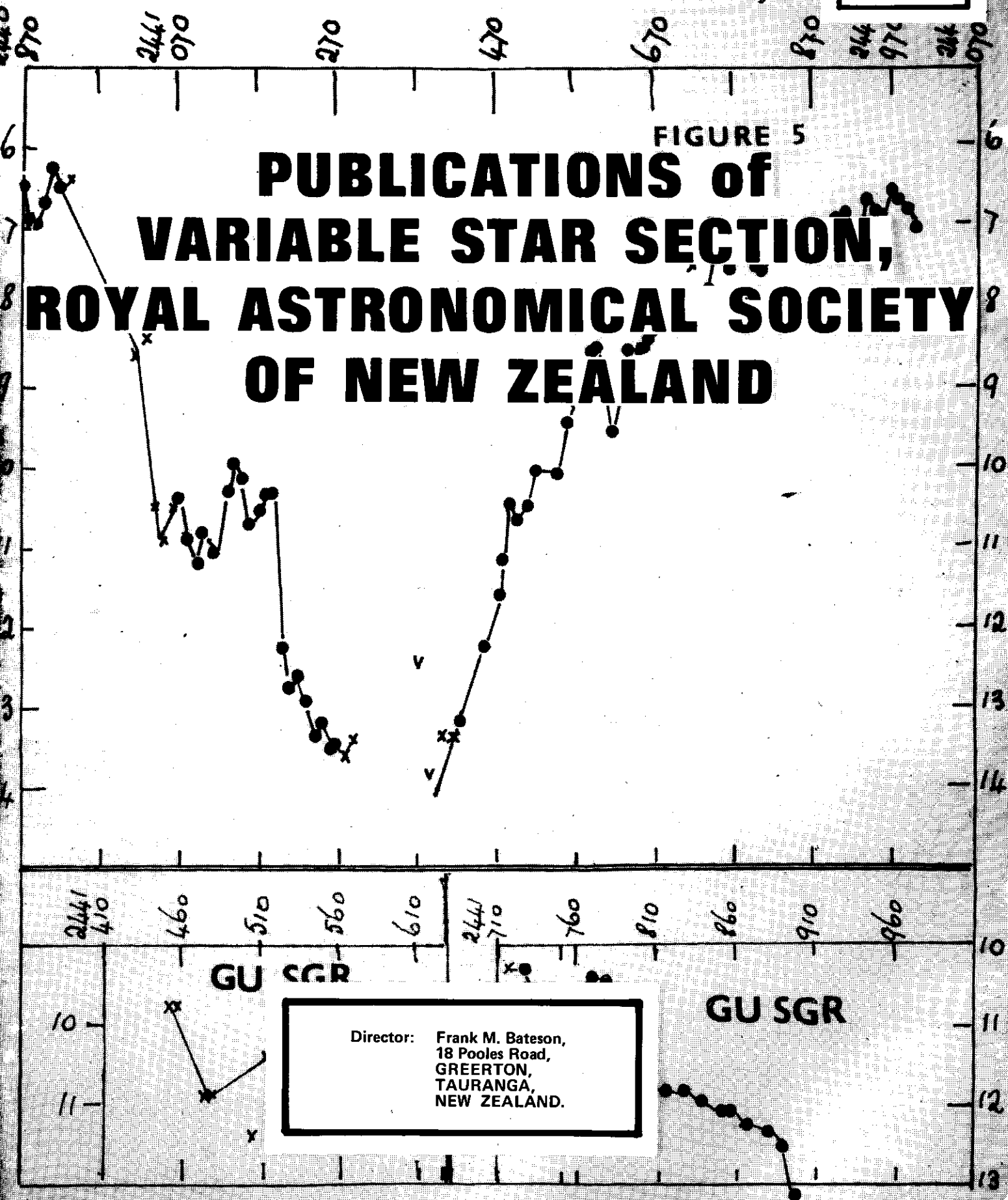




CONTENTS.

		<u>PAGE.</u>
VARIATIONS OVER THE ORBITAL PERIOD IN VW HYDRI.	J. Bailey	1
S APODIS	I.D. Howarth	4
THE DWARF NOVA, WX HYDRI	F.M. Bateson	5
THE SPECTRUM OF BV 1616 LEP AND ITS COMPANION	J. Whelan	15
SEQUENCES FOR SEVEN DWARF NOVAE (BB Vel; CU Vel; V436 Cen; MU Cen; V591 Cen; EX Hya; BP CrA).	B. Warner	18
Charts for BB Vel		21-22
CU Vel		23
V436 Cen; MU Cen; EX Hya		24
V591 Cen		25-26
Finding Charts for V451; V467; V746 Cen		26
Charts for BP CrA		27-28
Finding Charts for V742 Sgr; V942 Sgr; V446 CrA; V622 CrA.		28
THE DWARF NOVA, MU CENTAURI	F.M. Bateson	29
THE DWARF NOVA, EK TRIANGULI AUSTRALIS	F.M. Bateson	39
NOTICE TO CONTRIBUTORS		Inside Back Cover.
PUBLICATIONS AND SUBSCRIPTION RATES		Outside Back Cover.

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1976 August 1

VARIATIONS OVER THE ORBITAL PERIOD IN VW HYDRI.

By Jeremy Bailey

SUMMARY: Visual observations from 1953 to 1967 of VW Hydri at minimum were analysed by the periodogram method. The visual light curve shows a hump in reasonable agreement with the elements derived by Vogt. There is no evidence at present for period changes in the system. A weighted mean is derived from visual and photoelectric observations for the period of the hump observed during quiescence.

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Recent photoelectric observations of the dwarf nova VW Hydri have shown it to be a binary system with an orbital period of only 107 minutes (Marino & Walker 1974; Vogt 1974; Warner 1975). In the quiescent state the light curve consists of a hump lasting for approximately half the orbital cycle. Similar humps have been observed in the light curves of other dwarf novae (e.g. U Gem) and are interpreted as being due to a bright spot formed where the stream of material from the red dwarf component strikes the accretion disk surrounding its white dwarf companion. During supermaxima of VW Hyi a hump has also been observed but this repeats with an apparent period slightly longer than the true orbital period (Vogt 1974; Warner 1975). At present there seems to be no satisfactory explanation of this phenomenon. This paper will be concerned only with the normal light curve observed outside outbursts.

Vogt 1974 has **derived** the elements

$$T_{\max} = \text{JD}_0 \ 2440128.0223 + 0.07427111E \quad (1)$$

$\pm 9 \qquad \qquad \qquad \pm 6$

for the time of maximum of the hump observed during quiescence. This is based on observations covering about five years. In view of the possible importance of period changes as a means of obtaining information about the mass transfer rates in such systems it would be helpful if this baseline could be extended. As has been shown in the case of U Gem (Bailey 1975) it is quite possible to use visual observations to detect such variations by carrying out a periodogram analysis of a large number of observations. The extensive series of observations of VW Hyi made by members of the Variable Star Section of the Royal Astronomical Society of New Zealand, starting in 1953, is ideal for such an analysis.

For the years 1953 to 1967 a total of 1399 observations were available, after omitting negative observations and observations of outbursts. For this purpose outbursts were taken to begin and end when the daily mean magnitude rose above and fell below magnitude 13.0. The mean Julian Date of observation was JD 2,437,383. These observations were then analysed by the periodogram method as described by Warner and Robinson 1972. The periodogram is plotted in Figure 1.

The orbital variations are clearly recorded in these observations since the periodogram shows a large peak close to the orbital period. The value of the period obtained from the periodogram is

$$P = 0.07427104 \text{ days} \quad (2)$$

± 8

Figure 2 shows the mean light curve over the orbital period from the same observations. Zero phase corresponds to the predicted hump maximum from the elements given above. It can be seen that the visual light curve shows a hump in reasonable agreement with the elements

though better agreement is obtained with a slightly amended period of

$$P = 0.07427098 \text{ days} \quad (3)$$

$$\pm 10$$

The three values for the period (1), (2), (3) agree to within their quoted errors so there is no evidence at present for period changes in the system. The visual and photoelectric observations of VW Hyi are therefore best represented by the linear elements

$$T_{\max} = JD_0 2440128.0223 + 0.07427107E$$

$$\pm 9 \quad \pm 5$$

where the period is a weighted mean of the three independent values given above.

It may be that further observations will make possible an investigation of period changes using the O-C diagram. For this purpose the visual observations discussed here can be represented by a single point having $E = -37000$ and $O-C = -0.005$ days, relative to the elements given by Vogt 1974. This point has an accuracy comparable with that of an individual photoelectric timing of maximum but will be of value because of its early epoch.

Acknowledgment. I wish to thank Melvyn Taylor for preparing the diagrams.

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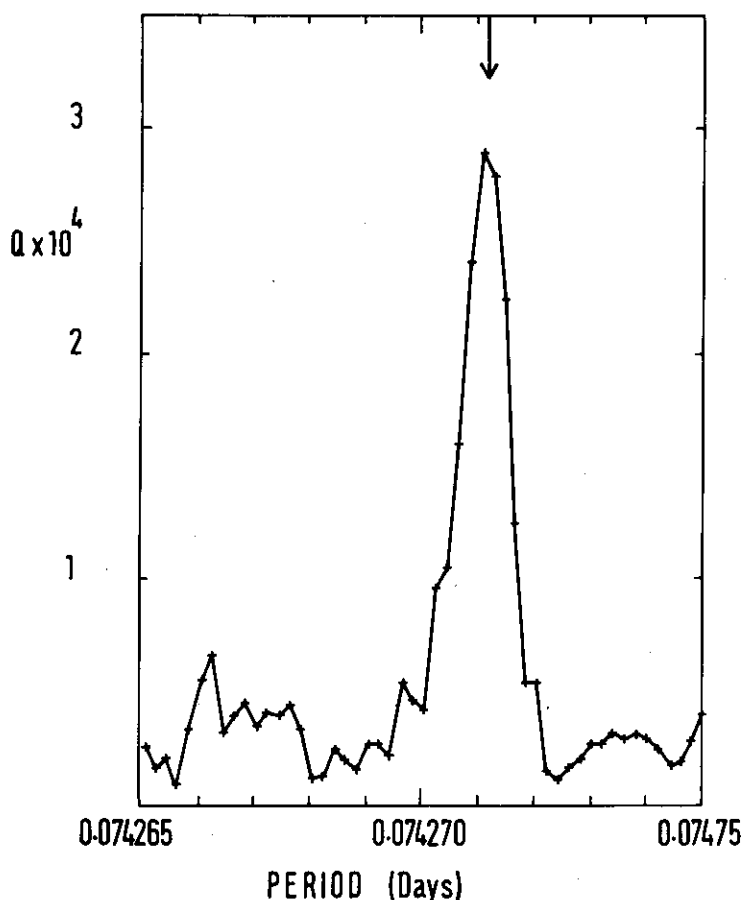


FIGURE 1. VW Hyi. Periodogram.

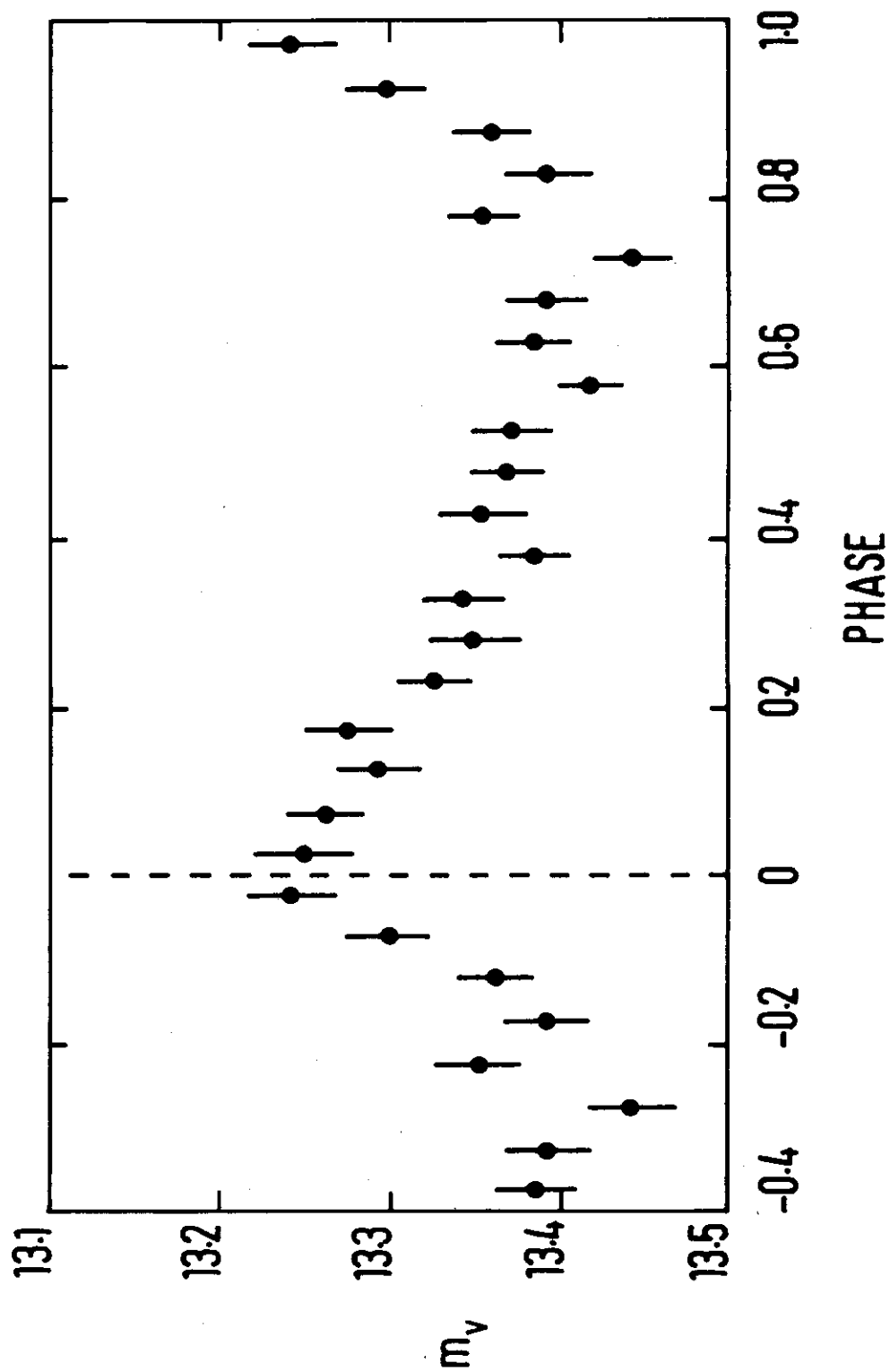


FIGURE 2. VW Hydr1 Mean Light Curve over orbital period during quiescent phase. Zero phase corresponds to the predicted hump maximum

S APODIS

By Ian D. Howarth

SUMMARY. Despite previous claims, the fades of S Apodis appear to occur at random.

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INTRODUCTION. The minima of R Coronae Borealis and SU Tauri fit satisfactorily an exponential distribution, that is, they are 'perfectly' irregular. Moreover, their initial declines conform to a Poisson distribution within the statistical and observational uncertainties, indicating their essentially random nature (Howarth 1976). Unfortunately, no southern R CrB variables (with the exception of RY Sgr) have published observations over a sufficient period of time for meaningful analyses of their minima to be carried out. A similar state of affairs exists for data on initiation of minima, except for S Apodis (CPD -71°1743). This star is of particular interest not only because of its late spectral class (R3), but also because Dwyer (1929), and, independently Waters (1966) have claimed an approximate periodicity of ca. 1000 days for the minima.

ANALYSIS. Table 1 lists the Julian dates on which $S\text{ Aps} = 11.0^M$ on the decline from maxima since the end of the last century. Where they are read from comparatively small-scale light curves (especially that of Dwyer 1929) they may be in error by perhaps $\pm 10d$, but this does not effect the results. Observations have been essentially continuous since 1915, although Shapley (1924) suggests a minimum may have occurred in 1922, when there is a gap in the observations. This appears to be no more than a guess on his part, and even allowing for a fade at that time the conclusions reached here are again not materially effected.

TABLE 1.

FADES OF S APODIS.

<u>J.D.</u>	<u>REF.</u>	<u>J.D.</u>	<u>REF.</u>
2,414,930	Dwyer 1929	2,427,730	Waters 1966
2,417,250	Dwyer 1929	2,430,730	Waters 1966
2,417,350	Dwyer 1929	2,432,050	Waters 1966
2,418,140	Dwyer 1929	2,434,350	Waters 1966
2,421,240	Dwyer 1929	2,436,240	Waters 1966
2,421,345	Dwyer 1929	2,437,480	Bateson 1963
2,421,410	Dwyer 1929	2,437,615	Bateson 1964
2,422,190	Dwyer 1929	2,439,745	Bateson 1968
2,423,910	Dwyer 1929; Waters 1966	2,441,070	Bateson 1974
2,425,290	Dwyer 1929; Waters 1966	2,442,837	Hull 1976
2,426,540	Waters 1966		

The mean interval between consecutive fades is 1249 days. We may now compare the actual numbers of fades per 1000d interval in the better observed periods with those expected from Poisson statistics; such a comparison is made in Table 2. It is at once apparent that agreement is satisfactory, and in fact the χ^2 test shows differences are nowhere near significant, even at the 10% level. This suggests fades occur randomly; moreover, the standard deviation of intervals between fades is 825d, so any claims for periodicity of the order of 1000d must be regarded as suspect. Nonetheless, and underlying periodicity may exist, possibly connected with the quasicyclic fluctuations of this star at maximum

TABLE 2.

FREQUENCY DISTRIBUTION FOR S APODIS.

No. of fades per 1000d	No. of Intervals	
	Observed	Calculated.
0	10	11.7
1	13	9.4
2	2	3.7
3	1	1.0
4+	0	0.2

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THE DWARF NOVA WX HYDRI

By Frank M. Bateson

SUMMARY: A light curve of WX Hyi is presented together with details of 77 maxima observed during the interval J.D. 2,441,066 to 2,442,743. This variable belongs to the sub-group of SU UMa stars, which have supermaxima and normal, short maxima. The mean interval between successive maxima, of all types, is 13.7 days. Successive supermaxima occur at mean intervals of 195.4 days and have a mean maximum magnitude of 11.41_v , compared to 12.5_v for normal maxima.

...

OBSERVATIONS: Members of the Variable Star Section, Royal Astronomical Society of New Zealand made 1,012 observations of WX Hydri between J.D. 2,441,066 and 2,442,743. Daily Means from the observations are listed in Table 1, where means at more frequent intervals are shown when necessary. The first column gives the mean J.D.; the second the number of observations in each mean, and the third column the mean magnitude, to tenths or hundredths. The light curve, on a small scale, derived from the means is shown in Figure 1.

METHODS: The individual observations were plotted on a large scale and the dates of observed maxima derived. These are listed in Table 2, in which successive columns give: the successive number for each observed maximum; type, as detailed below; observed date; visual magnitude; interval, in days, between successive maxima; the width of maximum at phase 13.01-13.00; the weight attached to the dates derived for each maximum on the usual scale of 1 (poor) to 5 (excellent); any remarks appear in the final column.

DISCUSSION: The determinations of dates for most maxima have been given low weights, because the coverage of the observations is in general inadequate. Frequently the observations merely indicate that a maximum took place about the assigned date. It had to be assumed that the majority of these reached a magnitude of 12.5, which may not be correct. These limitations mean that the conclusions reached should be regarded as preliminary, and are subject to revision when the star is better observed.

Maxima fall into two broad classes, viz. supermaxima and normal maxima. Supermaxima have a mean maximum magnitude of 11.41_v, ranging from 11.2 to 11.6. The average width at phase 13.0I-13.0D is 10.61 days, with extremes of 8.5 to 14.0 days. The interval between successive supermaxima averages 195.4 days but these fall within the wide limits of 114.1 to 284.6 days. Nine supermaxima were observed, and these are denoted by "S" in the second column of Table 2. It is probable that one or two supermaxima were not observed. A typical supermaximum is shown in Figure 2. It is probable that with better coverage supermaxima can be divided into distinctive types.

Normal maxima are short and steep. On the basis on widths at phase 13.0I-13.0D they are tentatively grouped into four types. These are:

Type A,	mean width	0.7 days;	mean maximum magnitude	12.50	(30)
B	"	" 1.2	" ; "	"	12.48 (32)
C	"	" 2.3	" ; "	"	12.40 (5)
D	"	" 3.5	" ; "	"	12.3 (1)

The single example of type D may be in error because it is possible that it really resulted from two maxima close together instead of one as shown in Table 2. The observations are too few to state definitely which interpretation is correct.

Maxima of Type A are little more than short, sharp spikes with a very steep rise, and a fall slightly less steep. Type B have a rapid rise with a less steep fall, whilst Type C has a rise and fall which are slower than those of types A and B. Some examples of these three types are shown in Figure 2.

The mean interval between successive maxima of all types is 13.7 days, omitting those intervals enclosed within brackets in the fifth column of Table 2, because these cover intervals during which it is apparent that some maxima passed unobserved.

CONCLUSIONS: WX Hyi can be assigned to the SU UMa sub-group of U Gem variables. Its behaviour closely resembles that of SU UMa itself. It is probable that the true interval between successive outbursts is shorter than the cycle of 13.7 days indicated by the present observations. WX Hyi, like other stars of the SU UMa sub-group, has both supermaxima and normal, short maxima. The observations suggest that both types can be sub-divided into distinctive classes, but those indicated in this paper will require revision when the star is better observed.

It is most desirable that WX Hyi should be observed on every possible night, preferably with each observer making estimates at approximately hourly intervals. It is only by so doing that outbursts can be adequately observed in view of the short mean cycle and the steepness of rise and fall.

TABLE 1.

DAILY MEANS OF WX HYDRI.

J.D. 2441000+	No.	MEAN Mag _v	J.D. 2441000+	No.	MEAN Mag _v	J.D. 2441000+	No.	MEAN Mag _v
066.00	2	13.35	178.24	2	12.60	268.02	2	14.50
068.04	2	11.50	.87	2	13.10	.96	1	14.5
.23	2	11.50	182.00	2	14.00	275.92	1	13.7
.91	2	11.55	184.21	2	14.50	278.15	1	(13.7
069.22	2	11.50	185.22	1	14.5	.89	1	(14.0
.90	2	11.55	186.08	2	14.25	282.10	1	14.3
070.21	2	11.50	.91	1	(13.7	283.91	1	12.7
.80	1	11.6	188.91	2	13.20	284.09	1	12.5
073.21	1	12.3	189.23	2	13.35	.15	1	12.9
076.87	2	12.65	190.94	1	12.0	.99	2	12.90
078.95	1	(12.4	191.23	1	12.7	285.14	1	13.2
080.25	1	14.2	.91	1	12.8	.98	1	14.0
087.78	1	(13.7	192.97	1	13.7	288.94	1	(13.7
088.87	1	(13.2	195.23	1	(13.7	291.95	1	(14.0
089.25	1	12.7	196.22	1	14.5	295.95	1	13.1
090.07	2	12.90	198.81	1	(12.5	296.12	1	12.6
093.22	1	(13.2	199.81	1	(13.0	.94	2	13.10
.81	1	(13.7	201.87	1	(13.7	298.12	1	14.0
094.27	1	14.0	202.94	1	(13.2	.90	1	14.4
.82	1	(13.2	203.91	1	(13.7	300.99	1	(14.0
095.24	1	13.8	206.84	2	12.70	302.95	1	(14.0
096.19	1	14.1	207.92	2	13.70	304.09	1	14.4
097.20	1	14.2	208.20	1	13.9	307.01	2	14.45
098.21	1	14.2	209.22	1	14.1	310.94	1	(14.0
099.94	2	12.85	210.02	2	11.75	313.90	1	(13.2
100.22	2	12.50	212.22	2	11.60	318.96	1	(13.2
102.23	1	14.0	214.92	2	12.05	319.98	1	13.1
107.20	1	14.3	215.22	1	12.4	320.96	2	13.10
113.93	1	(12.5	216.91	2	11.50	323.94	1	14.0
114.78	1	(13.0	217.22	1	12.5	325.92	1	(14.0
115.95	1	(12.5	218.93	1	12.3	326.92	1	(14.0
116.92	1	(12.5	219.21	1	13.1	328.90	1	(14.0
117.97	2	13.70	220.19	1	13.4	331.11	1	(13.7
118.93	1	12.8	.86	1	13.5	333.92	2	13.25
121.24	2	14.10	221.98	1	13.7	334.11	1	13.6
.99	1	(13.7	222.91	1	13.7	335.11	1	(14.0
122.23	1	14.0	224.20	1	14.2	.97	1	(14.0
123.01	1	(13.7	229.86	1	(13.2	339.11	1	(14.0
129.00	1	(13.7	233.20	1	(13.2	342.99	1	(13.2
.22	1	14.0	.89	1	13.8	347.89	1	(13.2
131.99	1	14.2	234.95	1	14.3	350.93	1	(13.2
132.94	1	(13.2	236.97	1	13.9	351.95	1	(13.7
133.22	1	14.2	237.91	2	12.50	357.02	2	13.55
136.27	1	14.2	238.18	2	13.15	358.04	1	14.2
138.22	1	(13.7	240.87	1	(13.7	359.89	1	(14.0
149.20	1	14.1	243.93	1	14.4	360.88	1	(13.7
.95	1	(13.7	249.15	1	13.8	362.14	1	(13.7
150.25	1	14.3	.98	1	14.3	.90	1	(13.7
151.23	1	14.3	250.94	1	(13.7	364.01	1	(13.7
152.24	2	12.60	251.15	1	14.5	365.95	1	13.4
153.25	2	13.10	254.12	1	14.3	367.14	1	12.5
154.92	1	(13.7	255.87	1	12.8	372.93	1	(13.7
156.23	2	14.40	256.13	1	13.2	373.91	1	(13.0
163.25	1	14.3	.91	1	13.7	381.90	2	11.50
164.12	4	13.10	257.90	1	(13.7	382.90	1	11.5
165.25	2	12.60	260.93	1	14.4	387.90	2	12.75
174.90	1	(14.0	262.05	1	(14.0	389.05	2	12.75
176.97	1	14.0	263.91	1	14.3	.89	1	12.5

TABLE 1 (cont). DAILY MEANS OF WX HYDRI.

J.D. 2441000+	No.	MEAN Mag _v	J.D. 2441000	No.	MEAN Mag _v	J.D. 2441000+	No.	MEAN Mag _v	J.D. 2441000+	No.	MEAN Mag _v
390.87	1	12.6	485.98	1	(13.2	578.20	1	14.0	711.11	1	(13.7
391.93	1	13.2	486.82	1	(13.2	580.19	1	14.4	714.90	1	(13.8
393.01	1	14.0	487.26	1	(14.0	581.20	1	14.3	715.92	1	14.5
.95	2	13.95	488.26	1	(14.0	582.89	1	12.9	716.90	1	(14.0
394.87	1	13.7	490.25	1	14.3	583.82	1	13.1	717.89	1	(14.0
395.88	1	(13.7	492.23	1	14.0	584.85	1	14.3	718.91	1	(14.0
396.98	1	(13.7	493.26	1	(13.7	586.83	1	12.9	720.92	1	(14.0
398.22	1	(14.0	494.27	2	12.55	587.95	2	13.40	722.15	1	(14.5
.93	1	14.0	.91	1	(12.5	590.17	1	14.1	.90	1	(13.7
400.84	1	13.5	495.26	1	12.8	591.18	1	(14.0	724.15	1	(13.7
407.83	1	(13.2	.79	1	(12.5	594.87	1	14.0	726.14	1	(13.7
408.83	1	(13.2	496.27	1	14.2	595.16	1	(14.5	728.14	1	(13.7
409.88	1	13.4	497.27	1	13.4	603.05	1	14.4	729.16	1	(13.5
410.21	1	12.5	500.00	1	(13.2	604.92	1	14.2	732.92	1	(13.2
411.90	1	(13.7	.83	1	(13.7	608.16	2	13.60	733.90	1	(13.2
416.24	1	(13.0	504.18	1	14.0	610.00	1	(13.7	734.87	1	(13.7
.84	1	(13.7	506.21	1	(14.0	611.16	1	(13.5	735.93	1	(13.7
417.98	1	(13.2	512.26	1	14.2	.89	1	(12.5	736.98	1	(13.7
418.95	1	(13.2	513.20	1	14.5	612.85	1	(12.5	738.95	1	(13.7
422.22	1	14.3	.95	1	(13.2	617.94	1	13.4	739.00	1	(14.0
423.02	2	(13.7	516.27	1	(14.0	618.94	2	12.55	742.91	1	(13.7
.84	1	14.2	517.27	1	(14.0	619.16	2	13.10	745.94	1	(13.7
424.24	2	12.40	518.27	1	(14.0	.92	2	13.35	748.06	2	(13.7
425.19	1	13.1	520.27	1	12.6	628.90	1	12.5	749.18	1	(13.7
.88	1	13.6	521.22	1	12.8	633.90	1	(13.7	757.90	1	(13.0
426.99	1	(13.0	522.25	1	14.3	635.92	1	(13.7	758.19	1	(13.7
428.90	1	14.0	523.26	1	(13.2	638.12	1	14.3	764.96	1	(13.2
430.18	1	(13.2	527.90	1	13.4	640.13	1	(14.0	765.98	1	(13.7
433.23	1	(13.7	528.94	2	(13.2	646.92	1	(12.5	766.84	1	(13.7
434.24	1	12.5	529.90	1	(14.0	653.09	1	12.9	768.92	1	(13.7
436.24	1	13.2	530.97	1	(13.2	655.09	1	14.3	769.86	1	(13.7
437.80	1	(13.0	531.97	1	12.3	657.90	1	(13.7	771.22	1	(13.7
439.85	1	(12.5	534.23	2	13.50	658.99	1	14.5	.93	1	(13.7
440.87	1	(13.2	.94	1	(13.2	659.97	1	(14.0	774.22	1	(13.7
444.23	1	(13.7	536.26	1	14.4	660.94	1	(14.0	.94	1	(13.7
.84	1	(13.2	.95	1	(13.2	662.90	1	12.6	775.92	1	(13.2
446.24	1	(13.7	539.85	1	(13.2	664.89	1	12.3	777.06	2	(13.2
447.87	1	(12.5	542.04	1	12.7	667.10	2	11.60	778.00	1	(14.5
449.05	1	(13.7	.94	1	13.1	.90	1	11.6	779.23	1	14.2
454.96	1	(13.2	545.24	1	14.5	669.91	1	12.4	780.84	1	(13.2
457.19	1	(13.7	546.25	1	14.4	670.97	1	12.5	782.23	1	(13.7
.81	1	(13.2	548.22	1	14.4	673.90	1	12.9	783.84	1	(13.2
459.26	1	(13.7	549.21	1	14.4	676.91	1	14.2	785.22	1	(13.7
460.25	1	14.3	550.84	1	(13.2	677.93	1	(14.0	788.92	1	(12.5
461.90	1	(12.5	552.25	1	(14.0	679.93	2	13.40	801.91	1	(13.7
462.93	1	(12.5	.97	1	(12.5	680.93	1	14.0	802.89	1	(13.2
465.80	1	(12.5	556.06	1	13.3	681.10	1	14.0	803.84	1	(13.7
468.88	1	(13.7	557.89	1	(13.7	.91	1	(14.0	806.93	1	(12.5
470.93	1	(12.5	564.08	2	(13.7	682.97	1	(14.0	813.23	1	(13.7
472.80	1	(13.2	.89	1	12.8	683.93	1	(14.0	814.82	1	(12.5
473.81	1	(13.2	.94	1	12.5	684.09	1	(14.0	817.22	1	(13.7
474.90	1	13.0	566.21	1	13.1	685.08	1	14.2	823.83	1	(13.7
475.25	1	12.5	.89	1	13.9	.92	1	(14.0	824.90	1	(13.2
476.06	2	12.95	567.85	1	(13.2	687.00	2	(14.0	826.80	1	(13.0
477.05	1	14.1	570.21	1	(14.0	695.09	1	14.3	827.81	1	(13.0
478.22	1	14.1	571.02	2	(14.0	701.91	1	(12.5	829.09	1	13.3
479.26	1	14.0	572.06	2	(14.0	702.93	1	(13.2	830.22	1	14.0
483.06	1	14.7	573.20	1	14.5	703.92	1	(12.5	832.86	1	13.2?
485.23	2	12.85	576.18	1	14.0	709.91	1	(14.0	833.23	1	(13.7

TABLE 1 (cont). DAILY MEANS OF WX HYDRI.

J.D.	No.	MEAN	J.D.	No.	MEAN	J.D.	No.	MEAN	J.D.	No.	MEAN
2441000		Mag _v	2442000+		Mag _v	2442000+		Mag _v	2442000+		Mag _v
833.82	1	13.0	002.91	1	(13.7	132.88	1	13.6	324.87	1	(13.7
835.26	1	(13.7	005.93	1	(13.7	134.87	1	(13.2	325.88	1	(13.7
839.87	1	(12.5	008.93	1	12.9	135.90	1	(13.2	328.00	1	(13.7
844.27	1	14.0	009.14	1	13.2	136.84	1	(13.2	331.90	1	(13.7
.93	1	(13.0	010.98	1	(13.7	147.94	1	(12.5	333.96	1	(13.7
846.26	1	13.0	011.93	1	(13.7	148.94	1	(12.5	336.90	1	(13.7
.83	1	(11.6	012.92	1	(13.7	160.81	1	(13.2	337.90	1	(13.7
850.81	1	13.0?	017.93	1	(13.7	162.79	1	14.2	340.91	1	(13.7
852.78	1	(12.5	025.06	2	13.15	163.84	1	(13.2	344.92	1	12.6
854.90	1	(12.5	028.94	1	13.5	165.83	1	(13.2	346.99	1	(12.4
855.79	1	(11.6	029.95	1	(13.7	166.83	1	(13.2	347.94	1	(13.0
859.91	1	(13.0	033.98	1	(13.7	173.82	1	(12.5	348.93	1	(12.4
861.88	1	(13.2	037.92	1	(13.7	176.79	1	(13.2	349.90	1	(12.5
863.18	2	14.30	043.89	1	14.7	178.86	1	(13.2	350.89	1	(13.2
865.81	1	(12.5	044.93	1	(13.7	182.80	1	(13.2	351.90	1	(12.4
867.25	1	14.0	045.92	1	13.6	184.21	1	14.1	354.98	1	13.9
871.10	1	14.5	049.91	1	12.9	185.22	1	(13.7	355.88	2	14.20
874.84	1	(12.5	050.91	1	(13.2	193.08	2	13.80	356.90	2	(13.7
882.87	1	(13.0	056.92	1	(13.2	.85	1	(12.5	357.90	1	(13.7
883.87	1	(12.5	059.91	1	(13.7	198.26	1	14.0	359.88	1	(13.7
887.87	1	(13.0	060.91	1	14.2	200.27	1	14.0	360.93	1	14.0
889.88	1	(13.2	062.95	1	(13.2	201.26	1	14.0	361.93	2	12.65
891.02	1	14.2	064.91	1	(13.7	207.78	1	(12.5	362.90	2	12.65
895.18	1	14.4	065.91	1	14.5	216.25	1	14.2	363.91	1	14.0
.95	1	(13.2	067.90	1	(13.7	218.25	1	14.2	365.96	1	14.2
897.84	1	13.2	068.90	1	13.7	227.26	1	13.6	366.90	2	(13.7
898.24	2	13.00	069.96	2	(13.2	239.94	1	11.6	368.92	1	(13.7
899.81	1	12.9	071.90	2	13.30	240.81	1	11.6	369.95	2	(13.7
900.93	1	(12.5	073.85	1	14.6	241.87	1	11.3	371.02	2	(13.7
901.20	1	13.3	075.94	1	12.4	249.25	1	13.6	.96	2	(13.7
904.22	1	(14.0	076.91	1	11.5	.95	1	13.9	372.93	1	(13.7
911.82	1	(13.7	077.90	1	11.6	251.90	1	(13.2	373.91	2	(13.7
916.95	1	11.6	078.98	1	11.6	253.90	1	(12.5	375.15	1	(13.7
917.81	1	11.1	083.95	2	12.40	255.25	1	13.3	.90	1	13.1
.89	1	11.8	084.89	1	12.4	259.25	1	14.2	379.89	1	(12.5
920.84	2	11.80	085.91	2	12.45	267.82	1	(12.5	381.06	1	(14.2
925.82	1	12.7	086.91	2	12.70	272.82	1	(13.2	382.00	1	(14.2
926.97	1	13.5	087.92	1	12.9	277.25	1	13.7	383.92	1	(13.7
929.81	1	(13.2	089.91	1	13.1	.96	1	(13.7	384.91	1	(13.7
930.94	1	(13.2	090.95	1	13.5	278.92	1	(13.7	385.95	2	(13.7
934.81	1	(12.5	091.93	1	13.6	279.91	1	(13.7	386.92	1	12.9
938.81	1	(12.5	095.93	1	13.3	286.23	1	13.3	389.92	1	14.2
950.83	1	(13.7	096.92	1	13.8	.91	1	(12.5	390.92	1	14.2
951.82	1	(13.2	097.92	1	14.2	289.91	1	(12.5	392.92	1	(13.7
954.84	1	(13.2	099.86	1	13.1	290.25	1	(13.2	393.92	2	13.70
955.86	1	(13.2	102.92	1	13.7	295.89	1	13.5	394.92	1	14.2
966.00	1	(14.0	103.91	1	13.5	296.95	1	(13.7	395.92	1	(13.7
970.86	1	(13.7	105.92	1	(13.2	301.23	1	14.1	396.91	1	(13.7
971.87	1	(13.7	107.89	1	13.7	.99	1	14.2	397.92	1	14.7
974.88	1	(13.7	110.89	1	13.0	303.89	1	13.9	398.92	2	12.80
976.97	1	11.3?	111.88	1	(12.5	304.05	1	12.5	399.92	2	12.85
981.14	1	(13.7	115.92	1	(12.5	.89	1	13.4	400.94	1	13.5
.91	1	14.1	117.95	1	(11.5	307.84	1	(13.7	403.00	1	14.1
982.93	1	12.4	118.87	1	13.4	310.00	1	(13.7	.91	1	(13.0
983.14	1	13.0	121.91	1	(13.7	.87	1	(13.7	404.92	1	(13.7
984.93	1	13.4	122.91	1	13.4	313.19	1	14.1	405.94	1	(13.7
987.97	1	(13.7	124.94	1	13.9	319.19	1	14.3	409.93	1	(12.5
994.93	1	(12.5	128.90	1	(13.6	320.00	1	(13.5	411.92	1	12.9
997.91	1	(13.0	129.84	1	(13.2	324.00	1	(13.6	412.97	2	14.10
999.91	1	(13.7	130.92	1	(13.7	.85	1	13.2	413.92	1	14.3

TABLE 1 (cont). DAILY MEANS OF WX HYDRI.

J.D.	No.	MEAN	J.D.	No.	MEAN	J.D.	No.	MEAN
2442000+		Mag _v	2442000+		Mag _v	2442000+		Mag _v
414.91	1	(14.0	505.89	1	(13.7	650.84	1	(13.2
417.00	1	(14.0	506.82	1	(13.2	655.04	1	(13.0
422.89	1	(13.7	507.88	1	13.6	656.82	1	(13.2
423.97	1	12.6	508.87	1	(13.0	659.01	1	(13.7
424.90	1	13.3	510.93	1	(13.7	661.94	1	(13.7
425.92	1	14.2	511.91	2	(13.7	670.93	1	(13.2
426.98	1	(13.7	513.83	1	(13.2	671.92	1	13.0
427.93	1	14.2	515.23	1	(13.2	672.94	1	(12.5
428.90	1	(13.7	517.86	1	(13.2	680.91	1	(13.7
430.09	1	(13.7	518.92	1	(13.2	681.90	1	(13.5
.94	1	14.1	519.91	1	(13.2	683.91	1	13.2
431.92	1	14.4	520.87	1	(13.2	685.94	1	(13.7
432.93	3	(13.7	528.82	1	(12.5	690.91	1	13.2
433.94	1	(13.7	532.93	1	(13.2	693.95	1	(13.7
434.91	1	(13.7	537.93	1	(13.0	694.91	1	(13.7
435.91	1	14.2	538.92	1	(13.2	695.92	1	(13.2
436.91	1	(13.0	540.92	1	(12.5	698.98	1	(13.7
437.91	1	(13.0	546.23	1	13.9	699.94	1	(13.2
439.94	1	(12.4	561.86	1	(12.5	700.96	1	(13.0
440.94	1	(13.0	571.25	1	14.3	708.97	1	(13.2
443.91	1	(13.7	572.96	1	(12.5	709.93	1	13.9
444.91	1	(13.7	579.95	1	(12.5	711.04	1	(13.7
445.92	3	(13.7	582.92	1	(12.5	.95	1	(13.7
446.91	1	(13.7	584.23	1	14.0	713.88	1	(13.7
447.93	1	13.0	590.96	1	(12.5	716.86	1	12.2
448.89	1	13.4	591.87	1	13.1	723.90	1	(13.2
450.91	1	(13.7	595.92	1	(13.2	727.91	1	(13.7
451.92	1	(13.7	597.95	1	(12.5	729.05	1	(13.7
452.94	2	(13.7	598.83	1	(12.5	733.96	1	13.0
453.90	1	(13.7	600.96	1	(13.2	734.91	1	13.2
454.92	3	(13.7	603.94	1	(12.5	736.95	2	13.70
455.91	1	(13.7	604.99	1	(13.2	737.93	1	(13.7
456.91	1	(13.7	606.26	1	(13.7	739.90	1	13.7
457.91	1	(13.0	610.95	1	(12.5	742.98	2	13.70
458.94	1	12.6	620.92	1	(13.2			
459.90	1	13.0	623.93	1	(13.0			
461.91	1	14.4	624.94	1	(13.0			
462.90	2	(13.7	626.94	1	(13.2			
463.91	1	(13.0	631.93	1	11.5			
466.95	1	(13.0	632.97	1	11.5			
471.90	1	13.7	633.97	1	11.5			
474.90	1	14.4	634.92	1	11.7			
475.91	1	(13.7	635.95	1	11.9			
478.90	1	14.8	637.07	2	12.45			
479.90	2	(13.7	641.23	2	13.05			
480.90	1	(13.7	642.06	1	13.0			
482.91	1	(13.7	649.83	1	(13.2			
487.91	1	11.2						
489.94	1	11.5						
491.94	1	12.2						
492.86	1	12.3						
493.89	1	12.3						
494.90	1	12.5						
498.93	1	(12.5						
499.88	1	(12.4						
500.89	1	(13.0						
502.84	1	(13.7						
503.90	1	(13.0						
504.94	1	13.5?						

TABLE 2. OBSERVED MAXIMA OF WX HYDRI.

No.	TYPE	J.D. MAX. 2441000+	MAX. Mag _v	Int. d	WIDTH AT 13 _d 0	Wt.	REMARKS.
1	S	069.0	11.5	...	11.5	5	
2	B	089.5	12.5	20.5	1.0	3	
3	B	100.2	12.5	10.7	1.2	3	
4	A	119.0	12.5	18.8	0.8	2	
5	B	152.2	12.6	(33.2)	1.1	2	
6	B	164.9	12.4	12.7	1.4	3	
7	B	178.2	12.6	13.3	1.0	3	
8	C	190.9	12.0	12.7	2.4	3	
9	A	206.9	12.5	16.0	0.7	2	
10	S	216.9	11.5	10.0	10.0	5	
11	A	237.9	12.5	21.0	0.7	5	
12	B	255.2	12.5	17.3	1.0	3	
13	B	284.1	12.5	(28.9)	1.5	3	Possible max. around 272 not observed
14	A	296.1	12.6	12.0	0.9	3	
15	A	320.5	12.5?	(24.4)	0.9	1	
16	A	333.5	12.5?	13.0	0.6	2	
17	B	356.0	12.5?	(22.5)	1.0?	1	
18	B	367.1	12.5	11.1	1.0	2	
19	S	382.5	11.50	15.4	10.5	3	
20	A	399.5	12.5?	17.0	0.8	2	
21	A	410.2	12.5	10.7	0.7	2	
22	B	424.2	12.4	14.0	1.0	4	
23	B	434.2	12.5	10.0	1.6	2	
24	A	475.3	12.5	(41.1)	0.9	4	
25	A	485.5	12.5	10.2	0.5	1	
26	B	494.3	12.5	8.8	1.3	3	
27	B	520.0	12.5	(25.7)	1.4	2	
28	B	532.0	12.3	12.0	1.7	3	
29	A	541.9	12.5	9.9	0.8	2	
30	A	555.5	12.5?	13.6	0.6	1	
31	B	565.0	12.2?	9.5	1.1	3	
32	B	582.5	12.5	17.5	1.2	3	
33	B	586.5	12.5	4.0	1.0	2	
34	A	607.0?	12.5?	(20.5)	0.6	1	
35	A	618.7	12.5	11.7	0.9	4	
36	A	628.9	12.5	10.2	0.7	1	
37	B	652.5?	12.5?	(23.6)	1.2	1	
38	S	667.1	11.6	14.6	10.5	5	
39	A	680.2?	12.5?	13.1	0.3	1	
40	B	828.3?	12.5?	(148.1)	1.0	1	
41	A	845.5?	12.5?	17.2	0.9	1	
42	C	899.0	12.5	(53.5)	2.0	3	Possible max. around 852 not observed.
43	S	917.8	11.1	18.8	9.5	3	
44	A	982.9	12.4	(65.1)	0.9	2	A single obs. of 11.3 on 977 may be max. but this is doubtful.
2442000+							
45	A	008.5	12.5	(25.6)	0.7	1	
46	C	026.0	12.5?	17.5	2.3?	1	
47	D	047.0?	12.3?	21.0	3.5?	1	
48	B	070.0	12.5	23.0	1.6	2	
49	S	076.9	11.5	6.9	14.0	5	
50	B	100.2	12.5?	23.3	1.4	2	
51	A	110.0?	12.5?	9.8	0.8	1	
52	C	120.0?	12.5?	10.0	2.1	1	

TABLE 2 (cont). OBSERVED MAXIMA OF WX HYDRI.

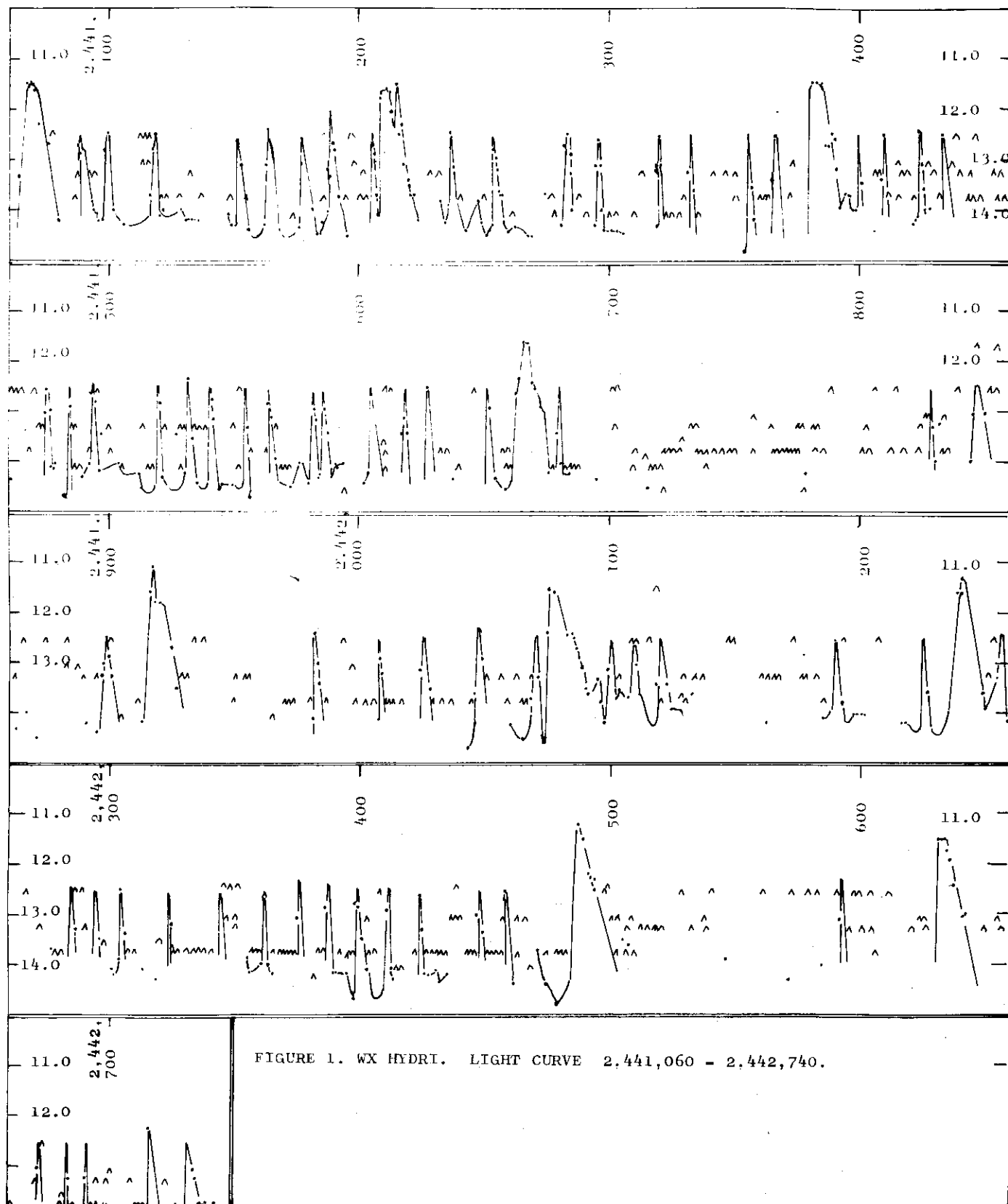
No.	TYPE.	J.D. MAX. 2442000+	MAX Mag _v	Int. d	WIDTH AT 13 _d ⁰	Wt.	REMARKS.
53	B	190.7?	12.5?	(70.7)	1.3	1	Possible max. around 133 not observed.
54	A	225.5?	12.5	(34.8)	0.8	1	
55	S	241.8	11.3	16.3	8.5	3	
56	B	256.0	12.5	14.2	1.4	2	
57	B	284.0?	12.5?	(28.0)	1.5	1	Possible max. around 275 not observed.
58	A	294.5	12.5?	10.5	0.9	1	
59	A	304.0	12.5	9.5	0.5	3	
60	A	325.0?	12.5?	21.0	0.3	1	
61	B	345.0	12.5	20.0	1.0	2	
62	B	362.5	12.5	17.5	1.0	4	Possible max. around 353 not observed.
63	A	376.2	12.5?	13.7	0.5	1	
64	B	387.2	12.5	11.0	1.0	2	
65	B	399.1	12.5	11.9	1.2	5	
66	A	412.0	12.5	12.9	0.7	3	
67	A	424.0	12.5	12.0	0.6	3	
68	A	448.3	12.5	24.3	0.6	2	
69	B	458.5	12.5	10.2	1.5	3	
70	S	487.9	11.2	(29.4)	11.0	4	Possible max. around 468 not observed.
71	B	592.5	12.5	(104.6)	1.3	1	Possible max. around 505 or 508 not observed.
72	S	632.0	11.5	(39.5)	10.0	4	
73	A	672.5	12.5?	(40.5)	0.6	1	
74	A	683.0?	12.5?	10.5	0.8	1	
75	B	691.3?	12.5?	8.3	1.0	1	
76	B	716.9	12.2	(25.6)	1.5	1	
77	C	731.3	12.5	14.4	2.8?	2	

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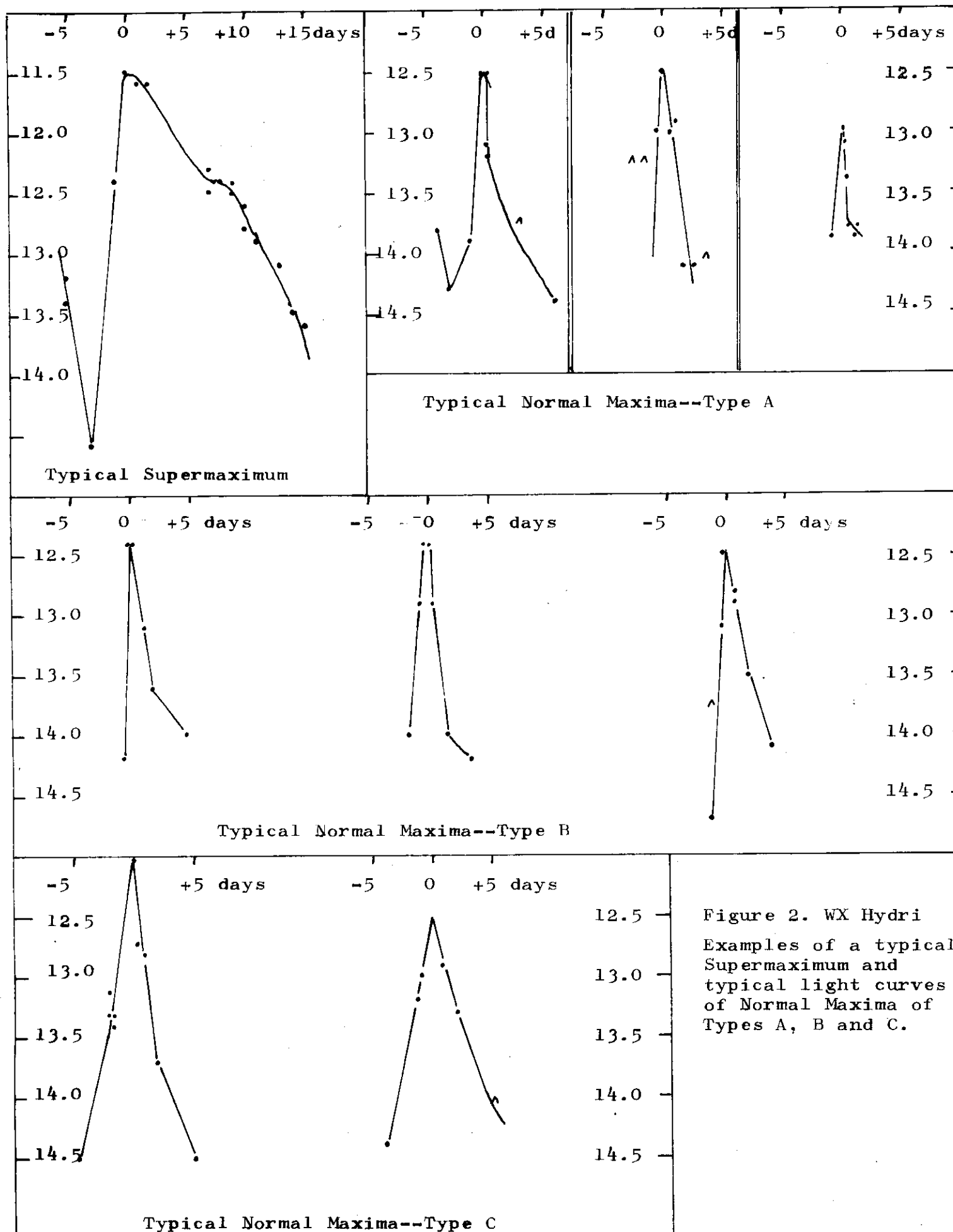


Figure 2. WX Hydri
Examples of a typical
Supermaximum and
typical light curves
of Normal Maxima of
Types A, B and C.

THE SPECTRUM OF BV 1616 LEP AND ITS COMPANION

JOHN WHELAN

SUMMARY: The spectral type of BV 1616 Lep is about M5e. It is not a dwarf nova but probably a Mira variable. An approximate magnitude and an accurate position are given, and the spectrum shown. The nearby companion to BV 1616 Lep is probably a late spectral type star with no special peculiarities.

INTRODUCTION: Information about the variability of BV 1616 Lep was summarised recently by Bateson (1976; M76/3 and M76/4). The star appeared to be variable by about 4 mag on a timescale of a few hundred days. It was suspected of being a long period eclipsing or eruptive variable. Its companion was also suspected of variability.

OBSERVATIONS: A spectrum of BV 1616 Lep was obtained on 1976 May 19.38 (UT) (JD 2442917.88) at the Anglo-Australian Telescope (AAT) with the fast Cassegrain Spectrograph. The detector used to record the light was a Wampler-Robinson Image Dissector Scanner (Robinson and Wampler 1972). In this device, the light, after dispersion into a spectrum by a diffraction grating, strikes the photocathode of an image intensifier tube. The photons are converted into electrons and accelerated down the tube by a strong electric field. The electrons at the end of the tube hit a phosphor screen which glows; the input light has now been many times amplified. The output light falls onto an image dissector (something like a TV camera) where it is again converted to electrons which are scanned by the final detector in an electronically controlled sweep every 4 milliseconds. The final output, after several minutes of scanning, is in the form of numbers representing the intensity in the spectrum, which is divided into 2048 points or channels.

The spectrum of BV 1616 Lep is shown in the figure. For comparison, the spectrum of RS Cen, a Mira-type variable, obtained on the same night and with the same equipment, is shown. The wavelength scale of the figure, which was calibrated from helium, neon and mercury arcs, is quoted in Angstroms ($\text{\AA}$) and is somewhat non-linear. The spectrum covers the wavelength range 4000-7100 $\text{\AA}$ at a resolution of about 10 $\text{\AA}$. Several features are identified by their wavelength. The intensity scale has not been absolutely calibrated.

It is clear that the two spectra are very similar. They both show the 'saw-tooth' shape which is typical of very late spectral type stars. These are very cool, with surface temperatures of about 3000 $^{\circ}\text{C}$. At such a temperature molecules can form, which absorb large chunks of the light causing the observed strong absorption bands. Hotter stars, such as the Sun with a temperature of 5600 $^{\circ}\text{C}$, do not show these features because the molecules have been dissociated into atoms. The molecules responsible for the different

bands are all due to titanium oxide except those at wavelength 5737Å and 6087Å which are due to vanadium oxide. H γ emission is present in both stars but H α emission is present only in BV 1616 Lep. H β emission has been suppressed by the strong absorption. The spectral type of BV 1616 Lep, based on the calibration of Keenan (1966), is about M5e, where e indicates emission features present, with an uncertainty of two spectral subclasses. BV 1616 Lep has more red radiation than RS Cen indicating a later spectral type than M1e - M4e, which is quoted in the Variable Star Catalogue for the latter. The luminosity class (giant or dwarf) of BV 1616 Lep cannot be determined from the present data. The spectrum of a dwarf nova, such as Z Cha, shows doubled hydrogen emission lines and a featureless continuum. In some dwarf novae a solar type absorption spectrum is also present. BV 1616 Lep is clearly not a dwarf nova.

Rough magnitude estimates were made by adding up the light of the whole spectrum or by "visual" observation of the field presented by the acquisition TV system of the AAT. The TV magnitude is a red one due to its particular spectral response. The effective magnitude at the epoch of observation of BV 1616 Lep was 15.2 ± 0.6 mag when compared with a white dwarf standard. In the red, BV 1616 Lep was brighter than star A of the chart in M76/3. This is not in contradiction with the above effective magnitude or with the report in M76/4 since A could be a much bluer star. BV 1616 Lep was 2.0 ± 0.3 mag. fainter than RS Cen.

The position of BV 1616 Lep determined at the AAT which has accurate pointing, was (1950.0) 06h 07m 28.5s -13° 06' 19" with an error in both coordinates of ± 3 arcsec.

A spectrum of the star 18" west of BV 1616 Lep was also obtained. It appears to be a star of solar spectral type or later and without any special peculiarities. It was about 0.5 ± 0.2 magnitudes fainter than BV 1616 Lep but not nearly as red.

DISCUSSION: The suspicion that BV 1616 Lep might be an eruptive variable was not confirmed. Its spectrum looks completely different from that of a dwarf nova. It seems to be a cool, M5e spectral type star similar to RS Cen. Considering its probable long period variability, its spectral similarity to a Mira variable and its H α emission, it is very likely that BV 1616 Lep is also a Mira-type variable. Whether it eclipses or not is another matter. A determination of the period and amplitude of the light curve would be useful.

ACKNOWLEDGEMENTS: I thank D.A.Allen, A.J.Longmore, S.K.Mayo, and D.T. Wickramasinghe for help.

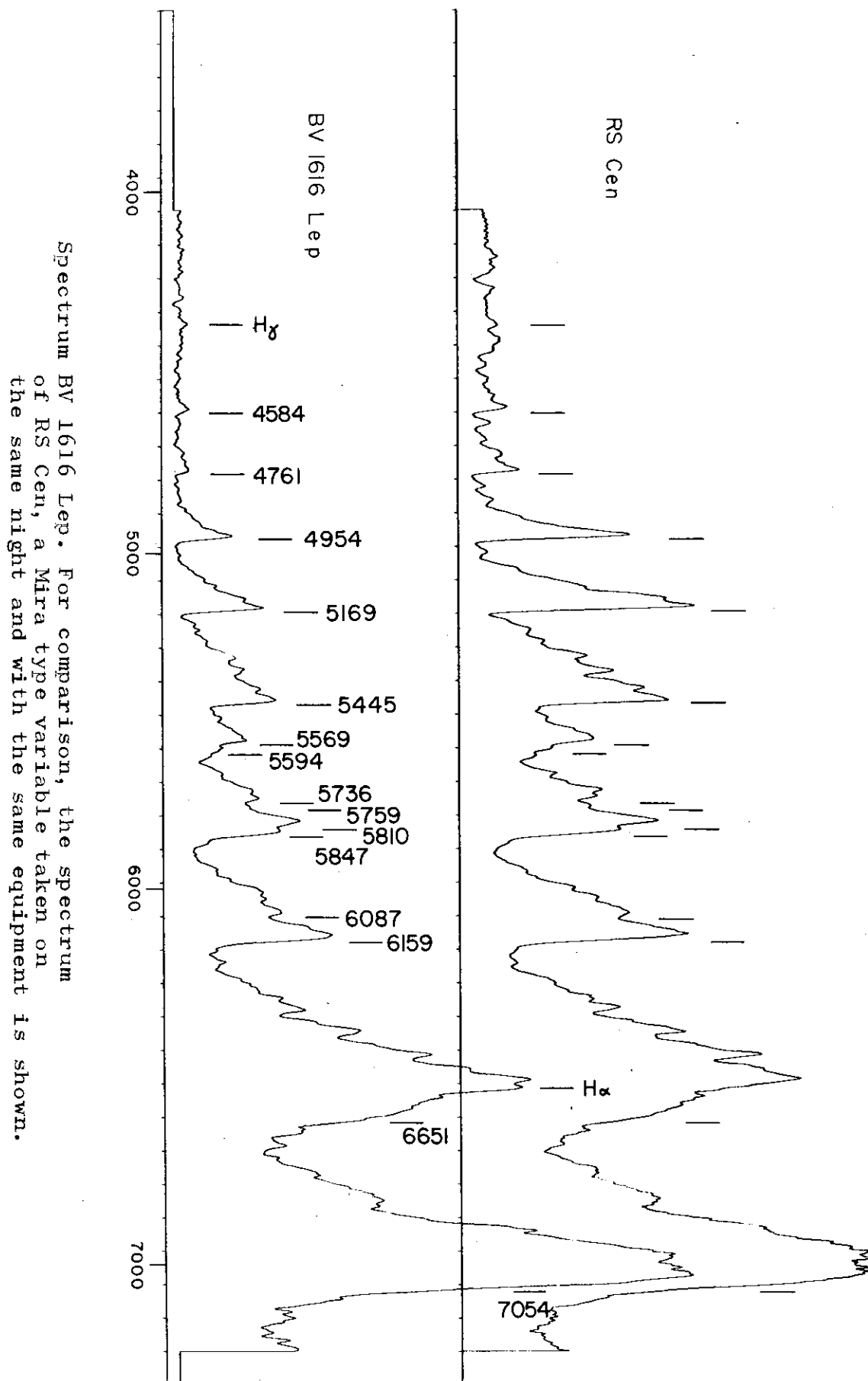
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SEQUENCES FOR SEVEN DWARF NOVAE.

By B. Warner

SUMMARY: Sequences are given for BB Vel; CU Vel; V436 Cen; MU Cen; V591 Cen; EX Hya; BP CrA. Charts are also reproduced.

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PHOTOMETRY: The photometry was performed at the Sutherland Observatory of the South African Astronomical Observatory. The stars were tied to the E-region standards given by Cousins (Mem. R.A.S. 77,223, 1973). The UBV filters were the same as those specified by Cousins. Errors are not expected to exceed 0.02 mag., except for those marked with a colon or the very faintest stars.

F.M. Bateson has added comments on the charts which appear on the pages following the sequences.

083347 BB Vel Sequence.

<u>CHART LETTER.</u>	<u>V</u>	<u>B-V</u>	<u>U-B</u>	
a	10.58	0.34	0.27	-47° 41' 34"
f	11.33	0.61	0.10	-46° 43' 70"
c	11.67	0.53	0.02	47° 41' 25"
b	12.22	0.56	0.02	
d	12.61	1.02	0.68	
l	13.41	0.49	0.18	
g	13.45	0.65	0.14	
k	13.54	1.71	1.53	
e	13.57	0.65	0.08	
h	13.71	0.31	0.23	
m	15.33	1.38	0.92:	

085441 CU Vel Sequence.

e	10.78	0.31	0.07
g	10.87	0.49	-0.04
k	11.45	0.34	0.12
m	12.05	0.53	-0.05
q	12.41	1.06	0.36
s	12.53	1.46	1.28
p	12.65	0.58	0.10
t	12.88	0.92	0.61
u	13.31	0.57	0.00
x ₂	13.52	0.65	0.15
n	13.69	0.54	0.16
x ₁	13.94	0.75	0.46
l	14.75	1.57	1.61
z	15.08	1.11	0.39:
y	15.14	0.88	0.57:

110937 V436 Cen Sequence.

a	10.49	1.01	0.60
b	11.05	1.68	2.04
d	11.75	0.61	0.03
e	12.01	0.63	0.07
l	12.26	0.60	0.00
f	12.53	0.89	0.49
g	12.93	0.81	0.36
h	13.19	0.70	0.24
k	13.56	1.07	0.68
n	14.09	1.00	0.57
m	14.81	0.72	0.17

120743 MU Cen Sequence.

CHART LETTER.	V	B-V	U-B
n	12.22	1.20	1.17
l	12.24	1.15	1.04
p	12.92	0.58	0.04
s	13.25	0.66	0.10
r	13.31	0.71	0.31
u	13.99	0.82	0.27
w	14.15	0.79	0.36
x	15.51	0.71	0.20

123633 V591 Cen Sequence.

a	9.19	0.37	0.18
b	10.92	0.97	0.59
d	11.35	0.59	0.06
e	11.76	0.66	0.11
f	13.00	0.91	0.52
c	14.19	0.68	0.11
g	14.35	0.59	0.05
h	14.76	0.62	0.11

124728 EX Hya Sequence.

a	9.64	0.43	0.11	= CoD - 28° 9754
a'	9.68	1.06	0.93	
b	10.47	1.07	0.87	
c	10.72	0.54	0.06	
d	10.98	0.45	-0.01	
g	11.41	0.90	0.51	
h	12.07	0.93	0.53	
k	12.21	0.61	0.07	
l	12.74	1.16	1.10	
p	13.52	0.63	0.05	
n	~~15.04~~ 12.92	~~0.95~~	0.56	ASAS3. Verr 0.10

183037 BP CrA Sequence.

g	11.78	1.04	0.81	
a	13.07	0.44	0.05	
h	13.11	1.10	0.80	
b	13.74	0.65	0.12	
d	14.41	1.01	0.68	— close triple. Not a good comp. star
c	14.43	0.39	0.13	
k	14.46	1.01	0.63	
e	14.64	1.62	0.63	
f	13.54	0.63	0.13	

CHARTS.

083347 BB Vel. Charts 366 and 367 are reproduced from Series 9, "Charts for Southern Variables" (In Press). The positions of a number of other variables are shown. Visual observations of these are not required at present. Charts for EN Vel (M. 11.1-(14.3p) and EP Vel (SRA 9.8-11.2p) will appear later. It should be noted that the position of the Cepheid, AM Vel, is incorrect in the GCVS. The correct 1950 position is given at the foot of Chart 367.

085441 CU Vel. A revised Chart 114, from Series 4 "Charts for Southern Variables" Visual observations are not required of the stars BF & GP Vel and SVS 101020 shown on this chart. The comparison star, marked "x", on the original chart in Series 4 is double and magnitudes are given on page 18 for both components. Observers should avoid using these stars for comparison if they cannot separate the components clearly.

110937 V436 Cen. Refer to Charts 101 and 103 in Series 4. On Chart 370, from Series 9, is a replacement for the enlarged chart in the upper left corner of Chart 103. Note the additional comparison stars--"l" and "m".

120743 MU Cen. Refer to Charts 123 and 124 in Series 4. On Chart 370, from Series 9, is a replacement for the enlarged chart in the bottom left corner of Chart 124. Note that comparison star "x" for which magnitudes are included in the sequence on page 19 is not shown on chart 370 as it has been omitted from the chart returned by Warner; its position will be advised to observers later.

123633 V591 Cen. Charts 368 and 369 are from Series 9. There are a large number of faint variables in the area covered by Chart 368, of which only the brightest have been plotted. The only one of interest to visual observers is V451 Cen, for which a finding chart appears on Chart No. 369 and a detailed chart will be issued later.

124728 EX Hya. Refer charts 140 and 141, Series 4. Chart 370, from Series 9, shows an enlarged area around EX Hya in order to clarify the position of the comparison stars. Observers are requested to report on comparison star "n" for which the magnitude given in Circular 159 is discordant.

183037 BP CrA. Charts 378 and 379 are reproduced from Series 9. On 378 only the brighter of the many variables in this area have been plotted. Finding charts for four of these of interest to visual observers appear on chart 379. Some comparison stars are indicated by letters on these finding charts and can be used for estimates pending the publication of more detailed charts.

GENERAL. Visual observers should use only those comparison stars listed by Warner for the seven dwarf novae, as shown on the charts now published. They use the magnitudes given under "V", but rounded off to tenths. The sequences now published are to be used as from the date of receipt of Publications No.4. Observers are requested to note on their returns "Pub. 4 sequence" on the first date on which they use these sequences.

ACKNOWLEDGEMENTS. Appreciation is expressed to B. Warner for his determination of these sequences, which will enable all observations to be reduced and published.

We are indebted to the Carter Observatory for photos of some of these fields.

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366

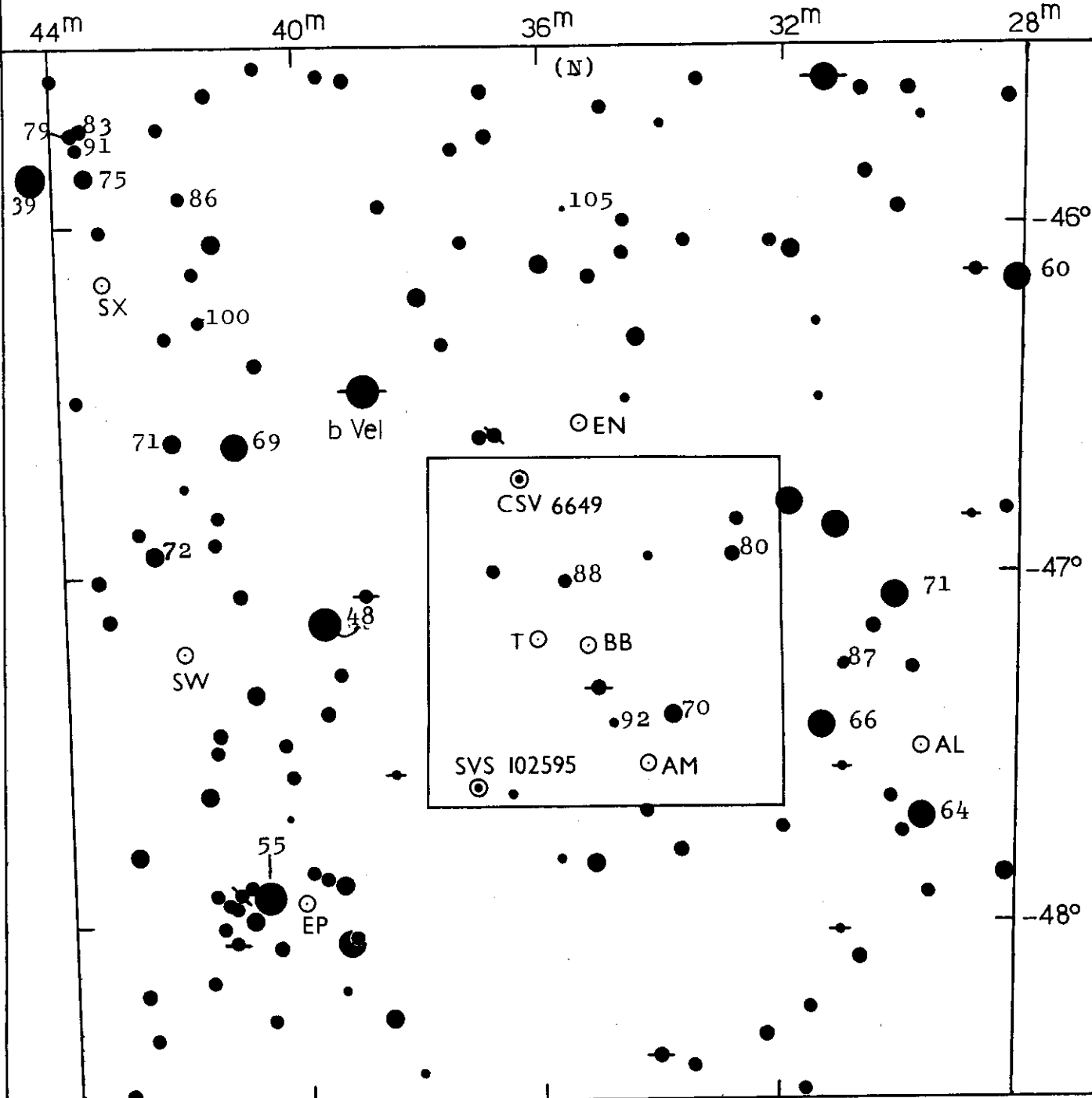
083347 BB VELORUM.

(1900): 08h 33m 35s -47° 01.9

(1950): 08 35 12 -47 12.3 (See also chart 367)

UG. 13.3-15.5p ($< 20^d$)Also shown: T; SW; SX; AL; AM; EN; EP Vel.
CSV 6649; SVS 102595.

Scale: 60" = 1mm

08h
28m

Plotted from SAO by M.M.

Epoch: 1950

Finder Chart: Atlas Australis V.

Mags: V, rounded to tenths, from R.O.Bull. 64 (1963)

F.M.B. 1 Aug. 1976

083347 BB VELORUM.

(1900): 08h 33m 35s $-47^{\circ} 01.9$ (See also chart
 (1950): 08 35 12 $-47 12.3$ 366)

UG. 13.3-15.5p ($< 20^d$)

Also shown: T & AM Vel.

CSV 6649=CoD-46 $^{\circ} 4393$ =CPD-46 $^{\circ} 2759$.Sp. Ma. $M_v = 7.4$ SVS 102595=CoD-47 $^{\circ} 4171$ =CPD47 $^{\circ} 2483$.K2. $M_v = 7.8$ 38 ^{m} 37 ^{m} 36 ^{m} 35 ^{m} 34 ^{m}

CSV 6649

(N)

Scale: 20" = 1mm

367

88

08h
32m

45

-47 $^{\circ}$
00'

15'

30'

SVS 102595

AM

Plotted from CoD by M.M.

Epoch: 1950

Position of AM Vel incorrect in GCVS. Correct position:(1950)

08h 34m 03s $-47^{\circ} 35.5$

F.M.B. 1 Aug. 1976

SUPPLEMENTARY CHARTS.

370

110937 V436 Centauri.

(1900): 11h 09m 12s -37° 08.1
 (1950): 11 11 35 -37 24.4

UG. 11.9 - 15.4p (32d)

Replaces enlarged chart in
 upper left corner of Chart 103.

Series 4. Finder chart: 101, Series 4.

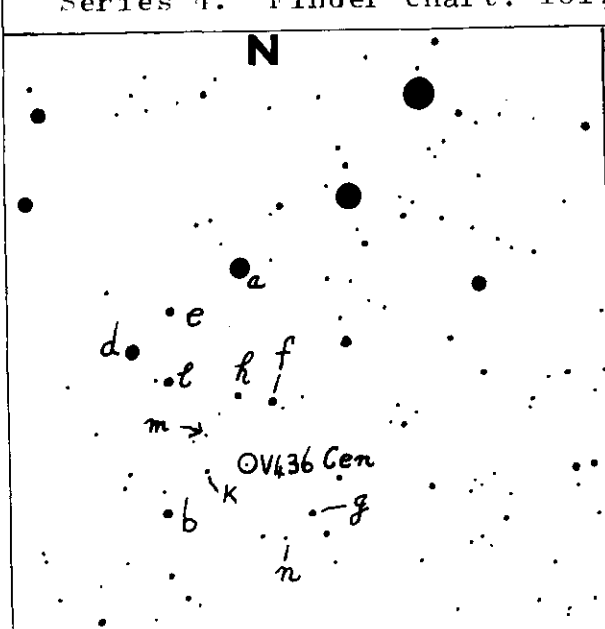
120743 MU CENTAURI

(1900): 12h 07m 42s -43° 54'
 (1950): 12 10 18 -44 11

UG. 12.4 - 15.5p (42d)

Replaces enlarged chart bottom
 left corner of Chart 124, Series 4

Finder Chart: 123, Series 4.



124728 EX HYDRAE

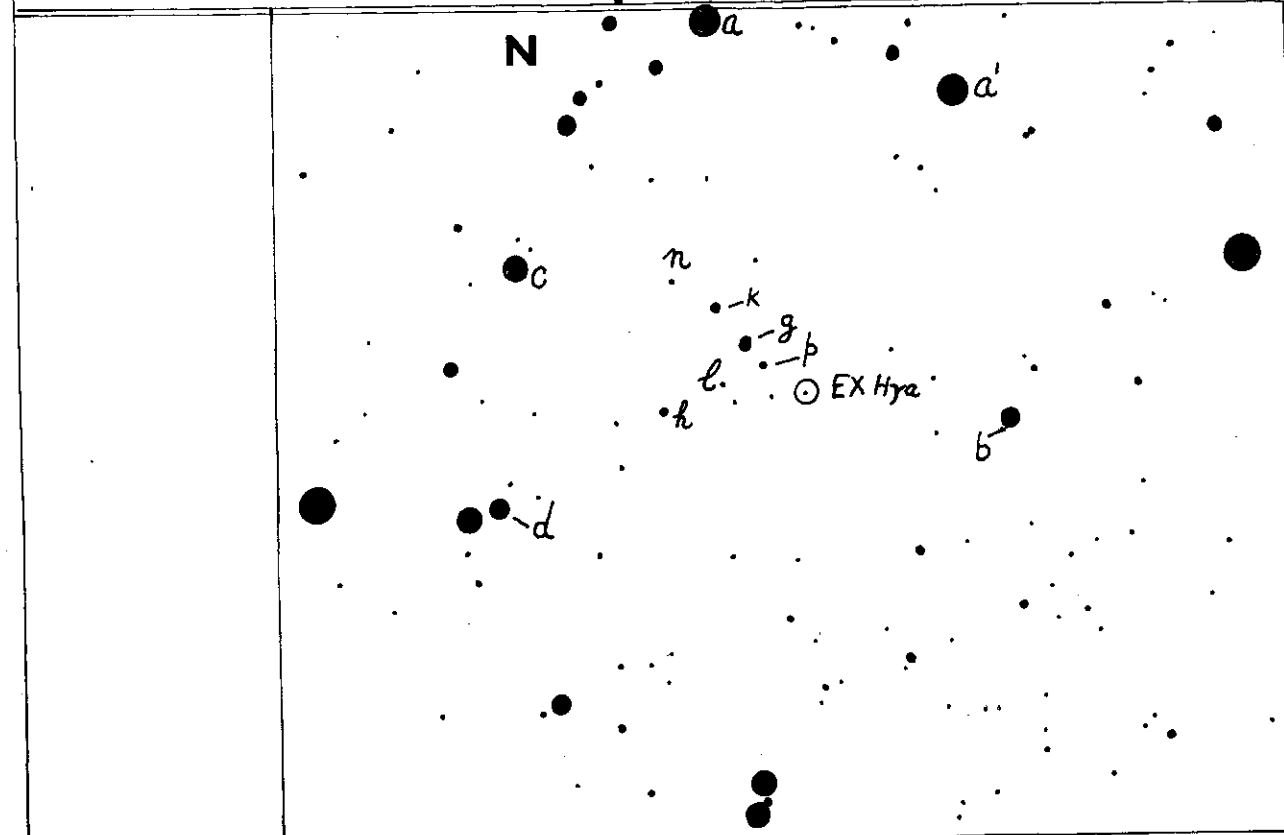
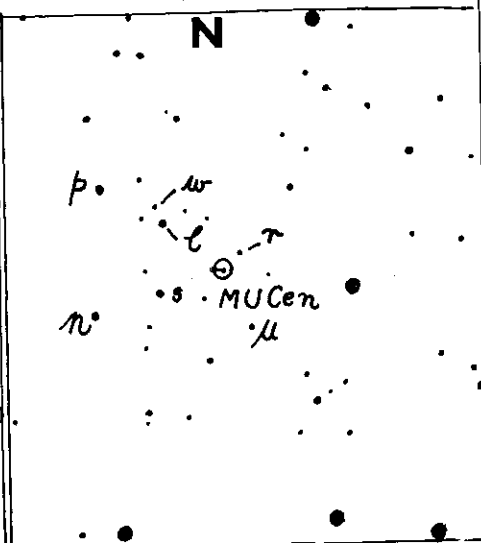
(1900): 12h 47m 01s
 -28° 42.9

(1950): 12h 49m 42s
 -28° 59.2

UG(EA). 11.4-14.8p

Finder Chart: No. 140.
 Series 4.

Chart below shows
 enlarged area around
 EX Hya-refer Chart
 141, Series 4.



Traced by FMB from identification charts.

FMB 1 Aug. 1976

369

123633 V591 CENTAURI.

(1900): 12h 36m 56s -33° 00.8

(1950): 12 39 37 -33 17.3 (See also Chart 368)

UG? 14.0 - 16.0p

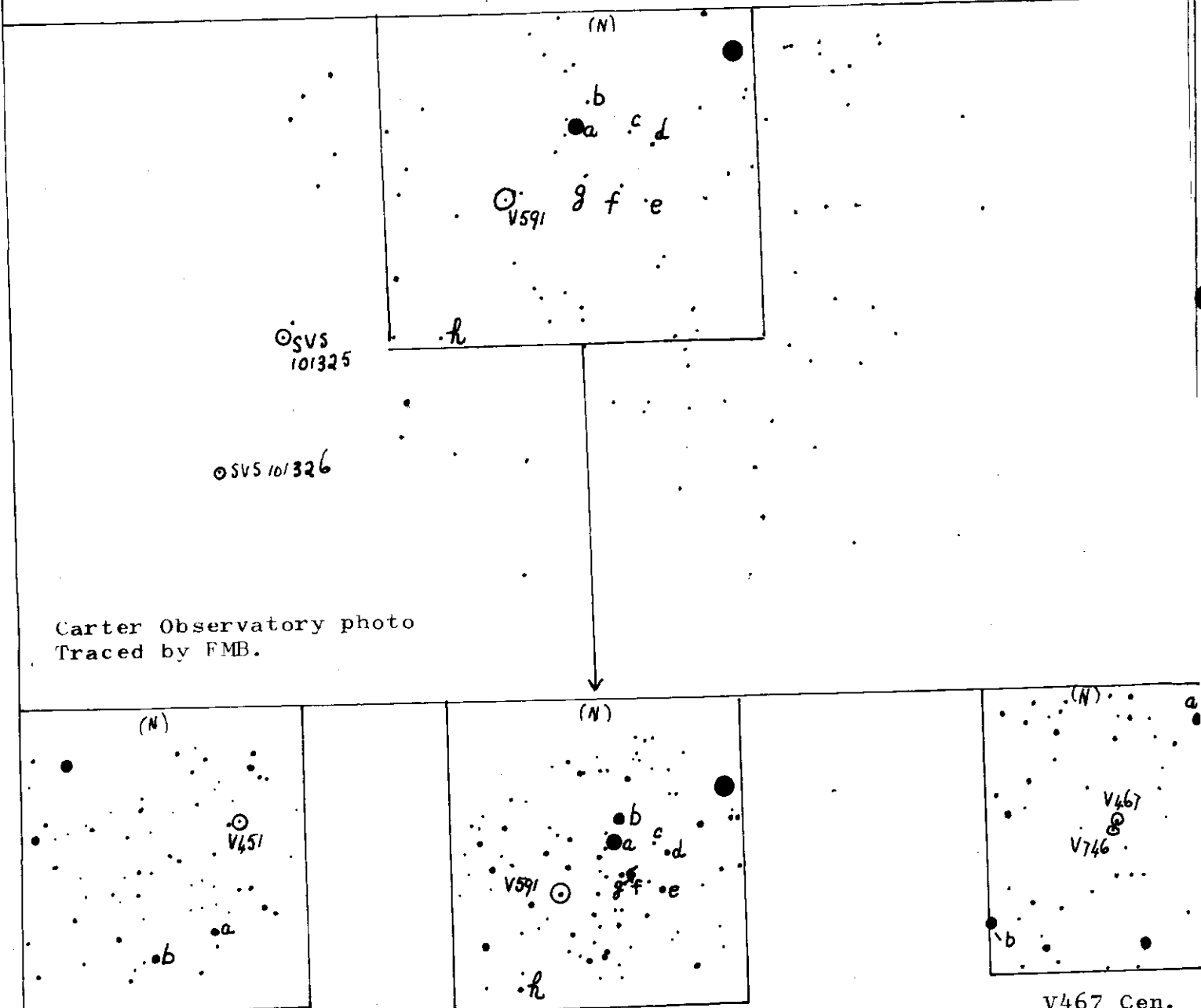
ALSO SHOWN: SVS 101325 (10.3p); 101326 (10.4v).

IDENTIFICATION CHARTS FOR:- V451 Cen (M. 12.0-15p. 201d)

V467 Cen (RR. 11.5-12.5p)

V746 Cen (E. 9.8-10.7p).

Scale: 20" - 1mm



V451 Cen.
 (1900): 12h 36m 23s -34° 23.0
 (1950): 12 39 04 -34 39.5

V467 Cen.
 (1900): 12h 42m 58s -33° 06.3
 (1950): 12 45 40 -33 22.7
 V746 Cen.
 (1900): 12h 42m 59s -33° 06.5
 (1950): 12 45 41 -33 22.9

Identification charts from "Atlas of Finding Charts of Variable Stars"
 traced by FMB

FMB 1 Aug 1976

378

183037 BP CORONAE AUSTRINAE.

(1900): 18h 30m 02s -37° 30.6 (See also Chart 379.)
 (1950): 18 33 26 -37 28.3

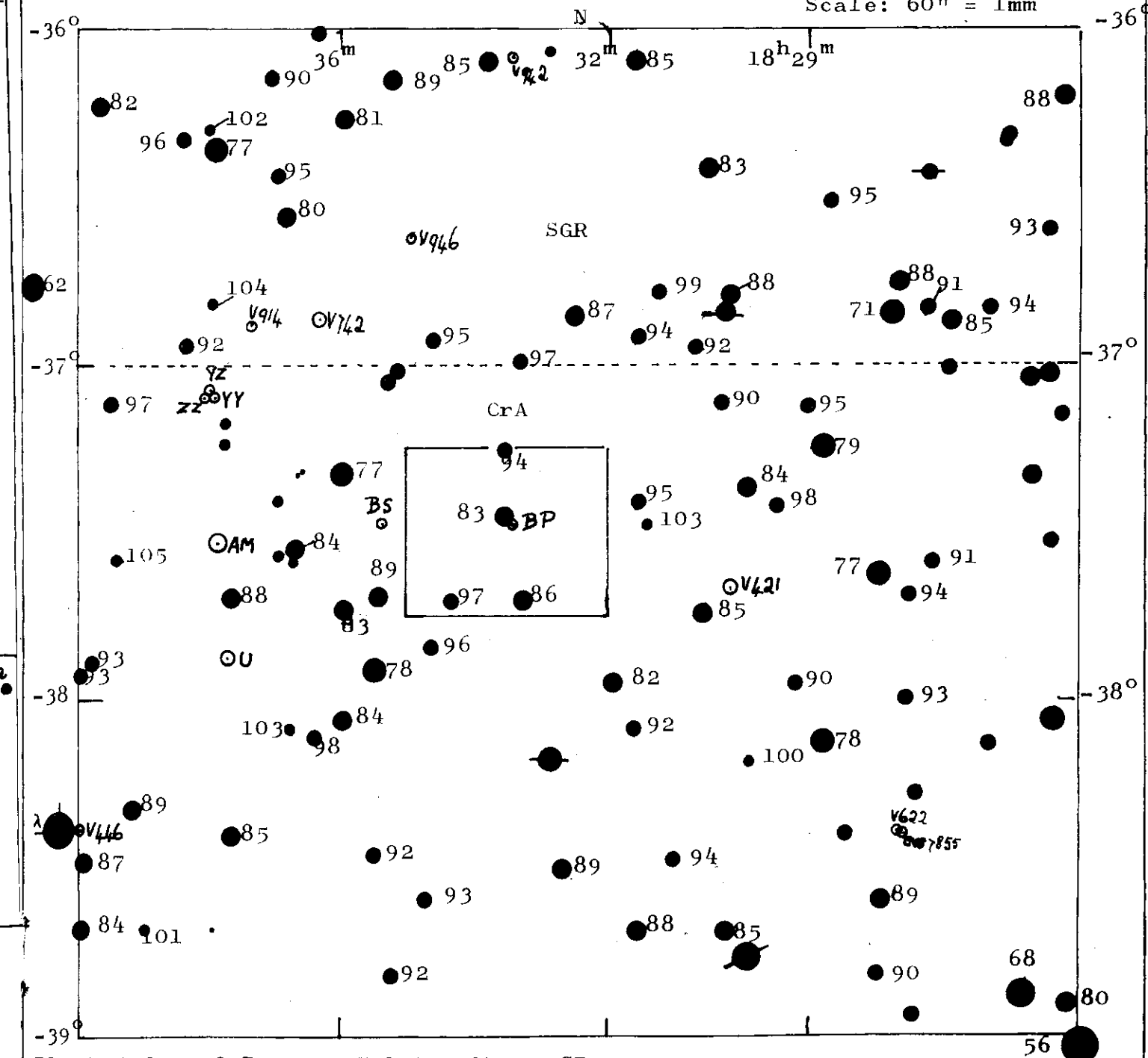
Z Cam? 14.1 - 15.6p (13.5^d).

Also shown: V742; V914; V942; V946 Sgr.

U; YY; YZ; ZZ; AM; BS; V421; V446; V622 CrA.

CVS 7855.

Scale: 60" = 1mm

Plotted from C.P.C. by F.M.B. Mags. SP_v

FINDER CHART: ATLAS AUSTRALIS X.

This field contains numerous faint variables; the positions of only the brightest plotted & charts for these will appear later.

EPOCH: 1950

FMB Aug.1, 1976

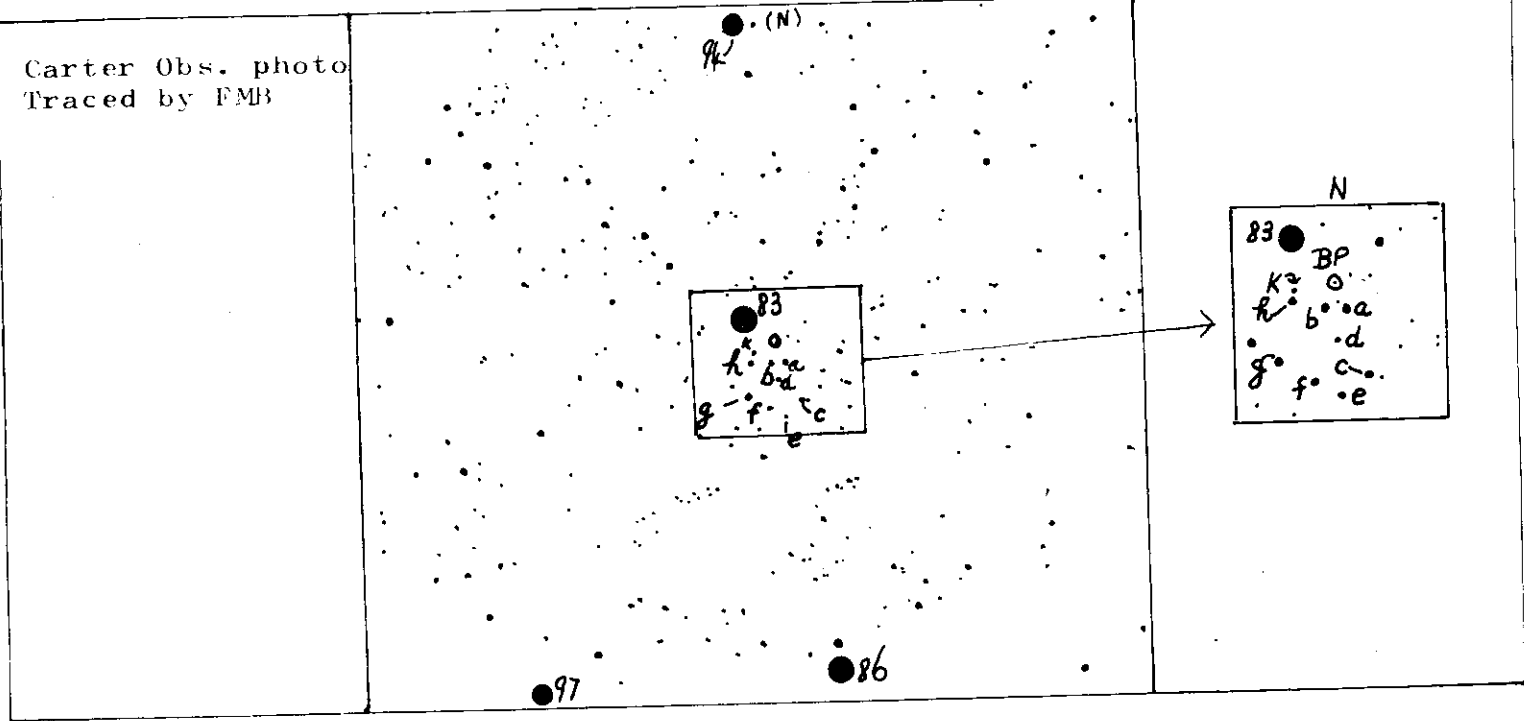
183037 BP CORONAE AUSTRIINAE.

(1900): 18h 30m 02s -37° 30.6

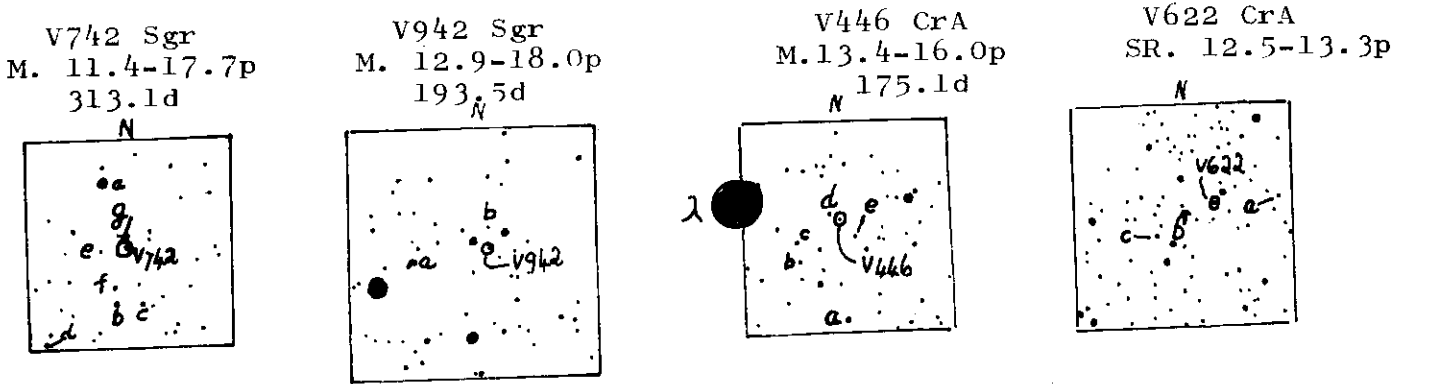
(1950): 18 33 26 -37 28.3 (See also chart 378)

Z Cam? 14.1 - 15.6p (13.5^d)

Scale: 20" = 1mm



FINDING CHARTS FOR SOME VARIABLES SHOWN ON CHART 378.



(1900): 18h32m56s-36°53.9. 18h30m04s-36°06.9 18h36m29s-38°25.7. 18h24m14s-38°25.4
(1950): 18 36 19 -36 51.5 18 33 26 -36 04.6 18 39 55 -38 22.9 18 27 40 -38 23.5

THE DWARF NOVA, MU CENTAURI

By Frank M. Bateson.

SUMMARY: A light curve of MU Cen covering the interval J.D. 2,434,887 to 2,442,850 shows 132 observed outbursts. The mean cycle is 44.9 days. Mean magnitude at maximum is 12.61_v. Outbursts are divided into three main types, which are illustrated and mean magnitudes at one day phases tabulated.

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INTRODUCTION: MU Cen was discussed by Bateson and Jones (1970) on the basis of step estimates assigned to the comparison stars. They tabulated 102 maxima during the interval J.D. 2,434,887 to 2,440,038, from which they found a mean cycle of 42.3 days.

The publication of a reliable photoelectric sequence by B. Warner (1976) has enabled the observations to be rediscussed on a more reliable basis. The interval covered by the following discussion is J.D. 2,434,887 to 2,442,850.

OBSERVATIONS: The light curve, from daily means, appears in Figure 1. Until 2,441,499 the number of observations in each mean was one or two. After that date observations were more numerous. The light curve shows that for much of the time MU Cen was well below the threshold of the instruments used. As a **result** nothing can be said on behaviour at minimum.

DISCUSSION: The observed maxima are listed in Table 1, where the first column gives the number assigned to each maximum. The second column shows the type of maximum, in accordance with the details given later in this paper. Successive columns then list for each maximum the observed date, visual magnitude, interval, in days, between successive maxima and the weight assigned to the date determined on the usual scale of 1 (poor) to 5 (good). Remarks appear in the final column and are mainly concerned in giving possible dates of maxima that were not observed.

The intervals in the fifth column are enclosed in brackets where it appears that gaps in the observations caused a maximum to be missed. Such gaps generally correspond to the times during which the variable was badly placed for observation. Some of the dates previously determined by Bateson & Jones (1970) have been amended.

A mean cycle between successive outbursts of 44.9 days is found from Table 1, omitting the intervals enclosed in brackets. Magnitudes at maxima are shown against epoch in Figure 2, and the distribution in maximum magnitude appears in Figure 3. Magnitudes at maxima range from 11.8 to 13.3, with a mean of 12.61_v. The mean number of maxima in successive intervals of 1,000 days is 17.6, but they range from 13 to 23. This is merely a reflection of how closely MU Cen was observed in each interval.

All maxima that were reasonably well observed were plotted on a large scale. The magnitude at one day intervals was read off from these curves. These magnitudes for each type of light curve were tabulated and the means taken, from which the mean light curves for each type were formed. These are illustrated in Figure 4 and shown in Table 2. In that table the first column, for each type, gives the phase, referred to maximum as the zero point, and the second column the corresponding magnitude read off the mean light curve for one day intervals. These mean curves were used to determine the type for those maxima not adequately observed.

It will be seen from Figure 1 that only the tops of the outbursts are observed. These are of short duration and therefore any classification of maxima into separate types is dependent on small segments of the light curve. However, when these segments are plotted on a large scale it is apparent that not all maxima are alike, either in their rates of rise and fall, or in the time during which MU Cen is brighter than magnitude 13.5.

Maxima were classified into three main types, A, B and C, each with sub-divisions. Type A are maxima that have a rounded appearance because the variable remains close to maximum brightness for a few days. The rise and fall rates for this type are either much the same, or the rate of rise is faster than that of the fall. The most rounded maxima are classed as A1, for the brightest, and A2 for the faintest. A3 and A4 represent those maxima whose rounded appearance is not quite so pronounced; A4 being those with maximum brightness distinctly fainter than type A3.

Type B maxima have sharp, pointed peaks and a faster rate of rise than fall. B1 represents those with brighter maximum magnitudes whilst B2 have fainter magnitudes at maxima. The rate of rise for B1 and B2 is almost the same, but B2 decline at a much slower rate compared to type B1.

Types C1 (bright) and C2 (faint) represent maxima where the fall is very much faster than the rise.

In the second column of Table 1 a question mark indicates those maxima which, either could not be definitely assigned to any particular type, or for which there is some doubt about the class shown.

Below are tabulated the main features for each class. The type appears in the first column; the second column gives the number of maxima which can be definitely assigned to each type. The third and fourth columns respectively give the rate of rise and fall per 1.0 days. The final column gives the width, in days, at phase 13.5I-D.

TYPE.	No.	RISE RATE PER 1. ^d 0	FALL RATE PER 1. ^d 0	WIDTH AT 13.5I-D.
		^m	^m	^d
A1	2	0.22	0.17	11.2
A2	13	0.12	0.11	11.3
A3	11	0.16	0.16	13.7
A4	9	0.20	0.19	7.9
B1	17	0.24	0.22	11.1
B2	17	0.23	0.12	8.7
C1	4	0.16	0.46	10.5
C2	3	0.19	0.25	7.0

Of the 132 maxima observed, 56 could either not be assigned to a definite type or their type was subject to some doubt. Three of these (Nos 10; 95 and 124) show fluctuations in the form of "dips" in brightness either before or after maximum was reached without declining to minimum. They may represent separate maxima superimposed on one another, or are prolonged maxima with distinct fluctuations.

CONCLUSIONS: MU Cen has a mean cycle of 44.9 days between successive outbursts, during which it is brighter than magnitude 13.5v for 7 to 13.7 days. In this respect it differs from U Gem variables having shorter mean cycles. Magnitudes at maxima range from 11.8v to 13.3v with a mean of 12.61_v.

Maxima are of three main types, for two of which the rate of rise is equal to, or faster, than the rate of fall. For the

third type MU Cen declines at a faster rate than it rises. There is some evidence to show that the star has a standstill at an intermediate magnitude, but this is close to the limits of most instruments used so no definite conclusion could be reached concerning standstills. Within the limitations of visual observing there are only three maxima during which fluctuations appear to occur around maxima.

At minima MU Cen is below 14.5 and well below the threshold of the instruments used. There appears to be no relationship between the different parameters derived from the light curve such as have been found for other U Gem variables.

ACKNOWLEDGEMENTS: I am indebted to B. Warner for determining a reliable sequence for this star. This paper has been prepared under a grant from the Carter Observatory Board.

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Warner, B. 1976. Pub. 4, V.S.S., R.A.S.N.Z.

TABLE 1.

OBSERVED MAXIMA OF MU CENTAURI.

<u>No.</u>	<u>TYPE.</u>	<u>J.D.</u>	<u>MAG_v</u>	<u>INT_d</u>	<u>Wt.</u>	<u>REMARKS.</u>
1	A1	2,434,952	12.2	...	4	
2	B1	2,435,070	12.4?	(118)	3	Possible max. around 990.
3	B1	113	12.2	43	4	
4	C1	160	12.4	47	3	
5	B1	207	12.0	47	3	
6	C1	248	12.6	41	4	
7	C1	297	12.2	49	4	
8	B2	338?	12.5?	41	1	
9	A3	428	12.5	(90)	2	
10	?	477	12.6	49	5	Distinct fluctuations at max.
11	A3	535?	11.9	58	2	
12	A2	586	12.7	51	3	
13	A2	628	12.8	42	2	
14	A2	672?	12.8?	44	2	
15	B2	714	12.9	42	1	Possible max. around 704.
16	A3	764	12.5	50	1	
17	A2?	810	12.6	46	2	
18	A4	859	12.6	49	1	
19	B1	907	12.0	48	1	
20	C2	955	12.6	48	2	
21	C2	991	12.8	36	5	
22	A3	2,436,034	12.4?	43	3	
23	B2	067?	12.7?	33	1	
24	?	114?	12.2	47	1	
25	A2?	154?	13.0	40	1	
26	B1	199	11.9	45	3	
27	A2	280	12.6	(81)	3	Possible max. around 240.
28	B2	324	12.8	44	4	
29	A2	372	12.6	48	5	
30	B2	417	12.8	45	2	
31	A4	460	12.6	43	1	
32	A3	547	12.1	(87)	3	
33	B2	587	12.8	40	4	
34	B2	623	12.6?	36	3	

TABLE 1 (cont). OBSERVED MAXIMA OF MU CENTAURI.

No.	TYPE.	J.D.	MAG _v	INT _d	Wt.	REMARKS.
35	A2	2,436,662?	13.2?	39	2	
36	B2	694?	12.6?	32	2	
37	A2	726	12.8	32	1	
38	B1?	772	12.3?	46	1	
39	B2?	805	12.9	33	1	
40	A2?	841	12.7	36	1	
41	B2?	879?	12.9?	38	1	
42	B2?	950?	12.7?	(71)	1	Possible max. around 916
43	A1	2,437,006?	12.4	56	2	
44	?	050?	12.8?	44	1	Possible max. around 030
45	B2	084	12.8	34	1	
46	B2	133	12.6	49	5	
47	?	220?	12.0?	(87)	1	
48	B1	290	12.4	(70)	3	
49	?	336	13.0?	46	1	
50	A3	376	12.4	40	3	
51	A3	470	12.4	(94)	3	
52	?	515?	12.6?	45	1	
53	B1	622	12.0	(107)	2	
54	A2?	658	12.8	36	1	
55	?	701	12.7	43	2	
56	B2?	742	12.8	41	1	
57	B1	779	12.2	37	2	
58	B2	839	13.1	(60)	2	Possible max around 812.
59	A4?	880	12.6	41	1	
60	A3?	970	12.3	(90)	1	
61	B1	2,438,049	12.1	(79)	3	
62	A4	087	12.8	38	2	
63	B1?	122	12.2	35	3	
64	B4?	154	12.9	32	2	
65	B1	193	12.4	39	3	
66	?	227?	13.0?	34	1	
67	?	270?	12.6?	43	1	
68	A3	360	12.5	(90)	2	Possible max. around 310.
69	A3	413	12.4	53	2	
70	B1?	482	12.4	69	1	
71	?	516?	12.6	34	1	
72	A4	550	12.8	34	2	
73	A4?	584?	12.7	34	1	
74	B1	705	12.4	(121)	1	
75	B1?	757	12.4	52	2	
76	A3?	792	12.5	35	3	
77	B2	843	12.6	51	1	
78	B2	903	12.6	60	2	
79	A2	939	12.8	36	2	
80	A4	2,439,100	12.6	(161)	1	Possible max. around 060.
81	A4?	148?	13.0?	48	1	
82	?	186	12.3	38	1	
83	B2	229	12.8	43	2	
84	A2	264	12.8	35	3	
85	?	299	12.9	35	1	
86	A2	347	12.7	48	2	
87	?	393?	12.6?	46	1	
88	?	463?	12.7?	(70)	1	
89	?	546?	12.9?	(83)	1	Possible max. around 492
90	B4?	605	13.0	59	1	
91	A4	646	12.8	41	2	
92	A4	687	12.7	41	2	
93	?	768?	12.7?	(81)	1	
94	A4	829	12.8	61	2	

TABLE 1 (cont). OBSERVED MAXIMA OF MU CENTAURI.

<u>No.</u>	<u>TYPE.</u>	<u>J.D.</u>	<u>MAG_v</u>	<u>INT_d</u>	<u>Wt.</u>	<u>REMARKS.</u>
95	?	2,439,895	12.2	66	4	Fluctuations after max.
96	?	949?	12.8?	54	1	
97	B1	987	12.3	38	3	
98	B2	2,440,024	12.9	37	2	
99	A4?	068	12.7	44	2	
100	?	124?	12.9?	56	1	
101	?	258	13.1?	(134)	1	
102	C2	297	13.1	39	3	Minor peak at 292 followed by decrease.
103	B1?	366	12.2	69	1	
104	?	418?	12.9?	52	1	
105	?	530?	12.8?	(112)	1	
106	?	572	12.7?	42	1	
107	A4?	617?	13.2?	45	1	
108	C1	713	11.9	(96)	5	
109	B2?	760	13.0?	47	1	
110	B2?	917	13.0	(157)	1	
111	B1	975	12.3	58	2	
112	A3	2,441,065	12.2	(90)	5	
113	B4?	125	12.8	60	2	
114	B2	185	12.7	60	1	
115	?	314	12.8	(129)	1	
116	?	376	12.8	62	1	
117	A3	427	12.4	51	3	
118	A4	503	12.8	(76)	5	
119	A2	546	12.8	43	2	
120	B3?	681	12.5	(135)	1	
121	A3?	732	12.5	51	3	
122	B1	781	12.3	49	5	
123	?	902	12.9	(121)	1	
124	?	2,442,073	13.0	(171)	2	Possible max. around 028. Minor peaks at 064 & 080.
125	B1	135	12.4	62	5	
126	?	176?	13.0?	41	1	
127	A2	212	13.3	36	5	
128	A2	454	12.8	(242)	5	Possible max around 312; 352 & 396.
129	?	498?	13.0?	44	1	
130	B2	594?	13.0?	(96)	1	
131	B1	643	12.2	49	3	
132	B1	837	11.8	(194)	5	Possible max. around 770.

TABLE 2. MU CENTAURI---MEAN LIGHT CURVES.

<u>PHASE_d</u>	<u>MAG_v</u>	<u>PHASE_d</u>	<u>MAG_v</u>	<u>PHASE_d</u>	<u>MAG_v</u>
A1		A2		A3	
-5	13.90	-5	13.43	-5	13.12
-4	13.17	-4	13.18	-4	12.91
-3	12.75	-3	13.19	-3	12.75
-2	12.47	-2	13.00	-2	12.58
-1	12.35	-1	12.89	-1	12.50
0	12.30	0	12.83	0	12.34
+1	12.31	+1	12.86	+1	12.39
+2	12.38	+2	12.94	+2	12.49
+3	12.45	+3	13.10	+3	12.68
+4	12.56	+4	13.14	+4	12.86
+5	12.79	+5	13.36	+5	12.93
+6	13.30	+6	13.51	+6	13.28

TABLE 2 (cont). MU CENTAURI--MEAN LIGHT CURVES.

<u>PHASE</u> <u>d</u>	<u>MAG_v</u>	<u>PHASE</u> <u>d</u>	<u>MAG_v</u>	<u>PHASE</u> <u>d</u>	<u>MAG_v</u>
A4		B2		C1	
-3	13.35	-4	13.90	-5	13.08
-2	13.17	-3	13.38	-4	13.01
-1	12.83	-2	13.37	-3	12.71
0	12.74	-1	12.94	-2	12.53
+1	12.80	0	12.77	-1	12.46
+2	12.97	+1	12.87	0	12.27
+3	13.19	+2	12.96	+1	12.59
+4	13.51	+3	13.17	+2	12.91
+5	13.67	+4	13.40	+3	13.26
		+5	13.38	+4	13.64
		+6	13.45	+5	14.56
B1				C2	
-5	13.39			-5	13.80
-4	13.28			-4	13.53
-3	12.99			-3	13.31
-2	12.69			-2	13.06
-1	12.40			-1	12.93
0	12.17			0	12.84
+1	12.35			+1	12.94
+2	12.59			+2	13.16
+3	12.84			+3	13.52
+4	13.06			+4	13.83
+5	13.29			+5	14.08
+6	13.51				

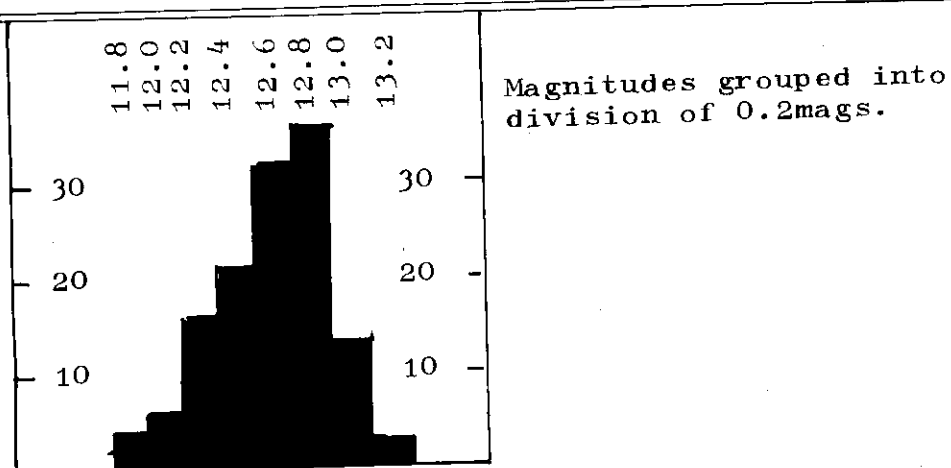
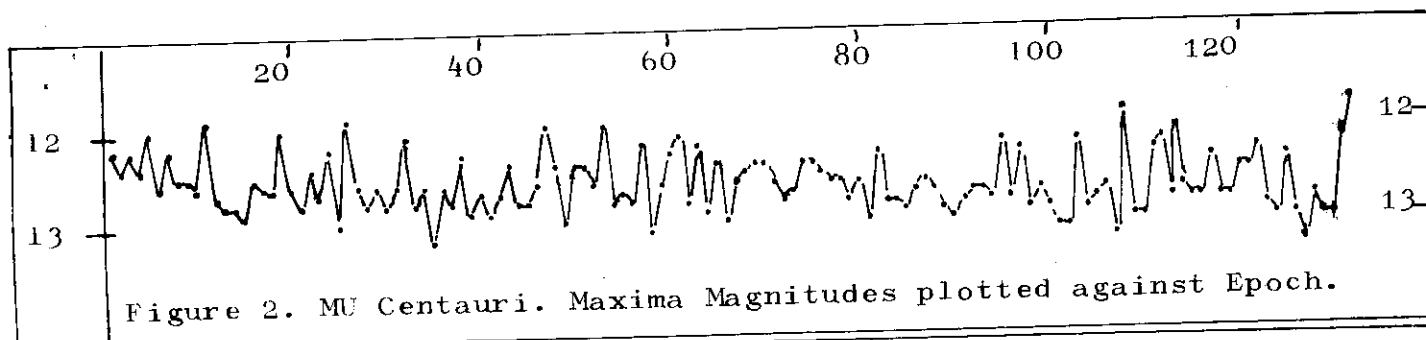
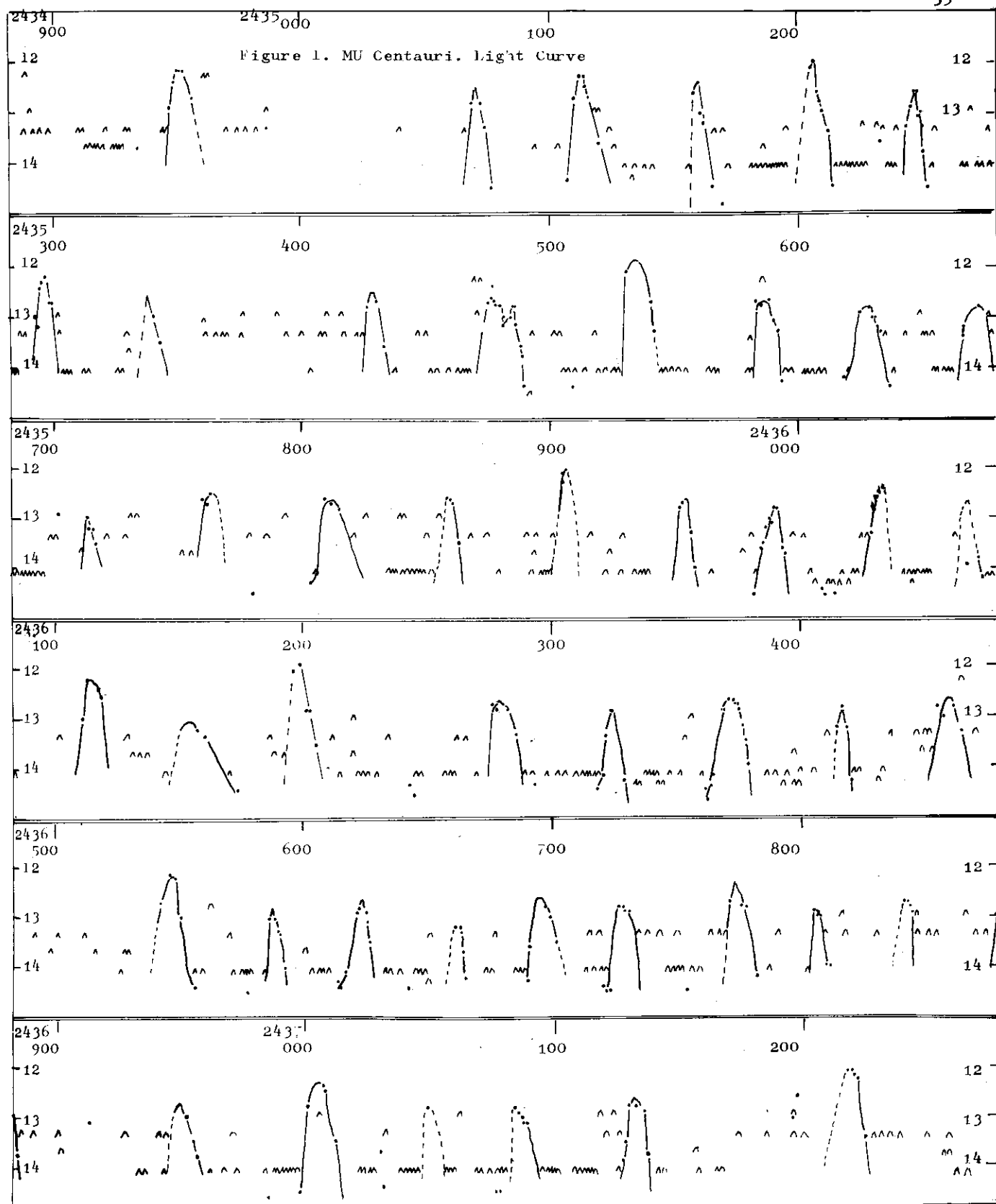
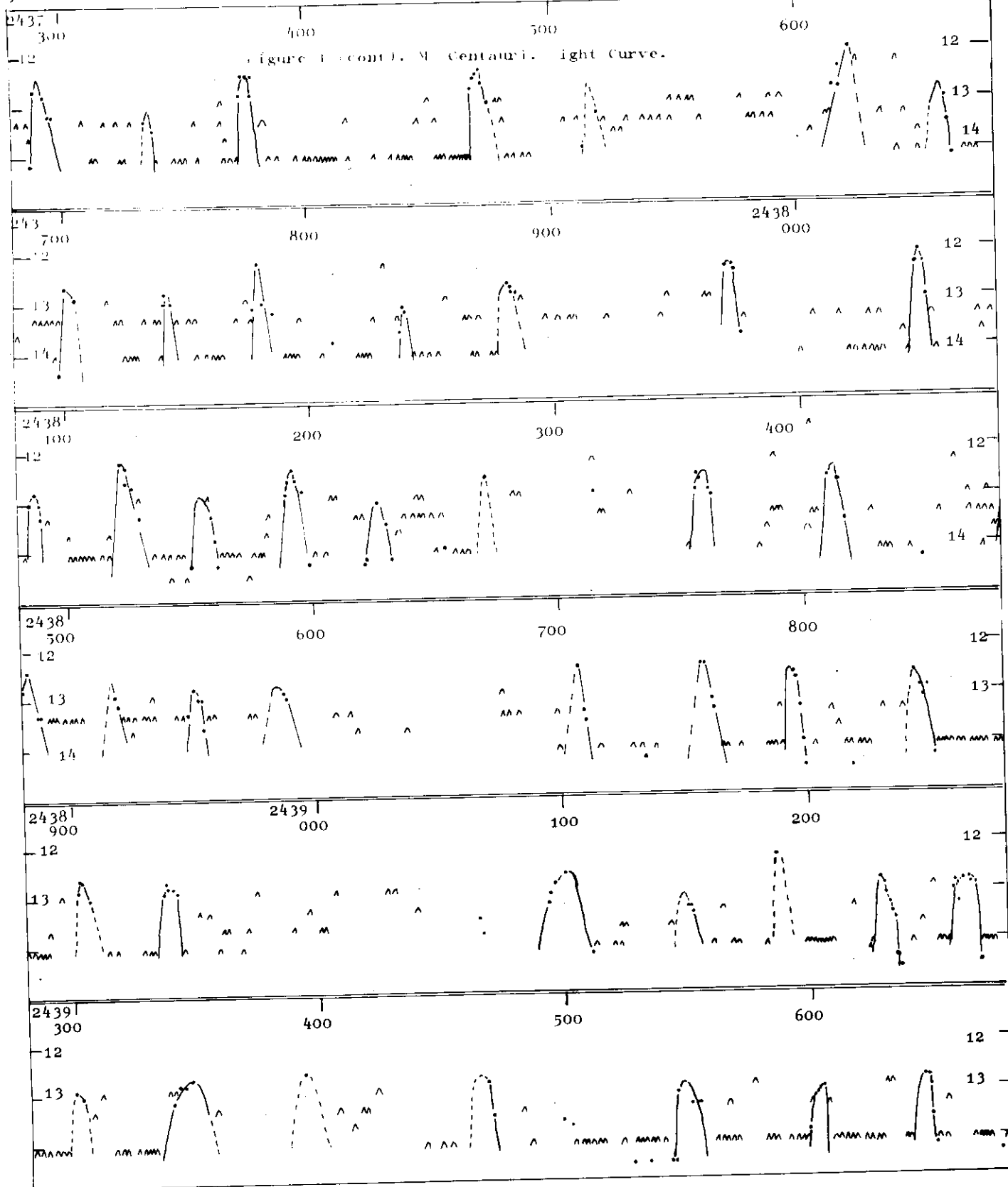
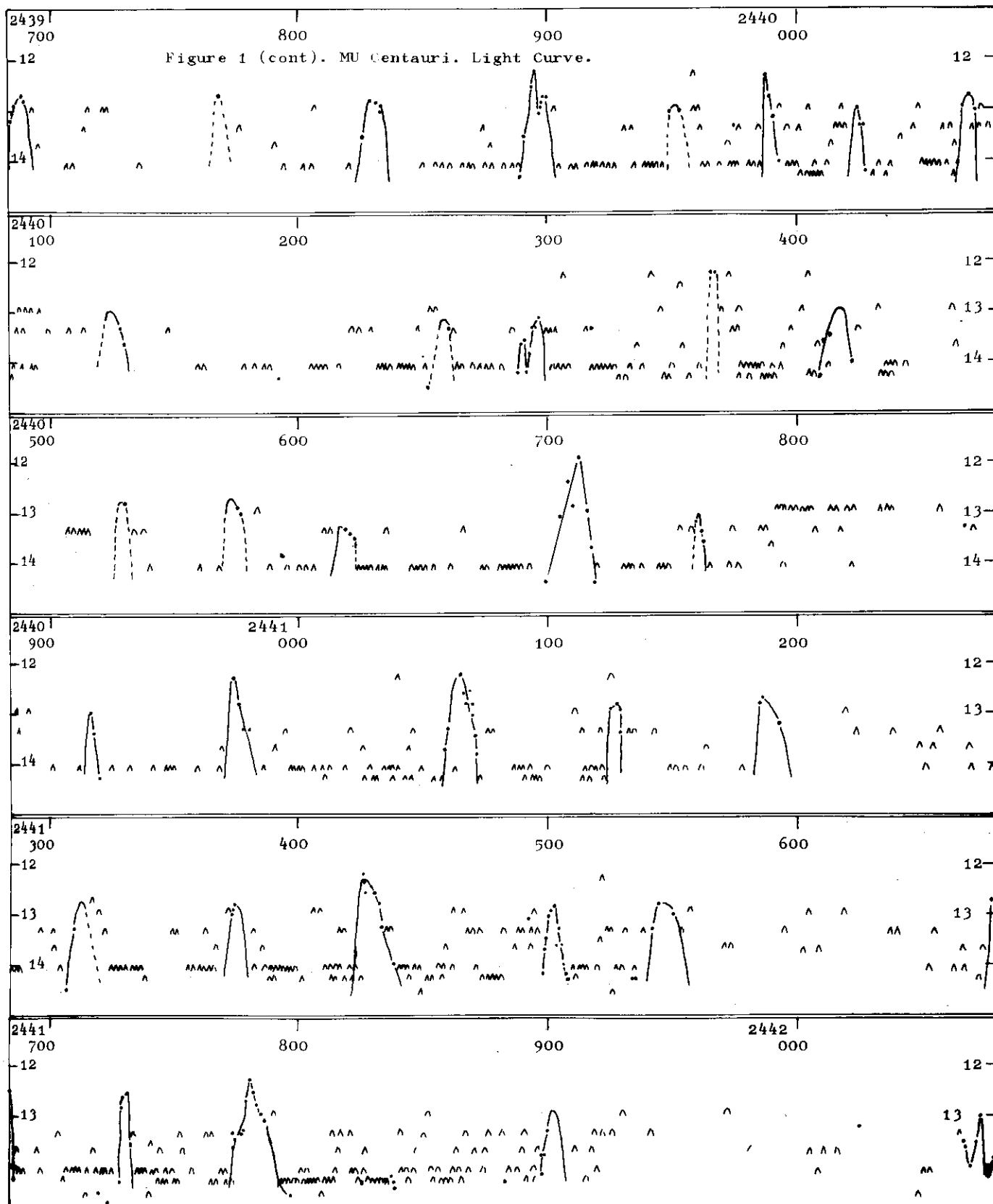
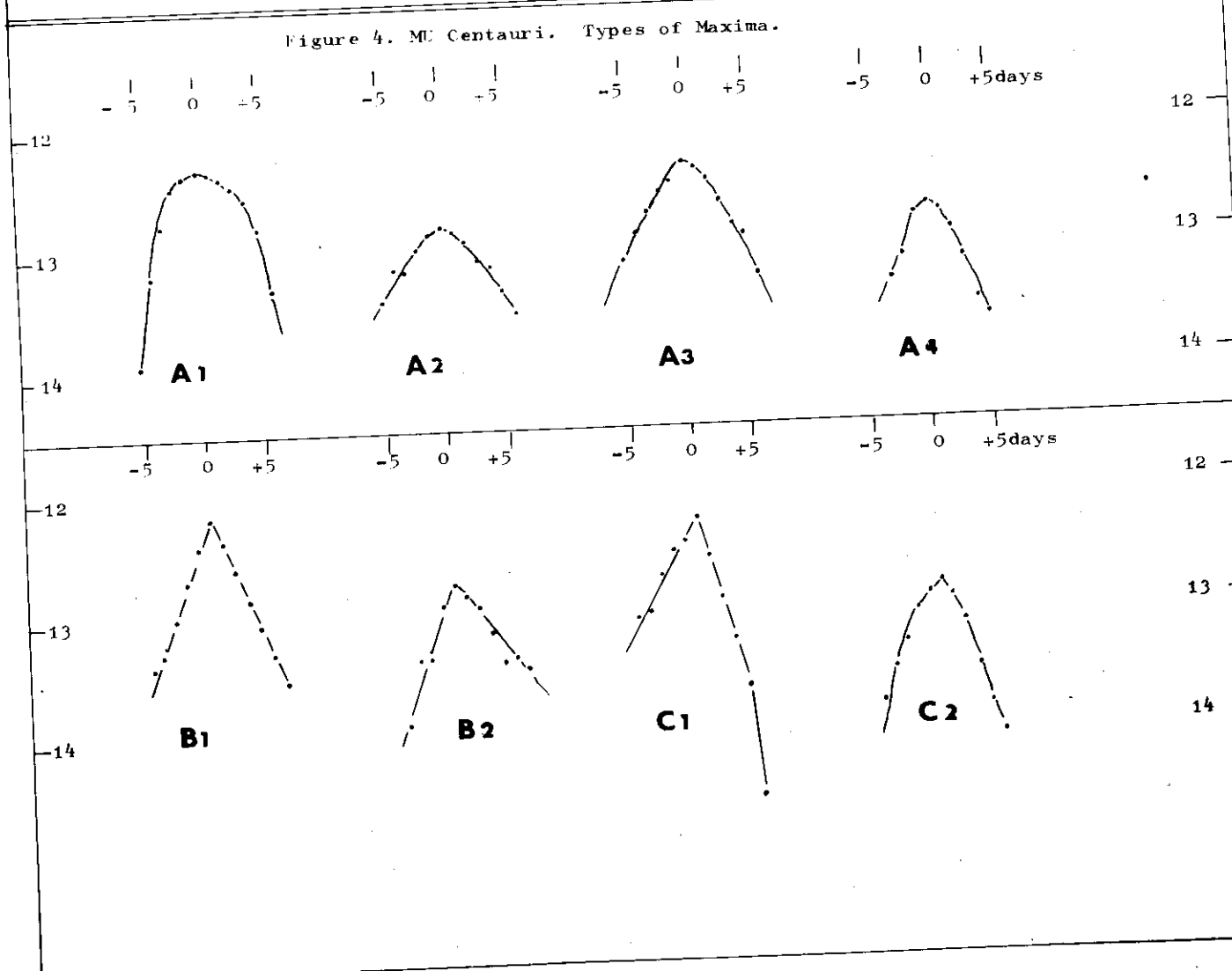
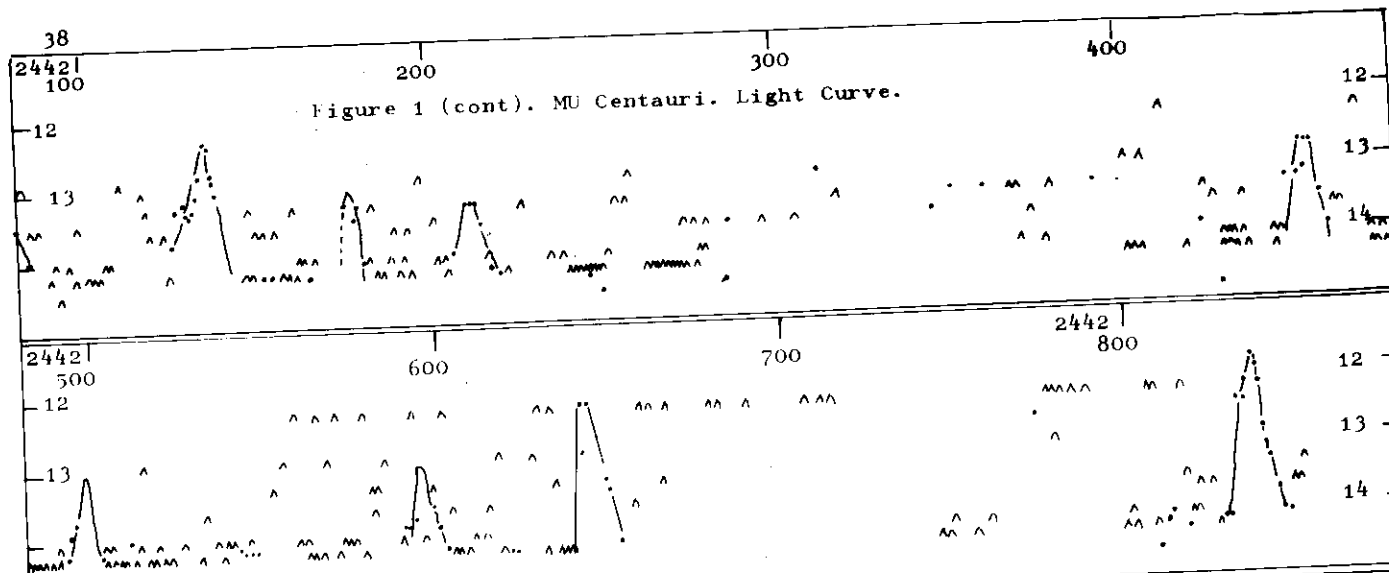


Figure 3. MU Centauri. Frequency of Magnitudes at Maxima.









THE DWARF NOVA EK TRIANGULI AUSTRALIS.

By Frank M. Bateson

SUMMARY: A chart and sequence of comparison stars with V and B magnitudes are given. Positive observations of EK TrA are tabulated for the interval J.D. 2,434,981 to 2,442,900. Thirty-five outbursts were observed and these were distributed at random. Outbursts are classified into two main types, broad and narrow. Activity is greater in some years than in others, and, in this respect resembles the Z Cam stars, although differing from them in having no short cycle when active and in its larger range of 10.4_v to (15.0_v) .

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INTRODUCTION:

EK TrA has a range of 11.9 to (17ptg according to Kukarkin, et al (1971) and is assigned to the U Gem class. It is identical with CSV 2282 and Sonneberg Variable 5005.

CHARTS AND SEQUENCE:

An identification chart appeared in MVS 318. Brun and Petit (1957) published a chart without a sequence. Charts 97 and 98 were published by Bateson, et al, (1966) and had comparison stars identified by chart letters. These included five of the seven comparison stars originally selected by A.F. Jones --- one was not measurable and was discarded, while a second star could not be identified from the original field sketch.

The remaining five stars, and an additional three stars at the brighter end of the sequence, were measured photoelectrically in 1959 at Mount Stromlo Observatory and reduced to the Johnson-Morgan system. A further six stars were added photographically, being measured in an Iris diaphragm using plates taken with the Uppsala Schmidt and Zeiss Oddie telescopes. Four Uppsala and two Oddie plates were measured to obtain visual magnitudes, and four Uppsala plates to obtain blue magnitudes. The emulsions used were Eastman Kodak 103aD and 11 a0. The already obtained photoelectric magnitudes for seven stars were used for reductions.

Star "s" could not be resolved on any of the plates, and was not used for reductions. Stars "f" and "z" were too faint to measure on the 11 a0 plates, and colours are therefore not available for these two stars. The comparison stars, identified by the letters shown on chart 98 are listed below together with their magnitudes on the Johnson Morgan system as determined at Mount Stromlo.

COMPARISON STARS.

<u>CHART LETTER</u>	<u>V_{JM}</u>	<u>B-V_{JM}</u>	<u>No. of Obs.</u>	<u>REMARKS.</u>
a	8.58	+0.61	7	Standard star
g	8.94	+1.65		Photographic
d	9.76	+0.91		Photographic
b	10.14	+1.81	2	
c	10.50	+0.11	2	
m	11.12	+1.92	7	Standard star
n	11.72	+0.39	4	
p	12.16	+0.49	4	
s	12.58	+1.24	4	
h	12.86	+0.82		Photographic
t	13.16	+1.20	4	
e	13.64	+0.40		Photographic
f	13.90	...		Extrapolated
z	14.19	...		Extrapolated

Of the remaining stars "u" was not identified; "x" was not measured and "w" was not measurable and was discarded. "w" is probably variable and will be the subject of a paper in a later issue of these Publications.

The photographic plates with the Zeiss-Oddie camera were taken by K. Gottlieb and those with the Uppsala-Schmidt by Bart J. Bok, who also did the photoelectric observing with the 1.88m reflector. Reductions were done by P. Fairfield-Bok and the photographic measurements by J. Basinski. The resultant chart is reproduced as Figure 1.

OBSERVATIONS:

EK TrA was first observed on J.D. 2,434,981 (1954 Aug. 26) and the observations to 2,439,672 were mainly made by A.F. Jones, supplemented by those from F.M. Bateson. After that date the star has been followed by a number of observers.

During the interval 2,434,981 to 2,442,900 (1976 May 1) a total of 4,897 observations have been made, of which the majority were negative with the variable invisible. Observations to 2,439,672 have been published in the Circulars of the Section, but these along with the later observations are included in the discussion in this paper.

Table 1 gives the daily means for the times when EK TrA was visible together with the negative observations immediately preceding and following the positive observations. The first column of this table gives the mean J.D.; the second the mean visual magnitude and the third column the number of observations in each mean. A question mark after an observation indicates that the observer considered the estimate doubtful, usually because the star was either at a low altitude or because of poor seeing.

EK TrA is circumpolar and has been observed in all months, but the number of nights without an observation is greatest in the months October to March because of the less favourable position of the star and the shorter summer nights.

DISCUSSION:

All positive observations were plotted on a large scale from which the dates of maxima were determined. These are listed in Table 2, where the first column gives a consecutive number to each maximum. The second column gives the type to which each maximum was assigned in accordance with the divisions explained later. Successive columns then give for each maximum, the J.D.; visual magnitude; interval between successive maxima, in days; weight given to the date determined on the usual scale of 1 (poor) to 5 (good); the width at phase 13.0I-D. Remarks appear in the final column, where possible maxima dependent on single observations are indicated. In column 4 if the magnitude at maxima probably exceeded the value shown the magnitude is followed by a plus sign.

Some observations suggest that a number of maxima below 13.5 took place. These have been excluded from Table 2 as there is considerable doubt whether these should be regarded as true outbursts.

Magnitudes at maxima range from 10.4_v to 13.0_v. Intervals between successive maxima show a large spread with a mean of 231 days. This value has little meaning since the distribution of the intervals appear to be random with every indication that the variable is more active in some years than in others. The number of maxima in successive intervals of 1000 days range from 2 to 8.

Before investigating any variation in activity from year to year a study was made of the best determined maxima. It was found that these fell into two distinct types according to their widths at phase

13.0I-D. Type A have widths of less than 2.5 days with a steep rise and fall; the latter being slightly less steep than the rise. Type B have widths greater than 6 days and usually exceed 10 days. The fall for this type is much less steep than the rise.

Type A were sub-divided into A1, when the maximum magnitude was brighter than 11.5, and A2, where it was fainter than 11.5. The subdivisions for type B are: B1, with widths greater than 10 days and maxima magnitudes of 11.0, or brighter; B2, with widths from 6 to 10.5 days and maxima of 10.9, or fainter; B3, with widths exceeding 13 days and maxima brighter than 11.0. Type B3 also has a pronounced shoulder on the declining branch, about half a magnitude below maximum. Those maxima in Table 2 which cannot definitely be assigned to a type are probably either A1 or A2. There appears to be no types that are intermediate between A and B.

The light curves derived from the best observed maxima are given in Table 4, and shown graphically in Figure 2. The first column of Table 4 gives the phase at half day intervals for types A1 and A2, and at daily intervals for the remaining types. Zero phase in each case being maximum. The second column gives the mean magnitude at each phase.

Maxima of type A are three times as numerous as those of type B, assuming that those not definitely assigned to a type are actually of type A. Type B maxima occur at intervals of from 579 to 1,540 days, with a mean of 904 days. This merely indicates that they occur at long intervals without displaying the semi-periodic nature found for supermaxima in U Gem variables with short mean cycles.

The distribution of the observations is shown in Table 3 for each whole year during which observations were made. The year is shown in the first column, with the number of outbursts in the second column arranged in accordance with the types assigned in Table 2. The third and fourth columns give respectively the total observations for each year and the number of nights on which observations were made. The final column lists the number of times each year in which gaps of six successive nights, or more, occurred without observations.

Table 3 shows that there appear to be differences in the level of activity as between one year and another. This view is supported when the outbursts recorded are compared to the number of nights on which observations are made each year and to the gaps of 6 days or longer in the records. All gaps of 10 days or longer occurred in either December or January.

It is probably entirely fortuitous whether the very short type A maxima are observed since a gap of two or three days would result in at least some of these being missed. However, with the longer durations of type B maxima, which presumably have greater energy, their distribution does appear to indicate that the star is more active at some times than at other times.

The positive observations included in Table 1, when EK TrA is below magnitude 13.0 and not undergoing an outburst suggest that the star fluctuates above minimum brightness. Although the evidence is far from conclusive it does suggest that possibly EK TrA in some respects resembles Z Cam stars in having erratic fluctuations at an intermediate magnitude. There is also a resemblance to the Z Cam variables in the apparent varying level of activity. However, EK TrA does not resemble the Z Cam stars in its range or in having

intervals during which a short mean cycle is evident.

CONCLUSIONS:

EK TrA is of U Gem type with an extreme visual range of 10.4 to fainter than 15.0. Outbursts are either narrow or broad with no evidence for any intermediate type. Outbursts appear to occur at random intervals, despite the probability that some narrow maxima have not been observed. Broad and narrow maxima do not alternate.

The star undergoes intervals of comparative inactivity, and there is some evidence indicating that it also fluctuates at times at an intermediate magnitude. In these respects it shows features normally associated with Z Cam variables, but does not exhibit their other features. EK TrA requires more observations with instruments capable of studying it at minimum.

ACKNOWLEDGEMENTS:

I have to thank Bart J. Bok for his assistance in arranging to determine the reliable sequence and to K. Gottlieb, P. Fairfield-Bok and J. Basinski for their work on the sequence stars. I thank A.C. Gilmore for supplying the photo of EK TrA field which he took at the Carter Observatory.

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TABLE 1. EK TRIANGULI AUSTRALIS --DAILY MEANS OF POSITIVE OBSERVATIONS.

J.D.	MAG.	No.	J.D.	MAG.	No.	J.D.	MAG	No.
2435000+			2435000+			2435000+		
015.99	(12.6	1	220.85	12.5	1	547.95	(13.9	1
033.95	12.50	2	222.02	14.05	2	548.92	11.6	1
034.05	11.5	1	.84	(13.9	1	549.86	11.6	1
.91	11.67	4				550.22	12.8	1
035.86	12.6	1	251.96	(13.9	1	551.97	(13.2	1
037.15	(13.8	1	252.83	14.4?	1			
			254.87	(13.8	1	585.22	(13.9	1
195.85	(12.2	1				588.25	13.5	1
205.02	12.6?	1	305.81	(13.9	1	590.86	(12.6	1
.91	(12.2	1	306.80	(12.6	1	591.82	(13.2	1
206.93	(12.6	1	.98	13.10	2			
207.81	(13.2	1	311.27	13.7	1	689.26	(13.2	1
208.88	(12.6	1	312.24	(13.9	1	690.84	14.0?	1
209.89	11.12	4				692.99	(13.2	1
210.23	10.7	1	366.21	(12.6	1			
.98	10.4	1	91	13.8	1	771.95	(13.2	1
211.23	11.4	1	368.87	(13.9	1	779.92	13.0?	1
213.92	10.95	2				780.89	(13.7	1
214.90	11.2	1	402.97	(13.2	1	786.92	(13.2	1
216.85	11.90	2	403.89	11.70	2	789.94	10.6	1
218.02	11.90	3	404.14	11.90	2	790.96	11.45	2
220.06	12.23	3	.91	13.0	1	791.90	11.4	1
			407.93	(12.6	1	794.04	11.50	2
			408.16	(13.2	1	.89	11.5	1
						800.92	12.35	2
						804.09	(13.2	1

TABLE 1--EK TRIANGULI AUSTRALIS--DAILY MEANS (cont).

J.D.	MAG.	No.	J.D.	MAG.	No.	J.D.	MAG.	No.	J.D.	MAG.	No.
2436000+			2438000+			2439000+			2441000+		
145.16	(13.8	1	087.19	(13.6	1	694.81	12.2	1	560.89	(14.2	1
149.92	12.1	1	088.21	13.0	1	695.85	12.1	1	561.93	12.10	3
151.17	(12.2	1	089.19	12.2	1	698.94	13.9	1	562.91	12.60	3
152.90	(13.8	1	.92	12.5	1	700.96	(13.6	1	563.90	(14.2	1
			093.86	(13.2	1						
590.14	(13.2	1				831.93	(12.6	1	737.00	(14.2	1
592.15	11.5	1	207.95	(13.6	1	833.12	13.1	1	738.00	15.3	1
593.94	11.3	1	208.91	11.95	2	834.12	(13.6	1	.03	(13.2	1
594.92	11.3	1	209.88	12.30	2				739.06	(14.2	1
599.95	11.5	1	211.94	(13.6	1	917.97	(13.6	1	.18	15.3	1
600.94	12.0	1				918.09	14.8?	1	.98	(12.6	1
603.96	12.3	1	366.94	(13.2	1	.10	15.1	1	741.05	15.3	1
606.95	(13.2	1	369.99	11.0	1	.95	(13.6	1	.98	15.3	1
			370.91	11.1	1				742.05	(13.6	1
748.92	(13.8	1	379.02	12.8	1	972.90	(14.2	1			
750.92	12.9	1	380.12	13.9	1	.92	14.6	1	752.93	(12.6	1
751.01	13.2	1	382.11	(13.6	1	973.08	(14.2	1	754.03	15.0	1
.29	13.6	1							756.22	(13.2	1
751.90	(13.8	1	451.07	(11.7	1	2440000+			757.91	(12.6	1
			455.86	12.1	1	141.86	(13.6	1	758.18	(13.6	1
842.91	(13.2	1	458.90	(13.2	1	.86	15.1	1	759.17	14.7	1
844.21	13.5?	1				.87	14.0	1	762.91	14.8	1
.86	(13.2	1	537.22	(13.2	1	.88	14.0	1	763.94	(12.6	1
			541.79	11.7?	1	143.90	(13.6	1	764.97	(12.6	1
2,437,000+			542.80	(12.6	1				765.98	(13.2	1
452.87	(13.2	1				335.97	(14.2	1	766.20	14.7	1
454.94	11.60	2	594.92	(12.6	1	337.97	14.6	1	.98	(14.2	1
455.92	10.95	2	595.89	12.5	1	.99	(13.6	1			
456.96	11.05	2	596.21	12.5	1	338.20	(13.6	1	771.96	(13.2	1
457.27	11.0	1	602.79	(12.2	1				772.02	14.7	1
458.89	11.8	1				414.27	(13.2	1	.96	(14.0	1
460.07	12.00	2	728.92	(13.2	1	415.25	13.2	1			
461.05	12.05	2	733.13	12.8	1	.83	(13.6	1	778.92	(13.6	1
462.02	12.20	2	734.10	13.8	1				779.06	14.2	1
463.10	12.35	2	.95	(13.2	1	666.84	(12.6	1	.08	(14.2	1
464.08	12.45	2				673.88	11.30	2	.08	15.0	1
.96	13.65	2	854.92	(13.6	1	674.83	11.5	1	.96	(14.0	1
465.26	(13.6	1	855.92	13.8	1	675.98	(12.6	1			
.94	(13.6	1	856.91	12.5	1	677.92	(13.6	1	790.97	(12.6	1
467.97	(13.6	1	857.20	12.7	1				792.99	14.8	1
468.93	(13.6	1	858.93	(13.6	1	2441000+			793.12	14.8	1
469.94	13.3	1	2439000+			227.82	(11.7	1	.81	15.0	1
470.00	13.4	1	242.92	(13.6	1	229.85	12.05	2	.91	(13.6	1
.92	(13.6	1	245.81	13.8	1	233.20	12.0	1	794.91	(13.6	1
			248.21	(13.6	1	.83	12.0	1	795.95	(13.2	1
641.95	(13.6	1				234.84	12.1	1	.98	14.7	1
643.01	11.9	1	291.93	(13.6	1	236.96	13.5	1	796.83	14.7	1
.10	11.6	1	292.91	14.1?	1	237.89	(13.6	1	.91	(14.2	1
.98	12.4	1	294.88	(13.6	1						
644.10	13.4	1				319.99	(11.7	1	799.93	(14.5	1
.96	(13.2	1	497.94	(13.2	1	320.97	12.5	1	800.18	15.2	1
			501.14	11.7	1	323.95	(13.2	1	.87	15.3	1
727.12	(13.6	1	502.15	(13.2	1				801.88	14.75	2
728.19	13.9?	1	685.01	(13.6	1	453.98	(14.2	1	802.90	(13.2	1
729.95	(13.2	1	686.81	11.9	1	454.98	12.03	3	803.95	14.3	1
			687.19	11.80	2	455.84	12.8	1	804.90	(14.2	1
			.81	12.3	1	456.06	13.3	1	805.16	(13.6	1
			691.26	10.9	1	.94	(13.6	1	.90	(14.0	1
			693.79	12.1	1				807.11	(14.2	1
									.81	14.7	1

TABLE 1---EK TRIANGULI AUSTRALIS--DAILY MEANS (cont).

J.D.	MAG.	No.	J.D.	MAG.	No.	J.D.	MAG.	No.	J.D.	MAG.	No.
2441000+			2442000+			2442000+			2442000+		
807.93	13.9	1	067.14	(13.6	1	424.90	(12.6	1	623.93	(13.2	1
808.07	(14.2	1	.15	14.8	1	425.93	(13.2	1	624.24	13.2?	1
.81	(14.5	1	.91	(13.2	1				.94	(13.2	1
809.02	14.6	1	069.93	(13.2	1	445.94	(13.2	1	625.02	14.6	1
810.94	(14.2	1				447.94	10.9	1	.24	(12.6	1
811.98	(14.2	1	073.06	(14.0	1	448.89	11.1	1	626.05	(13.9	1
812.07	(13.6	1	074.03	14.20	2	452.01	11.7	1	.23	(12.9	1
.78	12.0?	1	076.00	13.90	2	.99	11.70	3	.94	(13.6	1
.92	(13.6	1	.92	(12.6	1	453.93	12.20	2	627.29	13.5?	1
813.09	(14.2	1	077.06	(13.2	1	454.96	11.70	2	628.23	13.1?	1
.23	(13.2	1				455.91	12.0	1	.92	(11.7	1
.92	12.20	2	079.00	(13.0	1	456.20	(12.2	1	629.35	(13.2	1
814.06	11.2	1	080.05	14.5	1	457.01	12.1	1	.96	(13.9	1
.91	11.75	6	081.13	14.60	2	458.98	(12.6	1			
815.15	12.25	2	.25	(13.9	1	459.23	13.7	1	635.96	(13.2	1
.22	12.40	2	083.98	13.6	1	461.00	(13.6	1	636.88	14.6	1
.88	13.2	1	085.91	(11.7	1				.91	(13.6	1
816.01	13.9	1	086.93	(12.2	1	510.94	(13.2	1	637.86	(13.9	1
.27	(13.2	1	087.97	13.50	2	511.84	14.3	1			
.88	(13.2	1	089.94	14.0	1	.90	(13.6	1	642.91	(13.6	1
817.23	(13.6	1	090.94	14.0	1	.99	(13.6	1	648.88	14.5	1
.79	14.1	1	092.03	(14.0	1	512.91	14.3	1	.90	(14.2	1
820.90	11.75	2	093.00	(14.5	1	513.84	(13.2	1	649.88	(13.9	1
821.93	11.82	4	094.00	(13.0	1						
823.91	11.90	4	095.08	14.8	1	520.96	(13.6	1	683.91	(13.2	1
824.88	12.10	3	096.00	(13.5	1	521.00	14.7	1	685.94	12.3	1
825.95	11.86	5	.99	(13.2	1	525.94	(14.2	1	686.21	(12.2	1
826.82	12.5	1	097.16	14.6	1	528.82	(12.6	1	688.20	(12.9	1
827.91	13.87	3	.98	12.60	4	531.90	(13.6	1	.95	(13.6	1
828.82	14.3	1	099.04	12.52	4	532.94	(13.2	1			
829.00	(14.2	1	.89	13.20	2	534.27	(13.2	1	809.06	(13.6	1
.94	13.9	1	102.93	(13.2	1	535.83	14.4	1	810.10	15.3	1
830.25	(13.6	1	103.10	(13.5	1	536.00	(13.5	1	811.10	(13.5	1
.96	14.5	1	.92	(13.2	1				.91	(13.2	1
831.89	(13.8	1	104.17	15.0	1	563.93	(14.2	1	812.10	(13.5	1
832.89	14.5	1	105.00	(13.6	1	564.24	(13.2	1	813.00	(13.6	1
833.94	(14.2	1	.98	(13.6	1	.84	14.8	1	.61	(13.6	1
834.97	(14.2	2	106.02	14.0	1	565.06	(12.2	1	815.00	15.3	1
835.84	14.8	1	107.89	(13.2	1	566.90	(13.6	1	818.00	(13.5	1
836.93	(13.2	1							819.04	14.7	1
837.87	14.9	1	124.95	(13.6	1	571.90	(13.6	1	820.00	(13.5	1
838.96	(12.6	1	125.09	14.9	1	572.07	14.5	1			
839.87	(13.6	1	127.10	(13.5	1	.96	(13.6	1	832.90	(13.2	1
840.85	14.25	2				573.00	14.6	1	834.99	14.5	1
841.94	(13.6	1	133.03	(14.2	1	.03	(13.8	1	835.90	(13.2	1
842.91	(13.8	1	.06	15.1	1	.92	(13.2	1			
843.03	14.8	1	.93	(13.2	1	574.95	(13.6	1	839.00	(13.5	1
.93	(13.6	1	134.16	14.5	1	575.92	(14.2	1	.97	(12.6	1
			.91	(13.6	1	579.02	(11.7	1	840.04	14.6	1
883.95	(13.6	1				.04	11.7?	1	.89	(13.2	1
884.91	13.9?	1	423.00	(13.8	1	579.95	(13.2	1	841.04	(14.2	1
887.82	(13.2	1	.98	(13.2	1	.96	(14.2	1			
			424.05	14.6	1						

TABLE 1--EK TRIANGULI AUSTRALIS--DAILY MEANS (cont).

J.D.	MAG.	No.	J.D.	MAG.	No.	J.D.	MAG.	No.
2442000+			2442000+			2442000+		
861.94	(13.2	1	872.01	(13.6	2	892.80	(13.6	1
862.60	12.9	1	.06	14.5	1	.96	14.6	1
.93	(13.3	1	.20	(13.6	1	893.20	(13.2	2
863.07	(11.7	1	873.00	(13.5	1	.93	(13.2	1
864.01	(14.2	1	.03	(14.2	1	894.94	(13.6	1
						895.04	(12.9	1
						896.79	(13.2	1
						897.90	11.0	1
						898.84	12.9	1
						899.82	(13.6	1

TABLE 2. EK TRIANGULI AUSTRALIS--OBSERVED MAXIMA.

No.	TYPE.	J.D.	MAG. _v	Int. _d	Wt.	WIDTH 13.01-D d	REMARKS.
1	A1	2,435,034	11.3	...	4	2.3	
2	B1	211	10.4	177	4	12.5	Possible dip after maximum
3	?	307?	11.6?	96	1	3.3	
4	A1	403	11.3?	96	2	1.7	A single observation suggests possible faint max. around 367
5	A1	549	10.9?	146	2	1.9	
6	B3	790	10.6	241	3	13.6	Single observations suggest possible maxima around 588 & 779
7	?	2,436,148?	12.1+	358	1	?	Single obs. of 12.1 on 149.92
8	B3	593	10.6?	445	3	13.3?	
9	A2	750?	12.9+	157	1	1.0	Falling branch only observed.
10	B1	2,437,456	10.5?	706	4	11.3	
11	A2	469	13.0?	13	1	...	
12	A1	643	11.2?	174	3	1.2	
13	A2	2,438,089	11.9?	446	2	1.2	
14	A2	209	11.9	120	1	2.2	
15	B1	370	11.0	161	1	10.4?	
16	?	455?	12.1+	85	1	?	Single obs. of 12.1 on 455.86
17	?	541?	11.7?	86	1	?	Single obs. of 11.7 on 541.79
18	?	596	12.5+	55	1	?	
19	A2	732	12.0+	136	1	1.8?	
20	A2	857	12.4	125	2	1.3	
21	?	2,439,501?	11.7?	644	1	?	Single obs. of 11.7 on 501.14
22	B2	691	10.9	190	3	10.2	Possibly double with preceding max. of 11.8 on 687.
23	?	833?	13.1+	142	1	?	Single obs. of 13.1 on 833.12
24	?	2,440,415	13.2+	582	1	?	Single obs. of 13.2 on 415.25
25	?	672	11.0?	257	1	?	
26	B2	2,441,231	11.5	559	2	6.5	
27	?	321	12.5+	90	1	?	Single obs. of 12.5 on 320.97
28	A2	455	12.0	134	2	1.5	
29	A2	562	12.1	107	1	1.9	
30	A1	814	11.2	252	4	1.8	)Double max. with dip to 14.0
31	B2	821	11.7	7	3	8.1	)separating them.
32	A1	2,442,098	11.2?	277	2	1.9	Probable max. around 086.
33	B1	448	10.9	350	3	11.7	
34	A2	685	12.3+	237	1	?	Single obs. of 12.3 on 685.94
35	A1	898	11.0	213	1	1.6	

TABLE 3. EK TRIANGULI AUSTRALIS--DISTRIBUTION OF OBSERVATIONS
1955-1975

YEAR	OUTBURSTS OBSERVED.			No. of Obs.	NIGHTS OBSERVED.	No. of gaps of 6 successive Nights or longer.							
	A	B	?			6	7	8	9	10	11	12	13+
1955	1	1	1	215	189	3	2	-	-	1	-	-	-
6	1	1	-	209	191	4	1	1	1	-	-	1	2
7	-	-	1	174	162	4	4	1	-	-	1	1	1
8	-	-	-	193	190	3	3	-	-	1	-	1	-
9	1	1	-	153	151	3	3	3	1	-	-	-	1
1960	-	-	-	184	176	7	2	2	-	-	-	-	-
1	2	1	-	201	180	4	3	1	-	1	-	-	-
2	-	-	-	183	178	6	1	-	1	-	-	-	1
3	2	1	-	174	167	4	1	2	2	-	1	-	2
4	1	-	3	146	145	6	1	1	2	-	-	-	1
5	1	-	-	151	150	2	1	3	2	-	-	-	1
6	-	-	-	127	125	4	6	3	2	-	1	1	1
7	-	1	2	196	166	1	7	2	-	-	-	-	-
8	-	-	-	300	215	5	-	-	-	-	-	-	-
9	-	-	1	250	198	2	2	-	-	-	-	-	-
1970	-	-	1	192	159	8	2	2	-	2	-	-	-
1	-	1	-	230	186	2	3	-	-	1	1	-	-
2	2	-	1	316	214	3	3	-	-	1	-	-	1
3	1	1	-	448	232	3	2	3	1	-	-	-	-
4	1	-	-	360	225	2	2	2	1	-	-	-	-
1975	1	1	-	336	207	3	5	-	1	-	-	-	1

Gaps of 13 successive nights or longer were:

1956 1 of 13 nights; 1 of 14 nights.
 1957 1 of 14 "
 1959 1 of 21 "
 1963 1 of 16 "
 1964 1 of 13 " ; 1 of 22 "
 1965 1 of 17 "
 1966 1 of 13 "
 1967 1 of 13 "
 1972 1 of 13 "
 1975 1 of 16 "

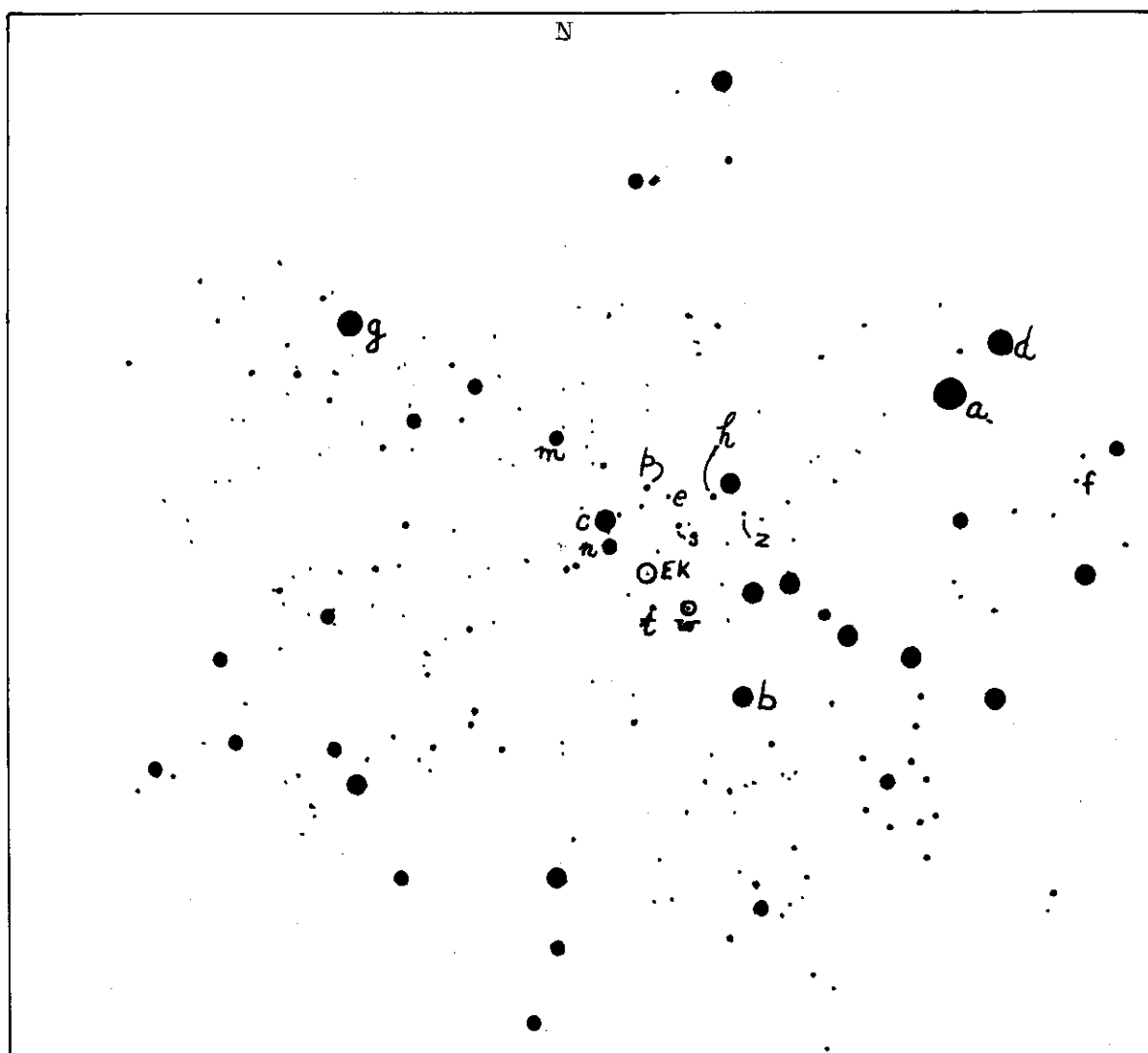
TABLE 4. EK TRIANGULI AUSTRALIS---MEAN LIGHT CURVES.

PHASE d	MEAN MAG.	PHASE d	MEAN Mag.	PHASE d	Mean Mag.	PHASE d	MEAN Mag.
A1		B1		B2		B3	
-1.0	(13.2	-3.0	(13.2	- 3.0	(14.0	- 3.0	(13.2
-0.5	12.57	2.0	12.45	2.0	11.85	2.0	11.55
0.0	11.18	1.0	11.20	1.0	11.72	1.0	11.40
+0.5	11.87	0.0	10.77	0.0	11.52	0.0	10.96
1.0	12.31	+1.0	10.92	+ 1.0	11.61	+ 1.0	11.24
1.5	12.87	2.0	11.07	2.0	11.77	2.0	11.37
+2.0	13.70	3.0	11.36	3.0	11.94	3.0	11.40
A2		4.0	11.57	4.0	12.15	4.0	11.42
-1.0	13.50	5.0	11.76	5.0	12.62	5.0	11.47
-0.5	12.80	6.0	11.94	6.0	13.17	6.0	11.53
0.0	12.30	7.0	12.01	+ 7.0	13.62	7.0	11.84
+0.5	12.72	8.0	12.30			8.0	11.93
1.0	13.05	9.0	12.71			9.0	12.07
1.5	14.00	+10.0	12.82			10.0	12.15
		+11.0	13.67			11.0	12.42
						12.0	12.86
						+13.0	13.36

FIGURE 1. EK TRIANGULI AUSTRALIS.

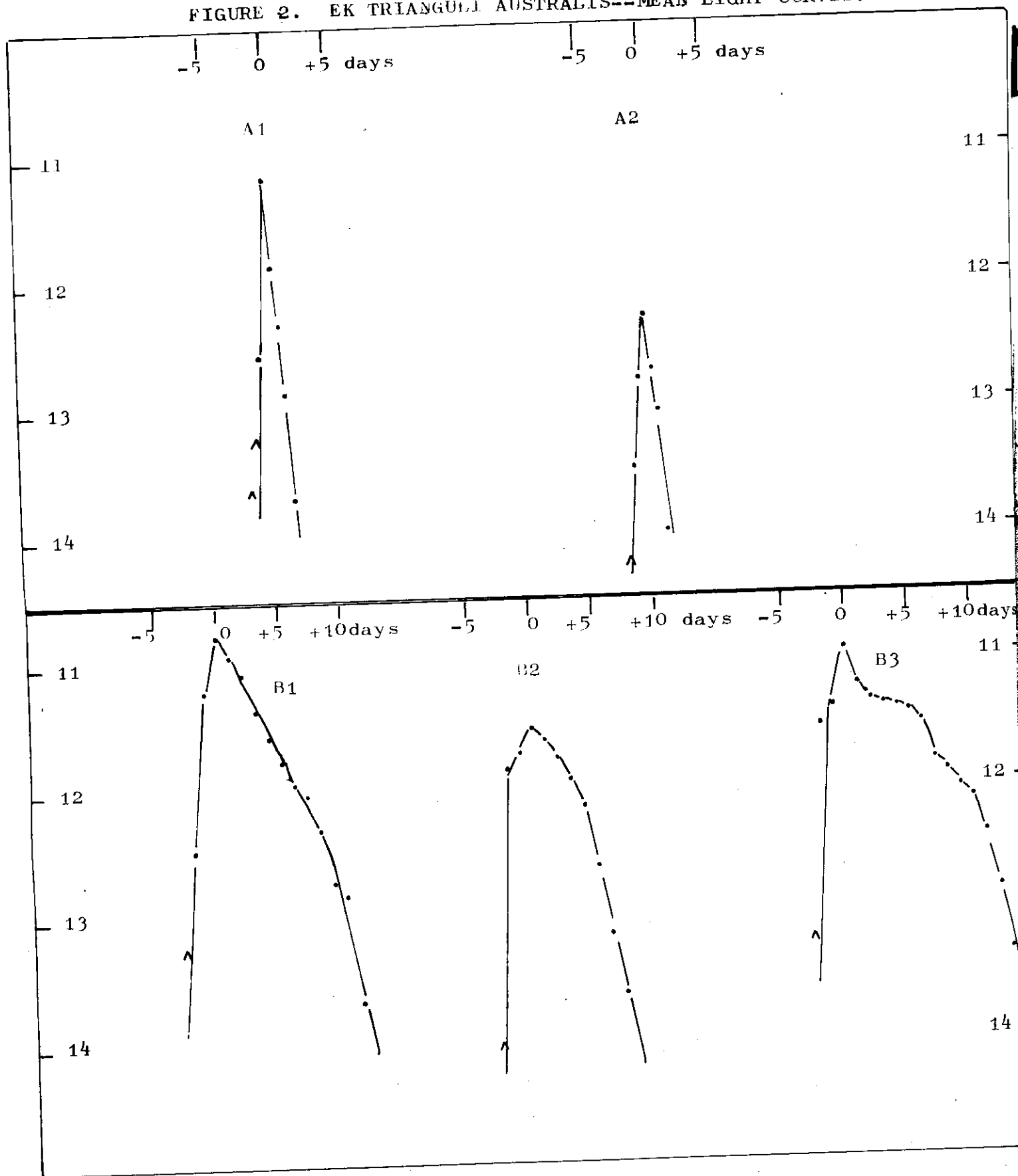
(1900): 15h 05m 23s -64° 43.7'
 (1950): 15 09 40 -64 55.1

Scale: 20"=1mm



Enlarged chart of that shown on Chart 98 in upper left corner, which the above replaces. Reproduced from photo taken at the Carter Observatory. Note that the comparison star "w" is probably variable. Details of the sequence are given on page 39.

FIGURE 2. EK TRIANGULI AUSTRALIS--MEAN LIGHT CURVES.



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

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