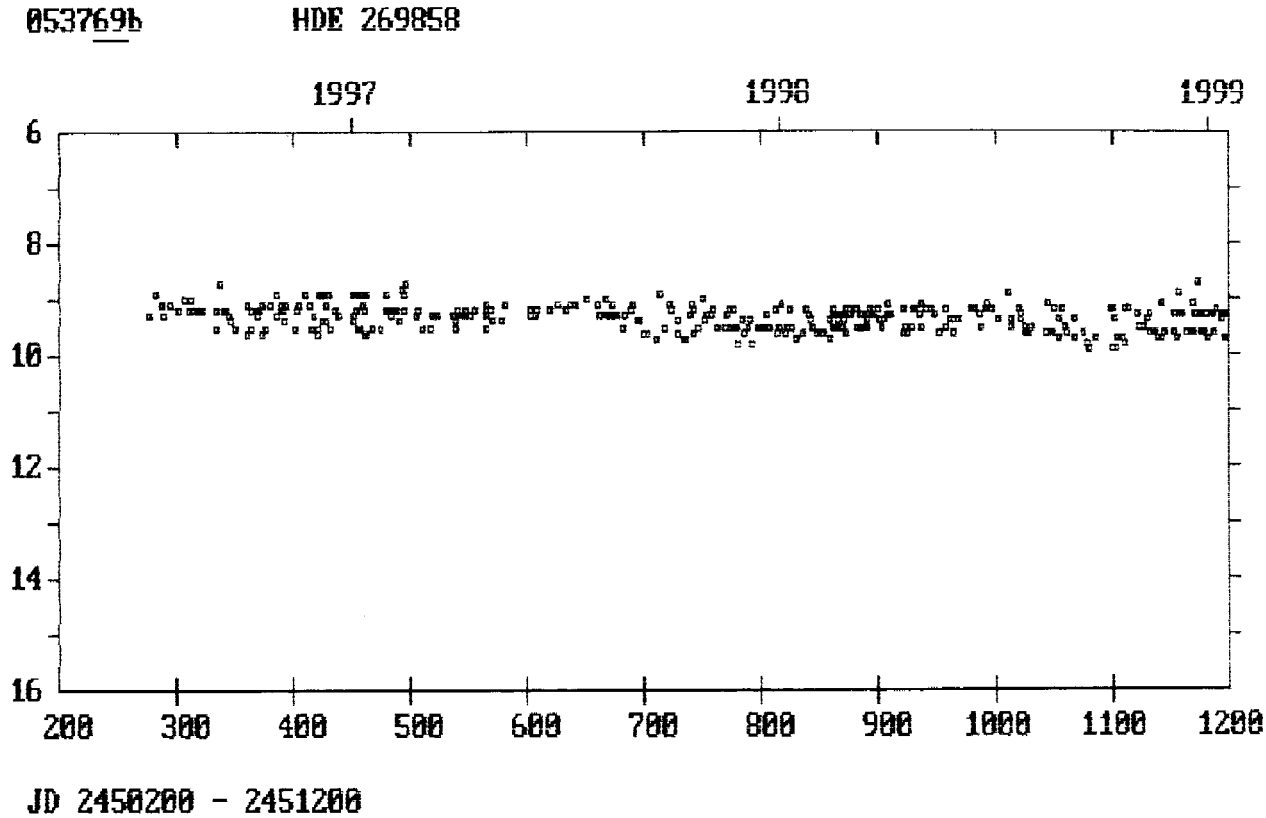


FIGURE 2
JD 2448,000 - 2449,000



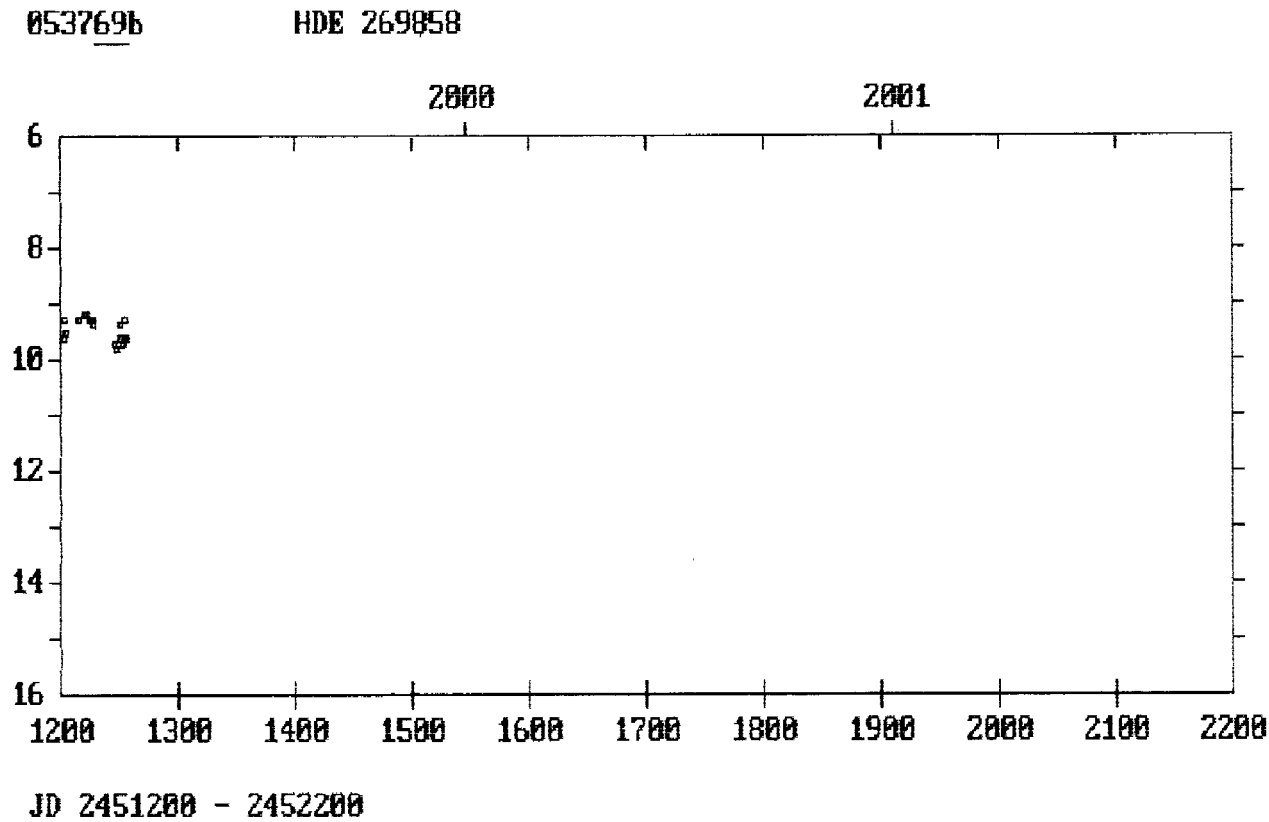


FIGURE 3

JD 2450,200 - 2452,200

THETA APODIS - A BRIGHT SEMI REGULAR VARIABLE

Peter F. Williams
Sutherland Astronomical Society & Variable Star Section, RASNZ

SUMMARY: Theta Apodis is a bright, small amplitude semi regular red variable of class SRB. Visual observations by members of the VSS RASNZ indicate a mean magnitude range of 5.6 to 6.4 and extremes of 5.2 to 6.8. An average period of 115.93 days is indicated. Dates of observed maxima are tabulated and O-C values calculated from the elements JD 2449588 +/- 115.93 days. A light curve and O-C plot are given.

1. INTRODUCTION.

Theta Apodis is classified as a semi regular variable of type SRB in the 4th edition General Catalogue of Variable Stars (1) based on a study of this star by Gaposhkin (2).

Details of its variability appearing in (1) indicate a photographic magnitude range of 6.4 to 8.6 and a period of 119 days. No epoch of maximum is given. Being a late type red giant whose spectral class is listed variously as M4 III or M7 III, it is visually much brighter and can be readily observed with binoculars.

Theta Apodis has a far southerly declination of -76 degrees, making it circumpolar for many southern hemisphere observers. Those with a reasonable southerly aspect can therefore provide continuous observation throughout the year without seasonal breaks.

This star has been observed sporadically since 1959 but good coverage did not commence until 1992 after which it has been regularly monitored on a continuous basis.

2. CHART AND OBSERVATIONS.

Theta Apodis is plotted on Chart 723 (3), the finder chart for the Mira variable T Apodis. This chart shows suitable comparison stars of V magnitudes 6.1 and 6.5 which are generally sufficient given the magnitude range of Theta Apodis.

A total of 553 observations from the VSS RASNZ data base are available for discussion. These have been grouped into 10-day means and plotted as the light curve shown in Figures 1A and 1B. Here, mean magnitudes from two or more observations are show as solid circles and single observations as open circles.

Only those portions of the light curve where the star has been sufficiently well observed are included.

Small amplitude stars such as Theta Apodis are recognised as difficult targets for visual observation. Great care must be exercised when making magnitude estimates, particularly if the variable is bright and clearly reddish in colour as in this case.

Where the mean magnitude range of the star under observation is not much greater than 1.0 magnitude, scatter within the observations will tend to mask the true variations of the star. The need for great care when observing such stars is therefore stressed. This has been discussed earlier by Bateson (4) to which all observers are referred.

THETA APODIS - A BRIGHT SEMI REGULAR VARIABLE (Cont.)

While Theta Apodis does at times show variations of half magnitude or more within a 10 day interval, as indicated by the results from the more experienced observers, some individual magnitude estimates appear to merely represent scatter between different observers. In some 10-day means, for example, this difference amounts to 0.9 magnitude and 0.5 to 0.7 magnitude is common.

Such scatter is evident in the light curve between JD 2449300 and 2449500.

The observations of Theta Apodis can be divided into five distinct intervals, with the star being better observed only in recent years. These intervals are:

(1) JD 2436847 - 2437063
(1959 October to 1960 May).

The earliest estimates are by Wayne Orchiston (Or) whose observations cover 216 days. There is only one well defined maximum evident in this data. There is a gap of 3917 days (10.7 years) before Theta Apodis is next observed.

(2) JD 2440980 – 2441240
(1971 February to 1971 September).

Observations during this 250 day interval were again by a single observer, Peter Williams (Wy). Three maxima are evident. This is followed by a gap of 5656 days (15.4 years) before the next observations.

(3) JD 2446896 - 2447745
(1987 April to 1989 August).

Three observers contributed during this 849 day interval, providing a uniform data set.

(4) JD 2447957 - 2448458
(1990 March to 1991 July).

This 510 day interval follows a gap of 212 days and contains results dominated by observers of the British Astronomical Association whose observations appear to be systematically brighter by several tenths of a magnitude. This has, however, not altered the period determination of this star. This interval includes a 120 day gap 2448156 to 2448276.

(5) JD 2448687 - 2451330
(1992 March to 1999 May).

This follows a 229 day gap in which only one observation was reported. Theta Apodis has been better observed during this time and on a continuous basis without seasonal or other gaps.

3. DISCUSSION.

A preliminary mean period of 115.78 days was determined from 14 maxima during the 1621 day interval JD 2449459 to 2451080. This was then extended to cover the 4057 days 2447023 to 2451194 to produce a revised mean of 115.91 days over 35 cycles. At this stage, however, it became apparent this second interval could also represent 34 cycles or a mean period of 119.32 days, close to that given in (1).

The final periods used in this discussion was derived by using these two periods to estimate the number of cycles which occurred during the entire span of the observations. These, for the 14144 day span of the observations, give alternative periods of 115.93 days for 122 cycles and 118.85 days for 119 cycles. Individual cycle lengths range from 63 to 155 days.

THETA APODIS - A BRIGHT SEMI REGULAR VARIABLE (Cont.)

Similar values were obtained for the data on dates of minimum light.

Table 1 lists the dates of observed maxima. The zero epoch from which the dates are tabulated is JD 2449588, chosen for being well defined and during the early stages of the interval number 5 when Theta Apodis was being well observed.

The Table gives the JD of the observed maximum, the interval to the next observed maximum or where bracketed this figure clearly represent non-consecutive cycles. This is followed by the date of maximum calculated using the period 115.93 days and the resulting O-C value. Next is the calculated date using the alternative period 118.85 days and the resulting O-C values.

The two O-C value sets are plotted in Figure 2. This shows some scatter as would be expected for a semi regular type star but clearly suggest a better fit for the 115.93 day period.

3. CONCLUSION.

The available observations show that meaningful visual data for low amplitude stars such as Theta Apodis can be obtained, provided the observations are made by exercising due care and when reliable comparison star magnitudes are available.

Theta Apodis is a typical semi regular variable of type SRB. A mean period of 115.93 days over 122 cycles is evident, subject to the usual uncertainties expected for this type of star.

Derived elements for Theta Apodis are JD 2449558 +/- 115.93 days.

ACKNOWLEDGEMENTS.

All observers are thanked for their observations. Frank Bateson is also thanked for his guidance.

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2. Gaposkin, C. Harvard Annals Vol 113. No.4.
3. 1983, Bateson F.M. Morel M., Charts For Southern Variables, Ser.16, Pub. By Astronomical Research Ltd, Tauranga N.Z.
4. 1992, Bateson, F.M. Publ.Var.Star Sec.Rastr.Soc.N.Z. Vol.18 p.33

TABLE 1.

LIST OF OBSERVED MAXIMA FOR THETA APODIS
with O-C values for the periods 115.93 days and 118.85 days.

MAX 240000	INT.	CYCLE No.	C115.93	O-C	CYCLE No.	C118.85	O-C
37050	(4040)	-108	37067.56	-17.56	-106	36989.90	+60.10
41030	120	-74	41009.18	+21.82	-72	41030.80	- 0.80
41150	90	-73	41125.11	+24.89	-71	41149.65	- 0.35
41240	(5783)	-72	41241.04	- 1.04	-70	41268.50	-28.50
47023	108	-22	47037.54	-14.54	-22	46973.30	+49.70
47131	155	-21	47153.47	-22.47	-21	47092.15	+38.85
47286	127	-20	47269.40	+16.60	-20	47211.00	+75.00
47413	63	-19	47385.33	+27.67	-19	47329.85	+83.15
47476	124	-18	47501.26	-25.26	-18	47448.70	+27.30
47600	(356)	-17	47617.19	-17.19	-17	47567.55	+32.45
47956	107	-14	47964.94	- 8.94	-14	47924.10	+31.90
48063	(387)	-13	48080.91	-17.91	-13	48042.95	+20.05
48450	(1009)	-10	48428.70	+21.30	-10	48399.50	+50.50
49459	129	-1	49472.07	-13.07	-1	49469.15	-10.15
49588	113	0	49588	0.0	0	49588	0.0
49701	131	+1	49703.93	- 2.93	+1	49706.85	-5.85
49832	138	+2	49819.86	+12.14	+2	49825.70	+6.30
49970	120	+3	49935.79	+34.21	+3	49944.55	+25.45
50090	107	+4	50051.72	+38.28	+4	50063.40	+26.60
50197	125	+5	50167.65	+29.35	+5	50182.25	+14.75
50322	91	+6	50283.58	+38.42	+6	50301.10	+20.90
50413	117	+7	50399.51	+13.49	+7	50419.95	- 6.95
50530	108	+8	50515.44	+14.56	+8	50538.80	- 8.80
50638	114	+9	50631.37	+ 6.63	+9	50657.65	-19.65
50752	94	+10	50747.30	+ 4.70	+10	50776.50	-24.50
50846	126	+11	50863.23	-17.27	+11	50895.35	-49.35
50972	108	+12	50979.16	- 7.16	+12	51014.20	-42.20
51080	114	+13	51095.09	-15.09	+13	51133.05	-53.05
51194	-	+14	51211.02	-17.02	+14	51251.90	-57.90

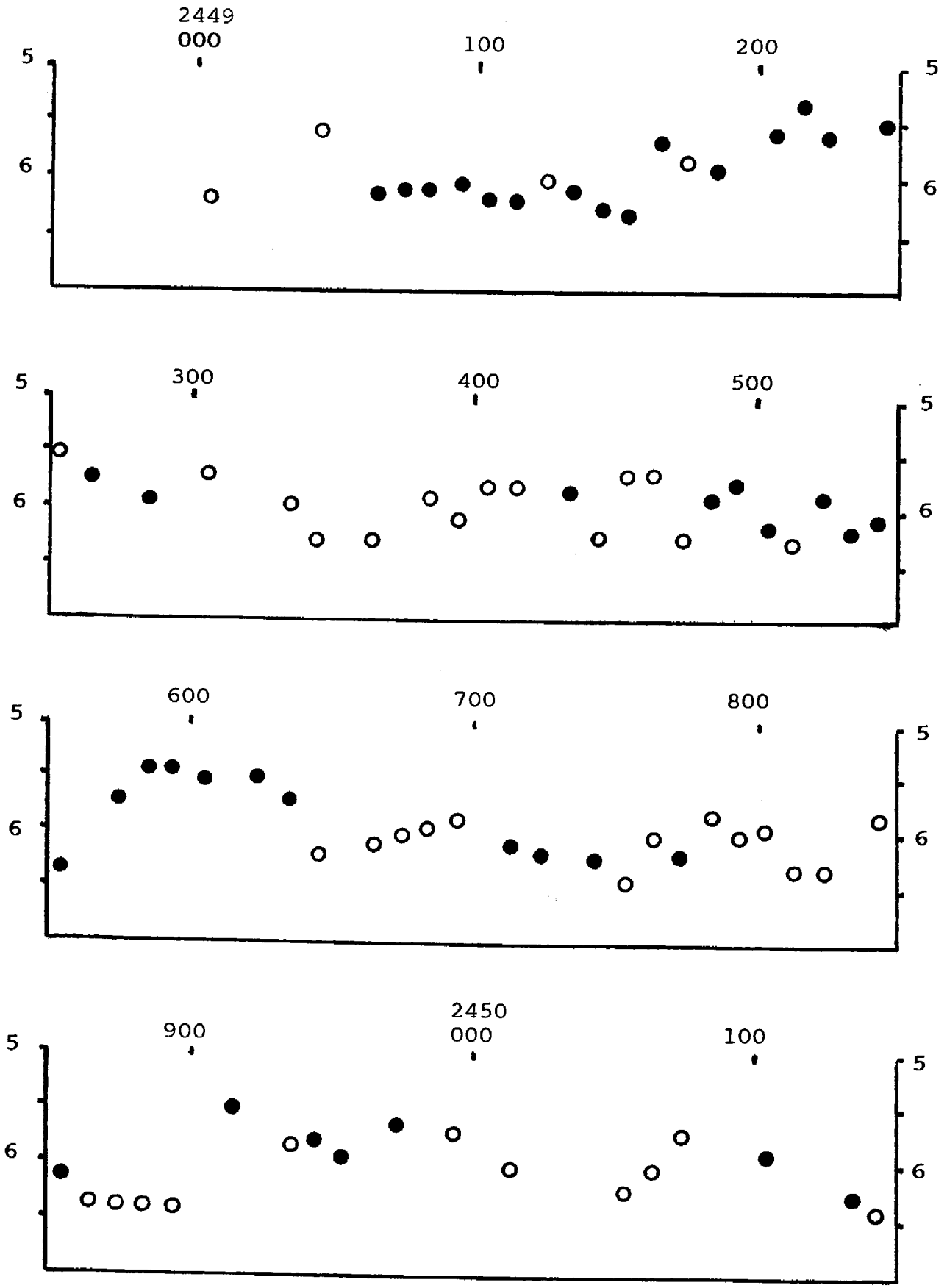

Figure 1A. Visual light curve of Theta Apodis, JD 2448950 to JD 2450150.

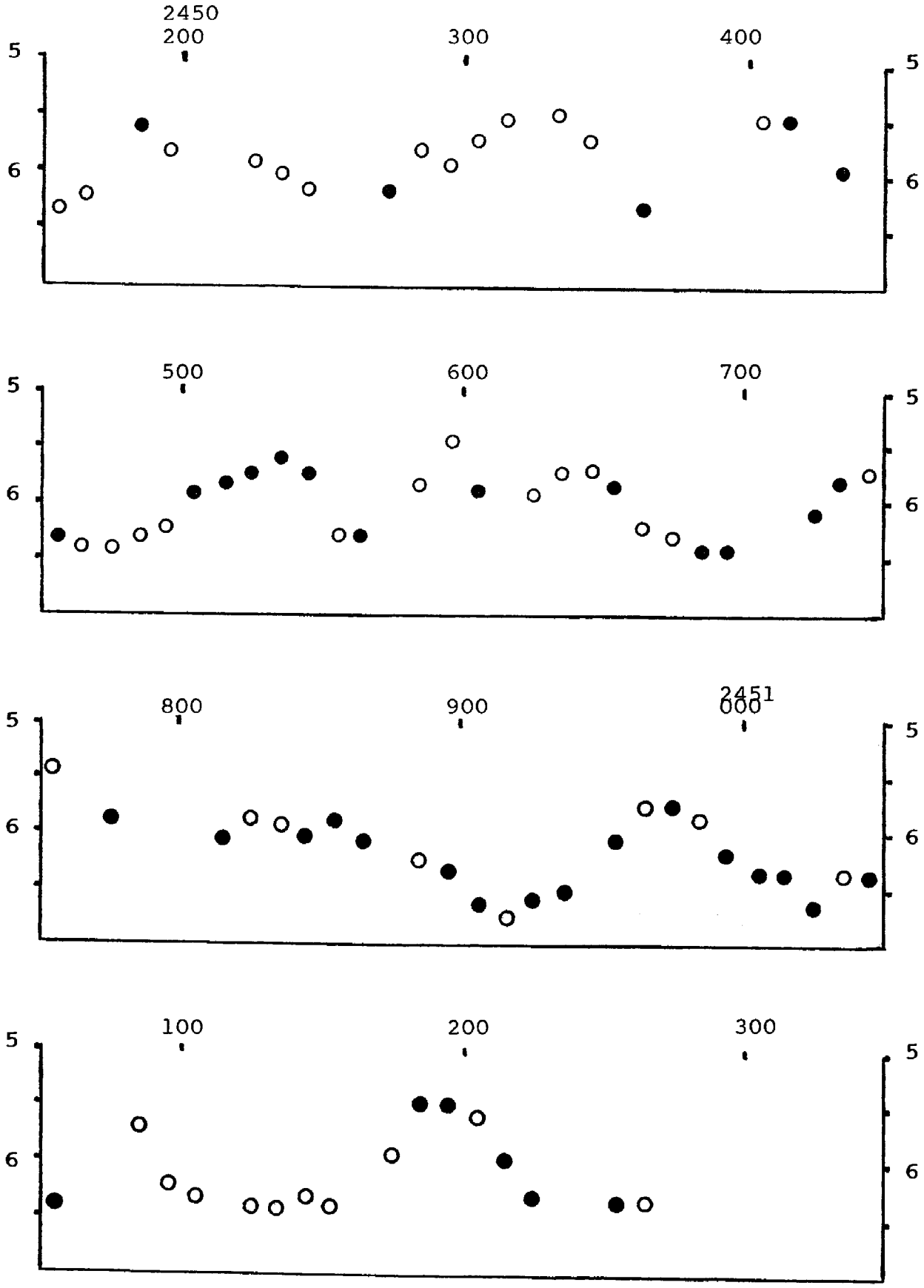

Figure 1B. Visual light curve of Theta Apodis, JD 2450150 to JD 2451350.

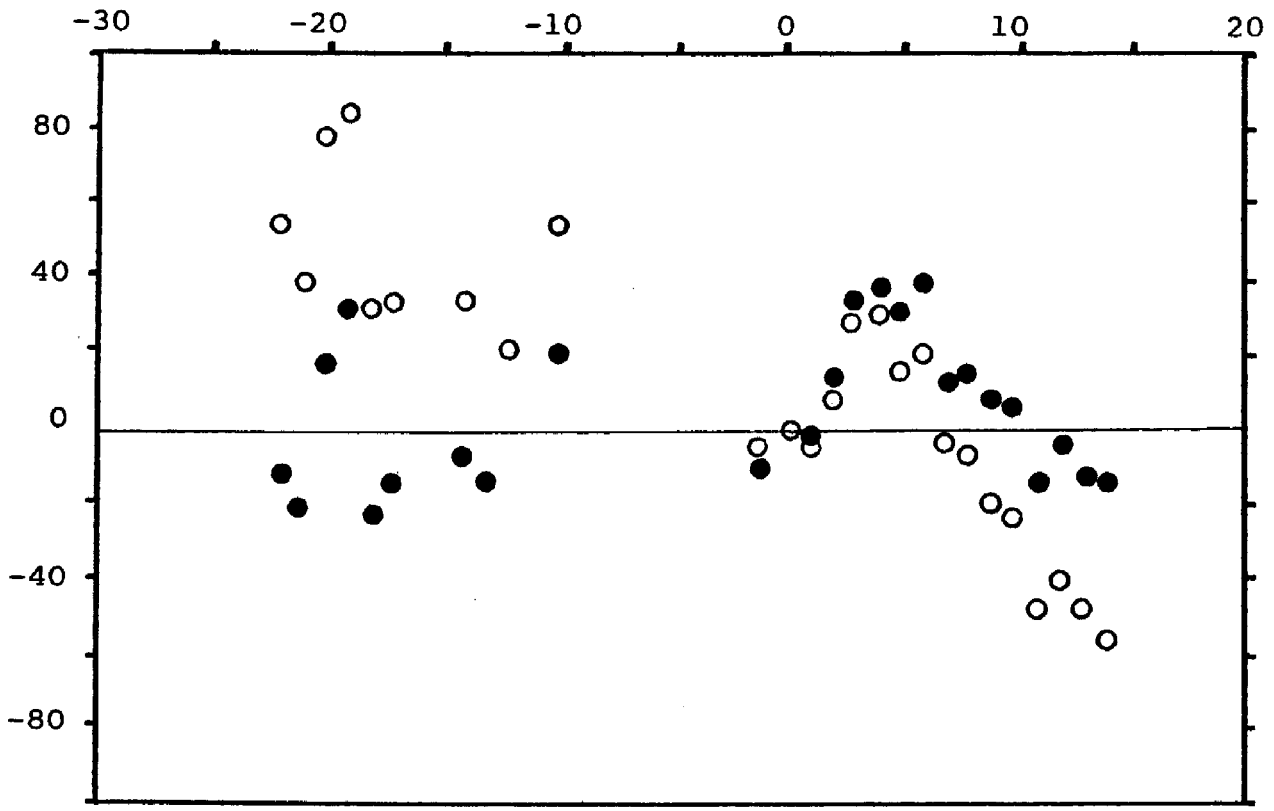

Figure 2. O-C plot for observed maxima of Theta Apodis Solid circles represent preferred period 115.93 days and open circles according to alternative period 118.85 days.

NSV 4189 HYDRAE - A LARGE AMPLITUDE RED VARIABLE

Peter F. Williams
Sutherland Astronomical Society & Variable Star Section, RASNZ

Eugene M. Brings
P.O. Box 582, Mendocino, CA 95460, USA.

SUMMARY: Attention is directed to NSV 4189 as a large amplitude red variable star. Visual and photographic observations during the 7 year interval 1994 through 2000 indicate this is a Mira type star of visual magnitude range 10.6 to fainter than 15.5. A preliminary ephemeris for maximum brightness is JD 2450190 +/- 448 days.

1. INTRODUCTION

In 1994 Eugene Brings commenced a programme to photograph red suspected variable stars from the NSV Catalogue (1) where significant variation had been reported at infrared wavelengths.

This was under the pretext such stars would turn out to be Mira or Semi Regular type variables when investigated at visual or photographic wavelengths.

NSV4189 is identical with the infrared source IRC-10202 which has shown diverse measurements ranging between 2.29 and 3.47 in the K spectral region. It also shows a 12/25mu IRAS flux ratio near 1.75 which appears consistent with NSV4189 being a dusty AGB or OH/IR star.

Brings uses a 14-inch F11 Schmidt-Cassegrain telescope located near Mendocino in northern California, at a latitude of 40N degrees. Exposure times are typically 10 to 15 minutes at F7 on hyper sensitized Fuji 400 colour or Kodak TP2415 B/W negative films which he processes himself. These photographs generally show stars to near 18th magnitude and the colour emulsions when used tend to highlight the red colouring of these stars.

Visually, this telescope reaches to near 15.5 magnitude.

Each field under investigation is generally photographed on a near monthly basis during the respective observing season and where a star shows clear variation a program of visual observation is undertaken.

Williams uses a 30cm F6 newtonian reflector at Heathcote , NSW, at latitude 34S degrees. This telescope typically reaches to visual magnitude 14.5.

However, because of the latitude difference between these two sites and the local horizon and conditions at each, there is a relatively narrow band of sky which is accessible in practical terms from both sites. This band is between declinations +5 degrees and -20 degrees.

Details of the red NSV stars photographed by Brings which have shown variation are summarised in Table 1. This lists the catalogue range given in the NSV, the photographic range detected by Brings and a preliminary classification of the star's variability type based on the available observations. Where the star has since received an official designation through other investigations, this is also indicated.

Several of the stars listed in Table 1 have not been detected visually to date and it is possible some may simply be too faint for visual study with the telescopes currently in use. This Table also hints at the potentially large number of suspected red variables which may be profitably studied with relatively simple means.

A programme such as this may be recommended as an ideal project for either individuals or small groups within amateur astronomical societies where there is ready access to photographic or CCD imaging equipment. The less well studied southern skies would seem particularly fertile grounds for such a programme.

2. CHARTS & MAGNITUDE SEQUENCE

Where the photographs revealed considerable variation, a chart is prepared by Brings based on his photographs and suitable comparison stars are selected for visual observation.

As no reliable sequence of comparison stars was available for this star, Arne Henden of the United States Naval Observatory kindly determined V magnitudes for the field of NSV4189. These V magnitudes have been used to reduce the observations discussed here.

The identification chart for NSV 4189 is shown as Figure 1, on which are shown the Henden V magnitudes.

Figure 2 is a negative reproduction of two images by Brings which clearly show the variation of NSV 4189.

3. DISCUSSION

During the initial preparation of this paper NSV4189 was observed at maximum light in January 2000. This maximum proved to be considerably brighter than that recorded for the 5 previous cycles, reaching magnitude 10.6. Wishing to take advantage of this unusually bright cycle, a summary of our data on NSV4189 to that time was posted to the vsnet web site of the Kyoto University in Japan, directing wider attention to this star.

That preliminary data has now been revised following the availability of reliable V magnitudes, resulting in the amended details presented here and as summarised through the vsnet web site (2).

A total of 58 visual and 4 photographic observations have been obtained during the 7 years of regular monitoring. These indicate only 6 partially observed cycles have been recorded for what is obviously a long period variable star. The date of only one maximum can be determined with any accuracy, that of JD 2450190.

Observations of cycles 2 through 6 have been plotted in Figure 3 as individual curves according to phase zero at JD 2450190 +/- 448 days.

In an attempt to better estimate the dates of other maxima and allow for establishing a preliminary period, the observations from cycles 2 through 6 have been stacked to provide a more complete 'best fit' light curve. This technique is often used on stars which show a more regular light variation, such as cepheids and eclipsing systems. It is, however, well known the Mira stars can show considerable deviation between consecutive cycles yet the mean curve appears to fit well when overlaid on the partially observed cycles, despite the range of intervals indicated between these cycles. The mean light curve for NSV 4189 obtained by this method is shown as Figure 4.

When superimposed over the original observations to produce a more complete light curve, the mean allows for better estimation of the dates for four additional maxima.

Figure 5 is a combined light curve in which visual observations are plotted as solid circles and photographic observations as open circles. The mean light curve overlay is represented by the dashed line. A mean period of 448 days is indicated from the 5 maxima shown.

The 448 day period yields O-C values ranging from +6 to -12 days relative to the revised epoch for maximum at JD 2450190. This is a much reduced range when compared to the initially proposed period of 465 days as reported in the vsnet-chat.

Table 2 lists details of the observed cycles. Here, column 1 gives the cycle number relative to the above epoch and column 2 the inferred date of maximum as determined from the light curve in Figure 5. Column 3 gives the visual magnitude at maximum and column 4 the interval to the following maximum. Columns 5 and 6 plus 7 and 8 compare the O-C values for the alternative periods 448 days and 465 days. These clearly indicate a better fit for the 448 day period.

We stress this is very preliminary data based on comparatively few cycles of a long period variable star and should therefore be treated with due caution. It is, however, suitable for estimating the approximate date of maximum brightness during future cycles, thereby allowing further refinement of the data.

4. CONCLUSION

NSV 4189 is a typical long period Mira type variable star. A period near 448 days is evident during the seven year interval 1994 through 2000.

A preliminary ephemeris for determining the date of maximum brightness is JD 2450190 + 448 days.

ACKNOWLEDGEMENTS

Thanks are due to Arne Henden (USNO) for determining V magnitudes for the field of NSV4189 and to Brian Skiff (Lowell Observatory) for background information on this star. Mati Morel provided additional bright V magnitudes from the Tycho-1 data.

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TABLE 1

NSV 4189 HYDRAE

Red NSV stars photographed by E M Brings and which have been shown to be variable.

NSV	CATALOGUE MAX	CATALOGUE MIN	OBSERVED RANGE		TYPE	PERIOD (DAYS)	NOTES
1710	2.35K	3.78K	10.6v	<17p	M	446	EO Eri
2533	2.07K	2.95K	11.0p	14p	L	=	V1187 Ori
4189	2.29K	3.47K	10.6v	<15.5p	M	(448)	=
9764	8.91I	10.58I	14.5p	16.5p	=	=	V2211 Oph
10270	2.59K	3.21K	13.5p	<15.5v	=	=	=
11912	1.63K	2.61K	14.0p	18.0p	M	=	V1420 Aql
12342	7.12I	8.80I	15.5p	<18p	=	=	V1415 Aql
13284	6.48I	7.98I	10.0v	<15.5p	M	(480)	FP Aqr

TABLE 1 - Notes

Name List where official designation assigned:

EO Eri	71st Name List
V1187 Ori	68th Name List
V2211 Oph	68th Name List
V1420 Aql	72nd Name list
V1415 Aql	71st Name List
FP Aqr	68th Name List

TABLE 2

NSV 4189 HYDRAE

Details of observed maxima of NSV4189 with comparative O-C values for alternative periods of 448 days and 465 days

NO	MAX 2400000+	MAG	INT.	E+/-448 2400000+	O-C	E+/- 465 2400000+	O-C
-1	49730	12.3	460	49742	-12	49725	+5
0	50190	11.9	450	E	0	0	0
1	50640	12.2	435	50638	+2	50655	-15
2	51075	(12.0)	465	51086	-11	51120	-45
3	51540	10.6	-	51534	+6	51585	-45

Figure 1.

NSV4189 HYDRAE

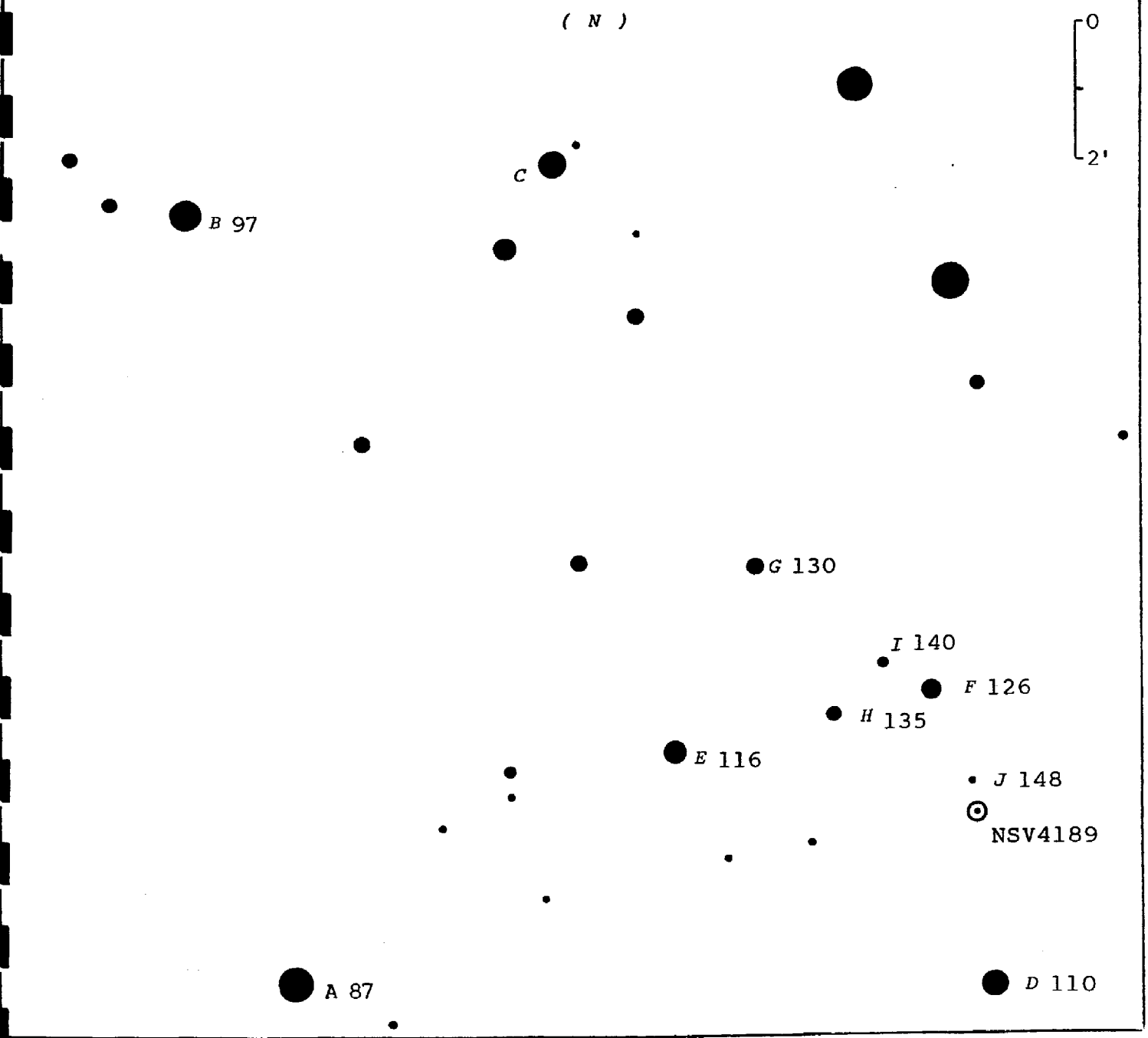
08h 38m 04s -14° 38'.3 (1950)
08h 40m 24s -14° 49' (2000)

11.5ptg - ? *Spec. M8*

Chart based on photograph by E.M.Brings shows stars to approx 15th mag.

Preliminary Chart. *scale 1mm = 5"*

Magnitudes V (Henden, USNO)



PFW 31 JAN 1995

Figure 2.

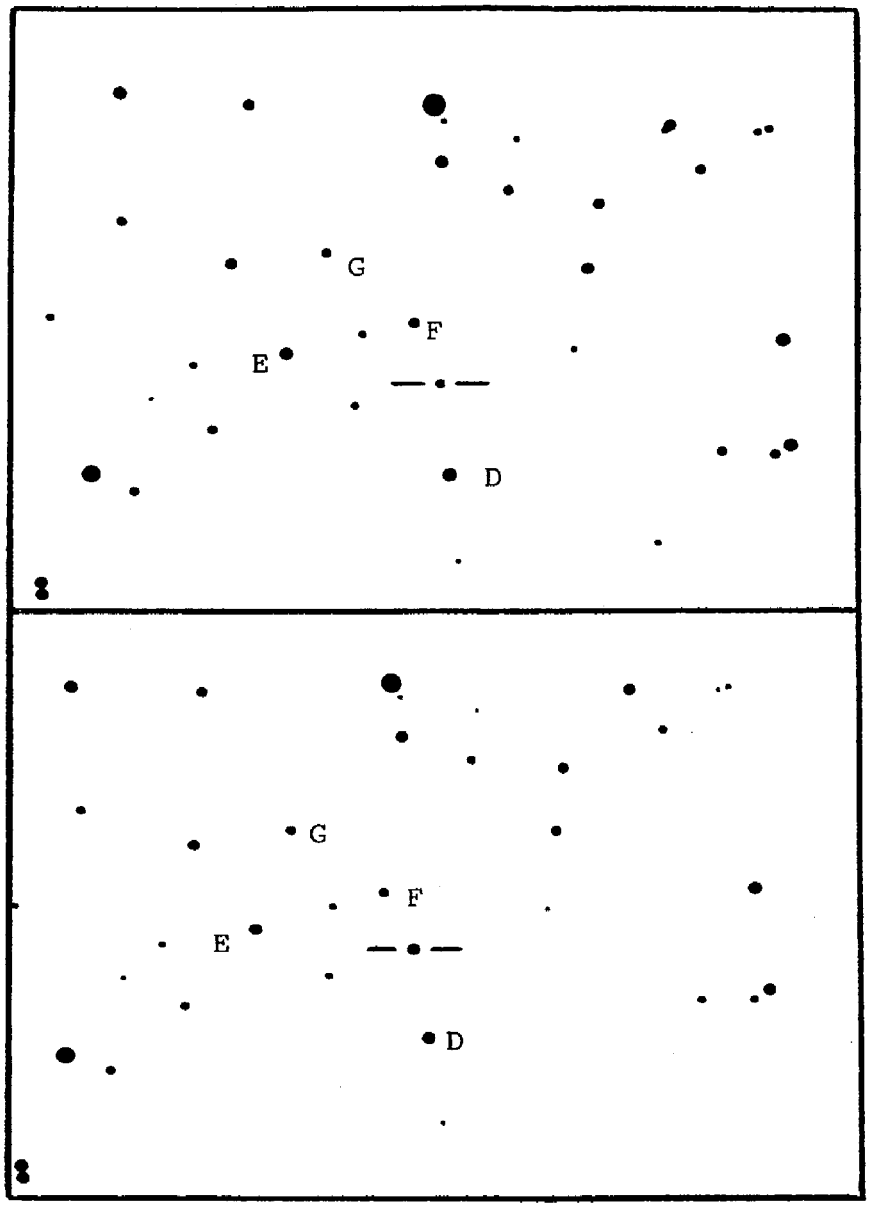


Fig.2. NSV4189 12 March 1994 (top) and 30 November 1994 (bottom).

Figure 3.

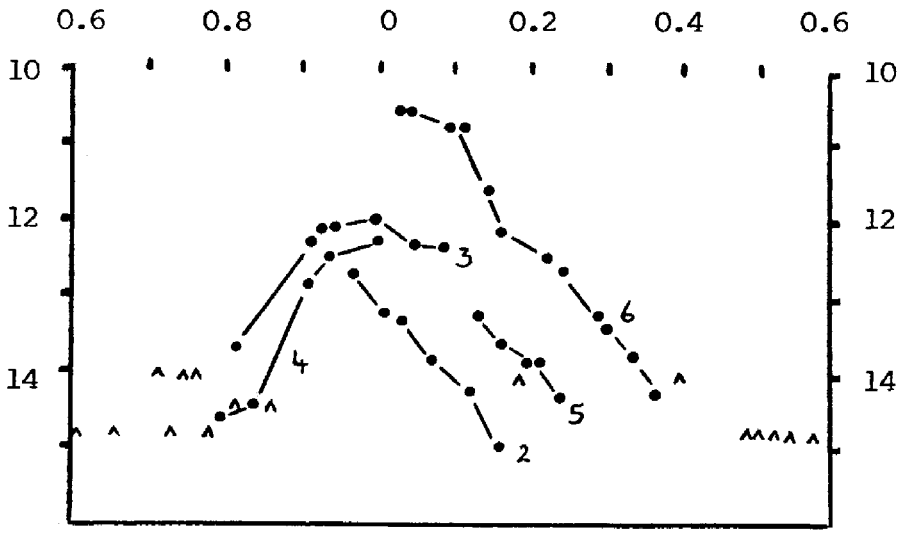


Fig.3. Phase plot of cycles 2 through 6 based on elements JD 2450190 +/- 448 days

Figure 4.

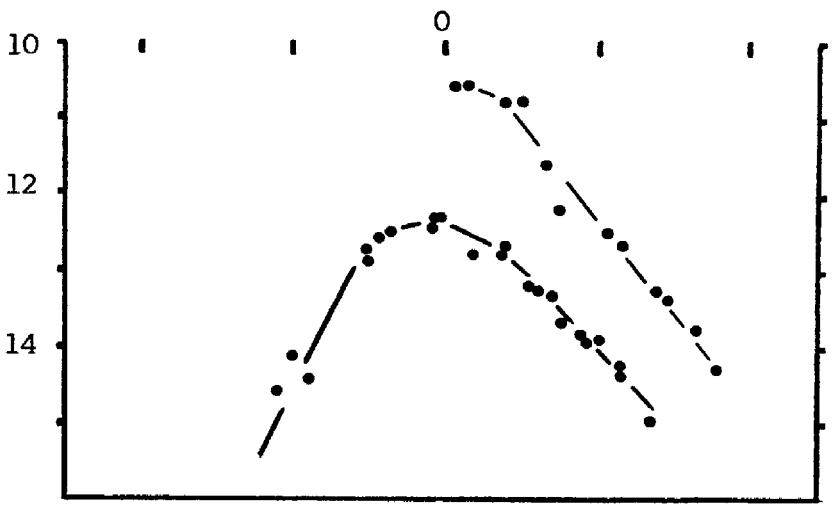


Fig.4. Mean light curve of NSV4189 for cycles 2 through 5 (bottom) and the unusually bright maximum of cycle 6 (top).

Figure 5.

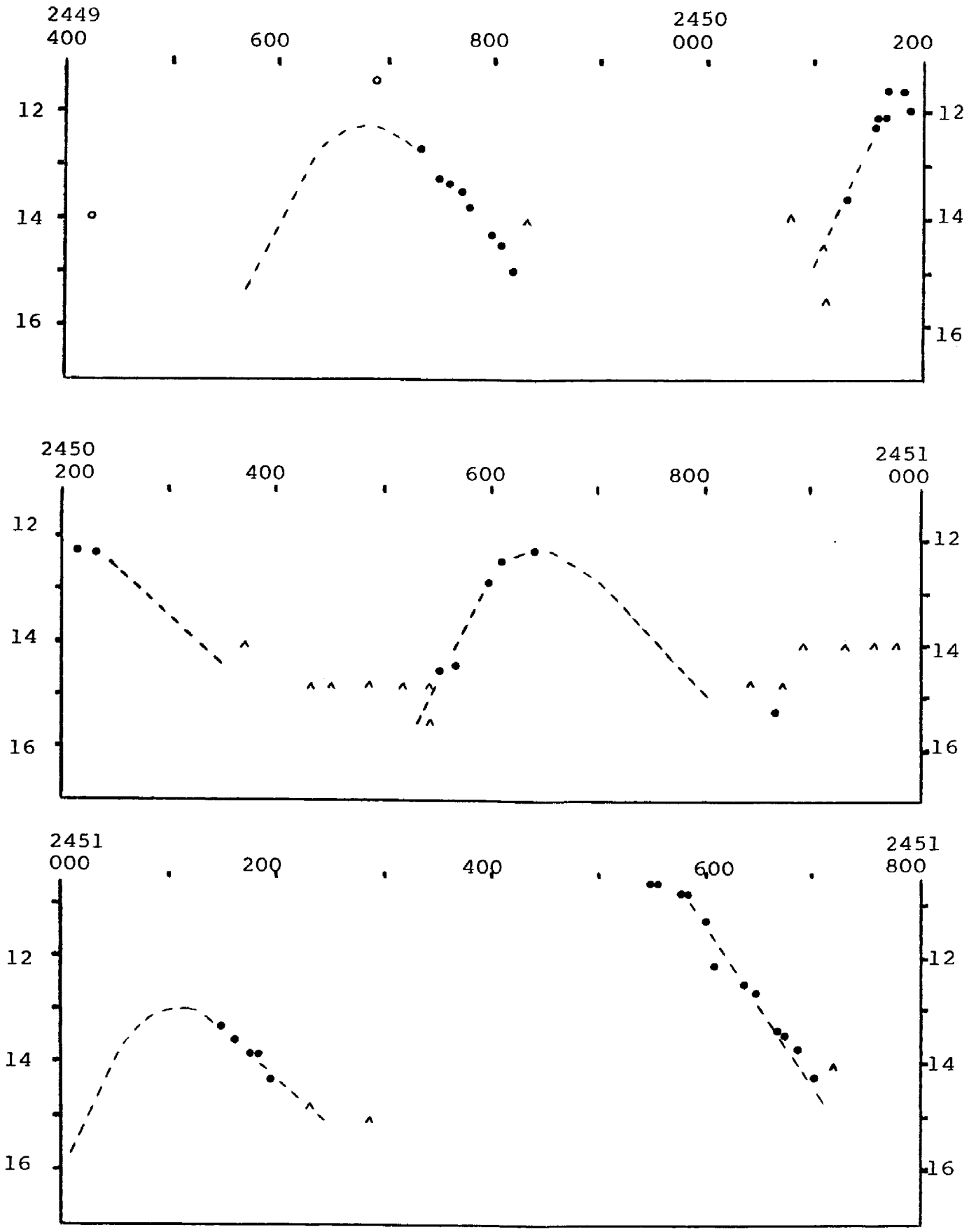


Fig.5. Mean light curve of NSV4189.

THE DWARF NOVA CW MONOCEROTIS.

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

SUMMARY: Outbursts of CW Mon between J.D. 2,450,721 and 2,451,575 are listed. These results are combined with those in previous papers to determine the mean maximum magnitude and mean width for both wide and narrow maxima. The possible length of the outburst cycle is discussed.

1. INTRODUCTION

Earlier visual observations of CW Mon were discussed by Stubbings & McIntosh (1) and Bateson (2). The conclusion reached in both papers was that CW Mon was a typical dwarf nova of of U Gem type with wide and narrow outbursts and a mean cycle of about 160 days. Kholopov (3) gives a range of 11.9 to 16.3p and a cycle length of 121.7 days. Bruch and Engel (5) give the quiescence magnitude as 16.51V.

2. OBSERVATIONS

The observations discussed here cover the interval J.D. 2450,721 to 2,451,575. The main observing season is September through May. There are gaps of 78 days after 2450,953 and of 47 days after 2451,337. These gaps are due to CW Mon being unobservable when in conjunction with the Sun.

A total of 719 observations were made during the interval reviewed here. Most were negative. There were several gaps of a few days during the main observing season. Portion of the light curve is shown in Fig. 1. Negative observations are shown by the sign "v". This figure illustrates two intervals when large gaps occurred in the observations when CW Mon was unobservable. However, these gaps diminished in length and number compared to previous intervals because of improved coverage.

Details of the five observed outbursts are listed in Table I. An additional possible outburst was rejected because negative estimates in close proximity on either side of the single positive estimate indicated that it was unlikely that an outburst had occurred.

There were a number of observations at, or near, minimum. These ranged from 15.7 to 16.5 with an occasional estimate of 15.0. It appears possible that these faint peaks may be due to rotation. However, the positive estimates were not frequent enough to verify this.

3. DISCUSSION

It is obvious from Table 1 that the five outbursts recorded in the interval in this paper are too few for any meaningful discussion of the mean cycle and average parameters of outbursts. Therefore I have combined the data in Table 1 with the data listed in previous papers (1, 2 & 4).

CW Mon has two types of maxima - wide and narrow according to the time the star was at, or near, maximum. The mean maximum magnitude of wide outbursts is 12.20 and for narrow 12.75. The average widths are:

THE DWARF NOVA CW MONOCEROTIS (Cont.)

Wide 8.5 days. Narrow 3.25 days. .

The foregoing values were determined from those outbursts for which magnitudes and widths were reliable. Outbursts for which the data was uncertain were omitted in determining the mean values.

There was no systematic trend in the order in which wide and narrow outbursts followed each other.

It is difficult to be precise in determining the mean cycle of outbursts because of gaps in the observations. Table 2 lists the number of gaps for different lengths between the outbursts listed in Table 1.

The number of outbursts that occurred during the intervals when CW Mon was unobservable due to conjunction with the Sun is very uncertain. The uncertainty is at least partly due to the wide spread in cycle length when observed outbursts are consecutive.

Previous papers have determined the mean cycle as about 150 days from outbursts that were probably consecutive. However, it was suggested that the mean cycle was shorter than 150 days. A mean cycle of 150.3 days was found for the outbursts in Table 1 but this value is possibly too large.

The average width of 3.25 days means that a narrow outburst could pass unobserved in gaps of a few days even in the main observing season.

4. CONCLUSIONS

CW MON is a typical dwarf nova of the U Gem type exhibiting two types of maxima, wide and narrow devoid of any regular pattern in the order in which these maxima follow each other. The mean magnitudes of the outbursts are 12.20 for wide and 12.75 for narrow. Outburst widths are 8.5 and 3.25 days respectively.

The outburst cycle is around 150 days from outbursts which are probably consecutive. However, the true cycle is shorter than 150 days because it is certain that some outbursts passed unobserved during gaps in the observations. Closer monitoring especially in the observing season of September through May is needed to refine the cycle length.

5. ACKNOWLEDGEMENTS

I am indebted to Frank Bateson for his help and encouragement in the preparation of this paper. All observers are thanked for their observations.

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THE DWARF NOVA CW MONCEROTIS

TABLE 1

CW Mon - Observed outbursts

No.	JD Max 244.....	Max $_{Mv}$	Int. $_d$	Width $_d$	Type	No. Obs	Notes
43	50736	13.5	81	?	?	4	2
44	50889	12.8	159	3+	W?	9	1
45	51047	13.6	158	?	?	3	3
46	51223	12.5	176	8	W	19	
47	51551	12.6	328	14	W	12	

Notes:

1. Gap of 6 days prior to this outburst, so this may have been a wide outburst judging by the rate of decline which was well observed.

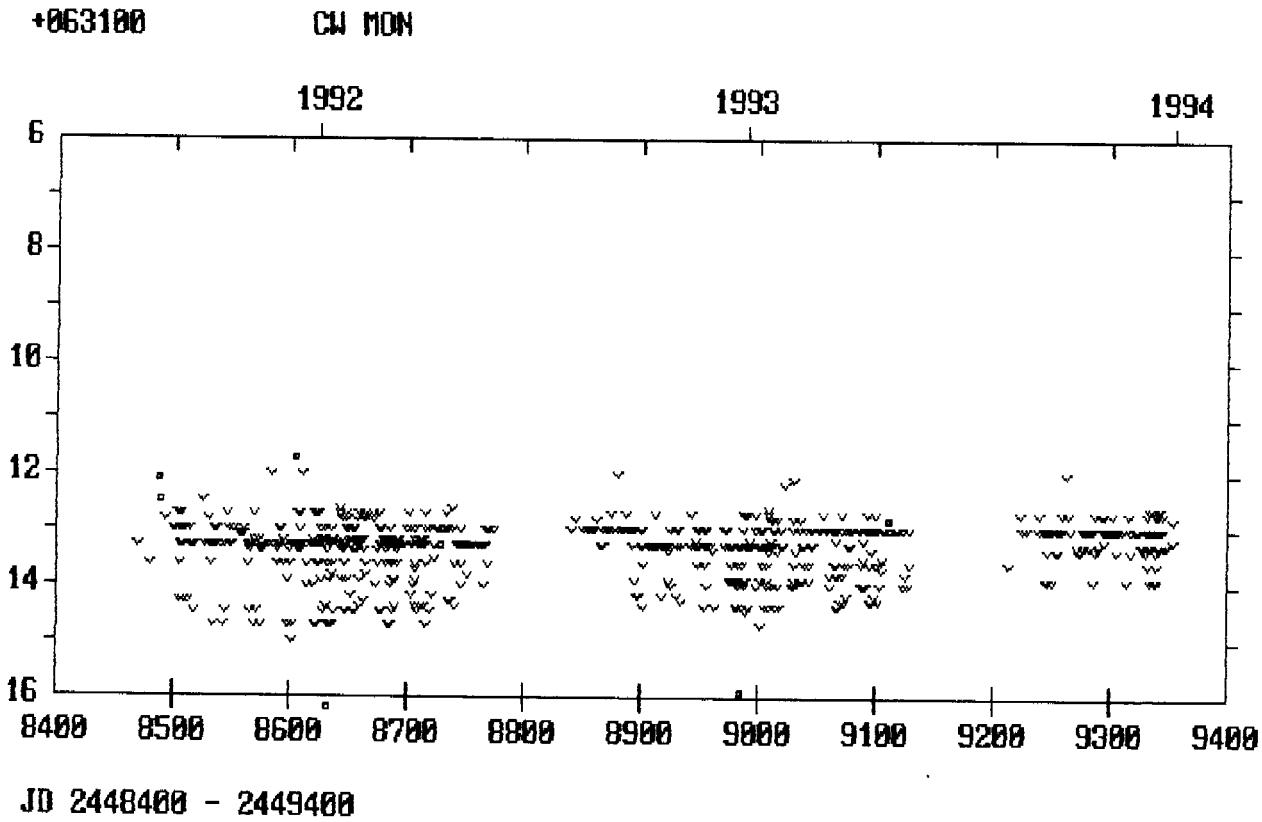
2. Positively identified over two nights, but poorly observed prior to and after these observations.

3. Positively identified on one night, but poorly observed prior to and after these observations.

TABLE 2

CW Mon - Observation gaps between different outbursts

Nos.	2_d	3_d	4_d	5_d	6_d	7_d	8_d	9_d	15_d	47_d	78_d
43	11	4	1	1	2						
44	5	1			2						1
45	16	5	2	1	2		1				
46	17	14	2	1		1		2	1	1	



CW MONOCEROTIS

Figure 1

J.D. 2448,400 - 2449,400

RESULTS FROM 10.5 YEARS MONITORING OF BX PUPPIS

Frank Bateson & Rod Stubbings
Variable Star Section, RASNZ

ABSTRACT: It is shown that the dwarf nova, BX Puppis, is a typical Z Cam type variable. Mean maximum magnitude is 14.06 and the mean cycle is 19.5 days. These results are from 10.5 years of monitoring.

1. INTRODUCTION

BX Puppis is at $07^h\ 54^m\ 15.58^s$ $-24^\circ\ 19'\ 36.4''$ (Equinox 2000) and has a range of 13.8 to 18.0V (1). A total of outbursts was listed in previous papers (2,3) from mainly fragmented data. The main observing season for BX Pup is December through June with limited observations in October and November.

2. OBSERVATIONS

BX Pup is shown on Charts 467, 470 & 471 (4) with a V sequence by N. Vogt (5). This sequence had V magnitudes for comparison stars from 8.02 to 13.00 with fainter stars lettered on Chart 471. B. Sumner estimated the magnitudes of some of the lettered stars from 13.3 to 14.6 and these were used in reducing the estimates, whilst some observers used the faint comparison stars with V mags in the nearby BV Pup field.

The observations used in this paper cover the interval JD 2446,891 to 2450,721. A total of 834 estimates were made, many of which were negative. There are many gaps in the observations some being for long intervals when BX Pup was not observed. There was, for example, a gap of 1157 days between the previous paper (3) and the present paper.

Positive estimates prior to JD 2449,829 were mainly made by W. Goltz, A Pearce and R. Stabenow, with occasional observations from other New Zealand members. From JD 2450,045 one of us (RS) has endeavoured to monitor BX Puppis closely.

4. DISCUSSION

The outbursts observed are listed in Table 1 with the outburst number being continued from the previous papers. The second column shows the JD for each maximum with the maximum visual magnitude in the third column. It must be stressed that these values are dependent on the number of positive observations as shown in the last column and when these are few there must be uncertainty regarding the figures in columns 2 and 3.

Column 4 lists the interval in days between maxima with the figure in brackets when we consider successive maxima are not consecutive. The next two columns give respectively the width of each maxima in days and the type. Either:
Narrow (N) its width is less than 5 days or
Wide (W) when it exceeds 5 days.

Both these columns reflect the number of positive observations for each maximum. Obviously the wide maxima are those during which more estimates were made.

RESULTS FROM 10.5 YEARS MONITORING OF BX PUPPIS (Cont.)

We found that the mean maximum magnitude is 14.06 derived from 91 maxima. This may be slightly too bright because it is possible that some of the earlier maxima magnitudes have been estimated slightly too bright due to the small systematic deviation of the observer.

A mean cycle of 19.5 days was derived from 74 intervals between maxima that were probably consecutive.

Light curves are shown in Figures 1 & 2 . These show that outbursts are short and frequent during intervals when observations are numerous. The sign (v) on the light curves indicate BX Puppis was invisible and fainter than the magnitudes shown.

4. CONCLUSIONS

We conclude that BX Puppis is of the Z Cam sub class of dwarf nova with a mean outburst cycle of 19.5 days. The mean maximum visual magnitude of outbursts is 14.06 which may be slightly too bright by about 0.1 to 0.2 magnitudes.

No information can be given on minimum magnitude or if standstills occur because both occur below the thresholds of the telescopes used.

ACKNOWLEDGEMENTS
We thank all observers for their estimates. We are indebted to Ranald McIntosh for the printout and lightcurves.

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(5) 1977. Vogt N. Pub. Var. Star Section, RASNZ, No. 5, p43.

TABLE 1

BX PUPPIS - OUTBURSTS OBSERVED

No.	JD Max 24	Max M_v	Int d	Width d	Type	No. Obs	
27	47086	13.3	-	?	?	1	
28	151	14.1	(65)	2	N	3	
29	177	13.5	26	4	N	7	
30	194	14.2	17	2	N	2	
31	209	14.3	15	2	N	3	
32	235	14.4	26	1	N	1	
33	265	14.3	30	7	W	9	
34	295	14.4	30	1	N	1	
35	394	13.6	(99)	1	N	2	
36	472	14.4	(78)	1	N	1	
37	512	14.4	40	1	N	1	
38	528	13.9	16	1	N	3	
39	540	13.9	12	1	N	2	
40	552	13.9	12	6	W	8	)Possible same outburst
41	560	13.7	8	2	N	3	)
42	585	140	25	2	N	3	
43	598	14.4	13	1	N	1	
44	612	14.4	14	4	N	4	
45	629	14.4	17	1	N	1	
46	643	13.6	14	1	N	2	
47	663	13.9	20	1	N	2	
48	678	14.5	15	1	N	1	
49	687	13.8	9	1	N	1	
50	700	14.4	13	1	N	1	
51	778	14.2	(78)	6	W	7	
52	835	13.9	(57)	1	N	1	
53	857	13.9	22	2	N	2	
54	864	14.5	7	2	N	3	
55	886	13.9	22	9	W	7	
56	910	13.9	24	5	W	4	
57	929	13.5	19	9	W	3	
58	946	13.9	17	6	W	5	
59	967	14.2	21	3	N	2	

TABLE 1 (Cont.)

BX PUPPIS - OUTBURSTS OBSERVED

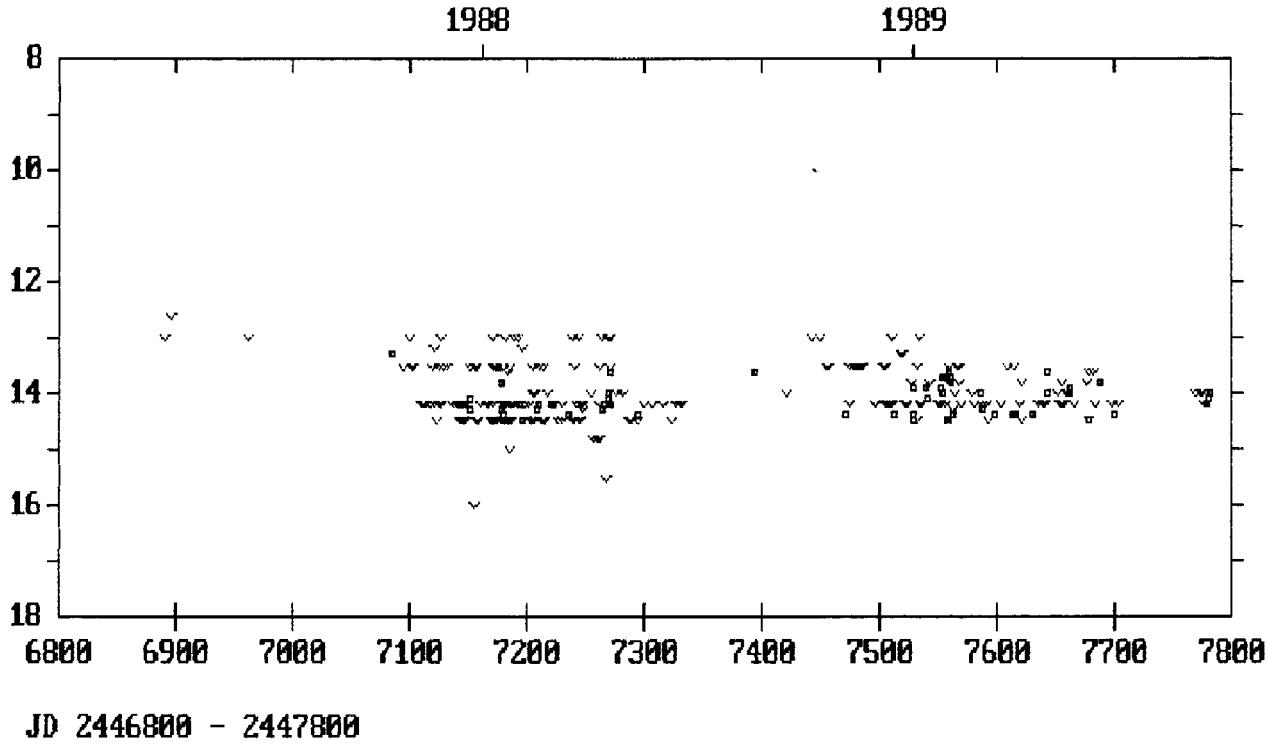
No.	JD Max 24	Max M_v	Int d	Width d	Type	No. Obs
60	979	14.2	12	2	N	4
61	48004	14.1	25	2	N	2
62	029	13.7	25	3	N	4
63	063	13.8	34	1	N	2
64	178	14.2	(115)	1	N	1
65	190	14.1	12	2	N	3
66	210	14.0	20	1?	N	1
67	225	14.1	15	4	W	6
68	249	14.1	24	4	N	3
69	264	14.1	15	3	N	3
70	284	13.6	20	9	W	4
71	326	13.9	42	4	N	4
72	340	13.9	14	3	N	4
73	352	14.1	12	3	N	3
74	369	13.9	17	?	?	1
75	390	14.6	21	?	?	1
76	418	13.5	28	?	?	1
77	569	14.2	(151)	5	W?	3
78	655	14.2	(86)	2	N	3
79	689	14.3	34	3	N	4
80	711	14.5	22	3	N	2
81	924	14.1	(213)	?	?	1
82	962	13.9	38	1	?	1
83	980	13.9	18	4	N?	3
84	49007	14.2	27	2	N	2
85	019	13.7	12	?	?	1
86	066	14.3	47	2?	N	2
87	076	13.9	10	2	N	3
88	091	14.1	15	4	N	4
89	104	13.5	13	?	?	2
90	123	14.1	19	3	N	4
91	153	13.3	30	?	?	2
92	453	14.2	(300)	?	?	1
93	513	14.3	60)	?	?	1
94	809	14.0	(296)	?	?	1
95	50097	14.5	(288)	3	N	4
96	112	14.6	15	?	?	2
97	156	13.9	44	3	N	2
98	175?	14.9?	19	?	?	1
99	186	14.2	11	?	?	2

TABLE 1 (Cont.)

BX PUPPIS - OUTBURSTS OBSERVED

No.	JD Max 24	Max M_v	Int d	Width d	Type	No. Obs
100	50201	14.4	15	5	W?	2
101	241	14.3	40	1	N	2
102	251	14.2	10	?	?	1
103	291	14.2	40	?	?	1
104	314	14.3	23	?	?	1
105	373	14.2	(59)	4	N	8
106	395	14.2	22	5	W?	6
107	410	14.2	15	1	N	6
108	462	13.6	52	7	W	9
109	484	14.2	22	4	N	6
110	515	14.2	31	5	W	10
111	531	14.0	16	9	W	9
112	551	14.2	20	1	N	2
113	565	14.2	14	4	N	7
114	578	14.2	13	2	N	4
115	594	14.2	16	9	W	7
116	614	14.3	20	1	N	4
117	636	14.2	22	3	N	5
118	675	14.2	39	6	W	3

075024 BX PUP



075024 BX PUP

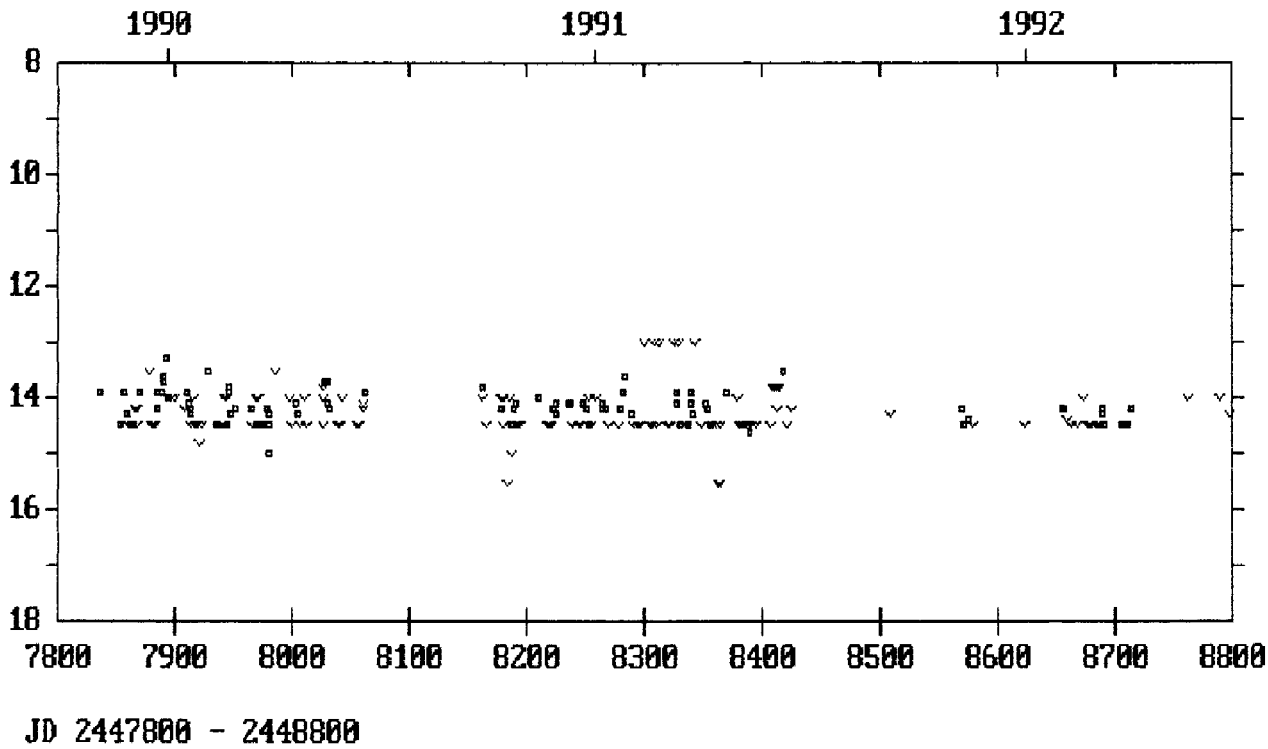
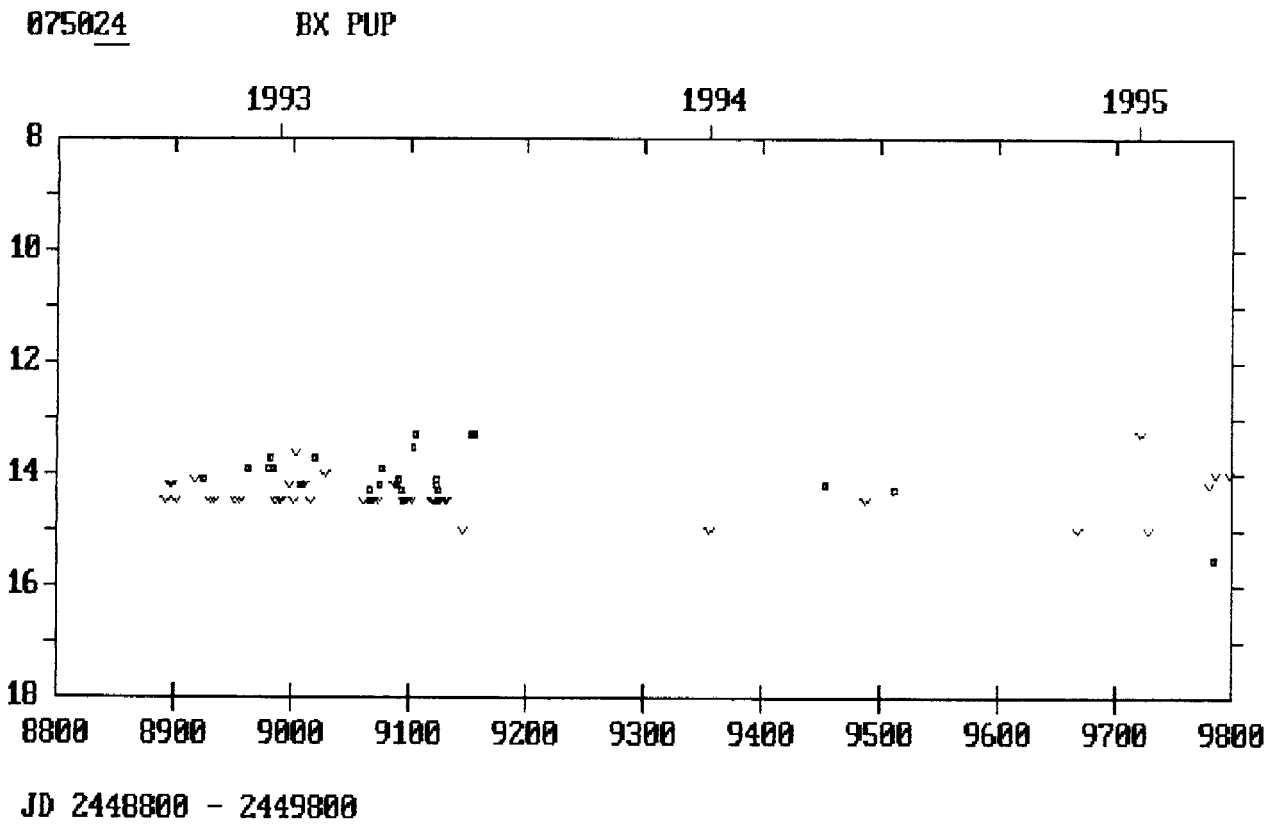


FIGURE 1

JD 2446,800 - 2448,800



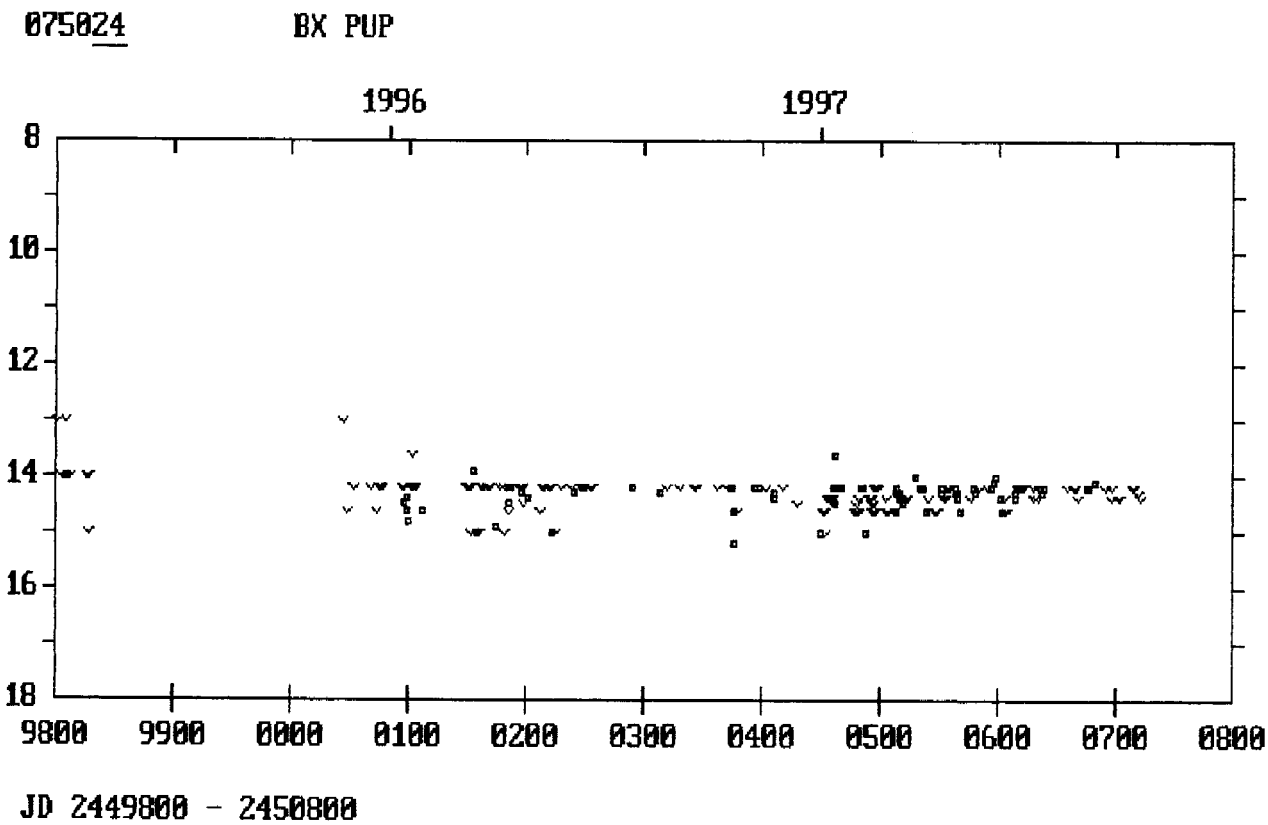


FIGURE 2

JD 2448,800 - 2450,800

OBSERVATIONS OF THE DWARF NOVA, TU MENSAE, 1991-1999.

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

SUMMARY: TU Men has three types of outbursts of which the most unusual are those during which TU Men remains bright for 20 days, or longer. Other outbursts are either short or super maxima of a few days duration. Short lived flares have also been recorded. The mean cycles for each outburst type are discussed.

1. INTRODUCTION

TU Men is a dwarf nova of the SU UMa type. This paper continues the list of observed outbursts given by Bateson (1)

2. OBSERVATIONS.

Members of the Variable Star Section, R.A.S.N.Z. made 2,631 visual observations between JD 2448,133 and 2451,423. The same V sequence of comparison stars (2) were used by all observers. The position of TU Men 04^h 11^m 40.71^s -76^0 36' 46.3" (Epoch 2000) enables most southern observers to monitor TU Men in all months. This has resulted in only 15 gaps in the observations exceeding 3 days. These gaps were one each of 7 and 6 days; two of 5 days and 11 of 4 days. Therefore it is unlikely that any superoutbursts have been unobserved because their duration is 7 days or longer.

However, it is possible that some normal outbursts and short lived flares passed unobserved. Table 1 lists the outbursts observed in continuation of previous lists. It is obvious that TU Men has three different types of outbursts in addition to short lived flares. We discuss each type separately in the following section.

3. DISCUSSION

(a) Prolonged Super Outbursts

Four super outbursts with a duration of 20 days, or longer, have been observed. These include outbursts Nos. 74 and 90 discussed in earlier papers (3 & 4) and Nos. 125 and 140 from Table 1. The duration of these are 20, 24.5, 23 and 27 days respectively. The intervals between these outbursts are: 2168; 4869 and 2009 days. We have carefully examined the data of other outbursts but concluded that there were no others that lasted for 20 days or longer.

(b) Super Outbursts

We have assumed that all outbursts listed in Table 1 are consecutive despite the possibility that some short normal outbursts may have gone unobserved. However, it is unlikely that any super outburst was missed considering the limited number of gaps in the records.

A super outburst is a maximum that lasts for longer than six days and has a visual magnitude of 12.0 or brighter. The mean super cycle was 253.23 days with individual cycles ranging from 108 to 535 days. Maxima magnitudes ranged from 11. 1 to 12.0 with a mean visual magnitude of 11.62.

(c) Normal Outbursts

These are short outbursts lasting six days, or less. Twelve normal outbursts are listed in Table 1. Maxima magnitudes ranged from 11.9 to 14.8 with a mean of 13.0. Three of these maxima were fainter than 14.0 and were possibly variations near minimum due to the orbital period. The mean maximum magnitude is 12.4 when these three faint maxima are omitted. We consider this to be the correct value

There is a tendency for several normal outbursts to follow in quick succession with the often prolonged super outburst intervals between consecutive outbursts increasing in length. The four normal outbursts immediately following super outburst 125 are an example. Otherwise normal outbursts follow no regular pattern.

(d) Flares

Flares are brightenings of very short duration during which the maximum magnitude is much fainter than those of outbursts. Flares are recorded mainly in dwarf novae of the SU UMa type, (5, 6). This is probably an observational effect due to the close monitoring of these objects. It is now known that flares occur at all wave lengths (7). Bateson lists flares in TU Men and others since the original list have been noted in the Monthly Circulars of the VSS RASNZ.

(e) Mean Outburst Cycle.

The mean outburst cycle from the 25 outbursts in Table 1 is 131.7 days with a range of 16 to 236 days. There were 13 super outbursts and 12 normal. Their distribution is random with a possible slight tendency for several normal outbursts to immediately follow a prolonged super outburst.

(f) Minimum

The faintest positive observations were 15.7 to 16.2 and did not form the start or end of an outburst. It appears these were due to variations near minimum possibly caused by orbital rotation. We assume that visual magnitude at minima is fainter than 16.0.

4. CONCLUSIONS

We conclude that TU Men is unusual among SU UMa variables in having super maxima during which it remains bright for 20 days, or longer. These outbursts occur at very long intervals of possibly 2100 days. They are in addition to the usual supermaxima which have a mean cycle of 253.23 days. It is unlikely that any supermaximum passed unobserved because there are no large gaps in the observations.

The mean maximum magnitude of normal short outbursts is 12.4. It is possible that a very limited number of normal outbursts may have gone unobserved. However the mean outburst cycle is 131.7 days when all outbursts in Table 1 are considered consecutively. We stress that it is essential that all observers monitor TU Men very closely. Observations should be made every two minutes whenever the star is visible. TU Men should be observed at least twice every night when it is faint or invisible. The first estimate should be made when first commencing the night's observing and the second just before ending the night's work.

It should be possible to determine any change in period if all observers follow the foregoing procedure.

ACKNOWLEDGEMENTS
We thank all members for their observations.

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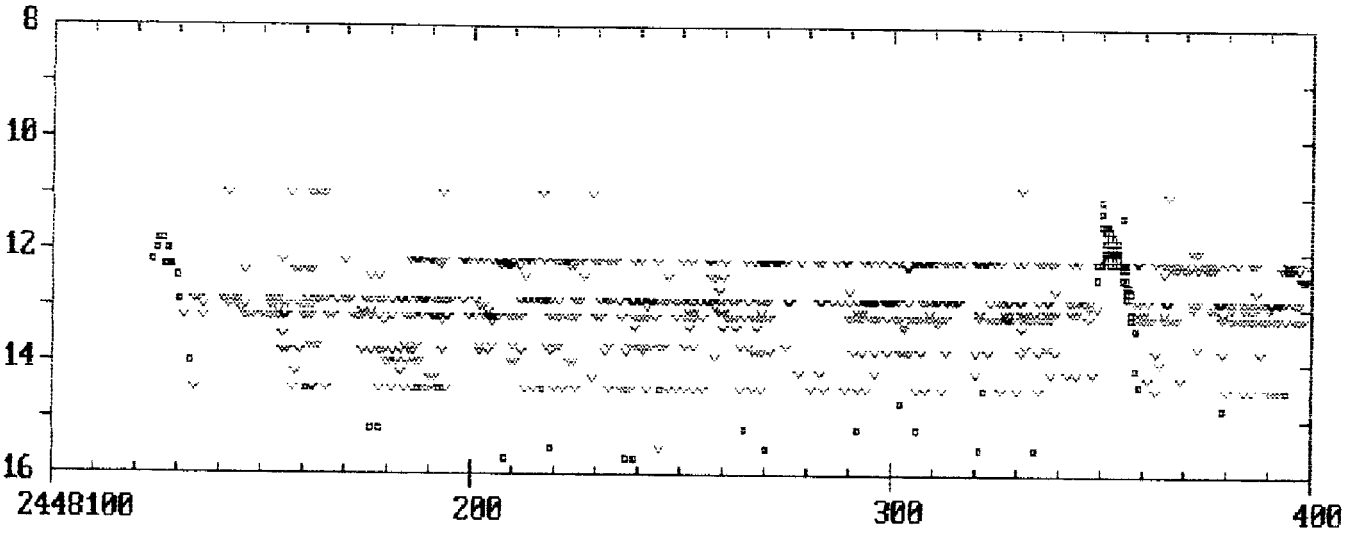
TABLE 1

TU MEN – Observed Outbursts

Max No.	JD Max	Max mag $_{mv}$	Int. $_d$	Width $_d$	Type	No. Obs	Comments
116	2448,350	11.1	227	9	S	64	
117	503	11.5	153	13	S	38	Flare to 13.3, 16^d before
118	634	14.7	131	1	N	2	
119	687	11.9	53	8	S	69	
120	867	11.9	180	4	N	7	
121	982	14.5	115	1	N	2	
122	2449,027	13.0	45	1?	N	1	Flare?
123	043	11.6	16	9	S	31	
124	175	12.5	132	4	N	6	
125	406	11.4	231	23	S	66	
126	486	12.4	80	3	N	8	
127	569	12.5	83	2	N	6	
128	685	12.4	116	4	N	11	15.5 on 683
129	792	12.0	107	3	N	6	Possible flare 15.5 (784); 13.9 (785).
130	941	11.5	149	11	S	36	
131	2450,068	13.2	127	2	N	2	
132	111	11.6	43	7	S	56	
133	299	11.8	188	8	S	34	
134	407	12.0	108	9	S	77	
135	593	12.0	186	6	N	17	
136	776	11.5	183	9	S	402	
137	893	14.8	117	1	N	2	<15.5 on 893.9140; 14.8 on 593.9340 & 9390; <14.5 on 593.9993.
138	973	11.6	80	8	S	23	
139	2451,179	12.0	206	7	S	32	
140	415	11.6	236	27	S	18	

044576 TU MEN



(Individual observations)

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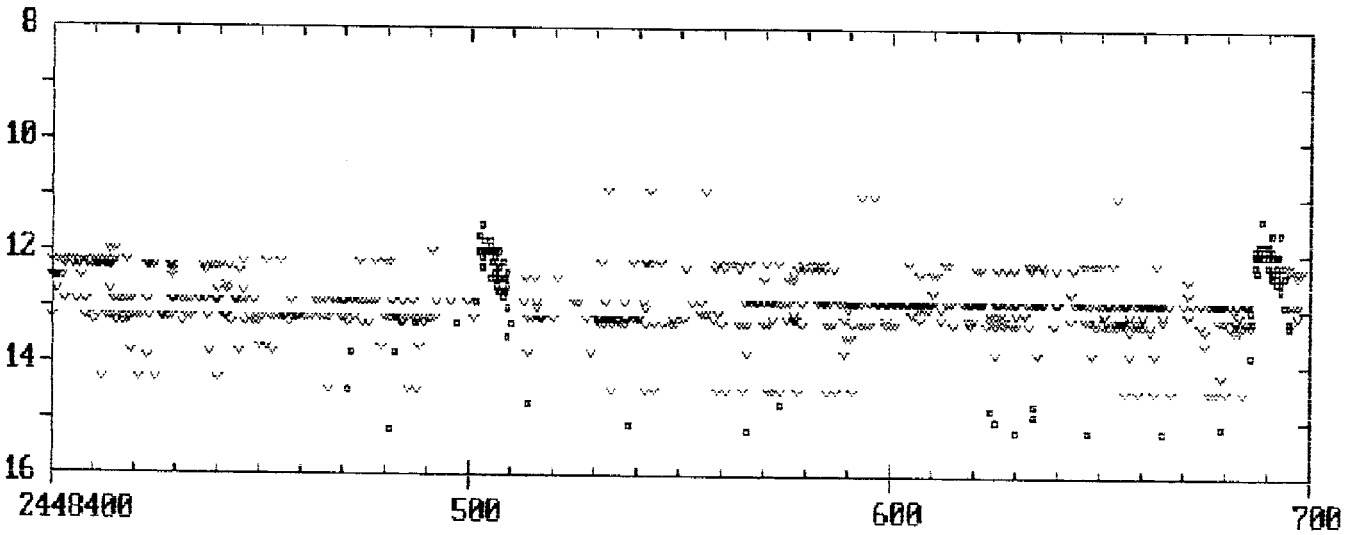

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FIGURE 1
JD 2448,100 - 2448,700

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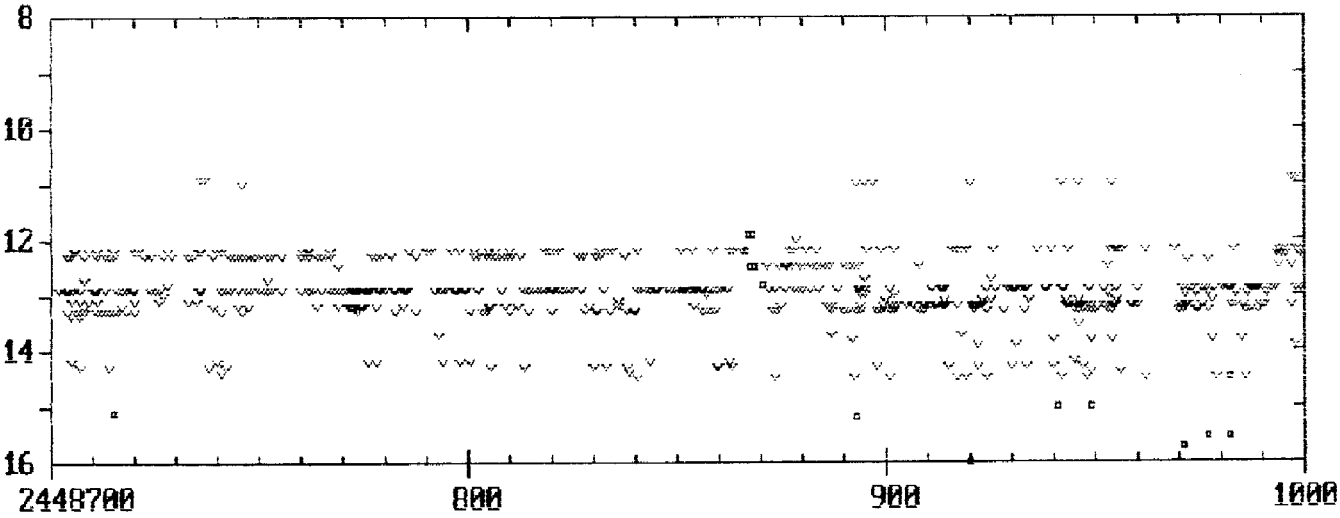

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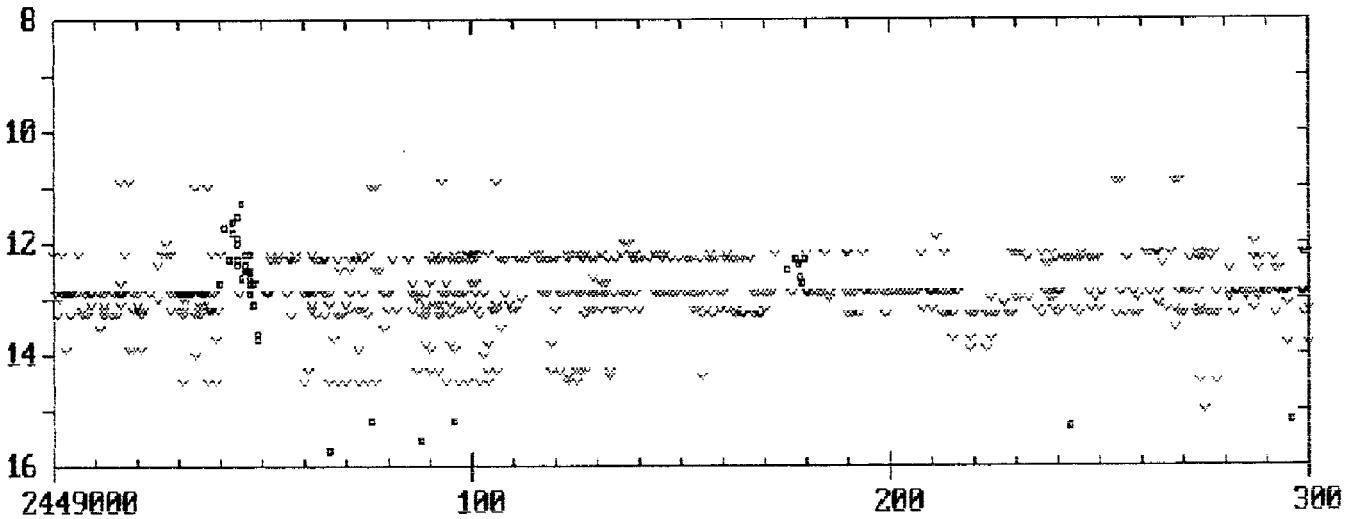
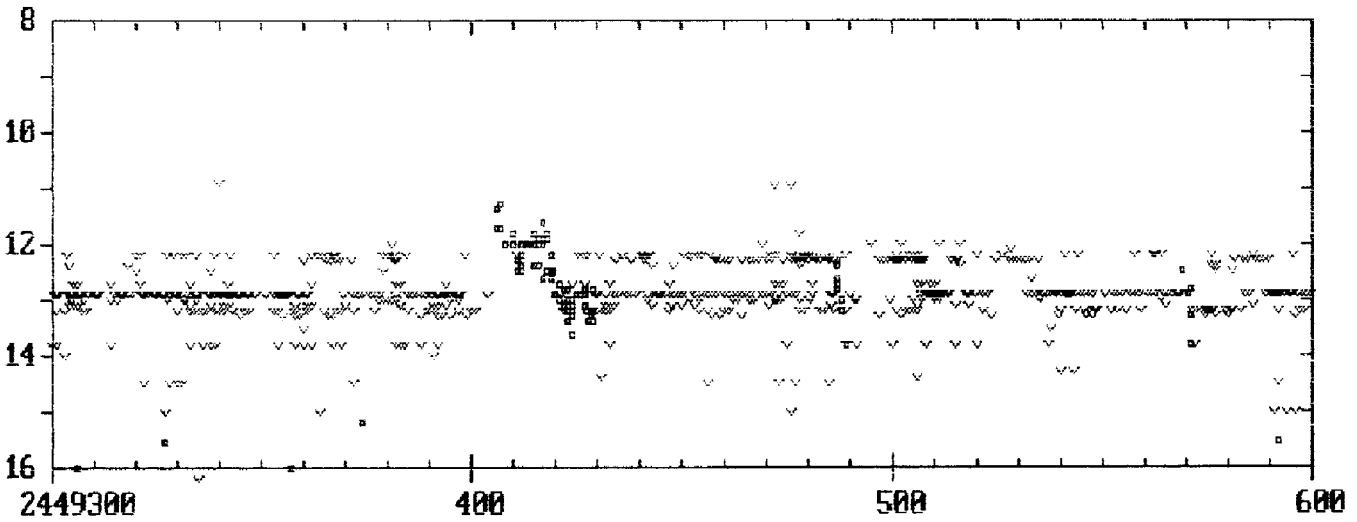


(Individual observations)

FIGURE 2

JD 2448,700 - 2449,300

044576 TU MEN



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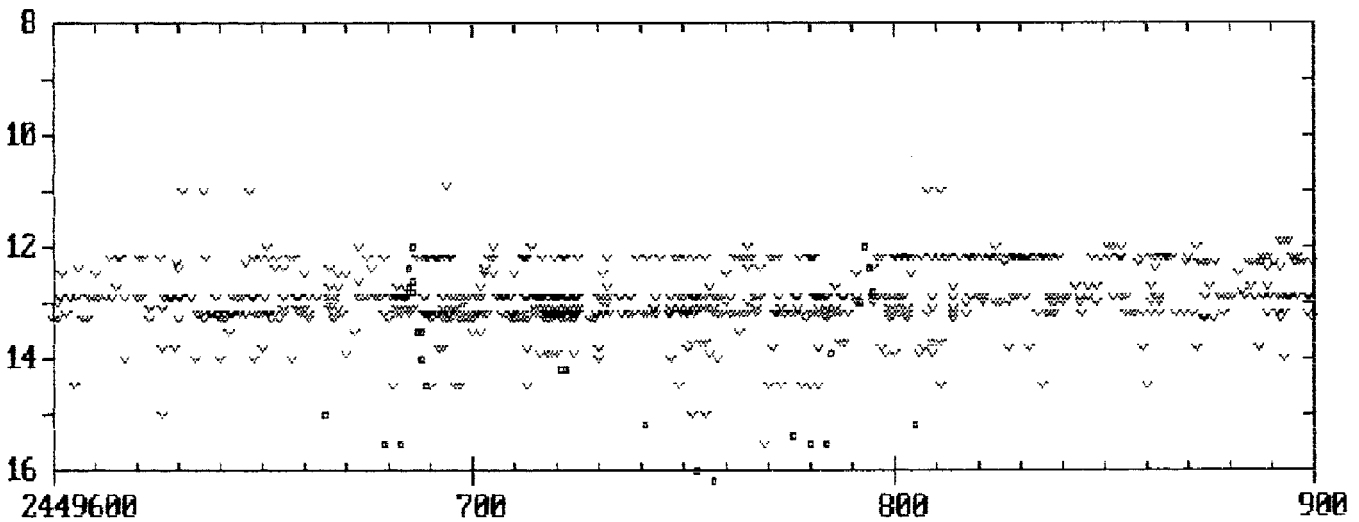
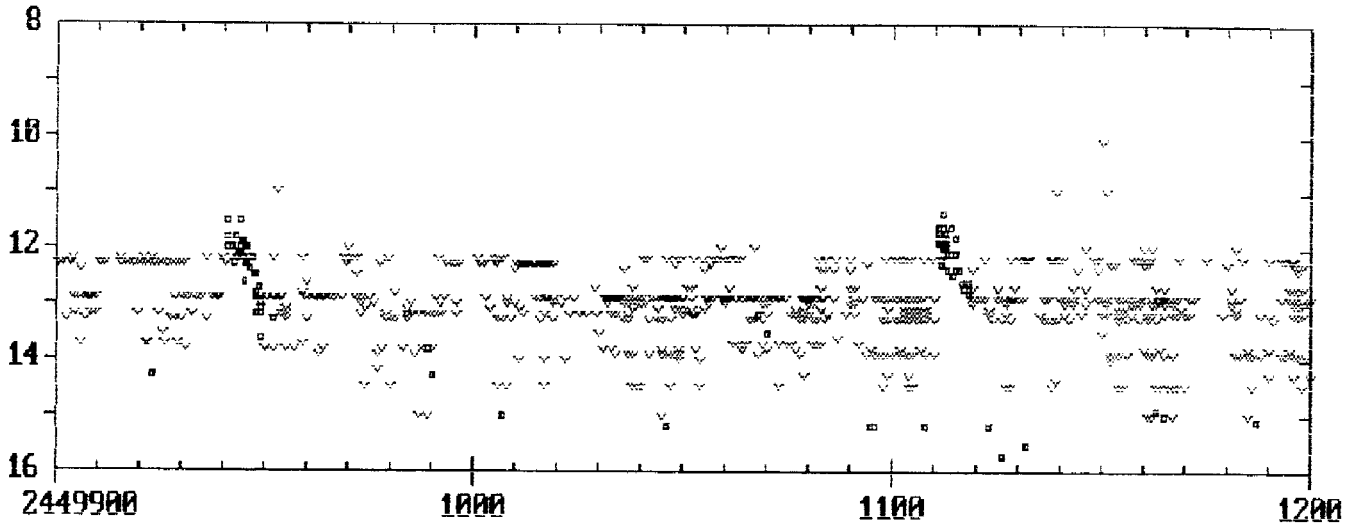


(Individual observations)

FIGURE 3

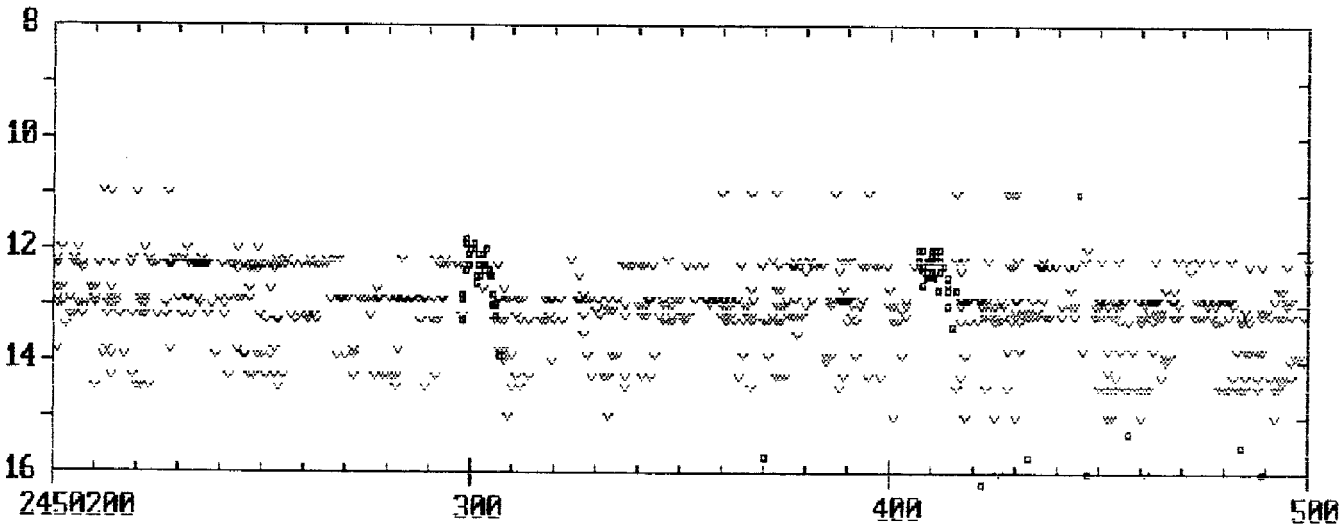
JD 2449,300 - 2449,900

044576 TU MEN



(Individual observations)

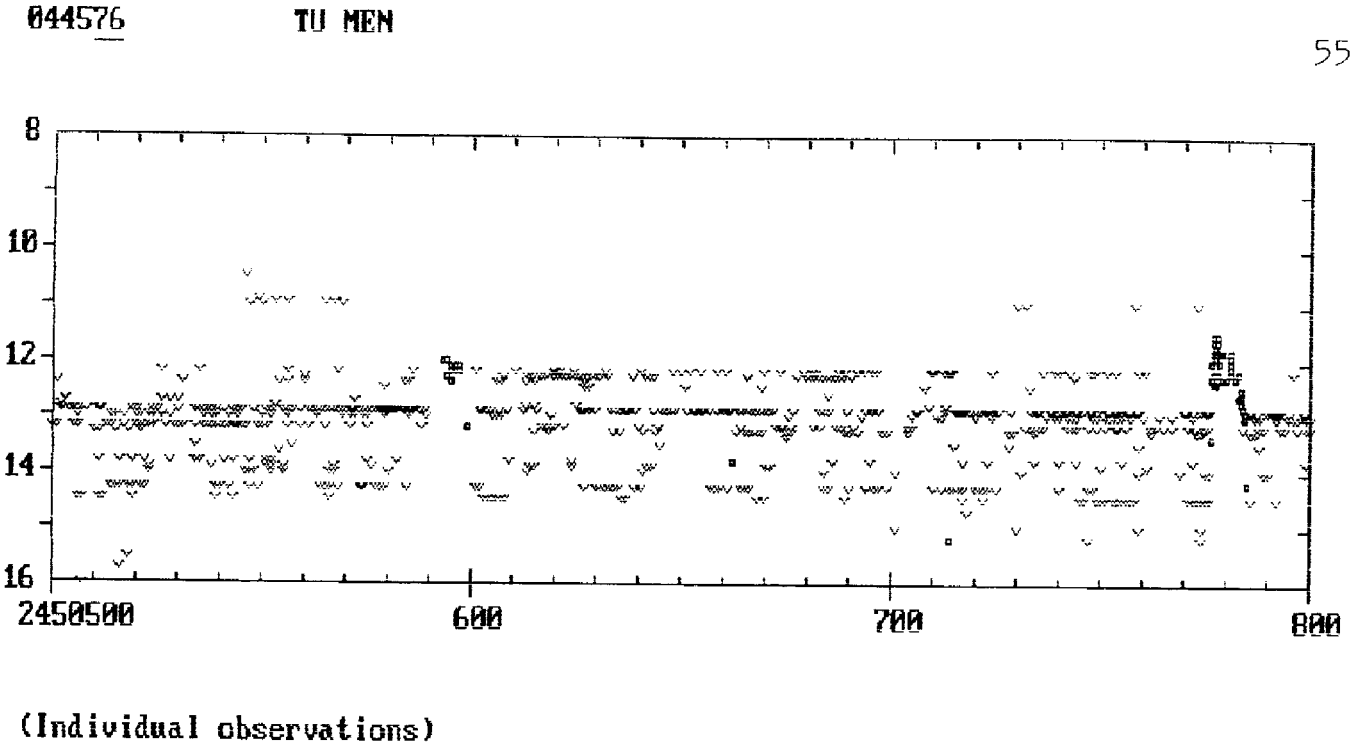
044576 TU MEN



(Individual observations)

FIGURE 4

JD 2449,900 - 2450,500



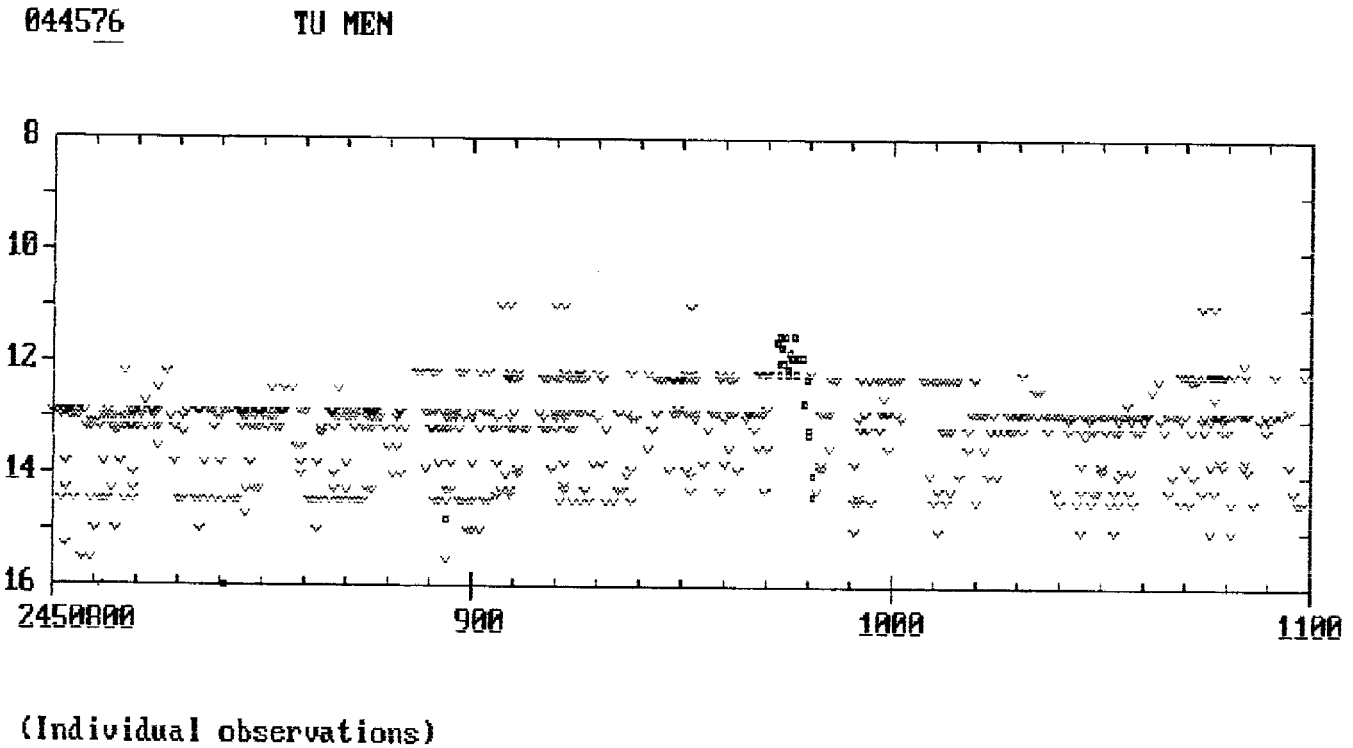
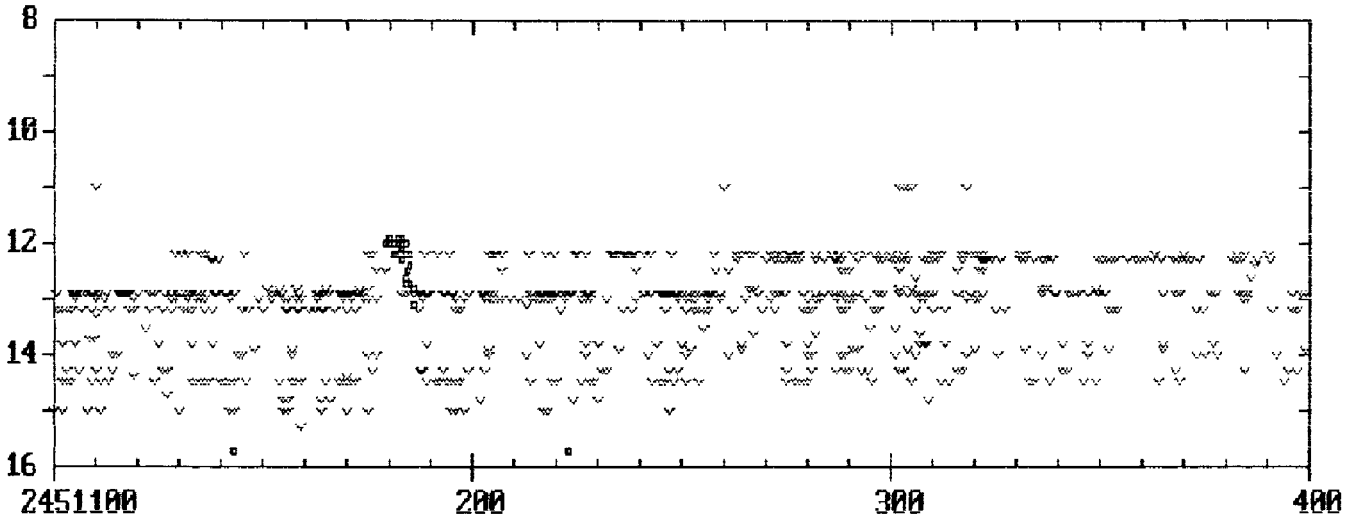


FIGURE 5

JD 2450,500 - 2451,100

044576 TU MEN



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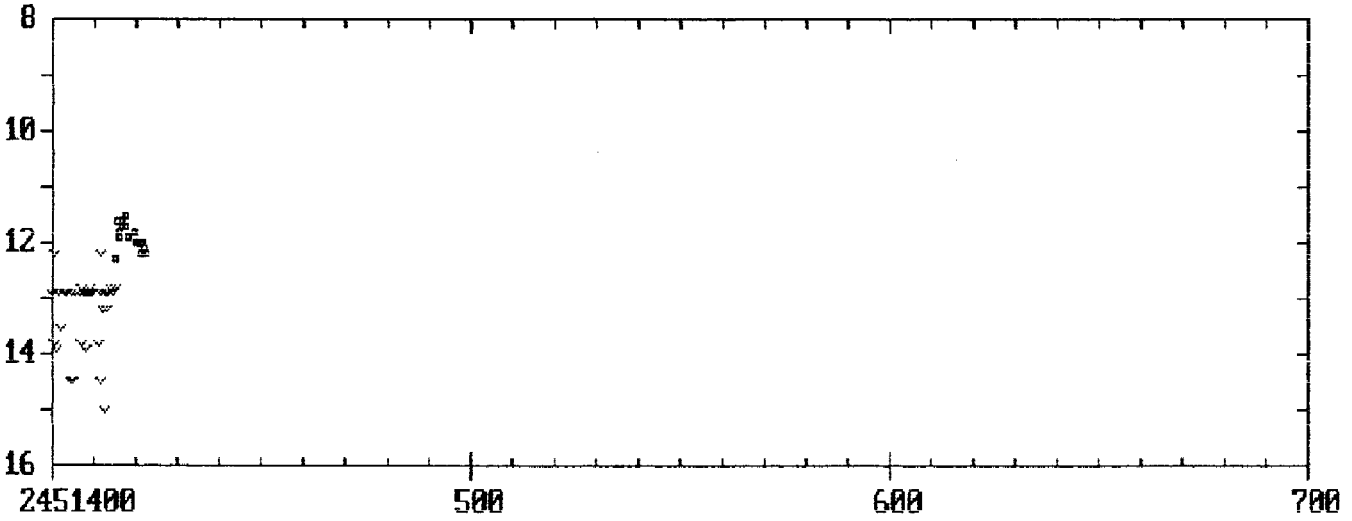

(Individual observations)

FIGURE 6

JD 2451,100 - 2451,700