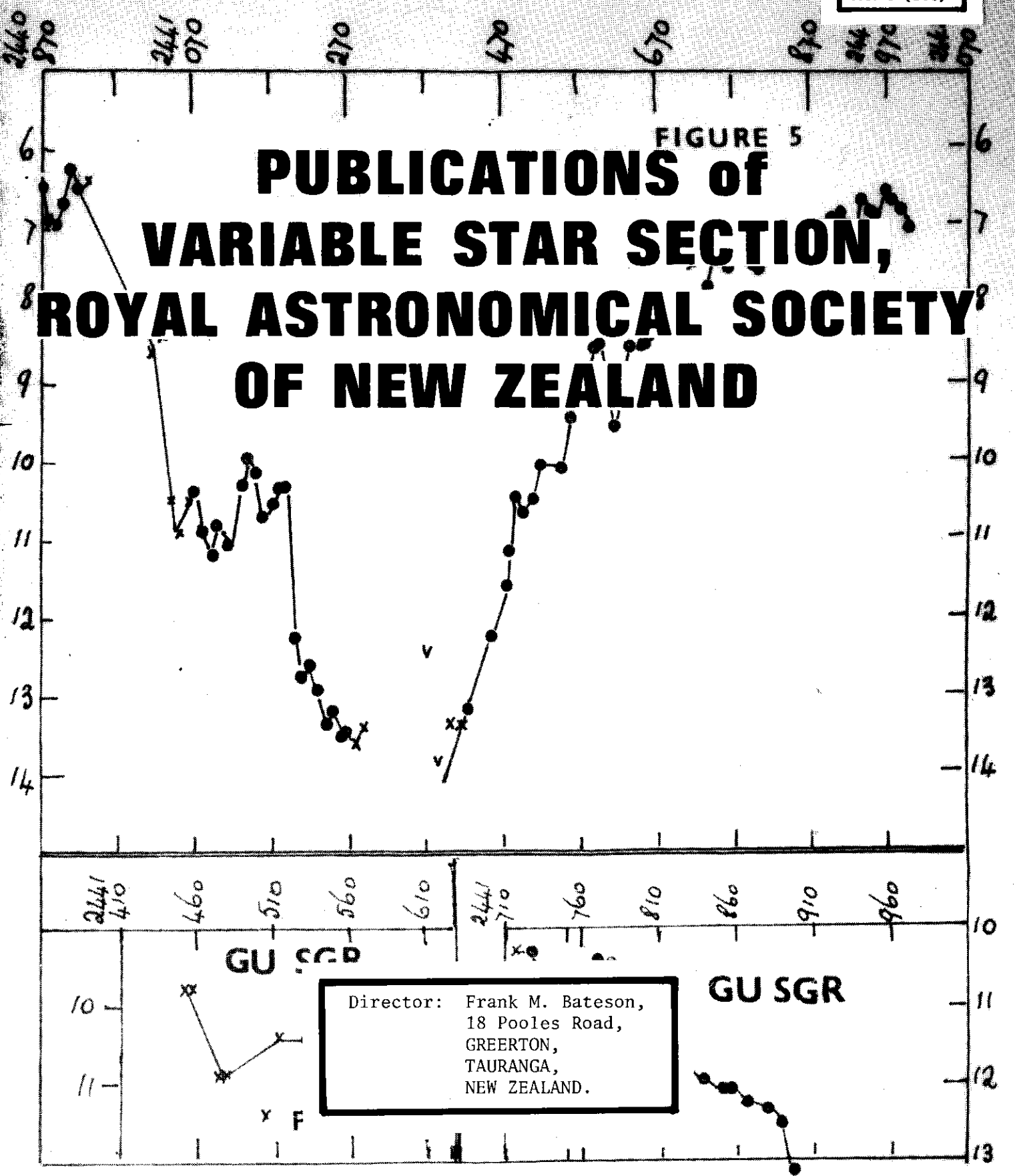




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(N.B. Previously Section reports have been distributed as reprints. These reports will now appear in the Publications so that they reach all observers, and reprints of these will not be issued).

1975 October 31.

OBSERVATIONS OF SOME SOUTHERN VARIABLES OF THE R CrB TYPE

by Frank M. Bateson

SUMMARY: Light curves are presented for UW Cen; S Aps; GU Sgr and RY Sgr in continuation of those previously published. Light curves are given for lengthy periods for DY Cen; AE Cir; RT Nor; RZ Nor; WX CrA; VZ Sgr; RS Tel and V CrA. All curves are from visual observations. The observations for each star are discussed, and for some stars charts are reproduced. Another star, V618 Sgr, was observed, but all observations were negative. Some photoelectric observations made at the Auckland Observatory are given in Section 2.

.....

LIGHT CURVES: In the light curves single observations are denoted by crosses; ten day means from two or more estimates are shown as filled circles. The number of observations used to derive these means varied from an average of 25 for the well observed stars--UW Cen; S Aps; GU Sgr and RY Sgr--to from 2 to 5 for the remaining stars. The majority of the visual observations for the less well observed stars were made by A.F. Jones. The scales used in reproducing the light curves differs in accordance with the need to show the type of variation. Magnitudes are marked at half magnitude intervals and J.D.'s at intervals of 50 or 100 days according to the scale used.

123753 UW Cen. The light curve in Figure 14 covers the interval J.D. 2,442,050 to 2,442,502 in continuation of that previously published (Bateson 1974). UW Cen remained at maximum during this interval. The semi-regular variation previously noted by Bateson and Jones (1972) persisted. As is usual, when the star is at maximum, the amplitude of these variations is small. The mean value for these minor variations is 40 days from secondary maxima; 37.2 days from secondary minima.

131953 DY Cen. This star was classified as R CrB type by Hoffleit (1930), who gave a range of 12.0 to fainter than 16.4p. Using 257 observations from Harvard plates she stated that well determined minima occurred in 1897, 1901, 1924 and 1929. Kukarkin et al (1974) states:- "The star differs from other R CrB type variables having no infrared excess. B-V:+0.35; U-B:-0.60." These colours agree with the more recent observations by Walker and Marino given in Section 2.

DY Cen has been observed since 2,437,017 and the light curve appears in Figure 1. The first 4,000 days are covered by observations from two observers with the majority of the estimates from A.F. Jones. Thereafter observations are more numerous. However the frequency of the records during the entire interval is sufficient to say that it is unlikely that DY Cen decreased to a deep minimum in these years.

Mean visual magnitudes have been:-

2,437,017	-2,437,999	12.19	from 93 observations
8,000	- 8,999	12.23	from 49 observations
9,000	- 9,999	12.20	from 46 observations
2,440,000	-2,440,999	12.24	from 45 observations
1,000	- 1,999	12.38	from 188 observations
2,000	- 2,480	12.37	from 152 observations

Photoelectric observations, in three colours, appear in Section 2. Whilst these cover a limited interval, the mean of the V observations is 12.38, the same as the visual records in the same interval. This, and a comparison of individual magnitudes with the visual estimates for the same dates, provides a good check on the accuracy of the visual observations. At times, especially when DY Cen has been well observed, there is a suggestion of a semi-periodic variation in a period of approximately 120 days. The amplitude is 0.2 to 0.3 magnitudes, which is normal for R CrB stars at maxima. Both the photoelectric and visual observations, when the latter are numerous, suggest small fluctuations of magnitude 0.2 on a shorter time scale. The overall slight fading shown on page 1 appears to be real.

143568 AE Cir. Visual observations from J.D. 2,434,860 to 2,441,960 are shown in Figure 2. These estimates are mainly from A.F. Jones and single estimates in any ten day interval dominate the light curve. They must be treated with caution although the observations form a very homogeneous series.

There is a suggestion that AE Cir varies rapidly at times with an amplitude of about one magnitude. The same effect is shown in the photoelectric observations between 2,441,114 and 2,441,210, which also indicate that the two visual estimates in the same interval are too bright by 0.9 and 0.7 magnitudes. Whether this applies elsewhere is uncertain because of the lack of photoelectric results. However, it does indicate that the visual estimates are correct in showing comparatively rapid changes which appear to be superimposed on a longer cycle of smaller amplitude. This latter cycle appears to be semi-periodic at times, with a period of around 100 days, but this period does not always hold.

AE Cir was mainly invisible in the intervals 2,436,260-2,437,910 and 2,440,680-2,441,960. Scattered positive estimates during these intervals indicate that the variable was probably not at a deep minimum but varying around magnitude 14.0. However, visual estimates at this magnitude are at the threshold of the instrument used and were usually classed by Jones as of class 2 or 3.

Walker and Marino have determined magnitudes of some of the sequence stars shown on a field sketch by A.F. Jones. The standards used, taken from Cousins and Stoy (1963) are:-

HD 127850 mV 8.04 B-V +0.46 U-B (1.59)c

HD 130940 6.98 0.58 (1.66)c

Field standard used was marked "A" on Jones' sketch and gave:-

mV 7.01 B-V +0.54 U-B +0.10

Magnitudes for part of the sequence have been determined as:-

"d" mV 11.44 B-V +0.55 U-B +0.19 (6 observations)

"d'" 11.92 +1.20 +1.01 8 "

"e" 11.56 +0.49 +0.09 2 "

"f" 11.70 +1.36 +1.4: 3 "

"g" 12.21 +0.31 +0.19 8 "

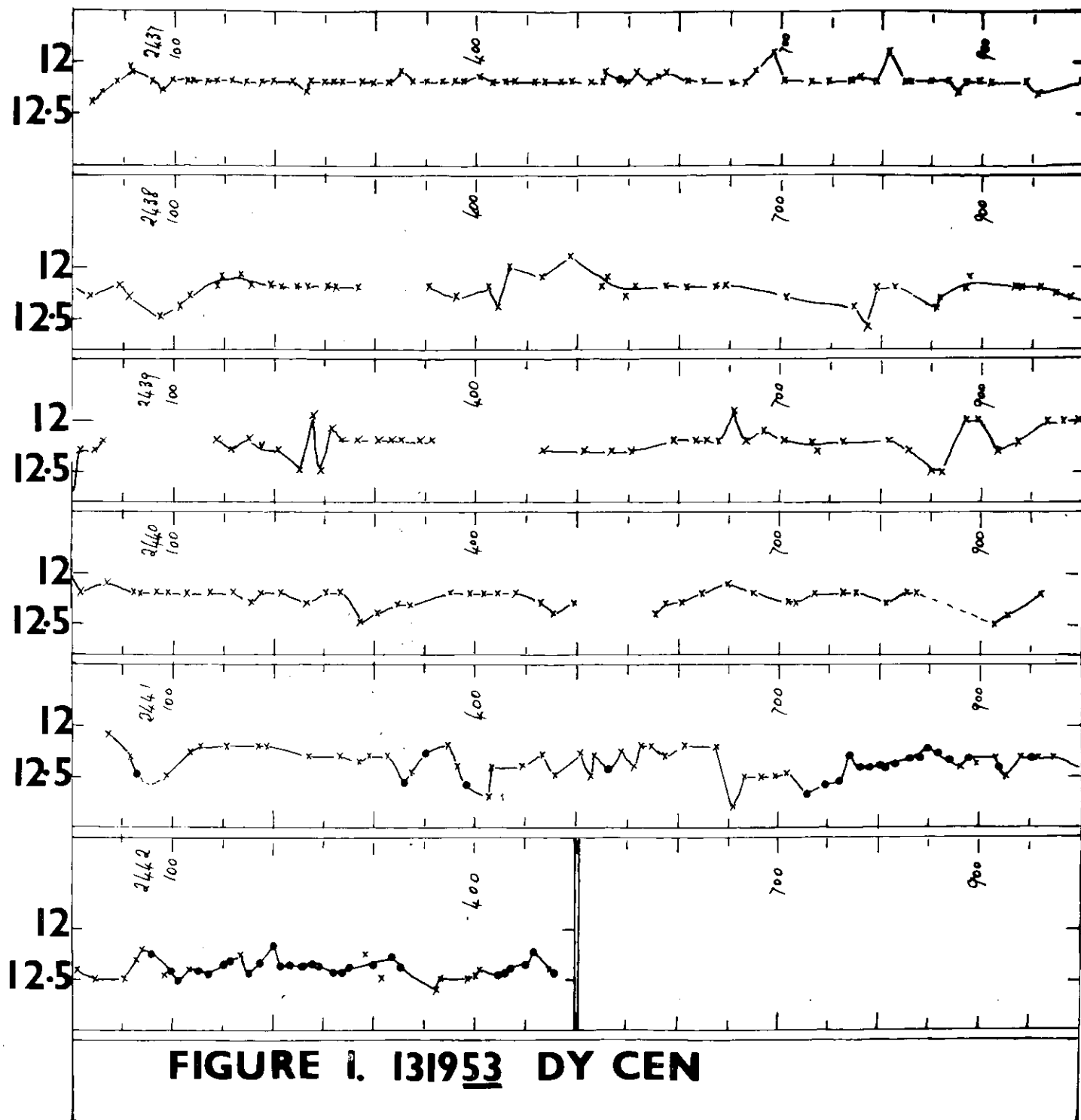
~~"h"~~ 11.75 +0.32 1 " Note 1

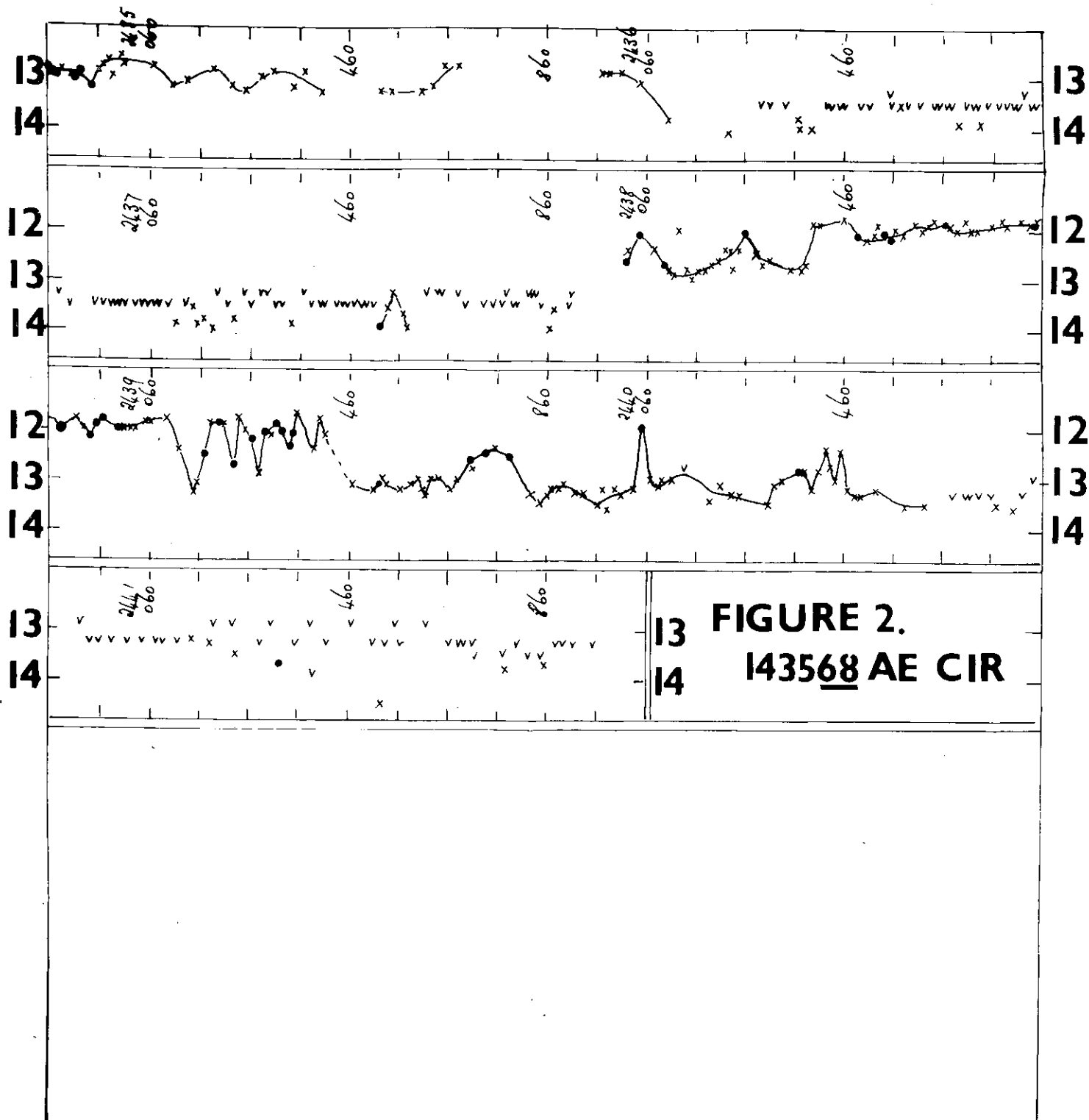
"l" 12.96 +1.29 +0.9 3 " "

"n" 13.30 +1.39 1 " Note 1

When the sequence is completed a chart will be issued.

Note 1. PEP measures are of different stars (h and n) to those selected by Jones.





145971 S Aps. The light curve in Figure 14 covers the interval 2,442,050 to 2,442,543 in continuation of that previously published (Bateson 1974). Some photoelectric observations appear in Section 2.

Comparison stars for S Aps appeared on an unnumbered chart issued by Bateson (1958) with visual magnitudes from H.A. 63,11. These magnitudes are in error but are universally used. So far three colour observations have been made for only four of the comparison stars. When the remaining sequence stars have had accurate magnitudes determined a revised chart will be published.

During the observations covered in Figure 14 S Aps has remained at maximum.

161559 RT Nor. Hoffleit (1931) gave the range of RT Nor as 11.3p to 16.3p. She used 360 observations from Harvard plates, and found well determined minima in 1901-02, 1905, 1920 and 1925.

A.F. Jones has consistently followed RT Nor since 2,435,157 (1955 Feb. 17). He used comparison stars selected by himself to which letters were assigned. Figure 7 includes a preliminary identification chart produced by enlarging a photo by I. Stranson. The original photo was on the scale of 60"=1mm. A full scale chart will be published when photoelectric magnitudes of the comparison stars are available. Meantime observers can use the small chart for observations, using the lettered stars for comparison.

As magnitudes of the comparison stars are not known step estimates by Jones have been used with the zero point of the sequence fixed by comparison with stars in an adjoining field. The magnitudes so determined have been used in the observations shown in Figures 3 and 4. Although not accurate they are sufficiently good to present a light curve, covering the interval 2,435,157 to 2,442,533.

Minima below 12.0v occurred on:-

2,435,100 approx. RT Nor probably rising from deep minimum when observations commenced.

2,438,120 mag. 12.25.) Double minimum separated by rise to

2,438,205 12.3) 11.7.

2,439,220 14.2?

2,441,278 14.6?

2,442,530 below 14.5

The time spent at minima is comparatively short when compared to some stars of this type.

There appears to be a quasi-periodic variation with an average cycle of about 59 days. At times this cycle is distinct with an amplitude of 0.2 magnitudes, but when the amplitude increases to 0.6 magnitudes the quasi-period seems to shorten and then lengthen for a time. If a smooth curve is drawn through the observations outside the times of falls and rises to or from minima below 12.0 small variations about the mean magnitude appear to occur in an approximate period of 175 days. The amplitude of this wave is 0.2 to 0.3 magnitudes.

162453 RZ Nor. Kukarkin et al (1974) classifies this star as "R CrB?" with a range 11.1p to below 12.7p. They note "The existence of bands of C2 in the spectrum is uncertain. Unlike the other stars of R CrB type there is no infra-red excess."

A light curve for the interval 2,435,520 to 2,442,290 appears

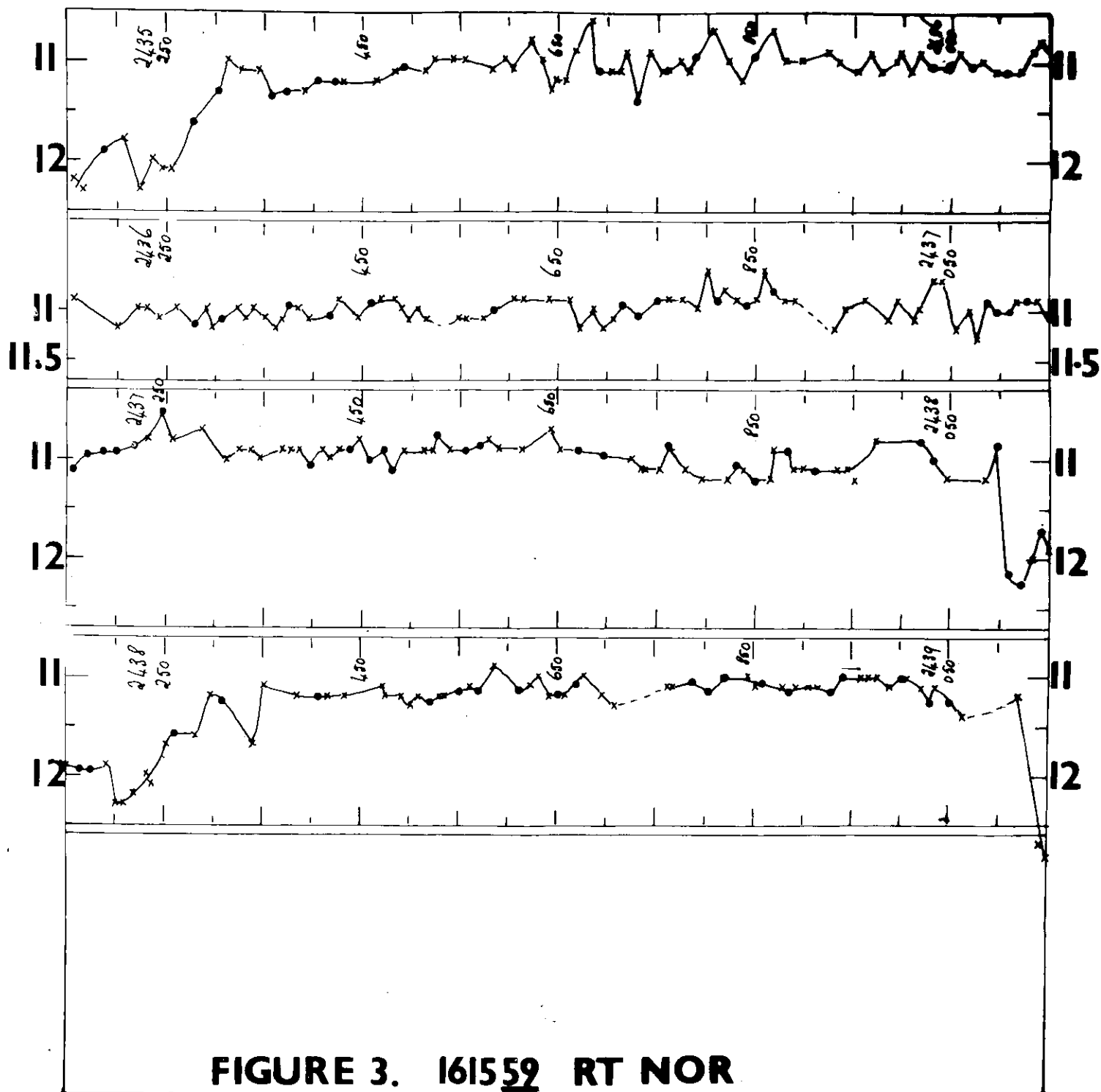
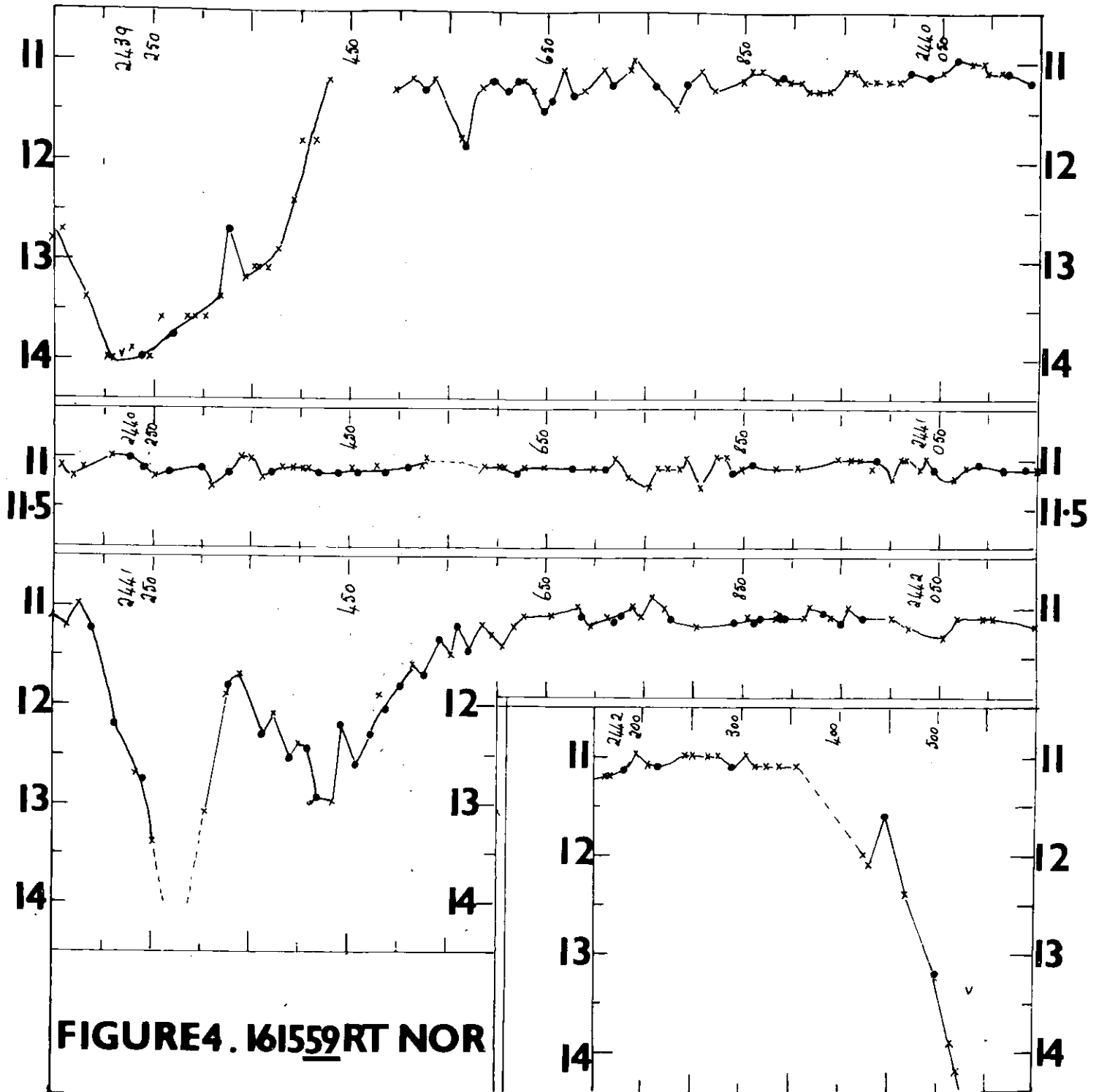


FIGURE 3. 161559 RT NOR



in Figures 5 and 6. The visual estimates have all been made by A.F. Jones. As a photoelectric sequence is at present incomplete the estimates have been reduced on the basis of step estimates converted to visual magnitudes by fixing the zero point of the sequence by inter-comparison with stars of established brightness in a near-by field. Although such methods are not strictly accurate they are sufficient to enable the general behaviour of the star to be plotted.

An inspection of the light curve shows that RZ Nor does not behave as a typical R CrB type variable, nor does it exhibit the range of such stars. The extreme range is 10.8v to 13.1v. Except for the intervals 2,439,870 to 2,440,620 and 2,442,066 to 2,442,290 the star has not remained at maximum for any lengthy period. Instead it has varied continuously, often markedly so within a few days, or it has fluctuated between extremes of 12.5v to 13.1v. In many respects the light curve resembles the curves for some of the rapid irregular variables. A very approximate quasi-period of 68 days is apparent in parts of the curve, disappearing in the sudden decreases.

A few photoelectric observations appear in Section 2. These indicate that Jones' visual observations are possibly too faint by 0.2 to 0.3 magnitudes. A finder chart appears in Figure 6 with a detailed chart in Figure 7, on which the comparison stars are denoted by letters.

180136 V618 Sgr. This star is classified as of R CrB type with a range of 11.0p to fainter than 16/5p. Observations by A.F. Jones from 2,435,618 to 2,441,595 total 242. With the exception of one doubtful estimate on 2,438,556 at magnitude 13.6v all observations have been negative with the variable invisible and certainly fainter than 13.5v.

180237 WX CrA. This R CrB variable is classified as having a range of 11.0p to fainter than 16.5p. Visual observations by A.F. Jones are plotted in Figures 8 and 9, covering the interval 2,434,830 to 2,440,930. The observations have been reduced by using step estimates to determine preliminary visual magnitudes.

WX CrA is a typical variable of the R CrB type with an extreme range of 11.0v to fainter than 14.5v. The actual minima could not be observed because they were well below the threshold of the instrument used. The following Table shows the dates on which WX CrA reached magnitude 13.0v on the fall to, and rise from, deep minima.

<u>13.0v on Fall</u>	<u>13.0v on Rise</u>	<u>Duration.</u>	<u>Remarks.</u>
2,435,498	2,435,740	242 ^d	
2,436,133	2,436,520	387	
2,437,789	2,437,975	186	
2,438,816	2,438,878	62	
2,439,749	2,440,143	394	Partial erratic recovery to 13.0 on 2,440,015 preceded a fall to 14.4 before final rise.

The falls to deep minima are smooth and steep, especially steep below 12.5v. Rises are also smooth and steep, although less steep than the falls until magnitude 12.0-12.5. Thereafter the rise is erratic

with distinct fluctuations having an amplitude of 0.5 magnitudes. These fluctuations continue through the maximum phase in approximately 60 days--secondary maxima give an average of 58.5 days and secondary minima 60.2 days. This is no more than a quasi-period which is departed from at times.

A chart will be published when the sequence has been accurately determined.

180829 VZ Sgr. Kukarkin et al (1974) classified this star as "R CrB?" type with a range of 11.8 to fainter than 14.0p. The spectrum is given as C and colours as B-V: +1.62, +1.72; U-B +1.63, +1.51; R: 3.78-4.02; R-I: +1.16, +1.24.

Visual observations from 2,435,280 to 2,441,630 are plotted in Figures 10 and 11. The observations have been reduced from step estimates converted to visual magnitudes on an arbitrary basis. It is possible that when reliable magnitudes are available they may result in altering the zero point of the sequence. This could result in making the magnitudes shown in Figures 10 and 11 brighter, but it will not alter the type of variation shown.

VZ Sgr is a typical variable of the type R CrB with steep falls to deep minima at random intervals, and erratic fluctuations on the rise and at, and near, to maxima. The falls to deep minima are very steep, whilst the recoveries are much less steep. Details of deep minima are:-

<u>Mag. 13.0v on Fall.</u>	<u>13.0v on Rise.</u>	<u>Duration</u>	<u>Remarks.</u>
2,436,207	2,436,672	465 ^d	Fall may have commenced later.
2,436,898	2,437,256	358	
2,438,256	2,438,680	424	
2,439,707	2,439,962	255	
2,440,147	2,440,230?	83	
2,441,246	2,441,328?	82	

Possibly another minimum occurred between 2,440,780 and 2,440,980 when there was a gap in the observations.

The extreme range is 10.8v to fainter than 15.0v. At certain parts of the curve there appears to be a semi-regular variation with a cycle of about 47 days but this does not hold at other parts of the light curve. The amplitude of these minor fluctuations ranges from 0.2 at maximum to 0.6 magnitudes during rises from deep minima.

An identification chart from a photo supplied by A.F. Jones appears in Figure 7. This is not very satisfactory because of the crowded nature of the field. A full scale chart will be published later.

181146 RS Tel. This star appears to have been neglected since the publication of the Harvard photographic observations for the interval 1889 to 1927 (Payne 1928). Figure 7 includes a finder chart for RS Tel from a photo by I. Stranson on the scale of 60"=1mm. The same Figure also includes an enlarged chart made from the enlargement of Stranson's photo.

The light curve, mainly from observations by A.F. Jones, is shown in Figures 12, 13 and 14 covering the interval 2,435,000 to 2,442,290. Magnitudes for some of the comparison stars have been determined by Walker and Marino and will be published later with a corrected chart. These have been used to reduced the estimates with the remaining stars

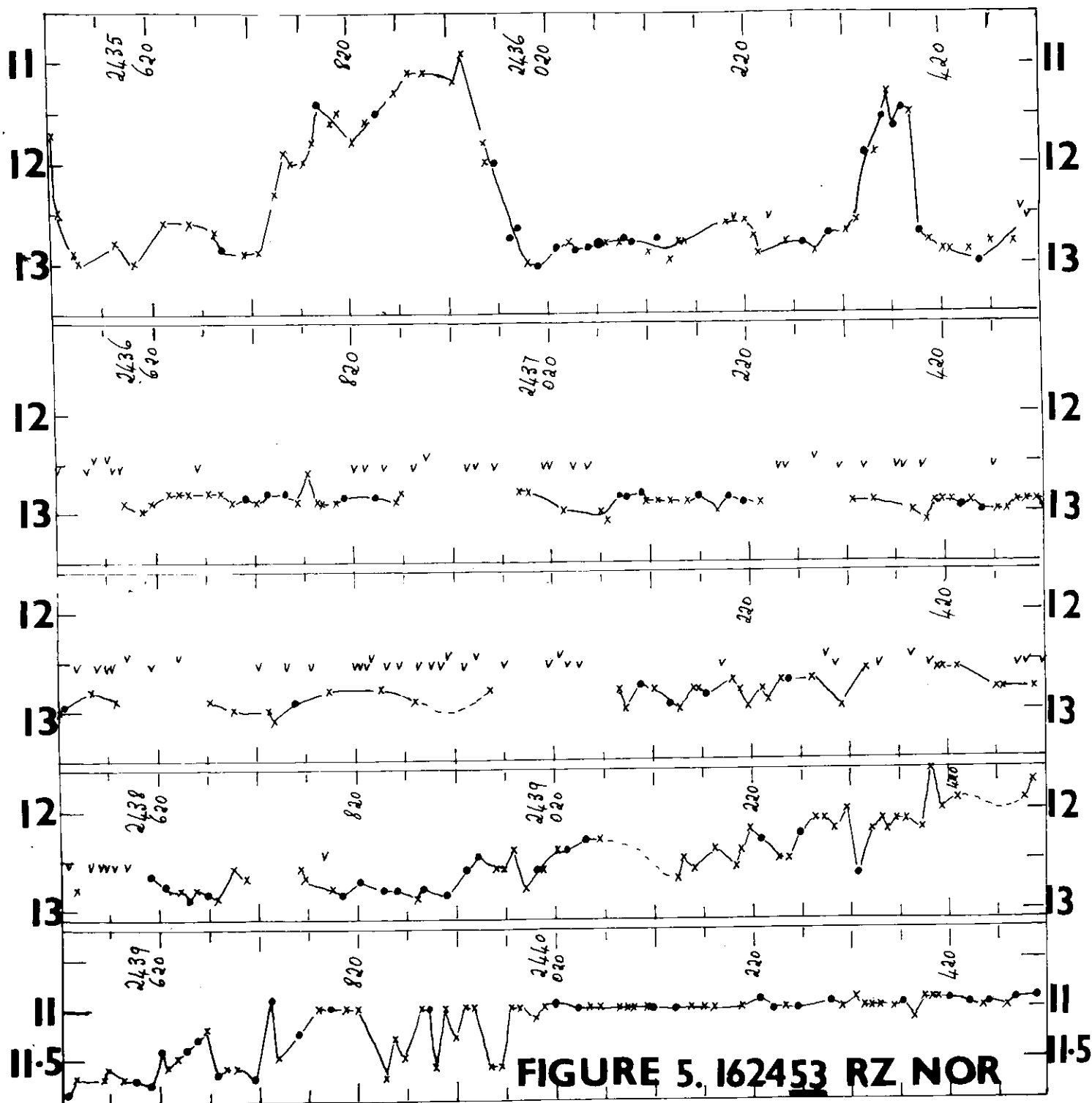
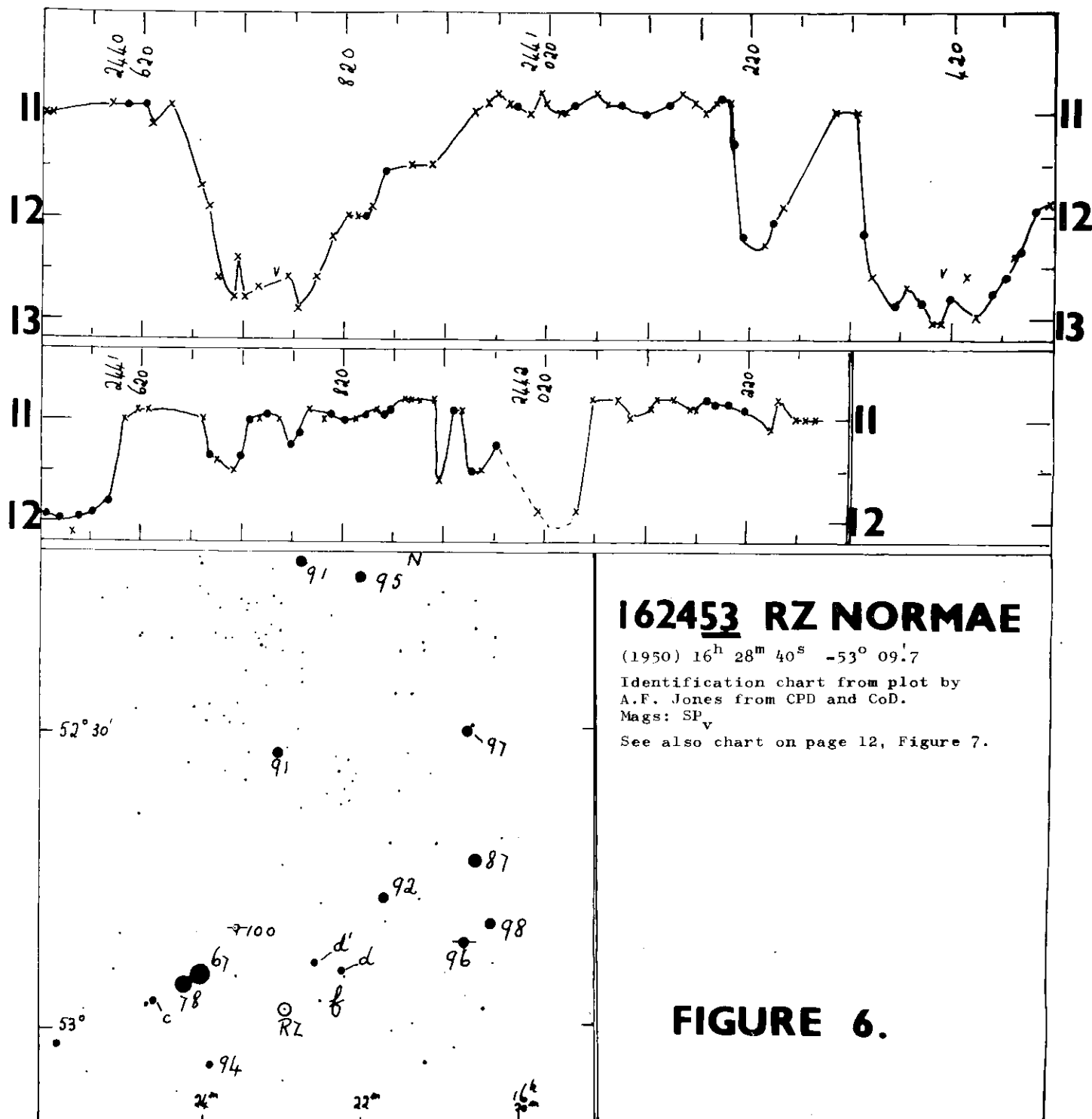
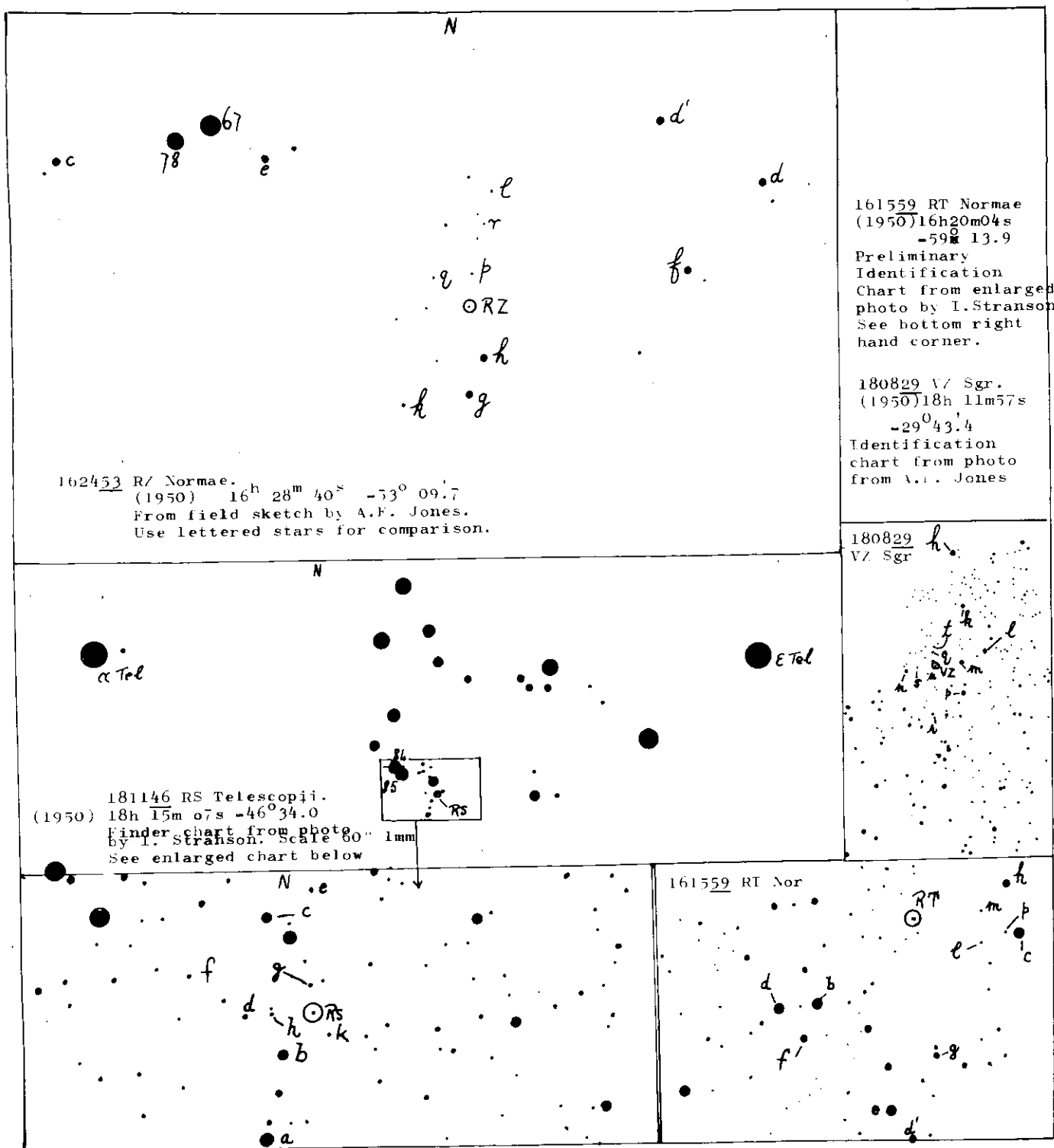
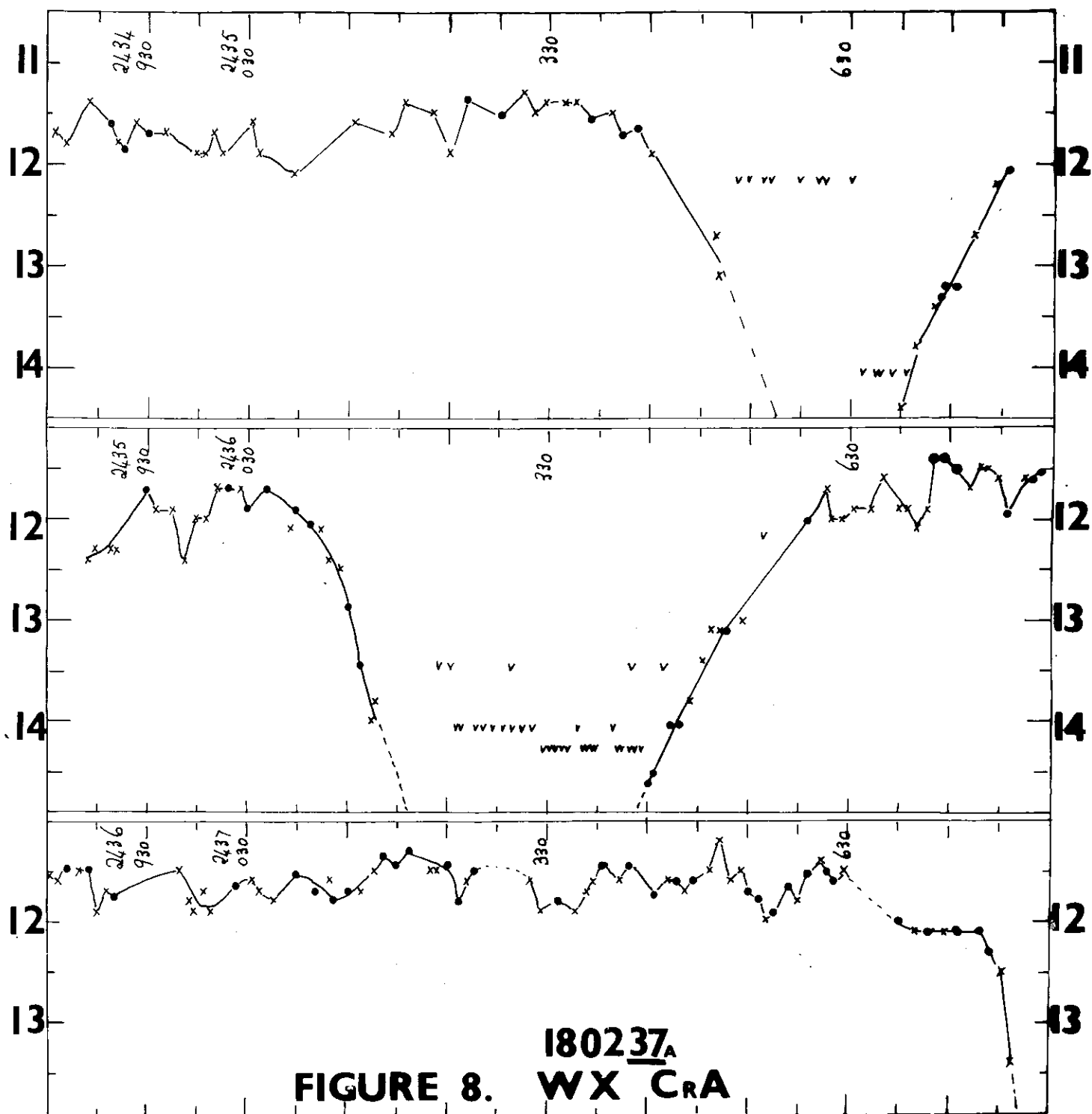
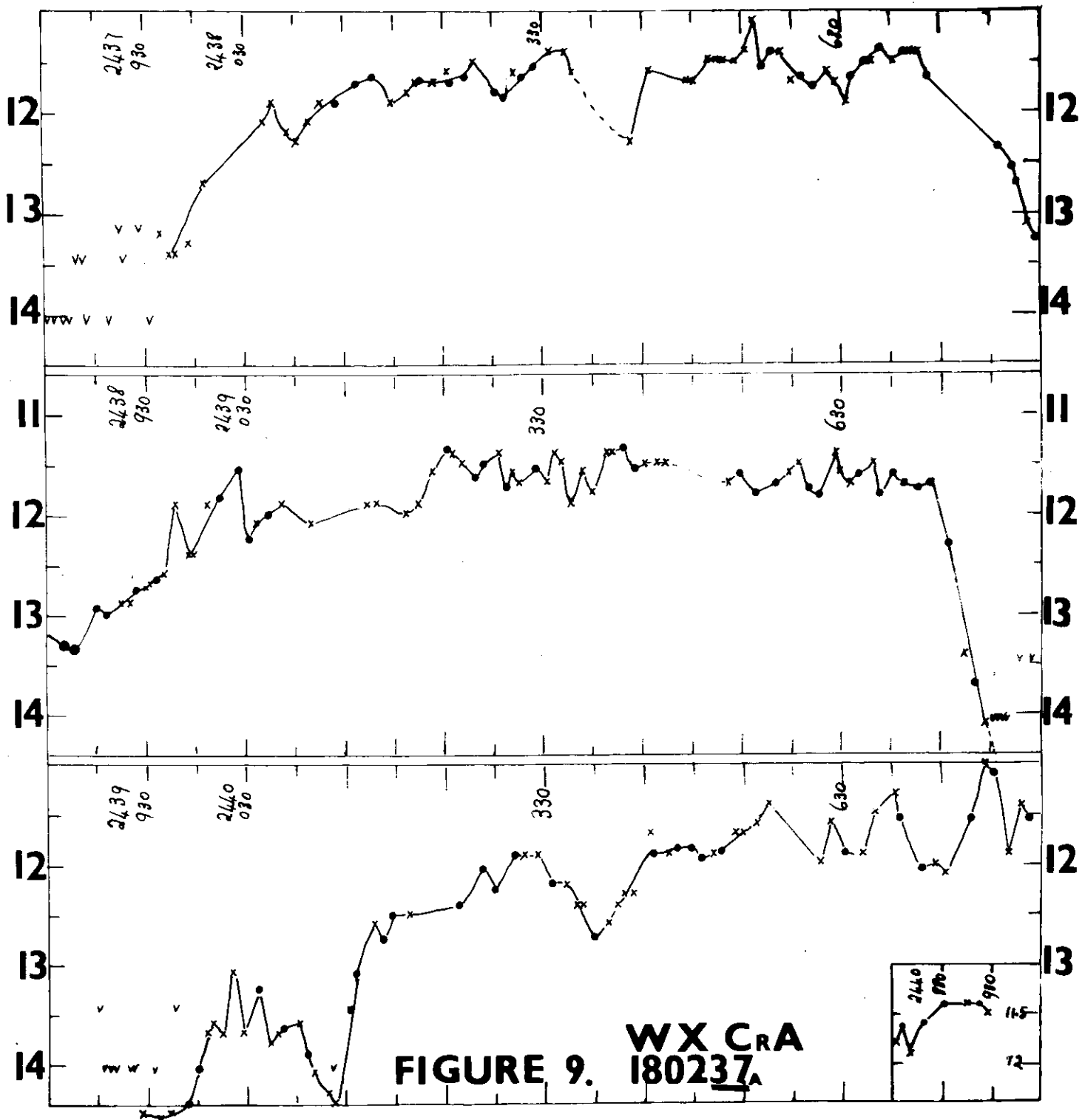


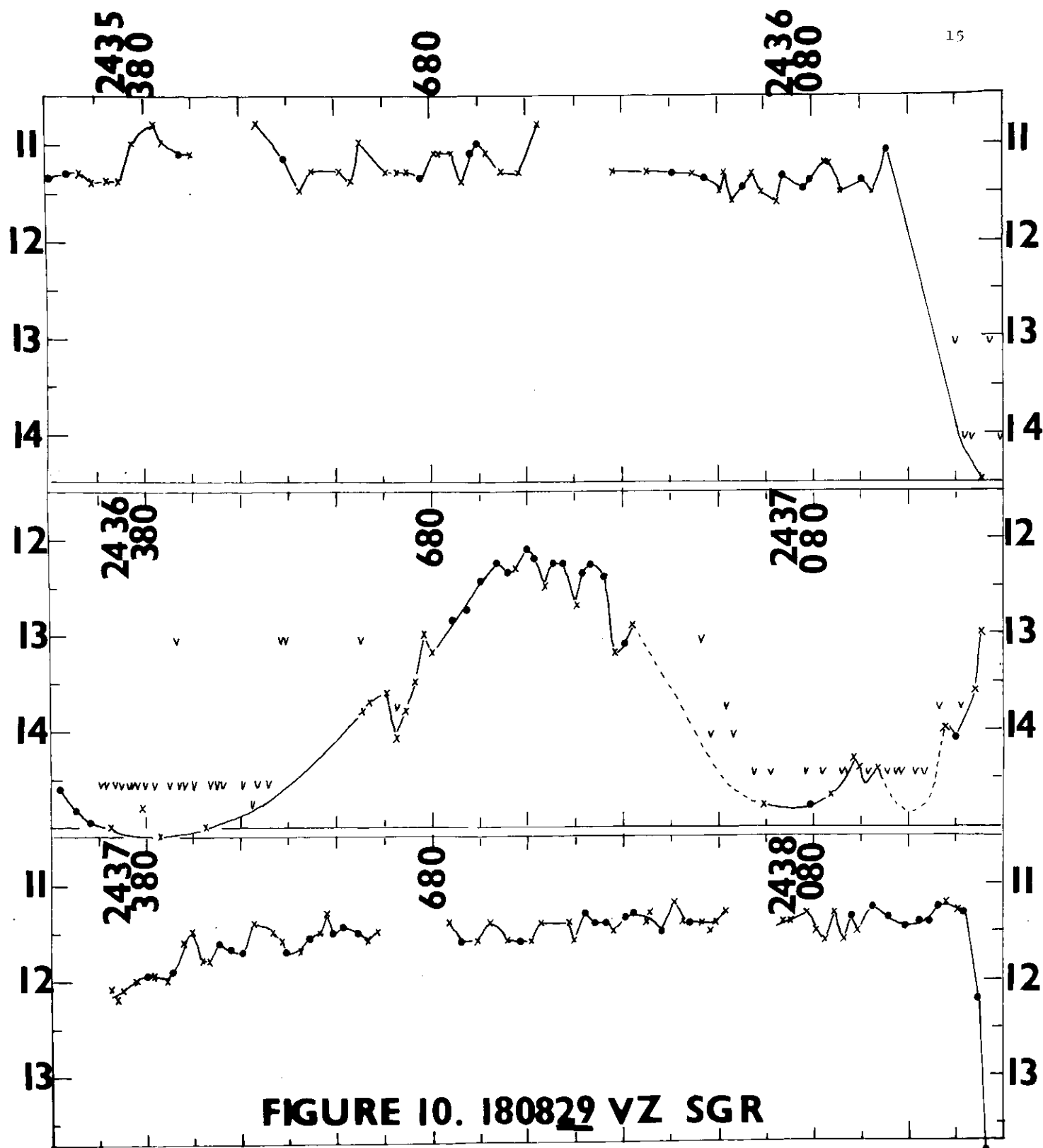
FIGURE 5. 162453 RZ NOR











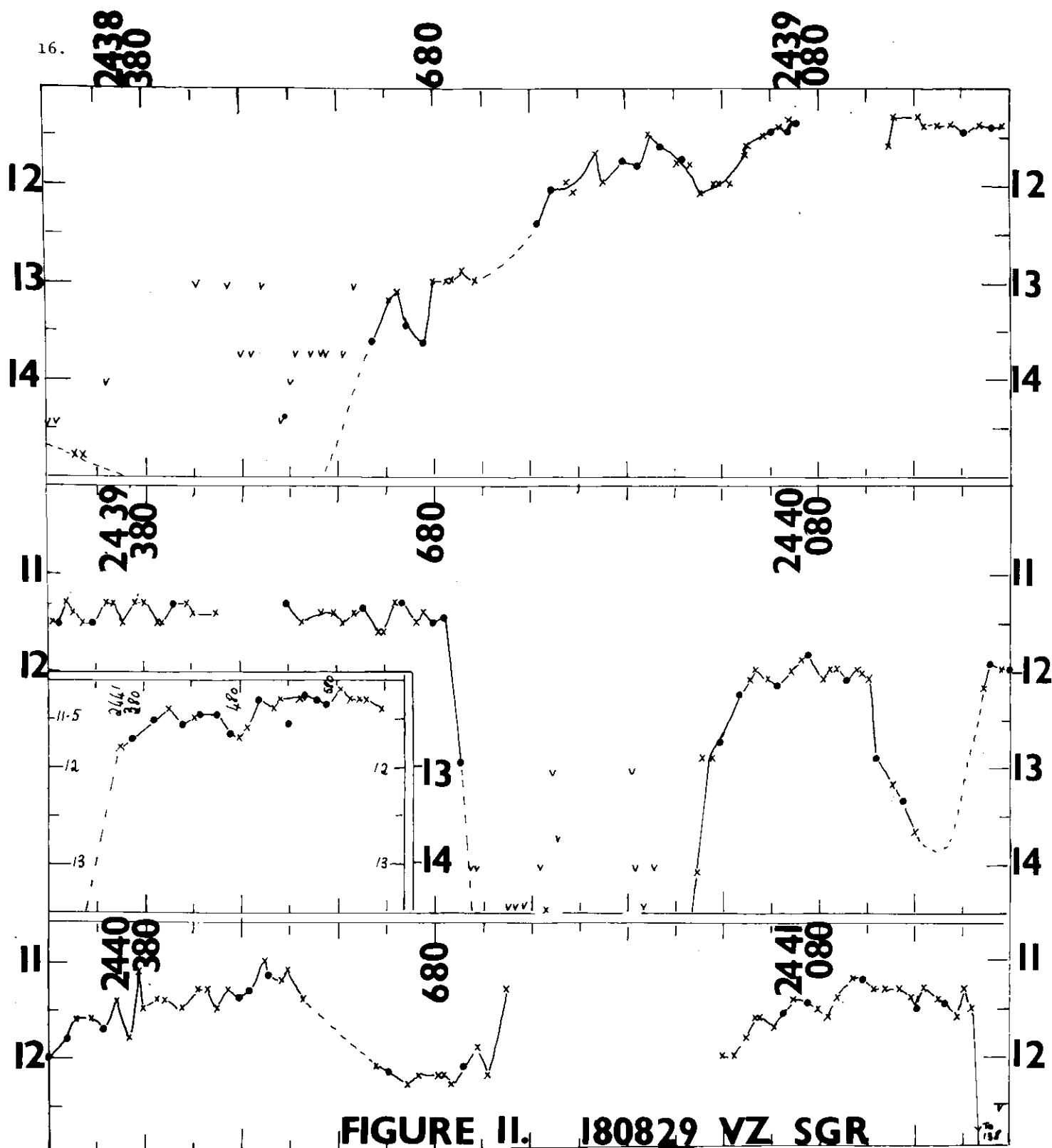


FIGURE II. 180829 VZ SGR

reduced to visual magnitudes by step estimates from those stars for which V magnitudes have been determined.

The following deep minima were recorded:-

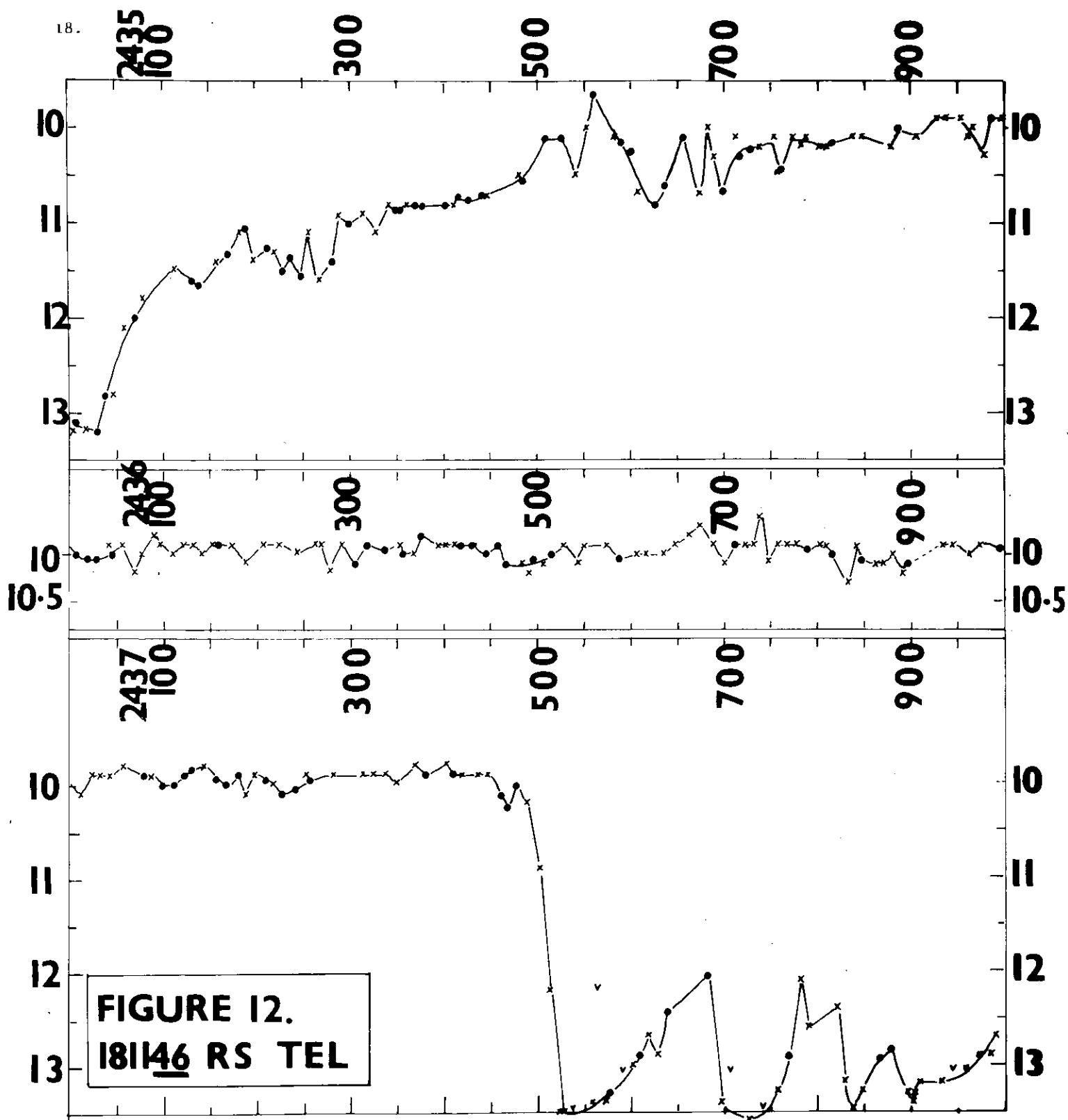
<u>11.0v on Fall</u>	<u>11.0v on Rise</u>	<u>Duration</u>	<u>Remarks.</u>
...	2,435,350	...	When first observed 2,435,003 RS Tel had commenced to recover from a deep minimum.
2,437,501	2,438,108	607 ^d	
2,439,810	2,440,086	276	
2,440,940	2,441,105	165	
2,441,288	2,441,615	327	Preceded by a dip to 12.05 followed by a rise to 10.9

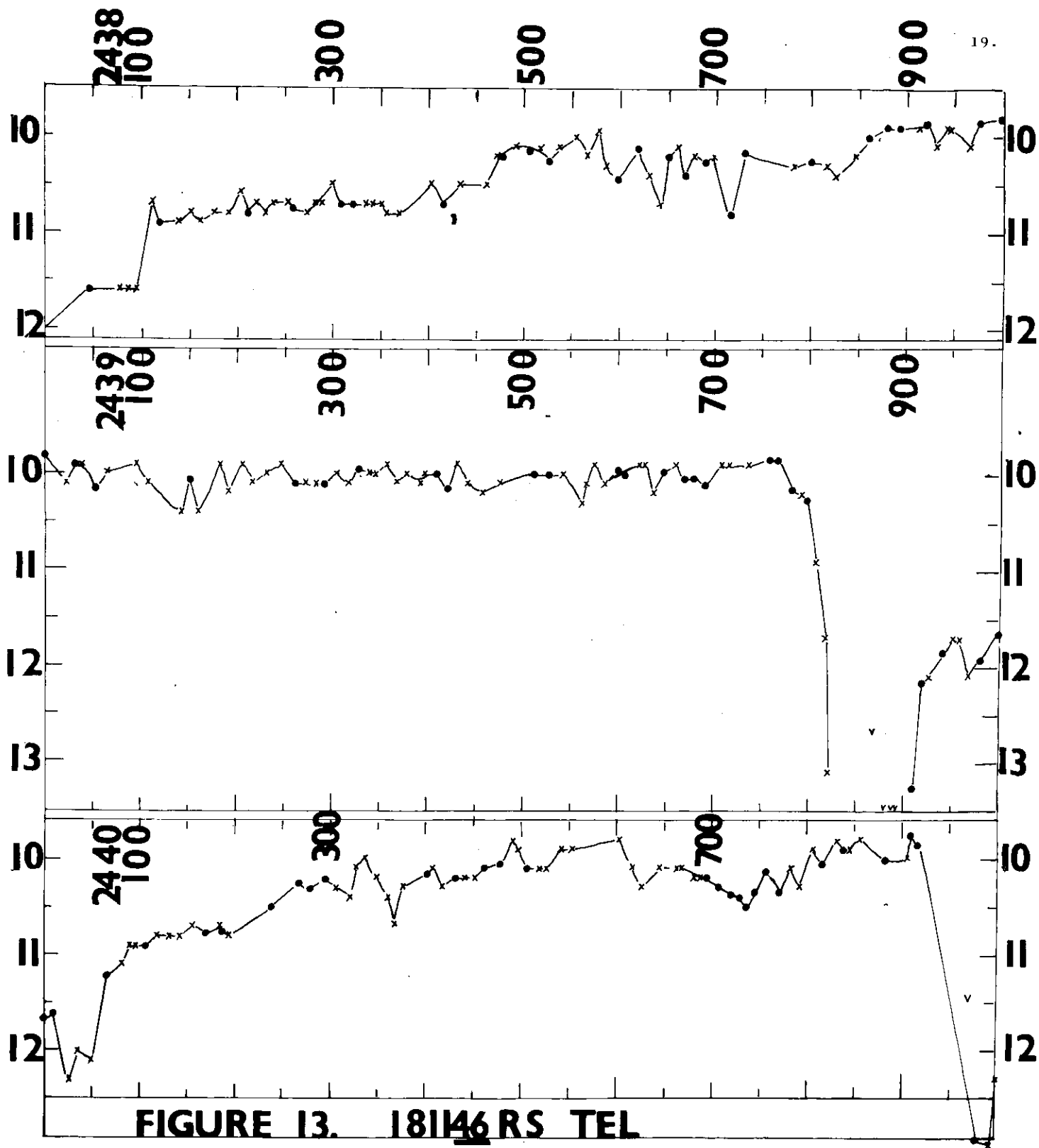
There is a distinct semi-regular variation is an average period of 45.8 days. This has a number of features which tend to repeat themselves. Firstly the semi-regular variation disappears during the sharp decrease to deep minima. Secondly the amplitude of these fluctuations usually increases during the initial rise from deep minima, and at the same time, the period lengthens until RS Tel is around magnitude 11.5. The fluctuations then become about 0.4 magnitudes, or less, as the star continues to rise and their period reverts to an average of 45 days. However, once the star has reached about magnitude 10.2 on the rise the amplitude of these fluctuations increase up to 1.0 magnitudes, remaining very marked for around 250 days. The star then settles down to fluctuations of 0.4 magnitudes in a fairly regular period of 45.8 days. Both secondary maxima and minima give the same average period at this phase, although there are wide variations so that this period can be only regarded as semi-regular.

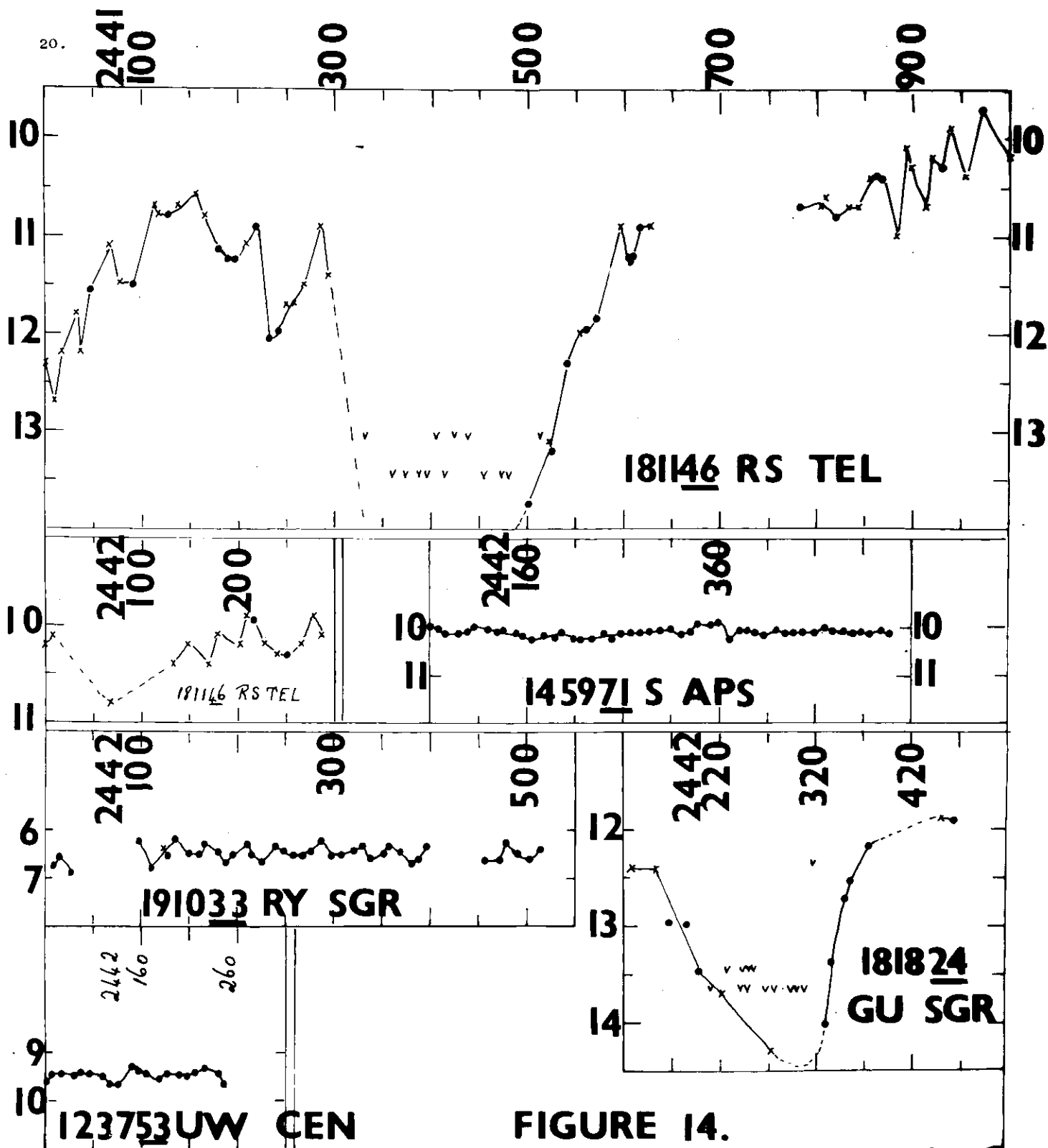
181824 GU Sgr. Bateson (1974) noted GU Sgr was invisible and below 13.7v after 2,441,914, having faded to magnitude 12.0v on 2,441,860. It remained below that magnitude, being recorded as fainter than 13.7 for the remainder of the 1973 observing season. When first observed in 1974 it was fainter than 12.3 on 2,442,081. It was visible on 2,442,129 at 12.4 and the observations from that date to 2,442,473 are shown on the light curve in Figure 14. After this partial recovery GU Sgr again faded to about magnitude 14.5. On the following rise it reached magnitude 12.0 about 2,442,410 making the time spent below 12.0 550 days.

184038 V CrA. Figures 15 and 16 show the visual light curve from 2,435,448 to 2,441,629. The extreme range is 9.5v to fainter than 14.0v. Minima below 12.0 are given below.

<u>11.0v on Fall</u>	<u>11.0v on Rise</u>	<u>Duration</u>	<u>Remarks</u>
		^d	
2,435,903	2,436,130	227	Rose to 10.9 on 2,436,060 but decreased immediately to 11.5 before rising again.
2,436,320	2,436,625	305	Rose to 12.4 on 2,436,428 and immediately fell to 13.7 before a slow rise to maximum.
2,437,499	2,437,732	233	Slight hump on rise
2,437,758	2,437,984	226	







<u>11.0v on Fall</u>	<u>11.ov on Rise</u>	<u>Duration</u>	<u>Remarks</u>
		d	
2,439,230	2,439,555	325	Standstill on rise at 11.2
2,440,644	2,440,690	46	
2,441,024	2,441,350?	326	

There appears to be a semi-periodic variation of about 75 days with an amplitude of from 0.2 to 0.9 magnitudes. This generally, but not always, has the smallest amplitude when the star remains at maximum for several hundred days. The amplitude usually increases prior to a fall to a minimum, and at times following a rise.

Figure 17 contains a chart showing the lettered sequence stars. For some of these V and B-V magnitudes have been determined by B. Menzies and his assistants. These are listed below, with the adopted magnitudes to be used by visual observers in the last column.

<u>CHART LETTER</u>	<u>V.</u>	<u>B-V.</u>	<u>ADOPTED.</u>
b	9.55	+0.46	9.5
d	10.03	+0.28	10.0
c	10.06	+0.17	10.1
e	10.15	+0.99	10.2
k	11.12	+0.59	11.1
g	11.20	+0.17	11.2
n	11.50	+1.00	11.5
o	12.26	+0.68	12.3
q	12.40	+0.94	12.4
p	12.40	+1.29	12.4

- r) Require more readings. "r" has 5 measures, three of which
t) agree near 12.45 and the other two agree near 12.65. "t"
u) appears to be varying and "u" almost certainly so as it
brightened at least 0.2 in V on each reading of four.

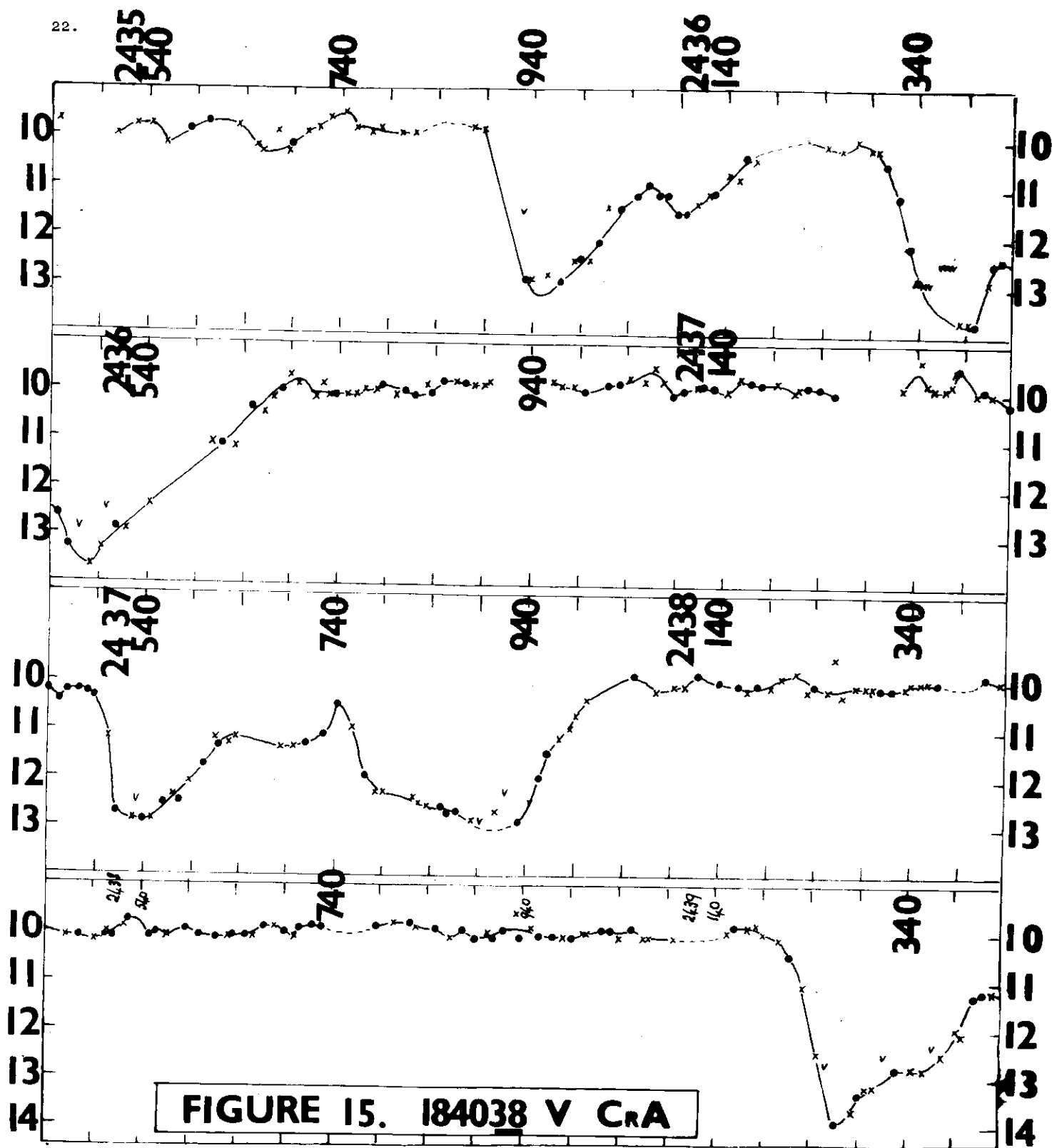
A revised chart will appear when all magnitudes of sequence stars have been determined. In view of the remarks above concerning "r" "t" and "u" these stars should not be used for comparison.

191033 RY Sgr. Figure 14 shows the light curve from 2,442,000 to 2,442,514 in continuation of the curve published by Bateson (1974). RY Sgr has remained at maximum during the interval covered by the present light curve.

SECTION 2.

PHOTOELECTRIC OBSERVATIONS AT THE AUCKLAND OBSERVATORY.

The following three colour photoelectric observations were made at the Auckland Observatory by W.S.G. Walker and B. Marino. They are presented in the same form as those previously published by Marino and Walker (1971). The quality scale listed in the last column is described in the previous publication (Marino & Walker 1971).



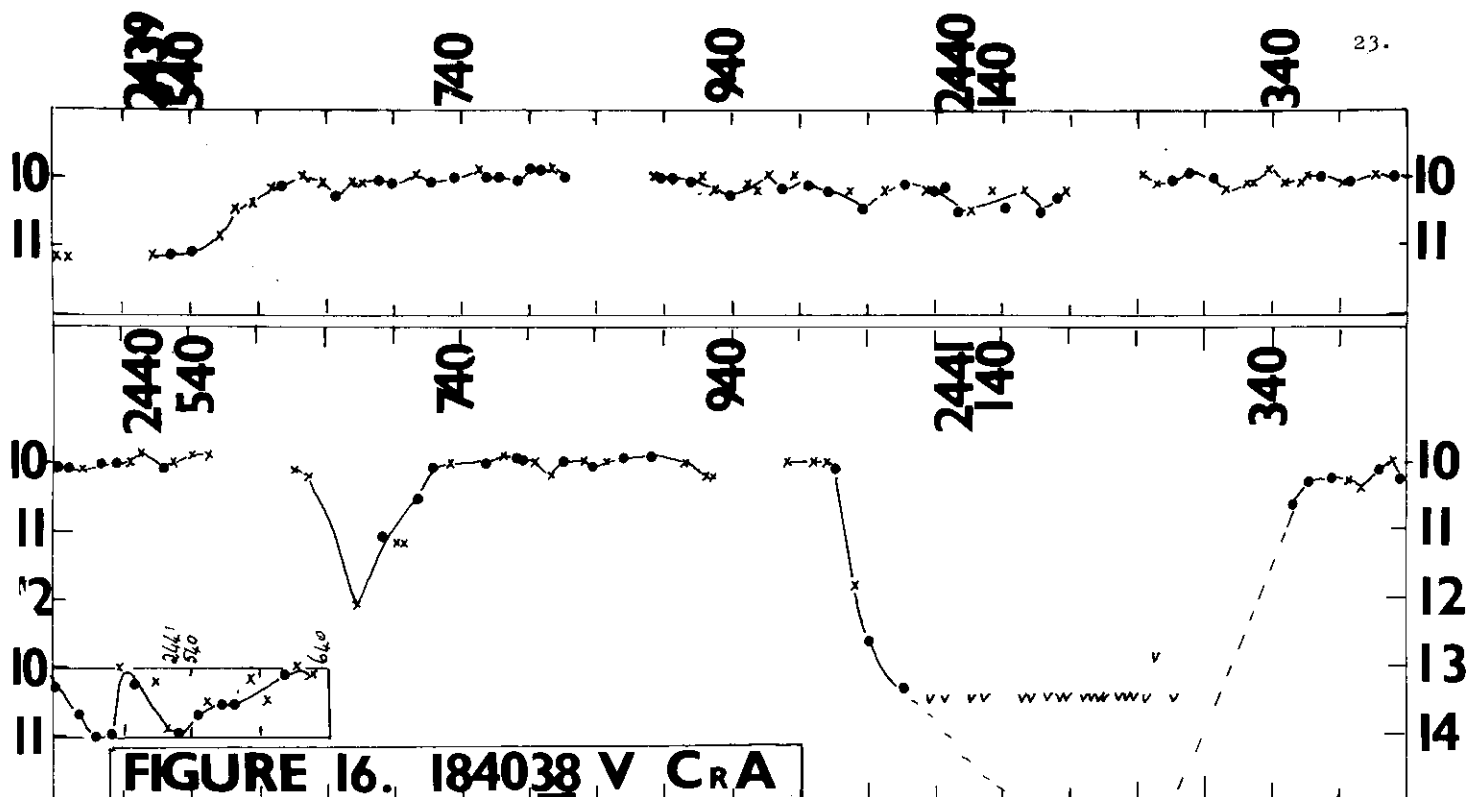
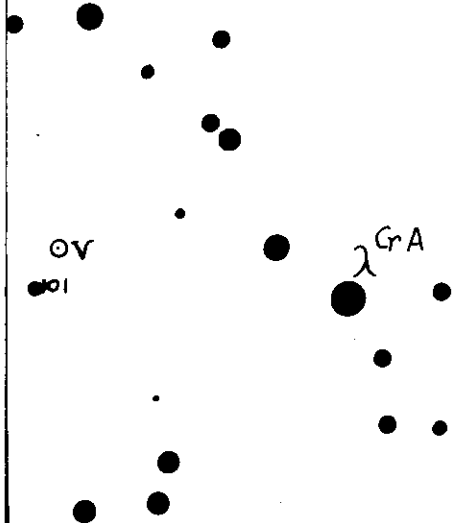


FIGURE 17.

FINDER CHART



184038 V CORONAE AUSTRINAE

(1950), 18h 44m 07s -38° 12.7

Preliminary chart from photo from Lick Observatory.
Use lettered stars for comparison.
Finder chart from M.V. Jones.

J.D. mV B-V U-B QUAL.
2,440,000+

UW Cen.

1342.0	12.89	+1.12	+0.16	3
366.1	12.16	+1.33	+0.75	2
m393.9	11.25	+1.18	+0.73	2
429.0	10.86	+1.16	+0.60	2
449.0	10.75	+1.02	+0.69	3
496.9	9.46	+1.04	+0.42	2
521.9	9.99	+0.90	+0.24	2
554.8	9.85	+0.91	+0.39	2

DY Cen.

1016.13	12.32	+0.36	-0.57	2
016.19	12.30	+0.39	-0.59	2
017.9	12.40	+0.40	-0.54	2
025.0	12.42	+0.36	-0.54	2
029.0	12.40	+0.26	-0.64	3
030.0	12.41	+0.33	-0.58	2
030.1	12.48	+0.32	-0.61	3
034.0	12.30	+0.38	-0.60	2
037.07	12.39	+0.32	-0.61	2
037.18	12.34	+0.33	-0.60	2
038.9	12.34	+0.34	-0.62	2
040.9	12.52	+0.34	-0.55	3
049.0	12.37	+0.31	-0.58	2
064.01	12.46	+0.35	-0.57	2
064.05	12.51	+0.31	-0.53	1
067.0	12.34	+0.28	-0.60	2
067.98	12.36	+0.36	-0.59	2
068.04	12.40	+0.33	-0.56	2
069.9	12.34	+0.36	-0.63	2
078.92	12.33	+0.34	-0.59	2
079.03	12.31	+0.36	-0.67	3
079.08	12.40	+0.28	-0.68	2
079.14	12.22	+0.42	-0.49	3
483.0	12.50	+0.31	-0.61	2
528.9	12.31	+0.36	-0.46	2

S Aps.

0990.0	9.60	+1.20	+0.54	3
1016.2	9.77	+1.20	+0.58	1
027.0	9.76	+1.22	+0.53	1
034.0	9.78	+1.18	+0.49	1
037.2	9.80	+1.15	+0.54	1
064.0	10.44	+1.21	+0.67	1
066.1	10.57	+1.22	+0.61	1
067.0	10.60	+1.24	+0.57	1
070.0	10.79	+1.25	+0.60	2
079.0	11.81	+1.16	+0.29	2
087.2	12.99	+1.29	+0.00	3
088.0	13.23	+1.51	-0.15	2

J.D. mV B-V U-B QUAL.
2,440,000+

S Aps.

1089.8	13.97	+1.37	...	4
092.0	14.32	+1.15	-0.47	5*
148.9	14.32	+0.68	+0.25	4*
152.9	13.39	+1.40	+0.33	4*
342.1	11.52	+1.60	+0.93	4
350.0	11.69	+1.52	...	4
366.2	11.26	+1.47	+0.8:	3
394.0	10.73	+1.37	+0.84	2
429.1	10.29	+1.28	+0.66	1
483.0	9.86	+1.24	+0.67	1
522.9	9.79	+1.26	+0.69	1
526.9	9.66	+1.19	+0.54	1
532.0	9.80	+1.26	+0.66	2
554.9	9.86	+1.27	+0.63	1

N.B. * possibly not S Aps.

RY Sgr.

1067.0	10.50	+1.01	+0.37	4
070.0	10.40	+0.90	+0.28	4
079.0	11.26	+0.91	+0.17	3
087.0	11.55	+1.08	+0.00	2
088.0	11.51	+0.92	-0.01	2
092.0	11.39	+0.89	+0.04	3
093.1	11.40	+0.93	+0.04	1
095.0	11.35	+0.94	+0.13	3
100.0	11.21	+1.06	+0.34	2
109.0	11.06	+1.30	+0.57	1
112.0	11.21	+1.42	+0.43	1
120.0	11.15	+1.35	+0.86	2
130.1	10.41	+1.15	+0/80	1
136.8	9.63	+1.06	+0.66	3
145.8	9.71	+1.25	+0.96	3
149.1	9.99	+1.19	+1.04	1
150.9	10.09	+1.25	+1.11	3
152.0	10.30	+1.24	+1.08	1
155.9	10.64	+1.23	+0.97	2
162.9	11.28	+1.23	+0.81	2
164.9	11.03	+1.42	+0.14	2
171.9	10.44	+1.04	+0.63	1
177.0	10.15	+0.99	+0.72	1
177.81	10.12	+1.00	+0.66	1
177.83	10.11	+0.98	+0.74	1
179.1	10.01	+0.97	+0.72	2
179.9	12.24	+0.83	-0/00	2
210.0	13.32	+0.67	-0.02	3
211.8	13.29	+0.60	-0.21	4
213.9	13.21	+1.07	-0.05	4
224.9	12.67	+0.86	+0.71	2
429.2	11.30	+0.45	+0.13	3
485.0	10.64	+1.26	+0.78	3

<u>J.D.</u>	<u>mV</u>	<u>B-V</u>	<u>U-B</u>	<u>QUAL.</u>	<u>J.D.</u>	<u>mV</u>	<u>B-V</u>	<u>U-B</u>	<u>QUAL.</u>
2,440,000+					2,440,000+				
<u>RY Sgr (cont)</u>					<u>RZ Nor.</u>				
1492.0	10.57	+1.25	+0.76	2	1114.1	10.63	+1.05	+0.52	1
514.9	10.33	+1.21	+0.67	2	130.0	10.72	+1.16	+0.55	1
526.9	9.92	+1.31	+0.93	1	163.1	10.58	+1.10	+0.53	3
554.9	9.75	+1.24	+0.72	1	169.9	10.66	+1.22	+0.74	1
<u>AE Cir.</u>					485.1	12.18	+1.00	+0.60	3
1114.0	13.67	+1.22	-0.43	4	497.0	11.83	+1.07	+1.20	1
130.00	14.08	+0.77	-0.44	3	527.0	11.45	+1.20	+1.30	2
148.9	14.11	+0.99	-0.48	3	<u>RS Tel.</u>				
156.0	14.35	+1.50	-0.31	3	1109.1	11.77	+1.05	+0.71	1
163.0	14.58	+0.83	-0.65	4	149.0	10.62	+1.01	+0.72	1
169.9	13.79	+1.42	...	4	170.0	10.86	+1.09	+0.88	1
185.9	13.96	+1.06	-0.03	3					
209.9	14.60	+2.3	...	5					
485.0	14.17	+1.21	-0.67	4					
<u>GU Sgr.</u>									
1079.2	10.45	+1.20	+0.72	1					
087.2	10.39	+1.26	+0.71	1					
093.2	10.34	+1.20	+0.74	1					
100.1	10.40	+1.24	+0.73	1					
149.0	10.40	+1.15	+0.89	1					
156.2	10.32	+1.06	+0.44	3					
163.1	10.20	+1.16	+0.71	2					
527.8	10.64	+1.24	+0.87	2					

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Acknowledgements: I wish to thank observers for their observations, and especially A.F. Jones for so consistently following a number of these stars over such a long period. His records form a very homogeneous series of observations. Thanks are also due to W.S.G. Walker and B. Marino for their photoelectric observations and determinations of magnitudes for some of the sequence stars. B. Menzies and his assistants have also made a valuable contribution by their determinations of magnitudes for other sequence stars. M.V. Jones has contributed charts for some of the variables and I. Stranson has supplied photos for some regions.

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AN ASTRONOMICAL PILGRIMAGE; VISIT TO NEW ZEALAND AND AUSTRALIA NOVEMBER 1974.

by M.D. Overbeek.

Introduction. Having visited variable star observers in the U.S.A. and attended a general meeting of the AAVSO, I was aware of the enormous benefits which result from personal contacts with other observers. This encouraged me to write to Frank Bateson, Director of the Variable Star Section of the Royal Astronomical Society of New Zealand proposing a meeting with some of the more active observers in the Antipodes. Frank suggested that I attend the Annual Conference of the RASNZ in Wellington and commenced to organise the visit with his usual thoroughness.

Before the visit started I became Director of the VSS of the Astronomical Society of Southern Africa on the resignation of Reginald de Kock, who had served the cause of variable star observing in South Africa so diligently for many years. The visit, which had started out as a personal one, now took a more formal colouring AND it seemed fitting to define its objectives. These were:

(1) To establish how the VSS of the ASSA can be encouraged to function with the greatest benefit to astronomy. At this stage it should be mentioned that there is a certain amount of duplication of effort in the activities of the AAVSO and the RASNZ. It would be nonsensical for our own small VSS to compete with these bodies by publishing data which further overlaps their data. If a programme could be developed which would serve South African astronomers and assist the overseas bodies, the visit would be worth while.

(2) To find out how New Zealand manages to produce ten times more V.S/ estimates than South Africa.

(3) To compare notes with Antipodes observers on methods and equipment.

THE VISIT. My wife, Jean, and I had planned to start the tour by meeting three well known VS observers north of Sydney; Taylor of Armidale, Matchett of Brisbane and Merv Jones of Maryborough. Jones is Australia's answer to the giants in other countries such as the Peltier/Hurless team and our own De Kock. An airline's pilots strike made the visit impossible and we made a beeline for Auckland instead.

As it happened, the Auckland visit was invaluable because we were able to meet the amazing Auckland team led by Stan Walker and Brian Marino on their home ground, as it were, instead of only seeing them at the conference in Wellington. It was a revelation to see how dedicated the various Auckland observing teams are and to witness the enthusiasm and professionalism at this Observatory. Visual observers in the Southern Hemisphere have reason to thank Menzies for his fine photometry of comparison stars. The work of Walker and Marino on dwarf novae is well known. The Transvaal Centre (and other South African Centres for that matter) could do well to study the history of fund raising which led to the acquisition of the fine building and Zeiss 50cm Cassegrain telescope, complete with photoelectric photometry equipment.

The visit by Tom Cragg of Mount Wilson two years previously was

recalled with pleasure by the Auckland group and several others. How can one forget a visitor who turns up with a 13cm telescope under his arm?

The next part of our visit was Tauranga where we spent two days with Frank and Doris Bateson. The time passed only too quickly in a flurry of sightseeing, itinerary planning, get-acquainted dinners and discussions ranging over the whole spectrum of variable star observing. Having known since the early 1950's of Bateson's interest in variable star work and having discussed the VSS of the RASNZ with a number of astronomers, I knew something of Frank's enthusiasm and drive. I had no idea, however that he is so deeply involved in New Zealand's national astronomical and other matters. He surely deserves the title of "Mr. Astronomy, New Zealand".

The non-astronomical highlight of our tour was a visit to the spectacular mountainous areas in the South Island. As we have visited scenic attractions in various other parts of the world, we are in a good position to judge and I can state without hesitation that the Southern Alps and Milford Sound are in the world class.

Reluctantly leaving Queenstown which was our scenic tour base, we called at Dunedin where I was able to discuss occultations with Professor Mackie. The other University staff whom we wanted to see had already left for the conference, where we met them later.

An afternoon and overnight stay in downtown Christchurch did not suffice for this city to reveal her charms to us and we pressed on to Wellington where the conference was held.

The conference exceeded our expectations, both in scope and in the number of delegates. I did not have an advance agenda and had no idea that the discussions would range so far and wide. The papers varied from the mundane to the highly theoretical and there was something for everybody. Since the discussions and papers will be summarised in other publications, I shall not do so here.

Another feature of the Conference which impressed us is the large number of astronomical groups in New Zealand. There seem to be 31 more or less active groups, of which 24 are affiliated to the Royal Astronomical Society of New Zealand. This is an impressive number for a country with such a small population and so few astronomical institutions. Delegates from many groups were present at the conference and gave a good account of their groups' activities.

The greatest benefit which the conference held for me was the number of contacts made with working astronomers. I am sure that some of the connections we made will endure for a long time.

I found the report of the variable star section important. We already had the dry facts and figures but what was interesting was Mr. Bateson's look into the future; More reliance on photoelectric work, more attention to be paid to small amplitude variables such as eclipsing binaries, and the management of the variable star section

one day when Frank cannot carry the burden alone. I for one look forward with interest to the 1977 meeting where this will be discussed in depth.

The conference ended with a visit to Carter Observatory, one of the few full time optical observing stations in New Zealand. (A tight schedule prevented a visit to Mount John, where the biggest instrument in New Zealand, a 61cm Cassegrain reflecting telescope is used). Carter's largest instrument is a 40cm Boller and Chivens Cassegrain. Spectrography, photoelectric photometry and astrography are actively pursued here. I was intrigued by a photograph of Bennett's Comet 1974. Bennett had discovered the comet a few days before we left for New Zealand, and the Carter observers obtained a photograph before anybody in South Africa could get a decent image of this diffuse object.

After the conference, we returned to the South Island in order to visit Albert Jones. Albert Jones is New Zealand's answer to Merv Jones of Australia and must be one of the most prolific and accomplished variable star observers of all time. Several factors militated against an evening at the eyepiece of Albert's 31cm Newtonian but we spent an interesting afternoon and evening at the Jones's and went through all my star charts together. Albert seemed to know every one of them like an old friend and could give me the benefit of his great experience. He was rather diffident about showing me his instrument because it has a decided rustic look. In fact the polar axis seems to be based on the wheel of an agricultural implement! My telescope has the same kind of polar axis and has a square tube like Albert's. It gave me heart to compare our instruments and we agreed that it is the boy who uses a stick and bent pin who catches the best fish.

Our last visit in New Zealand was to the Rotorua thermal region where we "did" the sights and absorbed Maori culture. Our spirits were a little dampened by a heavy continuous downpour which all but extinguished the underground fires and nearly inundated our motel. We enjoyed a thoroughly relaxing stay there, however and left New Zealand with real regret.

Back in Sydney, we booked a bus trip to Canberra and Melbourne in order to see as much of the Australian countryside at close quarters as we could. Time did not permit a surface journey through the more desolate parts of Australia so dear to the hearts of novelists but then I had seen plenty of desolation in various parts of Africa and America and could do without this particular treat!

Frank, with his usual efficiency had smoothed the way for me at Mount Stromlo and I was able to spend a whole day there while Jean explored Canberra. I came away with a good idea of the activities at this very active station and received some excellent tips on the coating of mirrors. A personal note must creep in here. As a first year student at Witwatersrand University in 1939, I used to peer through the windows of the building housing the 69cm Yale refractor which was being used for a long series of parallax and proper motion studies. Encroaching city lights and traffic made the site unsuitable and the

telescope was moved. It was quite a reunion when I encountered the same telescope at Mount Stromlo, the peripherals modified but still doing the same work.

On our arrival in Melbourne, variable star observer Bruce Tregaskis took us under his wing and gave me a day and a night for our benefit. A visit to the old Melbourne Observatory site was interesting. The old 127cm Newtonian which I suspect had never really distinguished itself in Melbourne, has been given a new mirror and transferred to Mount Stromlo. The local amateurs inherited some of the remains of the observatory and are putting them to good use. The situation is analogous to the Johannesburg one, where the best instrument has been removed to the atmospherically more favourable Sutherland, and the rest of the equipment left behind.

An evening at the Tregaskis home, after being feasted in true Australian style and comparing instruments and star charts rounded off a most enjoyable visit to Melbourne.

Next came Hobart, Tasmania. Having read Mark Twain's "More Tramps Abroad", I pictured Tasmania as a densely wooded island and was astonished at the wide vistas and open fields which we saw. An ascent of Mount Wellington (1200m) gave us a good view of Hobart. We were intrigued to find some ice at the summit, only a fortnight before the summer solstice.

The Hobart climate is decidedly cool and cloudy but this did not deter the local University from building a very fine and modern 101cm telescope. What impressed me is that the mirror is being ground and figured in Melbourne. It speaks volumes for Australian enterprise.

Long ago, a prominent astronomer gave this advice on what to observe: "Young man, if it is in the sky, observe it." This came to mind when Eric Harries-Harris introduced me to an old variable star observer, Reg Shinkfield. Reg observed variables faithfully from 1927 until he suffered a coronary attack recently. When the Sun hid the variables he used to do a sunspot count and when the Sun was hidden by cloud he could project cloud images on a grid and deduce wind velocity at a given altitude from his knowledge of cloud heights! Let us hope that he will recover completely and resume his variable star observing activities.

In Adelaide we were adopted by the Harries-Harris family. The family looked after us well for two nights and a day. Eric's own observatory is worthy of note. It must be nearly the smallest observatory proper in the world but is convenient; a sine qua non for VS work. So, little free space is available, that his clock is mounted on the telescope tube! His comparator is also mounted on the tube and he uses it by observing a rheostat-controlled artificial star image with one eye and the variable or comparison image with the other. I have some reservations about this method but Eric is happy with it and after all the proof of the pudding is in the eating!

Our last port of call was Perth where we did much non-astronomical sightseeing. Dr. S.E. Williams of the University of West Australia kindly arranged a visit to the impressive astronomical complex 32 km east of the city. We were impressed by the instruments, the programmes and especially by the site which is a clearing in the bush on high ground. Kangaroos regularly visit the observatory at night but during the day bush flies in vast numbers take over. These are not the ordinary domestic flies and carry no infection but they certainly made their presence felt!

A quick dash from the observatory to the airport completed our Antipodes tour and soon we were on our way home.

IMPRESSIONS. What impressed me most was the close co-operation between professional and amateur astronomers in New Zealand. Illustrative of this is the appellation "part time astronomer" which is commonly used instead of "amateur." The consistent use of this term must alone foster co-operation. The membership of the New Zealand National Committee for Astronomy is headed by Bateson, an amateur (and here I use the term deliberately) and it has two part-time astronomer members. All the part-timers engaged in advanced work seemed to have strong ties with Universities. It would be hard to imagine an astronomical symposium in New Zealand to which "amateurs" are not invited.

In Australia I did not notice the same mutual involvement although it probably exists here and there. We were not there long enough to make an in-depth study of the situation.

In the past, South Africa had some shining examples of interaction between "town and gown" (or in astronomy, should we say "home and dome"). Although contact still exists, there is much room for closer co-operation. This is not a thing which can be imposed by decree. It grows out of mutual respect for the other group's intentions and capabilities. In the Transvaal Centre we are making a positive effort to involve Universities and we hope that the availability of our Centre observatory with its photoelectric capability will further the cause.

The second striking thing about astronomy in New Zealand is the amount of money which overseas and local institutions, banks, building societies, industries and private individuals have granted for buildings and equipment. There is a lesson for us here; money is tighter than in South Africa but astronomical groups make a real effort to obtain funds.

I would like to conclude this section with some comforting notes for the part time astronomers in South Africa. The New Zealand variable star observers are way ahead in productivity and in photoelectric photometry but we have the same capability and are sure to receive expert help if we are serious about getting started. Also, we are ahead in the field of lunar occultations. We are more active in observing total and grazing occultations and our high speed photometry of occultations is far ahead of the New Zealand work.

CONCLUSION.

This account is a personal one and makes no attempt at giving an accurate picture of astronomy in the Antipodes. Detailed information can be found in the Royal Society of New Zealand's "Report on Astronomy in New Zealand" (May 1974) and the IAU's "Information Bulletin for the Southern Hemisphere" (April 1973) on Australian astronomy.

Finally there is no simple answer to my question as to why the New Zealand variable star group is so active compared with our own.

There are sociological differences but the biggest single factor is the astronomical and organisational expertise, and the devotion and energy shown over so many years by Frank Bateson.

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PHOTOELECTRIC PHOTOMETRY IN THE SMALL OBSERVATORY

By W.S.G. Walker and Brian F. Marino

Whilst photo-electric photometry is a fairly routine observational technique amongst professional astronomers very few part-time astronomers seem to have attempted this type of observation. This is a little suprising to us, for the amount of finance and time required is very little different from that required to set up a good amateur radio installation and is sometimes less than many people spend upon developing photographic facilities at the telescope, with which they attempt to compete with Mt. Wilson or Palomar. We suspect that many people and groups avoid photo-electric work because of its reputed complexity. Unfortunately little has been done to dispel this air of mystery, but we hope that the comments in this article will serve to present modern photo-electric techniques in a comprehensible manner.

It has two great advantages over visual observing. Accuracy is better, usually to ± 0.02 magnitudes and this can be improved if necessary with special techniques. By a choice of suitable detectors and filters measures can be made at different wavelengths and the spectral energy distribution of the star determined. By using spectral scanning techniques spectro-photometry of a star is performed. More commonly, however, various combinations of narrow band or broad band filters are used and from these are derived a magnitude in some colour system plus a series of colour differences or indices. Normally these are reduced to a standard system so that observations at different places can be compared.

The most widely used system of colour measures and the only one which we consider suitable for part time astronomers is the Johnson UBV (or three colour) system. Almost every other system

introduces complications - either in special photomultiplier tubes, or expensive and inefficient filters, or theoretical knowledge requirements - and may cause disappointment. Even worse it may result in unwitting errors and the production of incorrect results. We have used the UBV system in Auckland since 1969 and have found it easy to understand and completely adequate for most purposes.

We do not wish to suggest that all visual variable star observers would be better off measuring them photo-electrically. This is not only impractical but would lead to a neglect of the Section's most important function. But there are areas where this type of observation is valuable and complements the work of the visual observers. Amongst readers of this publication there may be a few interested in extending their observations by photo-electric techniques. Alternatively, some societies or groups may feel that this is a useful project for some of their more technically minded members. And certainly visual observers will find some value in understanding a little more about this mysterious art.

The UBV three-colour system uses three filters which in combination with a photo-multiplier tube, the cathode of which is sensitive to particular wavelengths of light, allow light to be measured from three regions of the spectrum each about 600 angstroms wide. The V filter is centred near the region where the eye is most sensitive and from this is derived a measure of the apparent brightness of the star, mV. The B filter measures a region in the blue part of the spectrum around 4500 angstroms. A comparison of the respective intensities of these two measures allows the slope of the spectrum to be determined and the temperature of the star ascertained. This B-V colour gives a colour index for the star which can be transformed into either spectral class or surface temperature, provided that a correction for interstellar reddening can be determined. The U filter measures a region shortward of the blue filter and includes the Balmer jump. From this measure is derived a U-B colour, which, used in conjunction with the B-V colour allow the reddening to be determined and makes the total system extremely powerful.

When these two colours are plotted upon a colour-colour diagram on which the main sequence locus is marked it allows the determination of such things as luminosity class of the star, its reddening by interstellar material, line blanketing, etc. When allied with even a rudimentary light curve, the position on this diagram allows a very good determination of the type of any variable star. In complex systems, such as dwarf novae, the colour changes can enable us to determine what is happening during outbursts and during eclipses.

All this information is not obtained without work and the sacrifice of some of the advantages of visual observing. To make a photo-electric measure (including comparison stars, etc) may take 15 minutes and three separate variable stars per hour is good going. Most good visual observers can do a lot better than this! The then observations must be reduced and analysed. And whilst visual observing

can be done by experienced observers in mediocre conditions photo-electric observers are defeated by haze, light cirrus and twilight. But if the two can be used to complement each other, the benefits gained are very worthwhile.

In setting up a photo-electric system a number of points must be considered. The most important are:

Are the resources - financial, technical, observational- adequate?

What type of programmes are of interest?

Will these be suitable for photoelectric photometry and will the installation be suitable?

Is the site good enough and is the instrument available suitable for this type of work?

Ideally the project would be attempted by a group of 4-6 people including at least one with some ability in the electronics field. Access to and ability to use metalworking machinery saves considerable initial cost. If people with ability in these two areas are available a photo-electric photometer and recording system can be set up at a cost of about \$750 N.Z. A professionally built power supply and optical train would add about \$800 to the cost. These figures may seem alarming at first sight but are no more expensive than a good amateur radio or photographic installation. Spread over a number of people and a couple of years it is not too great a hurdle - certainly less expensive than smoking or betting on the races.

TABLE 1.

COMPONENTS OF A PHOTO-ELECTRIC SYSTEM AND APPROXIMATE COSTS.

(a) Optical Train, including filter banks and photo-multiplier tube housing.	\$30 materials \$ 450 labour
(b) Filters	\$ 30
(c) Eyepieces (2)	\$ 30 - \$50
(d) Photomultiplier Tube, Base & Shield	\$ 50 - \$200
(e) EHT Power Supply	---Built by Group \$ 100 ---Commercial \$ 450
(f) Digitiser	\$ 30
(g) Digital Display Unit	\$ 300

When operational you will require a couple of two-man observing teams, the electronics expert for maintenance, and two or three people for data reduction. Only simple arithmetic and algebra is necessary but at least one and preferably two people should have a reasonable knowledge of the astronomy behind the programme. On the organisational level someone must see that the whole project is completed and the results finally appear in a published form. Whilst one person can manage all of this a group of 4-6 people seems to produce best results. Large groups create problems unless the organisation is very good and

it is better for a small number of people to become absolutely familiar with the installation at first. In Auckland we have about 6 very proficient people, about 12 regular assistants and about the same number of 'casuals'. This works very well.

In programme selection the main rule to remember is to keep them simple and don't attempt programmes unsuited to your installation or theoretical background. You can of course obtain help in the latter once you have convinced the right people of your observational ability.

The most suitable telescope is a Cassegrain, at least 15cm in diameter. German equatorial mounts are best. Newtonian telescopes from 20-30cm can be used but are less satisfactory. Larger than this they are dangerous due to the height above ground of the observing platform. Fork-mounted Cassegrains present some problems but can be used if already available. The drive must be relatively smooth and capable of tracking to better than 30 arcseconds for 10 minutes. (Most drives would perform to better than 10 arcseconds over this period). Fine adjustments in both declination and right ascension are necessary. Guiding facilities are an unnecessary luxury in most applications.

As far as the site is concerned, almost anywhere is suitable. Naturally clear dark skies are preferable but convenience for observing can make up for the disadvantage of a poorer site. Things to avoid are interferences of a variable nature - e.g. car lights shining on the telescope, smoke, etc. You will undoubtedly be told you cannot do photometry at a poor site but don't be alarmed - we have managed fairly well in the heart of Auckland city.

In the remainder of this article we discuss the assembly of a complete photo-electric system. Because of space considerations this is only a very superficial description and any attempt to build up equipment from this would probably end in disaster and disillusionment. We suggest that any person or group seriously interested in constructing this equipment should contact the writers directly and we will be prepared to supply much more extensive information on all aspects of the system, also on reductions and other useful points.

Before rushing ahead spare some thought for the overall installation to ensure that the best use is made of the finance. It is surprising how many people combine an expensive 40cm telescope with a mediocre photomultiplier tube, achieving about the same result as a 7.5cm telescope with a more modern tube. Similarly the recording systems used are often old fashioned and entail many hours of extra work when with fractionally more expenditure modern equipment will save hours of time and result in more efficient use of available time.

The tube we recommend is the EMI 9502, selected for low dark current. This costs something under \$200 but is well worth the expenditure. This will enable measures to be made of anything visible in

the telescope. The less sensitive EMI 6097 is sometimes used and costs only a quarter of this sum. But a 3-4 magnitude loss in sensitivity is hard to live with. Both these tubes have S11 photocathodes and are used end on. There is no great virtue in purchasing the quartz versions of these tubes unless you feel that the \$20-30 extra is a good investment. The 1P21 (and the ultraviolet 1P28 version) are now obsolescent and we see no virtue in using them - even if someone has given you one. They are just too insensitive and noisy to be worthwhile.

By using the low noise EMI 9502 the necessity of refrigeration is avoided. Magnetic shielding is essential but is simple. The gain is high enough to drive recording equipment without any preamplifier, thus removing a troublesome component.

The design of the photometer optical train is important and at Auckland it was built from box section aluminium with flanges. The filter banks and aperture wheels were then constructed as a rotary unit and sandwiched into place. This has allowed the addition of extra banks of filters as required. It is very simple to make this way. Apart from this it is a simple two eyepiece system. Following classical design we have erred by making the second eyepiece a sliding type. Both eyepieces should work in conjunction with flip up mirrors. A dark slide to protect the photomultiplier tube is a must.

A power supply is needed to provide E.H.T. for the tube. Requirements are 1700 volts at a few milliamps with stability of 0.01%. These cost several hundred dollars commercially but can be constructed by a capable person much more cheaply. Provision for intermediate voltages is required. It serves two purposes - to allow a gradual warm up which is a little easier on tubes and also to allow a change of gain to give added range to the system. We operate between 1000 and 1600 volts to give an overall range of about 12 magnitudes (about 7 at any one voltage). Some change in colour response at different voltages was expected but has not materialised in spite of exhaustive testing.

The only filters needed are the standard UVB from either Corning or Schott. These are relatively inexpensive and supply could be arranged through the authors. The U Filter also transmits some light in the red region of the spectrum. This 'red leak' is a problem with older tubes but the sharper spectral cut off of the EMI tubes avoids this problem almost entirely.

Once this part of the system is operational and the telescope is pointed at a star a signal current is obtained from the tube. This is of the order of a few nanoamperes, rising to a few microamperes in extreme cases. Fairly sensitive recording equipment is required and a choice between analogue and digital equipment needs to be made. The first involves a good chart recorder (and possibly a preamplifier), the second a digital display unit or less satisfactorily a sensitive meter. Since in almost all programmes the observations require some form of reduction they must at some stage be digitised. It is much more convenient to do this prior to recording, thus avoiding hours of tedious measuring on paper rolls. In a few programmes analogue

recording has some advantages, and if these are your specialty a chart recorder is the answer. But generally digital techniques are far superior.

To record a digital signal you will require a digitiser and a digital recorder - total cost about \$350 N.Z. After this, if you really want it, a chart recorder can be acquired and operated to provide a visual record. We have never found it necessary.

Apart from this the requirements are normal to any observatory. A good clock and a radio, plenty of recording forms and graph paper, comfortable surroundings and keen and able people to make it all go.

Comes the great night and the data begins to emerge. Suddenly you realise that something more is required before the numbers you are writing down can be presented as a sensible observation of a variable star. There are a number of steps. (We assume that the reader is familiar with the mechanical ones of obtaining net intensities of the measured objects and converting these to magnitudes).

Initially the photometric system must be calibrated, i.e. standardised so that the observations can be converted to outside atmosphere values in the Johnson UBV system. The linearity of the equipment must be confirmed and the atmospheric effects at the site evaluated. It sounds complex but is quite simple, provided that a methodical approach is adopted.

The atmospheric effects must be tackled first. These arise because the atmosphere attenuates blue light much more than red light. In passing through the atmosphere starlight is reddened, and blue stars are reddened more than red ones. By measuring pairs of red and blue stars in three colours at various altitudes (with different atmospheric path lengths) it is possible to measure this effect. If we define the atmospheric thickness at the Zenith as one air mass we can calculate the air mass at other positions. A graph showing the changes in intensity will then yield values for the colour changes and these can be extrapolated to zero air mass or outside atmosphere values. The coefficients are:

K_v	Extinction in 'v'.
$K'b-v$	Extinction in b-v of a star of zero b-v in the natural system.
$K'u-b$	Extinction in u-b of a star of zero u-b in the natural system.
$K''b-v$	The difference in extinction of two stars separated in colour by one magnitude in the natural system.
$K''u-b$	The difference in extinction of two stars separated in colour by one magnitude in the natural system.

The natural system relates to the values obtained by you before any corrections are applied. There is no colour term with the visual filter.

Approximate values can be derived in a single night but these measures should be kept ~~up~~ ⁱⁿ, usually as part of a programme, and

evaluated from time to time.

The tube filter combination will not exactly reproduce Johnson's original system but linear corrections are readily derived. The method is to measure a number of standard stars of different colours as near as possible to the same air mass (preferably near the zenith) and to plot the observed colours against the known colours. The observed colours must first be corrected for atmospheric effects as described above.

This plot should reveal small linear corrections for V, B-V and U-B (ϵ , μ and ψ respectively). These are often called the scale factors of the tube and remain fairly constant unless you move the tube, rewire the base, change the filters or so on. Once again the initial measures are obtained in a single night and checked once or twice per year.

The final check is linearity. Select a number of stars of similar colour over a 6-7 magnitude range and measure these a number of times. The magnitude differences in V in your system should correspond with the published differences to the accuracy desired.

Some programmes can be done without calibration and of course observations made prior to calibration can later be reduced providing nothing is changed too drastically. In any case make as many measures as possible and get to know your system. After a few weeks the measuring of stars with a purpose in mind can begin. There is a great temptation to attempt everything. Don't be bashful, measure everything in sight, reduce the data and try to learn something from it.

After a few weeks or months - dependant usually upon how clear the skies are - you feel ready to tackle a serious observational programme.

The range of possible programmes is very large but initially we would hope that you will work in areas which benefit the Variable Star Section. A summary of these is shown in Table 2. The first three we would consider the most valuable and the most in keeping with the traditional purposes of the section. They are also the easiest! It is not possible to cover, in an article of this type, the reasons behind the selection of these particular ones. All we can say, after about 7 years of photo-electric observations, is that this is the area where we think that part-time observers, using photo-electric equipment, can make the most useful astronomical contribution.

A number of people are concerned about the time spent upon reductions. This is a particular consideration for the part time astronomer, who does not normally have access to large computers, and it is essential that mountains of unprocessed data do not accumulate. Only when programmes of the last two types are attempted is this likely to become a problem and before these are attempted the data handling aspects should be studied and procedures established.

Select a programme after consultation with someone who can advise

you sensibly, bearing in mind the extent of your equipment and other resources. He can advise you on the accuracy required, both in time and magnitude of the star, the method of observing, selection of comparison and check stars, etc. Initially it pays to duplicate someone else's work as a check until you acquire the feel. But once experience is gained then provided you follow the rules your results will be accurate and reliable.

After a while your results can be drawn up into graphs which will show what your star is doing. Finally the project is completed and -- to put it into perspective --you know a little about one particular star that no one else on Earth does. This is the time for an observational note or paper. Present your observations in the prescribed form, draw whatever graphs are necessary and describe what you have found. If necessary, more experienced people are always pleased to help you with this. When your note or paper is published you can feel a sense of achievement that, in presenting something which was not known before, you have not only added a little to our astronomical knowledge but have done something just a little out of the ordinary.

TABLE 2.

<u>PROGRAMME</u>	<u>SKY REQUIREMENTS</u>	<u>TIME REQUIREMENTS</u>	<u>DATA REDUCTION.</u>
1. Light curves L.P. Variables 50-1000 days UBV	30 minutes clear twice weekly	15-30 minutes per obser- vation	30-45 minutes per point.
2. New Variables, Suspected Variables UBV	--ditto--	--ditto--	--ditto--
3. Measurement of periods-- either maxima or eclipses. Single colour filter.	A reasonable number of clear evenings during the programme.	Cepheids, as above Eclipsing binaries 2-4 hours about eclipse	Twice observing time, plus 2 hours per O-C point
4. Light curves Eclipsing Binaries, etc. UBV	An expectation of 2-3 nights per week clear.	Usually 2-3 times the period of the star spread over about 10-20 cycles.	Time consuming reductions--about 3 times observing time. Computing facilities almost essential.
5. Flare Stars, B or U mainly	Dependant upon programme. Can often use mediocre conditions & short clear intervals.	Not strict. Usually as much as observer is prepared to use.	Easier if chart recorder used. Can produce masses of data, requiring 2-3 times observing time to reduce.

NOTES TO TABLE 2 ON VALUE OF PROGRAMMES.

1. No-one in this field at present, colour changes are of interest for a variety of reasons.

2. Confirms variability, determines type of star. Provides light curves and colour changes.
3. Establishes regularity of periods. Detects changing periods due to evolution, mass transfer, etc. Long term in nature.
4. Accurate light curves allow determination of various physical parameters of star by someone with appropriate ability. Professional guidance essential. Programme not recommended except to large groups. Useful as a practice programme on occasions.
5. Debatable. Chief value in confirming flares in other spectral regions, e.g. X-ray and Radio. High speed, 3 colour data could be highly valuable, but beyond part-time resources.

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SEQUENCES FOR SOUTHERN VARIABLES

by B. Menzies.

SUMMARY: V and B-V magnitudes are published for part of the sequences for KW Car and AL Car, charts for which have already been published.

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

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

Visual observers are requested to use the magnitudes given under "Adopted" (V magnitudes rounded off to tenths), in place of chart letters when making their estimates.

ACKNOWLEDGEMENTS: I wish to thank the Board of Trustees of the Auckland Observatory for the use of their 50cm Zeiss reflector and auxiliary equipment for this programme. I also wish to convey my personal thanks to my observing team of Graham Blow, Peter Connolly, Philip Ellis, Trixie Stewart and Faye Williams for their work on this programme, which includes the details published in additional papers appearing in this Publication. Also my gratitude to Grant Christie for having the observations reduced by computer.

REFERENCES:

1970. Bateson, F.M. & Menzies, B. "Sequence Determination". Circ. 148, VSS, RASNZ.
1971. Bateson, F.M., Gordon, P.J. & Menzies, B. "Sequences for Southern Variables". Circ. 177, VSS, RASNZ.
1971. Bateson, F.M., Jones, A.F. & Stranson, I. "Charts for Southern Variables -- Series 7". Published by Bateson.
1972. Bateson, F.M., Gordon, P.J. & Menzies, B. Circ. 187, VSS, RASNZ.

SEQUENCES

085358 KW Carinae (Chart 297). Standard H.D. 77370

<u>CHART LETTER</u>	<u>V</u>	<u>B-V</u>	<u>ADOPTED.</u>
a	11.26	+0.62	11.3
b	11.71	+0.54	11.7
c	11.97	+0.39	12.0
d	12.05	+1.46	12.1
e	12.59	+1.23	12.6
f and g	Not yet determined.		

085759 AL Carinae (Chart 297). Standard H.D. 77370

a	9.80	+1.45	9.8
c	10.38	+0.27	10.4
d	11.29	+0.46	11.3
e	11.78	+0.37	11.8
b, g, h, f	Not yet determined.		

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SY MUSCAE

Frank M. Bateson, A.F. Jones & B. Menzies.

SUMMARY: V and B-V magnitudes are listed for the comparison stars for SY Mus. Visual observations from 2,434,910 to 2,441,510 are presented in a light curve. The elements derived are:-
 EPOCH (Primary Minimum) 2,436,460 $\pm$ 621.8
 RANGE:- 10.2_v to 12.7_v. (mean 10.8_v to 11.8_v)

Secondary minima, average magnitude 11.25_v, tend to occur 170 days before primary minimum. Secondary minima are short and sharp. Maxima are broad and flat.

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CHARTS: SY Mus and its comparison stars are shown on Chart 298 (Bateson et al 1971). The comparison stars included those used by Uitterdijk (1934), and others selected by A.F. Jones. The accompanying Figure shows these stars.

SEQUENCE: Menzies, using H.D. 100508 as a standard, has determined V and B-V magnitudes for the comparison stars. Table 1 tabulates these measures. The adopted magnitudes, rounded off to tenths, are given in the fourth column, and these are the values to be used by visual observers.

OBSERVATIONS: The light curve shows the visual observations from 2,434,910 to 2,441,510. Before 2,440,930 the estimates are mainly from A.F. Jones, supplemented by a few observations by Bateson. The scattered records since 2,440,930 are from several observers.

In the light curve single estimates within a ten day interval are plotted as crosses. Filled circles indicate ten day means from two or more observations.

TABLE 1.MAGNITUDES OF SEQUENCE STARS FOR SY Mus.

<u>CHART LETTER.</u>	<u>V</u>	<u>B-V</u>	<u>ADOPTED</u>
A	10.19	+0.43	10.2
c	10.54	+0.67	10.5
e	10.90	+1.49	10.9
d	11.03	+0.68	11.0
h	11.72	+1.77	11.7
f	12.26	+0.92	12.3
g	12.67	+1.37	12.7

DISCUSSION: The mean visual range of 10.8 to 11.8 makes SY Mus a difficult star to observe visually. Small fluctuations appear to be often continuous and irregular. However, if such fluctuations are ignored, and a smooth curve drawn some regular features become apparent.

Primary minima, as given in Table 2, are generally distinct with a mean period of 621.8 days.

TABLE 2.PRIMARY MINIMA OF SY Mus.

<u>OBSERVED J.D.</u>	<u>MAG_v</u>	<u>INT_d</u>	<u>O-C_d</u>
2,435,222	11.5	...	+ 6
830	11.8	608	- 8
2,436,460	11.6	630	+ 0
2,437,115	11.2	655	+33
710	11.8	595	+ 6
2,438,318	11.9	608	- 7
920?	11.6?	602	-27
2,439,533	12.1	613	-36
2,440,140	11.8	607	-51
790?	11.6?	650	-23
2,441,440?	12.7	650	+ 6

In the above Table O-C residuals are calculated for the Epoch 2,436,460 $\pm$ 621.8 days.

Short, sharp secondary minima tend to occur around 170 days before primary minima. However, whilst obvious at times, they are often so shallow that it is possible that some are due to the errors inherent in visual estimates. The best that can be stated is that SY Mus probably has secondary minima.

Maxima are generally broad and flat, with small peaks at intervals during the maxima. Whether these peaks are real, or merely the effect of seeing conditions on the estimates is impossible to decide.

The extreme range of SY Mus is 10.2_V to 12.7_V with a mean range of 10.8_V to 11.8_V. This star has a composite spectrum (Henize 1952) which is why it is tentatively assigned to the Z And class. The long period variation is probably due to a Mira type star. Whether a much hotter companion is responsible for the minor fluctuations, and whether these are real, can only be determined by photoelectric observations.

References:

1971. Bateson, F.M., Jones, A.F. & Stranson, I. "Charts for Southern Variables--Series 7". Published by Bateson.
 1952. Henize, K.G. Ap. J. 115, 133.
 1934. Uitterdijk, F. B.A.N. VII, 256.

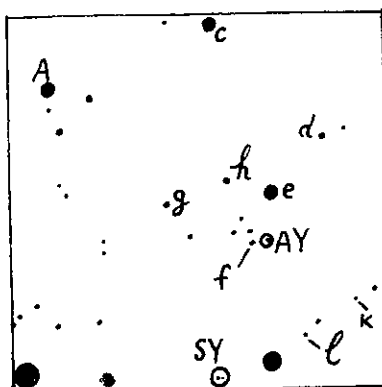
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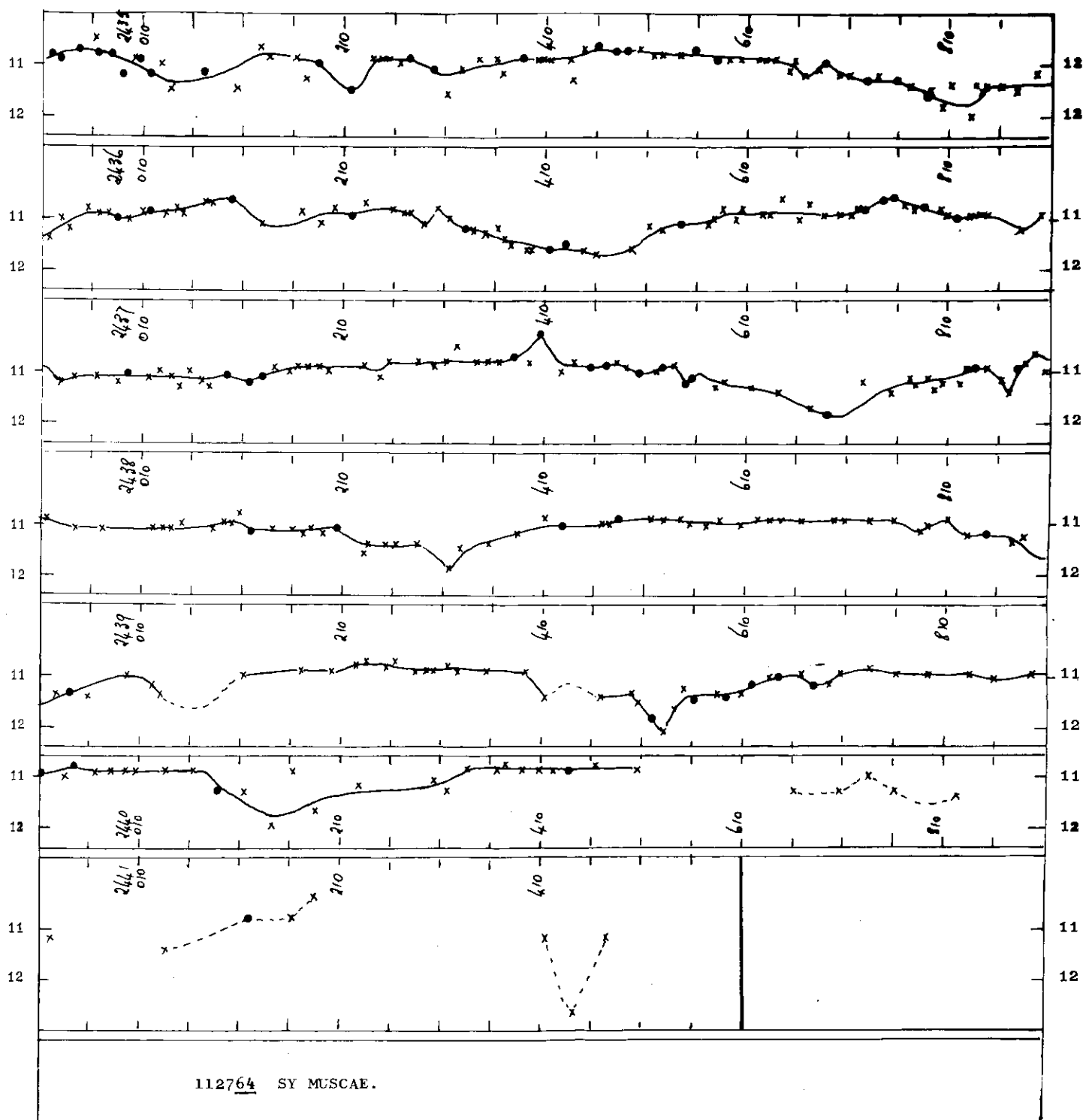
IDENTIFICATION CHART FOR SY Mus.

112764 SY Mus. (1900) 11h 27m 36s -64° 52'
 (1950) 11 29 51 -65 08

Star "A" is HDE 310,588. Spec. Ao.

N.





U FORNACIS.

Frank M. Bateson, A.F. Jones & B. Menzies.

SUMMARY: V and B-V magnitudes for the comparison stars for U For are given, together with visual observations in the form of a light curve. Period determined is:-

EPOCH (Max). 2,436,365 $\pm$ 319.75 days.

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CHART & SEQUENCE: A chart was published by Walker and Olmsted 1958. Jones selected comparison stars, which are shown in Figure 1. Menzies determined V and B-V magnitudes, using HD 24339 as standard. The values are given in Table 1, the last column of which gives the magnitudes to be used by visual observers.

TABLE 1.

COMPARISON STARS FOR U For.

<u>CHART LETTER</u>	<u>V</u>	<u>B-V</u>	<u>ADOPTED</u>	<u>REMARKS.</u>
A	9.63	+0.83	9.6	CoD -25 ⁰ 1525
d	10.20	+0.87	10.2	-25 1529
g	11.86	+0.51	11.9	-25 1526
k	12.34	+0.54	12.3	} not in
l	12.64	+0.53	12.6	
m	12.66	+0.75	12.7	
p	13.28	+0.46	13.3	
t	13.67	+0.57	13.7	} does not exist
w	Not determined			

OBSERVATIONS: Jones has observed U For from 2,436,260. His observations are plotted in Figure 2, as individual estimates. The observations decreased in number after a few maxima had been observed because observing was directed to more southerly stars. The observations after 2,440,260 were:-

2,440,000+		
275 13.5	419 (13.7	626 (13.7
304 (13.7	486 11.9	682 (13.7
325 (13.7	510 11.9	773 (13.7
383 (13.7	563 11.7	813 11.6
		921 (13.7

DISCUSSION:- Maxima derived from the observations are listed in Table 2. O-C residuals in the fifth column are based on Epoch (Max) 2,428,730 + 318.0 days as given by Kukarkin et al (1969); those in the sixth column were obtained for Epoch (Max) 2,436,365 + 319.75 days which appears to satisfy the observations.

Maximum magnitude appears to change little between one maximum and the next. Minima are below the limit of the instruments used and are probably below 15.0_v.

TABLE 2.OBSERVED MAXIMA OF U For.

<u>J.D.</u>	<u>MAG_v</u>	<u>INT_d</u>	<u>Wt.</u>	<u>O-C_d(1)</u>	<u>O-C_d(2)</u>
2,436,365	10.3	...	4	+ 3	$\pm$ 0
691	10.1	326	4	+11	$\pm$ 6
2,437,009	9.8	318	3	+11	+ 5
319	10.3	310	3	+ 3	+ 5
651	10.4	332	4	+17	- 7
957	10.2	306	3	+ 5	- 7
2,438,286	10.2	329	2	+16	+ 3
600	10.0	314	1	+12	- 3
930	10.0	330	2	+24	+ 7
2,439,250	10.0	320	1	+26	+ 7
568	9.9	318	2	+26	+ 5
881	10.1	313	2	+21	- 1
2,440,202	10.0	321	1	+24	$\pm$ 0

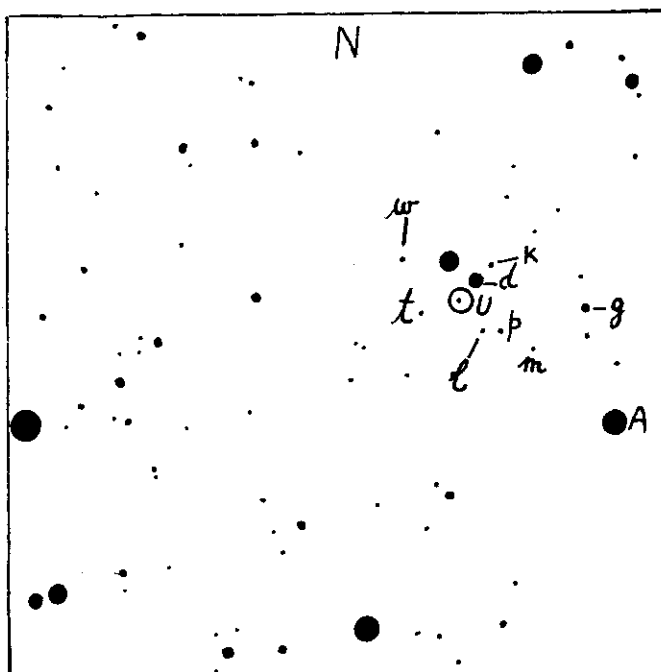
REFERENCES:

1969. Kukarkin, B.W. et al. General Catalogue of Variable Stars, Vol.1
3rd Edition. Moscow
1958. Walker, A.D. & Olmsted, M. P.A.S.P., 70, ~~416~~.
496

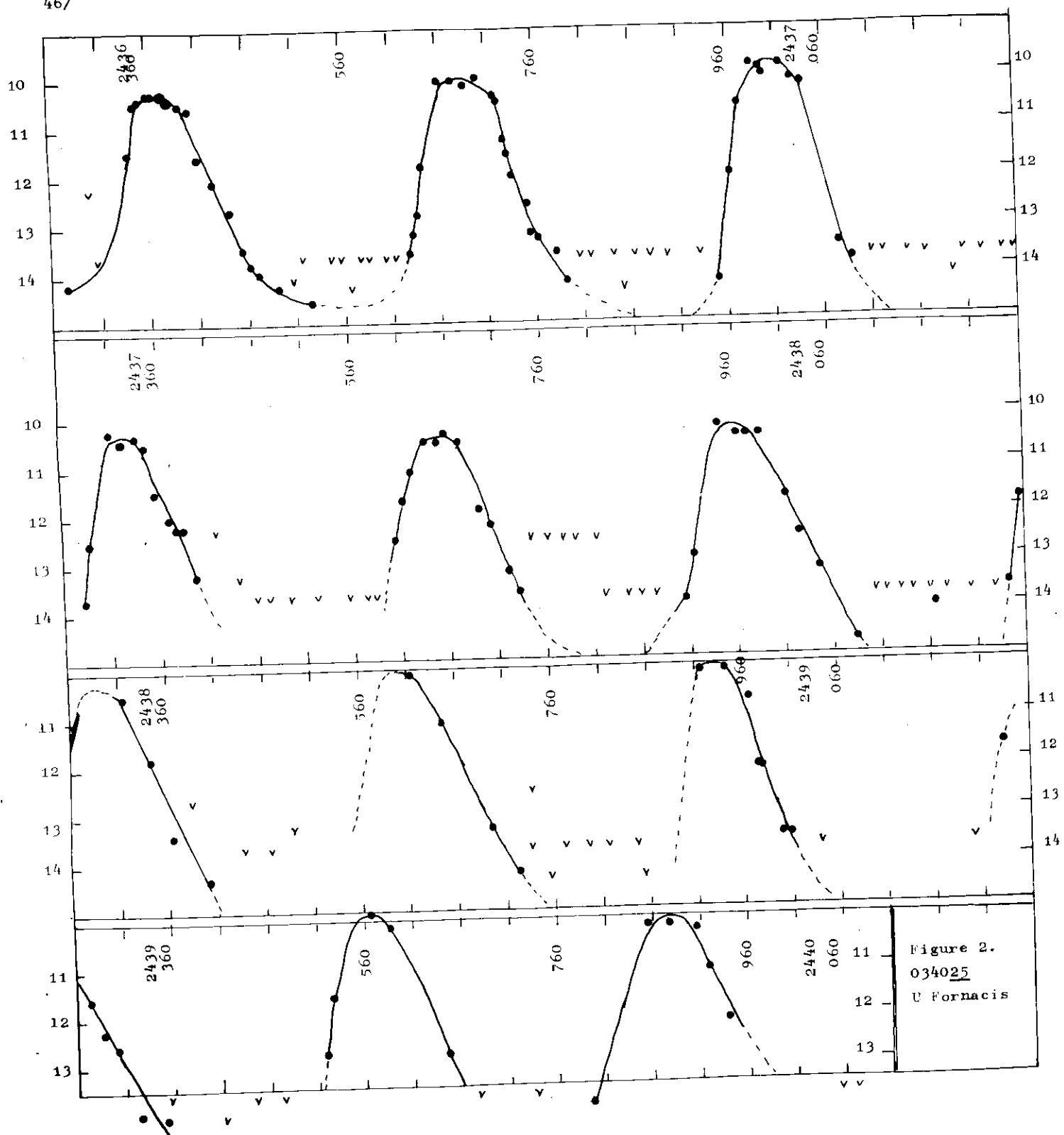
FIGURE 1.IDENTIFICATION CHART FOR U For.

034025 U For. {1900} 03h 40m 17s -25° 32.5'
 {1958} 03 42 24 -25 23.0

Star "A" is CoD -25°1525



W - not found in JEN-A20



SU CARINAE

Frank B. Bateson and B. Menzies.

SUMMARY: The Mira-type variable, SU Car, is shown to have a period of 575.6 days instead of one of 230.9 days as adopted hitherto. Maximum visual magnitude varies from 8.5 to 10.9, whilst the minima are far below the threshold of instruments used.

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CHART & SEQUENCE: SU Car is shown on chart 284 (Bateson et al 1971), with lettered comparison stars, for which SP_v magnitudes are given for the brighter stars only.

Menzies has determined V and B-V magnitudes for the fainter stars of the sequence, using HD 88293 as standard. These measures are listed in Table 1. Visual observers should use the values given in the final column.

TABLE 1.COMPARISON STARS FOR SU Car.

<u>CHART LETTER.</u>	<u>V</u>	<u>B-V</u>	<u>ADOPTED.</u>
l	9.52	+1.10	9.5
m	9.85	+1.02	9.9
q	10.87	+1.25	10.9
p	11.19	+1.67	11.2
t	12.01	+1.71	12.0
r	12.89	+0.24	12.9
k, n, o	Possibly variable, but this is not definitely established yet.		
s, u	Measures not yet complete.		

OBSERVATIONS: For long intervals SU Car has been below the threshold of the instruments employed, and the records at such times are negative. The following is a summary of results:

<u>YEAR.</u>	<u>J.D.</u>	<u>REMARKS</u>
1961	2,437,462-2,437,651	Six observations; 1 per month except for July- all negative
1962	2,437,692	Invisible
	766-2,437,651	14 positive obs. See Figure 1.
	943-2,438,023	4 negative obs.
1963	2,438,033-2,438,297	16 negative obs.
1963/4.	353-429	6 positive obs. See Figure 1.
1964	492-760	5 negative obs
1965	799-879	5 negative obs.
	899-2,439,095	13 positive obs. See Figure 1.
1966	2,439,144-2,439,448	14 negative obs.
1966/7	470-649	13 positive obs. See Figure 1.
1967	669-857	10 negative obs.
1968	866-2,440,009	13 negative obs.
1968/9.	2,440,052-2,440,243	15 positive obs. See Figure 1.

1969/70.	2,440,265-2,440,633	24 negative obs.
1970	646-773	10 positive obs. See Figure 1.
1970/1	794-2,441,148	18 negative obs.
1972	2,441,340-	359 5 positive obs. See Figure 1.
1972	363-	406 5 positive obs. at faint limits using comparison stars for which mags. not yet determined.

DISCUSSION: The positive observations are shown in Figure 1 as seven small segments of the light curve. It appears that for five of these the dates of maxima can be determined, whilst for another it can be guessed at, but for the seventh it is beyond reasonable determination.

Table 2 lists the maxima determined which give an average period of 575.6 days. The only previous determination of the period was Epoch (Max) 2,410,168 + 230.9 days (Worssell 1919), with a photographic range of 9.5 to 17.5.

The negative observations are so spread that they preclude the possibility of this shorter period unless intervening maxima have been fainter than 13.0_v. Elements determined are:-

EPOCH (Max). 2,437,794 ± 575.6 days

In Table 2 the O-C residuals in the final column are based on the above elements. The next maximum is due on 1976 July 14, and observers are requested to pay particular attention to this star from 1976 April onwards in order that a complete curve of the maximum can be obtained. It should be remembered that variables with such long periods can be two months out compared to the predictions.

TABLE 2.

OBSERVED MAXIMA OF SU Car.

<u>J.D.</u>	<u>MAG_v</u>	<u>INT_d</u>	<u>O-C_d</u>
2,437,794	8.5	...	± 0
2,438,338?	9.6?	544	- 32
946	9.8	608	+ 1
2,439,498	10.2	552	- 23
2,440,093	8.7	595	- 3
672	10.9	579	± 0

REFERENCES.

1971. Bateson, F.M., Jones, A.F., Stranson, I. "Charts for Southern Variables, Series 7.". Published by Bateson.
 1919. Worssell, W.M. Union Obs. Circ. 46.

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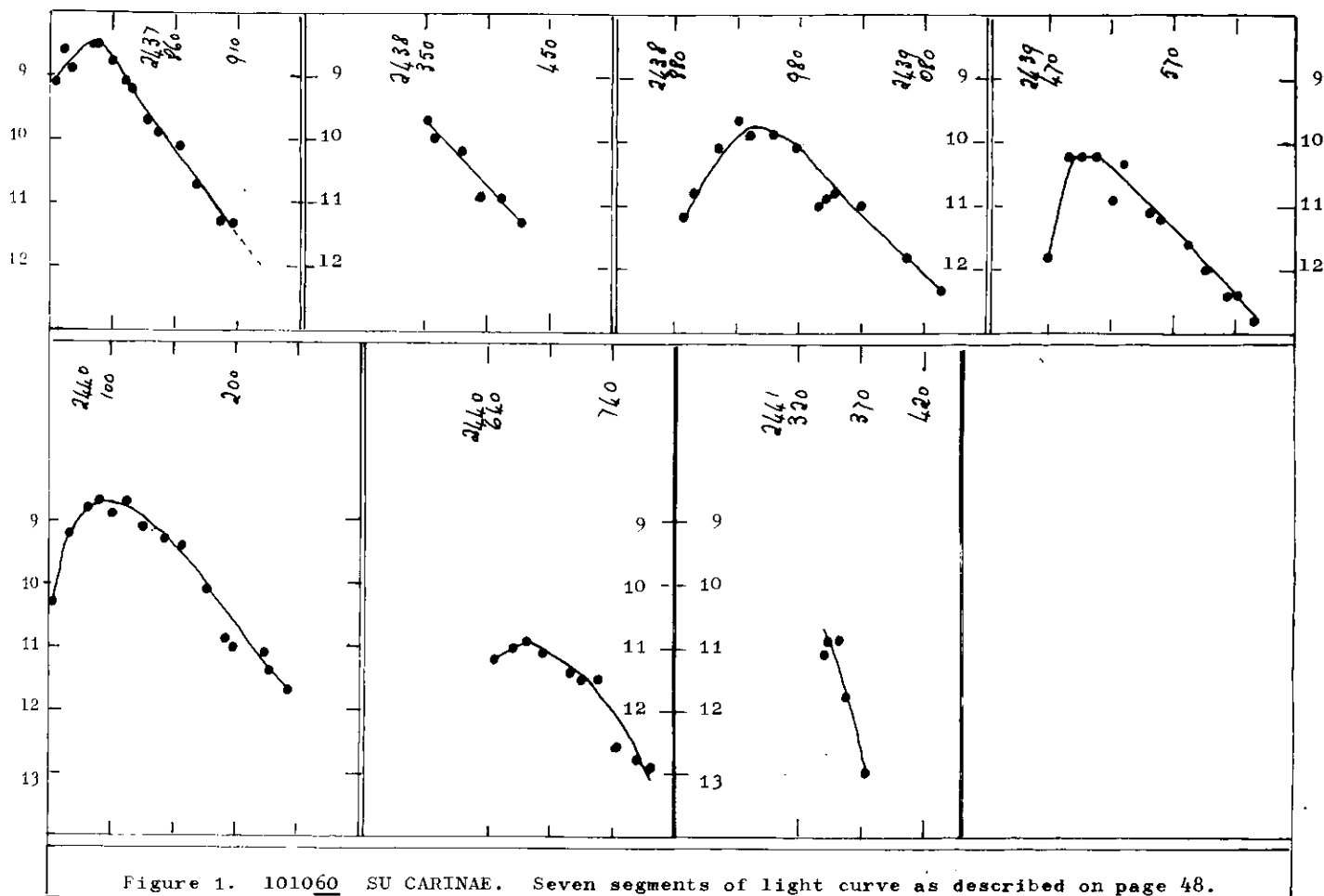


Figure 1. 101060 SU CARINAE. Seven segments of light curve as described on page 48.

REPORT OF SECTION FOR YEAR ENDED 30th SEPTEMBER, 1974

Observations Since the last report the following visual observations have been received:

<u>OBSERVER</u>	<u>NO. OF OBS.</u>	<u>NO. OF STARS</u>	<u>OBSERVER</u>	<u>NO. OF OBS.</u>	<u>NO. OF STARS.</u>
Adams, M.	15	4	Jones, A.F.	6,908	124
Adocck, B.S.	8	6	Jones, M.V.	5,563	244
Allcott, M.	1	1	Kent, (Mrs). K.	7	4
Allen, J.	14	2	Kissling, W.M.	193	13
Ashdown, M.L.C.	12	2	Lumley, E.	533	20
Ashwell, K.W.	42	9	Matchett, (Dr).V.L.	1,378	119
Baldwin, A.J.	175	18	Mayer, S.	14	4
Beal, G.	13	5	Menzies, B.	1,214	159
Beuning, J.	23	9	Morel, M.	1,249	37
Beuning, L.	35	9	McMillan, S.	40	25
Blow, G.L.	569	75	Nelson, R.W.	54	11
Bryant, K.	19	2	Nikolau, B.	156	24
Catto, H.	36	5	O'Connor, G.	58	15
Clements, S.	9	9	Overbeek, M.D.	3,068	184
Connolly, P.	54	34	Parsons, S.	4	1
Cragg, T.A.	435	95	Petrovic, J.P.	2	1
Crossley, G.	12	12	Price, R.T.	70	17
Dale, (Mrs) P.J.	51	9	Putt, D.	1	1
Davis, J.	7	2	Putt, G.	1	1
Devine, G.	2	2	Roberts, G.	8	4
Dirksen, S.	10	2	Robinson, I.	462	15
Dunsbee, E.	14	6	Rowe, G.	823	65
Elliott, A.	1	1	Sheedy, M.	6	1
Ellis, P.	30	11	Shinkfield, R.C.	204	34
Evans, R.W.	57	7	Sommes, G.	35	3
Fett, E.	11	8	Stephenson, S.M.	188	41
Fortescue, D.	4	2	Stuart, R.	2	2
Freeth, G.	728	27	Tattersall, J.	184	14
Giller, R.H.	815	60	Taylor, (Dr). N.W.	1,346	139
Goodman, D.	87	13	Thomas, M.	30	8
Granc, (Fr) A.A.	60	18	Tregaskis, T.B.	535	96
Grimmett, M.J.	151	12	Venimore, (Rev) C.W.	983	49
Grundill, J.C.	28	14	Walker, W.S.G.	57	14
Hamilton, J.O.F.	12	6	Walmsley, J.	21	4
Hammond, S.	75	8	Walmsley, M.	34	4
Harries-Harris, E	1208	46	Ward, T.	1	1
Herald, D.	16	14	Wild, B.D.	126	14
Hull, O.R.	948	121	Winnett, R.	325	74
James, M.	237	37			

Total Observations 31,934.

As usual only visual observations have been included in the above totals. Compared to the previous year observations increased by 8,363 or 35%.

Publications: Publications during the year consisted of:-

Monthly Circulars Nos. 73/9-73/12; M74/1-M74/8 inclusive.

Special Circular No. S.3. Matchett's Nova in Sagittarius.

Publications No. 1 (C73) comprising:-

Maxima of VW Hyi in 1972-73

W Phoenicis - A Mira type Variable

The Visual Comparator.

Four R CrB Type Variables with light curves of UW Cen;

S Aps; RY Sgr; GU Sgr.

Light Curves of Mira Cet Variables with light curves for

S, T, U & V Scl; S, T & U Tuc; T & V Phe; R & X Hor; S Mic;

R, S & T Gru; R & S PsA; R Ind.

Reprint 27

Charts:- Series 3 (4th Edition); 5 (5th Edition); 6 (5th Edition).

"The Observation of Variable Stars" (Instructional Manual; Revised Edition, 1973).

General: Publication No. 1 is currently being distributed. This is the first issue of the new style publications that replace the old format for the Circulars. Other editions will, it is hoped, follow in fairly quick succession now that the changes discussed in the last report have been completed.

The new system of handling records has worked extremely well throughout the year. As these are received each month they are used for the Monthly Circulars, after which they are passed to Gordon Smith who is responsible for the maintaining of observers' totals, and for entering the observations on to the permanent sheets. As these are completed they are returned to Headquarters enabling plotting to proceed. Close co-operation between Smith and the Director has enabled the system to develop in an efficient manner.

The publication of the new edition of the Instructional Manual has been well received, and has served to increase the number of observers. This booklet has been very widely distributed, not only to members and potential observers, but also to a large number of libraries throughout Australia and New Zealand, as well as further afield.

The regular publication of the Monthly Circulars has also served to foster interest in observing. These Circulars, providing prompt advice on the behaviour of Eruptive and Unusual Variables, have been in demand by overseas observatories, who have their copies air-mailed. To keep postage costs down the format has been changed from No. M74/9 to a four page production on 25cm by 17.5cm paper, of light weight and reproduced photographically. Provided present demand is maintained this publication is entirely self supporting. Observational Notes appear in these Circulars. The suggestion of including notes from observers at roughly quarterly intervals has been adopted at the request of observers at the last Annual Conference. These notes have proved popular.

Co-operation with other National Organisations has continued. In fact it has been extended. It is expected that even closer co-operation will result during the coming year through the visits of Directors of other National Organisations to our headquarters.

Charts: The steady demand for charts, already published, has continued not only from observers, but also from observatories. Fresh editions of several issues have been necessary during the past year.

Last year I mentioned that the publication of Series 8 depended on the speed with which the charts could be prepared. Fortunately two members, M. Morel and R. Winnett, have undertaken the production of the final charts from material supplied by the Director. During the past few months these members have completed 30 charts. It is expected that the remaining 20 will be completed within the next two months, which will make the publication of this issue possible. Series 9 will follow.

Sequences: B. Menzies and his assistants have continued their very valuable photoelectric determinations of the magnitudes for sequence stars. Results for a number of stars have been received and these will appear shortly in the Publications, together with light curves for the variables concerned and other data.

The Auckland Observatory have communicated an amended sequence for VW Hydri. This will enable all observations to date to be amended in accordance with this photoelectric sequence so that the results in Memoir No.2, dealing exclusively with this star, will be based on the new magnitudes. A revised chart for VW Hydri will also be published.

We are indebted to several institutions for the supply of charts and sequences.

Index to Circulars: C.W. Venimore has completed an index to Circulars Nos. 1 to 199 which will prove most useful. This index will be published in the Publications.

Novae: Several old novae and a number of recurrent novae have been kept under observation. Several suspected novae have been reported during the year but were found to be either known variables or hitherto undiscovered Mira Ceti stars.

U Gem Type Variables: Very close attention has been made by the more experienced observers to the southern members of this type of variable. Several co-operative programmes have been maintained with overseas astronomers, who have found our predictions and light curves of value, in their studies.

Rather regular patterns in the behaviour of several U Gem variables have been found. Charts have been supplied to the Carter Observatory for their programme on the fainter members of this class. B. Warner has kindly supplied preprints of various papers in which the work of the Section has been useful. It is most pleasing to see the wide use made of the excellent photoelectric observations being obtained at the Auckland Observatory, by the team led by B. Marino and W.S.G. Walker.

R Coronae Borealis Type Variables: Since the establishment of a system of cabling notification of the sudden fadings of these stars none have faded! Nevertheless, observers have continued to pay close attention to these stars with the result that their semi-regular, short period

variations have been closely studied. Light curves for four stars of this type illustrating previous fadings have appeared in Publications No.1. The number of stars of this class under observation has been extended.

Cepheids: E. Harries-Harris has continued his observations of several Cepheids with the aid of his comparator. The results are currently being reduced. Several classical Cepheids continue to be observed for possible period changes. Such research is long term in its aims.

Other Types: Stars of long period, irregular and semi-regular, T Tau, nova-like and Z And types have all continued to be reasonably well observed; some extremely well, others require somewhat more frequent attention. The institution of a complete prediction service, as apart from our previous predictions to overseas astronomers on request, should serve to increase observations of particularly Mira Ceti stars. Observers will be saved from the trouble of watching for stars that are far below the thresholds of their instruments.

Suspected Variables: The warning published in the last report has been heeded by observers with the result that suspected variables of possibly small range have been dropped from the lists of most observers. Such objects are best observed photoelectrically. However several objects of larger range are under observation, and several hitherto unsuspected objects have been reported.

Photographic: B.Ward, and others, have continued their patrol work. The move of Ward to Tauranga makes the exchange of data between us very prompt. Advantage of this was taken when an observer reported an object in Corona Austrina. It was possible for Ward to secure a photo within two hours of the object being reported. Unfortunately it proved to be a known variable.

Memoir No.2: The reworking of the observations of VW Hydri referred to earlier in this report means a certain amount of extra work to complete this Memoir. However, it is progressing well. A.F. Jones has brought all his records of Eruptive and Unusual Variables up to date. This allows the orderly reduction of all results that are necessary for the first few Memoirs.

Instructional Handbook; This publication has been issued and well distributed. I am indebted to I.P. Debono for his skilled draughtmanship in the production of the charts included in the booklet.

International Co-operation: The monthly Circulars have kept members in touch with the special international programmes arranged from time to time. In addition a considerable amount of data has been supplied on request to overseas astronomers.

The services of the Section are constantly being sought both in programmes and in the supplying of information in addition to light curves and predictions. For our part we have received wonderful assistance from many overseas astronomers.

Correspondence: The tidal proportions that this has reached was reported on last year. In an endeavour to keep it within bounds the acknowledging of every set of observations received has had to be dropped. Despite this, the flow of correspondence has increased with the result that, at times, outward correspondence has not always been as prompt as could be wished. Steps have already been taken to curtail other activities so that all time available can be spent on the essentials to the efficient running of the Section. It must be remembered that many letters call for very detailed replies and a considerable amount of data, which throws a load on the typiste.

Acknowledgements: This report makes no attempt to cover completely the full activities of the Section. Three matters make this year a milestone in the history of the Section. Firstly is the completion of the changes referred to in previous reports which will enable a steady flow of published results to be issued. Secondly, the large increase in both the total number of observations and in the observers taking part in the work of the Section. Thirdly the way in which members have taken part in the 'desk' work to which reference has been made in several sections of this report.

Once again I am indebted to the Trustees of the Low Estate for their continued support. The Bateson Family Trust has again been most generous in contributing the costs of a typiste's salary, and in other ways have helped the Section. The financial support from both these Trusts has enabled a great deal more to be done than would otherwise have been possible. I am also indebted to the subscribers to our publications. This support has enabled the change in format to be carried out.

The entire success of the Section is due to the observers, be their returns large or small. Without them there would be no Section. I thank every member for his contribution and also thank them for the careful attention they have paid to setting out their observations. The skill and accuracy of these observations is the best tribute to their devotion.

In particular I owe a great deal to the leaders of the various groups in each centre. These leaders have guided their members, collected and checked their records and have continued to foster interest in Variable Star observing amongst their members. Those who have carried out this work include O.R. Hull and Mrs. D. Paterson (Auckland); I.P. Debono (Sydney); R. Giller & M. Morel (N.S.W.); M.V. Jones (Queensland); B. Tregaskis (Victoria); R.C. Shinkfield and E. Harries-Harris (South Australia). The active group in Auckland owes a great deal to the inspiring leadership of B.F/Marino and W.S.G. Walker.

I am also indebted to B. Menzies and his assistants for their work on sequence determinations. This work is invaluable and of an extremely high standard.

A very close co-operation has been established with M.D.Overbeek, Director of the V.S.S., Astronomical Society of Southern Africa and with J. Bortle of the AAVSO. Again I have had the pleasure of frequent exchange of data on sequences, charts and observations with T.A. Cragg.

A.J. Baldwin has undertaken the production of a trial computer light curve of S Car. This it is hoped is the forerunner of more computerised results for the stars that justify such treatment.

The senior observers continue to set a very high standard of accuracy that cannot but help other observers. The results from A.F. Jones; M.V. Jones; M.D. Overbeek; V.L. Matchett; N.W. Taylor; M. Morel; B. Menzies; E. Harries-Harris and T.A. Cragg all reach a very high standard indeed. Many others with less years of experience are reaching the same standard. However, the Section is based entirely on the team effort of each and every observer. To all of them I express sincere thanks for their contribution. They can be certain that their efforts have been well worth while.

The Director and staff of the Carter Observatory have provided close co-operation and ever ready assistance in so many ways. For this I am most grateful. Once again we are indebted to so many overseas astronomers for their support, encouragement and continued interest.

Finally I wish to thank all who have assisted the Section in any manner whatsoever, be it by observations, financially or by shouldering one or more of the 'desk' jobs that have contributed so much to our progress. Not all names have appeared in this report, not because their contributions have been small, but simply because the limitations of space prevent the inclusion of every aspect of the Section's work. Whatever has been done is the result of a team effort which alone makes the Section function.

Frank M. Bateson

. Director.

1974 October 12

REPORT OF SECTION FOR YEAR ENDED 30th SEPTEMBER 1975.

Observations: Since the last report the visual observations, listed on page 56, have been received. The total is 2,219 observations fewer than last year's record figures. This is due to the fact that A.F. Jones has sent in his lowest number of records for many years, some 2,707 fewer than last year, whilst M.V. Jones could only communicate 2,891 observations compared to last year's total of 5,563.

Understandably, A.F. Jones is no longer able to observe as much as in the past. M.V. Jones has to give up observing because of the demands of his own affairs. It is hoped that this situation will only be temporary, as his contributions have always been extremely valuable.

Publications: Publications during the year consisted of:-

Monthly Circulars Nos. M74/9-74/12; M75/1-M75/8 inclusive

Special Circular No. S.4 Nova Sagittarii 1974

Publications No. 2 (C74) which included:-

Light Curve of BV Cen; "Amateur Photographic Astronomy"-

A Personal View by M.B. Ward; BH Cru; Light Curves for

T & V Aps; R, T, RT, RV & RX Cen; W Hya; R & T Nor; R & Y Lup;

RR, RS & RZ Sco. Some predictions for 1975; Index to Circ.

Nos 1-199 by C.W. Venimore.

Charts:- Series 3 (5th edition); 6 (6th Edition).

A second printing of the Instructional Manual.

<u>OBSERVER.</u>	<u>No. of OBS.</u>	<u>No. of Stars</u>	<u>OBSERVER.</u>	<u>No. of OBS.</u>	<u>mNo. of STARS.</u>
Adcock, B.S.	340	25	McMillan, S.C.	951	174
Anderson, P.	5	1	Nikolau, B.	292	33
Ashdown, M.L.C.	34	5	Norgate, M.	2	1
Ashley, M.	112	28	O'Connor, G.	4	4
Baldwin, A.J.	154	19	Overbeek, M.D.	3,654*	213
Beuning, J.	19	8	Page, A.A.	6	1
Beuning, L.	44	10	Paterson, (Mrs) D.	173	43
Blow, G.L.	78	25	Pleever, N.	105	31
Clements, S.	55	19	Potter, N.	38	10
Cragg, T.A.	231*	65	Petrovic, J.P.	6	2
Curnick, (Dr) A.L.	224	26	Powell, H.C.T.	4	1
Dods, J., Jnr	9	3	Price, R.T.	18	12
Elwin, S.J.	9	1	Robertson, S.	19	5
Evans, R.W.	3	2	Robinson, I.	293	13
Freeth, G.	376	29	Rowe, G.	1,043	83
Giller, R.H.	881	83	Russell, J.	4	1
Gooden, D.	12	3	Ryder, G.	3	1
Granc (Rev) A.A.	83	30	Ryder, J.	1	1
Gray, M.	3	2	Salisbury, J.V.	36	13
Grimmett, M.J.	63	13	Salisbury, R.	1	1
Hammond, S.	53	12	Sammes, G.	40	7
Harries-Harris, E.	776	71	Shinkfield, R.C.	105	17
Hayward, G.	105	13	Smith, K.	7	1
Heather, A.	4	1	Stephenson, S.M.	1,101	88
Henley, J.	2	1	Stewart, M.	50	13
Horn, P.L.	4	1	Stewart, T.	2	2
Hull, O.R.	2,004	181	Sumner, B.	51	26
James, M.	12	9	Tattersall, J.	76	9
Jones, A.F.	4,201	72	Taylor, (Dr) N.W.	1,964	144
Jones, M.V.	2,891	259	Thomas, (Dr) M.	481	66
Kent, (Mrs) K.	5	4	Thompson, G.	3	1
Kissling, W.	87	16	Thomsen, T.	3	3
Leslie, (Mrs) A.M.	230	12	Toner, G.	6	3
Lumley, E.	351	18	Tregaskis, T.B.	882	198
Marino, B.	11	6	Turk, C.	55	16
Matchett, (Dr) V.L.	856	88	Venimore, (Rev) C.W.	1127	56
Maw, K/	8	3	Walker, W.S.G.	64	14
Menzies, B.	1,495	193	Walmsley, J.	31	6
Morel, M.	691	43	Walmsley, M.	26	5
Morse, K.I.	21	7	Wilkinson, J.	1	1
Morton, J.G.	59	4	Williams, P.	206	14
Mundt, F.	5	2	Winnett, R.D.	175	51

* = Results also communicated to AAVSO

TOTAL OBSERVATIONS 29,715.

General: The new style Publications have been well received. No.3 should have been issued during the year, but has been delayed because of the Director's overseas trip. It has now been assembled and should be despatched at the end of November.

The Monthly Circulars continue to meet the requirements for providing prompt advice on the behaviour of Eruptive and Unusual Variables as well as providing a means of communicating observational notes that need prompt circulation. Demand for the Instructional Manual, "The Observation of Variable Stars" made a second printing necessary.

Gordon Smith has continued to enter observers' estimates on the permanent sheets, maintaining this work up to date. The completed sheets are returned to Headquarters and the improvement in plotting has been maintained. Gordon Smith also kindly produced the Monthly Circulars during the Director's absence from N.Z.

Director's Overseas Visit: Probably the most important event of direct benefit to the Section was my visit overseas. This enabled me to attend the IAU Symposium No. 73 on "The Structure and Evolution of Close Binary Systems" held at the University of Cambridge; the European Conference on Astronomy at the University of Leicester and IAU Colloquium No. 29 on "Multiple Periodic Variable Stars" held at Budapest.

A separate report is being circulated to Council and some other organisations and individuals. I received considerable benefit from attendance at these meetings, and especially from the numerous discussions with individual astronomers who gave so freely of their time and knowledge to help me. The trip was made possible through grants from the Kingdon-Tomlinson Bequest, The International Astronomical Union and the University of Cambridge. I am extremely grateful for this support.

Many matters, affecting the Section, arose during this trip. In this report only a few matters are mentioned briefly since they are covered in the separate report and will also be commented on from time to time in the Publications.

Cooperation with AAVSO and VSS, BAA. During my trip it was possible to have full discussions with Dr. Janet Mattei, Director, AAVSO., and with Mr. John Isles, Director, VSS, BAA, London. These have resulted in very much closer co-operation between these organisations and our own Section. This is bound to benefit them and ourselves by leading to uniform charts and an interchange of observations, as well as in many other ways.

Charts: There continues to be a steady demand for charts, already published. Two reprintings were required during the year.

Last year I reported that two members, M. Morel and R. Winnett, had undertaken the production of final charts for the next issue. They have now supplied sufficient charts to allow the publication of Series 8 and 9. The former would have been circulated had I not gone overseas. It goes to the printer shortly and should become available in December. Series 9 will then follow.

Sequences: B. Menzies and his assistants have continued their very valuable photoelectric determinations of the magnitudes for sequence stars. Some results appear in Publications No. 3 and others appear

with Series 8 of the chart issues.

Offers have been received to obtain reliable sequences in the fields of dwarf novae down to faint limits. These offers have been accepted and the Carter Observatory are supplying photographs of the regions concerned.

Memoirs: Last year I reported that the Auckland Observatory had communicated an amended sequence for VW Hyi. This has been used to revise all estimates of this star since observations first commenced two decades ago. Tables of daily means have been completed and the small scale light curve covering 8,000 days completed. Most of the large scale plots of maxima have also been completed. These, and the general layout of the Memoir No. 2, were taken overseas by me. This enabled the format and results to be thoroughly discussed with Professor B. Warner and others. I am grateful to them for their valuable advice and suggestions. It is now merely a question of completing the work and having the MSS typed and tracings made of the light curves for reproduction.

Because of the current interest in dwarf novae, and also because our results are so valuable, it is proposed to issue a separate Memoir for each dwarf nova under observation. This is in accordance with the suggestions made to me by overseas astronomers. This work is supported by the Carter Observatory, for which I express my appreciation.

Dwarf Novae: Observers continue to pay close attention to these objects. This is most desirable since it is essential that we are able to supply complete light curves for all stars of this type.

Our predictions of the dwarf novae having supermaxima have proved of value to overseas astronomers, who have also benefited by our cabled advice on outbursts. Light curves have also been supplied for their use, and also have been supplied to those engaged in satellite observations.

Novae: Several old novae and a number of recurrent novae have been kept under observation. Observations have also been made of recent novae.

R CrB Type Variables: Visual light curves for a number of these objects have been supplied to Dr. P.J. Andrews, Royal Greenwich Observatory, for use with his observations. In addition, through the co-operation of the Auckland Observatory it was possible to supply Dr. Andrews with some photoelectric observations, made by W.S.G. Walker & B. Marino.

Sequences established by B. Menzies, and his assistants, and also by W.S.G. Walker and B. Marino, have enabled complete light curves to be published for some of the R CrB type variables. Other stars have been reduced on the basis of step estimates of the comparison stars made by A. Jones, or myself. Light curves for all these variables appear in Publication No. 3.

Cepheids: E. Harries-Harris has resumed his observations of several Cepheids. He has amassed sufficient records to allow good light curves

to be derived. Publication of these are overdue but have had to take second place to work on dwarf novae. Several classical Cepheids are under observation for the purpose of studying possible changes in period when the observations have been continued for a long enough interval.

Red Variables: Observations of Mira Ceti, irregular and semi-regular variables have continued/ Some stars are well observed; others need more attention. As far as is possible members are asked not to neglect these stars. Changes in period and amplitudes have taken place in a few stars of these classes. Others can occur and it is only by having a continuous record that such changes can be investigated.

Other Types: Close attention has been paid to observing a number of variables of the class Z And, T Tau and nova-like. It is hoped, in due course, to devote an issue of the Publications to the results on these stars.

Suspected Variables: Observers continue to report suspected variables. None of those recently reported appear to be variable except in a very small range. Visual observers must remember that objects of small range are best left to the photoelectric observers. B. Menzies in his sequence programme has continued to find variables, mainly of small range.

Computer Programme: A.J. Baldwin has finalised the computer programme and forwarded the instructions to Headquarters. A trial run is to be made on the observations of S Car since this star was first observed by the Section, nearly 50 years ago. It is hoped that an assistant can take over the work of preparing the observations for the computer. However as the instructions arrived just prior to my departure for overseas nothing has been done as yet in training my assistant to handle this problem.

Correspondence: I have decided that the mounting flow of correspondence just cannot be arrested! Nor is it desirable that this be done since so much of it is the use of our services in providing data that is required by our professional colleagues. All I ask is that members be patient when replies are delayed since it is solely the result of coping with other demands for our results.

International Co-operation: The services of the Section are being constantly sought in the supplying of results, light curves and opinions on observations to be undertaken on large instruments. It is a tribute to the observational skills of our observers that these requests are being made in such volume. For our part we have received wonderful assistance from so many overseas astronomers.

Jubilee 1977: The Section will celebrate its Jubilee in 1977 at the time of the Annual Conference of the Society. Council have accepted the invitation of the University of Waikato, and of the Section, to hold this conference at the University of Waikato, Hamilton.

It is proposed to hold a Variable Star Symposium just prior to the Conference, or immediately following the Conference. A number of overseas astronomers have expressed their intention of attending. Naturally at this early stage such intentions cannot be considered firm, but I am most hopeful that it will be possible to arrange a worth while Symposium attended by many observers and theoreticians from overseas, as well, I hope of many of our Australian observers. If this proves true it will be a great stimulus to the Society, in general, and the Section in particular.

Acknowledgements: This report makes no attempt to cover completely the activities of the Section. As I have commented so many times the entire success of the Section is due to the observers, be their observations few or many. I thank every member for his, or her, contribution, and also thank them for the careful attention they have paid to setting out their records. The skill and accuracy of these observations is the best tribute to their devotion.

This skill and accuracy is due in a large measure to the example of the more experienced observers, who have provided the guidance to new observers. Leaders of the various local groups have continued to guide their members, collect and check their records and generally foster interest in Variable Star observing. For this I would particularly like to thank Mrs. D. Paterson and O.R. Hull (Auckland); R. Giller and M. Morel (N.S.W.); T.B. Tregaskis (Victoria); R.C. Shinkfield and E. Harries-Harris (South Australia); M.D. Overbeek (South Africa); M.V. Matchett and M.V. Jones (Queensland). B.F. Marino and W.S.G. Walker have continued to provide inspiring leadership to the very active group in Auckland as well as making most valuable photoelectric results available.

The high standard of the work done by B. Menzies, and his assistants, on sequences has proved of the greatest value. We are indebted to the Trustees of the Auckland Observatory for allocating telescope time for this programme.

The Director and staff of the Carter Observatory have continued to provide close co-operation and ever ready assistance in so many ways. For this I am most grateful. Once again we are indebted to so many overseas astronomers for their support, encouragement and continued interest. The senior observers continue to set a very high standard of accuracy. The results from A.F. Jones; M.V. Jones; M.D. Overbeek; V.L. Matchett; N.W. Taylor; M. Morel; B. Menzies; E. Harries-Harris; R.C. Shinkfield; T.A. Cragg and C.W. Venimore all reach a very high standard indeed. Many others have now reached this standard. However the Section is based entirely on the team effort of each and every observer. To all I express sincere thanks for their contributions, which they can be certain have been well worth while. To Gordon Smith I owe an immense debt of thanks for shouldering so much of the routine work of the Section. His care and attention to the observational records is worthy of the high standard set by the observers themselves.

Finally I wish to thank all who have assisted the Section in any manner whatsoever. Space precludes mention of all those who have helped, either by observations, financially or by desk work. The high standard of the Section is a tribute to everybody since it is purely by the team effort that the Section functions.

1975 October 29

Frank M. Bateson
Director