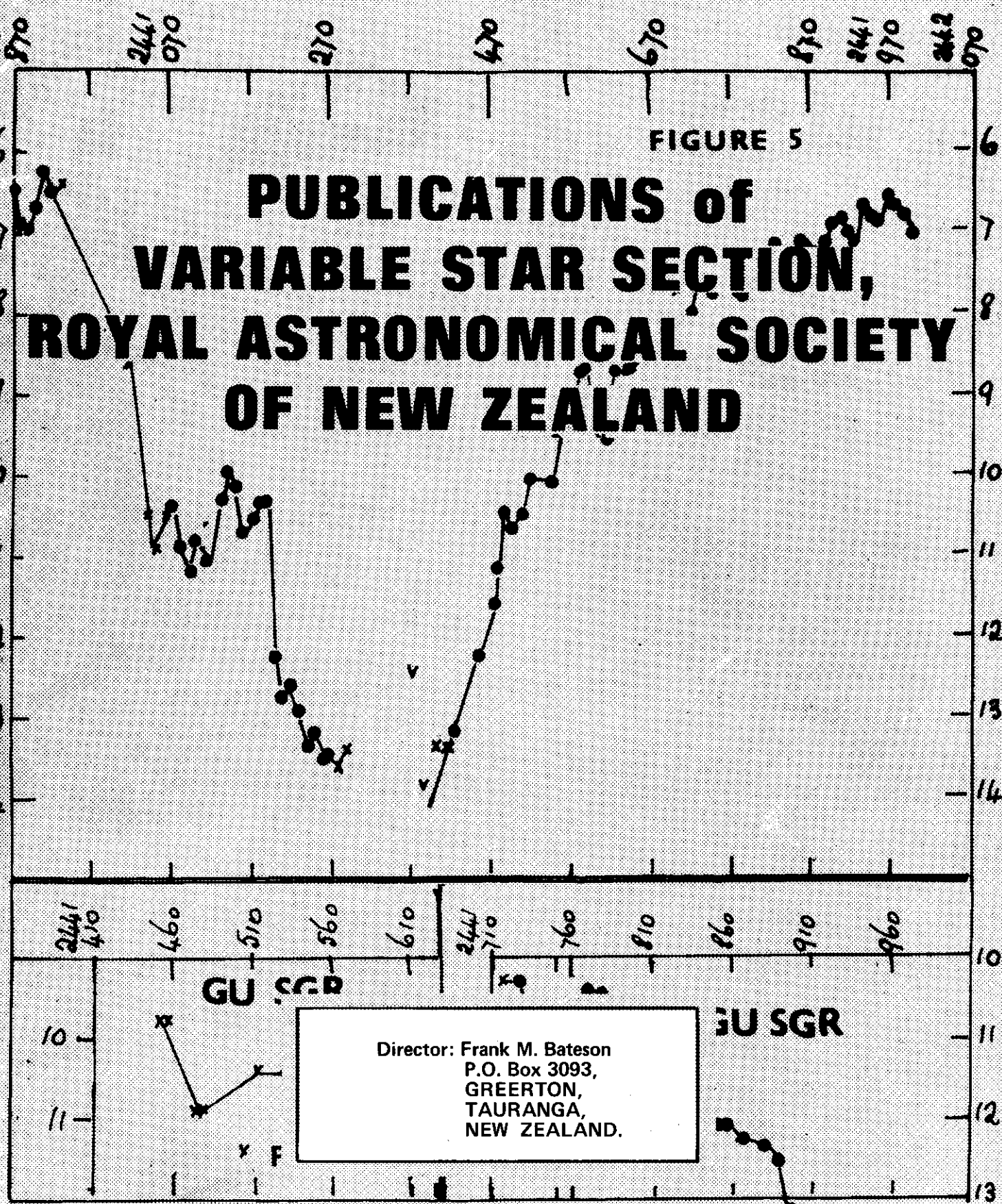


FIGURE 5

PUBLICATIONS of VARIABLE STAR SECTION, ROYAL ASTRONOMICAL SOCIETY OF NEW ZEALAND



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1978 July 12

OUR GOLDEN JUBILEE.

This issue marks the Golden Jubilee of the Variable Star Section of the Royal Astronomical Society of New Zealand. The range and diversity of the papers presented in this number are in marked contrast with our modest beginnings.

The first Circular appeared on 27 July 1928. It stressed the need for observations of southern variables, and included a list of 19 variables to be observed, mainly of Mira Ceti type. Circular No. 2 appeared a few days later with instructions on observing and recording. The response from observers was such that on 12 September 1928 a further list of 20 variables was published. Thereafter the Circulars merely listed the observations made. This continued until 1944 when the first Memoir of the Section was published. In this a total of 35,379 observations made during 1927-40 were discussed. It also contained a discussion of the systematic deviations of the individual observers. The war years, during which most members were on active service, brought difficulties and a drop in the number of observations. It was, however, in these years that A.G. Crust, one of our members, independently discovered the brilliant nova of 1942 (CP Pup), which despite the difficulties of the times, was very well observed. These observations and a light curve up to 1950 were published in Circular 49. The nova was followed closely until it faded below the thresholds of the instruments available fifteen years after its discovery.

It is not my purpose in this Editorial to write a history of the Section. Maybe some day, when I can find time, I shall get round to so doing. Then it will also be a history of Astronomy in New Zealand over the past 50 years, because the Section has been associated, to a greater or lesser degree, in almost every stage of advancement of our science in New Zealand during that interval. In fact it was largely responsible for many of the developments that have taken place. History, written by a person who has had a hand in its making, is rarely objective. It tends largely to become an attempt to justify his own actions. I have no intention of falling into that trap.

Strictly speaking I should now quote the total observations made and list the contributions of individual observers. Such figures indicate, to a certain extent, the activity of members. They appear each year in the Annual Report. Long ago I gave up maintaining a running list of such totals because these tend to turn the work into a numbers game which variable star observing is not. All I can firmly state is that the total observations are now in excess of 1,000,000; more likely they are around 1,500,000.

A Golden Jubilee is certainly a milestone. It is a good time to consider the future, rather than pass in review the achievements of the past.

It is therefore pertinent to restate briefly the aims of visual observing, which naturally forms the major portion of our observing. Firstly these are to obtain accuracy and quality rather than quantity. Secondly the observations must be of variable stars for which results are both useful and needed. Thirdly the results obtained must be published in papers that are readily accessible in a form that is acceptable to those making use of them. Finally the programmes must be kept fluid so that as trends change amendments can be made to include fresh objects. At the same time every encouragement must be given to part time astronomers to use photographic and photoelectric techniques when they are within the resources available to them.

In speaking at the 1974 Annual Conference of the Royal Astronomical Society of N.Z. on 'Fifty Years of Variable Stars' I termed the present years 'The Years of Harvest'. That year had seen the

the commencement of our Publications (C Series). These replaced the old style Circulars and provided a better and more permanent way of publishing the results. This was justified because after following the behaviour of many variables for so many years there was available data that was meaningful.

Some people feel that visual observing has little place to-day, and will have none in astronomy of the future. Certainly visual work cannot attain the accuracy of photoelectric observing. There is, however, a greater demand to-day for visual results than ever before, because there are a host of variable stars which are best observed visually rather than by other methods. Many examples have been quoted in both our Publications and Monthly Circulars of the value of visual observations that there is no need to detail them here.

No organisation, such as ours, can be better than its observers. It would be invidious to single out individuals for mention since contributions have come from over 400 members. It is their combined efforts that have resulted in the high regard in which our observations are held. One and all they can be proud of what they have accomplished.

It is quite useless making observations if they serve no purpose unless one is merely observing for one's own amusement. There must therefore be close co-operation with professionals in order that the data they need is obtained and made available. Right from the early days of the Section we have been most fortunate in establishing and maintaining close co-operation with professional colleagues. This has been by no means a one way street in which they request certain observations. They have provided a great deal of material assistance and wise advice and guidance. Again it would be invidious to mention names because so many have given freely of their time and knowledge to assist us.

The future is bright. There is much to be done. There is a devoted band of observers backed up by many working behind the desk checking, entering and preparing results for publication. The programmes are more than sufficient to keep everybody occupied. There is, however, a challenge awaiting some keen, well qualified person to ultimately take over the Directorship. He, or she, will need to devote a large part of his life, and much cash, to directing, helping, writing and publishing. But the rewards are rich. These come from the friendships that bind our organisation together.

This Editorial has been so much harder to write than expected, because there is so much more to say than space permits. I must however conclude on a personal note. I trust that all members can feel pleasure in what they have accomplished. To so many I wish to say a very sincere "Thank you" and especially for the friendship that has bound us together in a common purpose. May the next fifty years be even more successful.

Frank M. Bateson

THE DWARF NOVA---AT ARAE

Frank M. Bateson

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SUMMARY: Visual observations of AT Ara from J.D. 2,436,260 to 2,442,958 are tabulated and discussed. Observed maxima give a mean cycle of $61^{\text{d}}.8$. It is shown that this star is characterized by outbursts of comparatively long duration, with a slow rise and fall, and by a wide range in the amplitude of maximum brightness.

...

1 INTRODUCTION.

AT Ara was investigated by H. Shapley and H.H. Swope (1934), who found 18 maxima on Harvard plates between 1895 and 1930. They placed the range as from $13^{\text{m}}.0$ to $15^{\text{m}}.8$ ptg., and the duration of maximum at about 20d. The common difference between their maxima was around $70^{\text{d}} \pm 20^{\text{d}}$. The photographic magnitudes of outbursts ranged from $12^{\text{m}}.9$ to $14^{\text{m}}.3$. Observations in 1931 showed more than usual irregularity.

Apparently no other investigation of AT Ara has been made.

2 CHARTS AND SEQUENCES.

A.D.Walker and M.Olmsted (1958) published an identification chart, from Harvard plate MF 26700 and an enlargement from plate A5920. A.F.Jones and F.M.Bateson both used these charts for their observations, selecting comparison stars independently.

A.Brun and M.Petit (1957) published charts without a sequence. M.V.Jones sent the author the chart he had produced, on which he had identified comparison stars by letters. Bateson, Morel and Winnett (1975) published chart 315, on which comparison stars as identified by M.V.Jones were shown using his lettering. Most of these stars were the same as used earlier by A.F.Jones and by Bateson, although lettered differently.

A two colour sequence for the comparison stars on Chart 315 was published by B.Menzies (1977), whilst N.Vogt (1977) published a three colour sequence for some of these stars, and selected four other stars as well to fill gaps in the sequence, and to extend it to fainter limits. N.Vogt also included a finding chart, based on the ESO Sky Survey, in his paper.

All observations discussed in the present paper were reduced by using the V magnitudes from Vogt's (1977) sequence, or from Menzies' (1977) sequence for stars not measured by Vogt. An additional four stars, not included in the measured sequences, were used by A.F.Jones (one of which was also used by Bateson). Magnitudes for these were determined from step estimates based on the V magnitudes of other stars in the sequence.

3 OBSERVATIONS.

Observations from JD 2,436,260 (1958 Feb.25) to 2,442,953 (1976 June 23) are given in Table 1 as daily means. All observations prior to 2,441,526 (1972 July 27) were made by A.F.Jones, supplemented by a limited number from F.M.Bateson. After that date observations were made by a number of observers. The number of observations in each mean have been omitted from Table 1, because prior to 2,441,526, the number is usually one or occasionally 2. After that date there is rarely more than 2 estimates included in each mean.

The observing season is February to October each year, with very few observations outside this interval. AT Ara was not monitored as consistently as other dwarf novae on the programme of the V.S.S., R.A.S.N.Z.

4 DISCUSSION.

Table 2 lists 63 observed maxima, numbered consecutively in the first column, although it is obvious that many outbursts were not observed. The Julian date of maximum is given in the second column followed by a question mark when the exact date is considered uncertain. The maximum magnitude is shown in the third column and is underlined when the star may have attained a brighter magnitude. The interval, in days, between successive maxima appears in the 3rd column. If it seems possible that the maxima were not successive the interval is included in brackets. The following two columns give the dates, when they can be determined, when AT Ara reached magnitude 14.0 on the rise and fall respectively. The width of the maximum, in days, at 14^m.0 is shown in the seventh column, and, the final column gives the number of positive observations used to determine the details in the preceding columns.

There were 29 other dates, on which positive observations of AT Ara were recorded at 13^m.5 to 14^m.8. Many of these were classed by the observers as doubtful, as indicated by the question marks in Table 1. Some probably are minor outbursts, but Table 2 only includes maxima that are quite definite, or probable. Even then a number rest on only one or two observations. However, either, because of the magnitude recorded, or because it appears that only the beginning or end of an outburst was seen, they are included in Table 2.

There is a wide difference in the amplitude of outbursts, which at maximum brightness range from 11.5^m. to around 14.0^m. It is probable that minor outbursts occur below 14^m.0. These could not be detected since the threshold of most of the instruments used was around 14^m.1.

The average width at phase 14^m0I-D for the 27 best observed maxima was 15^d.7, ranging from 6^d to 25^d. The mean magnitude at maximum is 12.4. The mean interval between maxima that appear to be successive is 61^d.8. Probably successive outbursts occur at intervals shorter than this.

In effect all the visual observer records is the upper segment of the outburst curve. This is sufficient to show that there is a wide diversity in the shape of the outburst curve. Some maxima show the normal very rapid increase, whilst others have an abnormally slow rise, taking many days to rise from 14^m.0 to maximum brightness. These latter belong to the anomalous type of maxima. In general AT Ara is characterized by maxima with a comparatively slow rise and fall, resulting in outbursts of longer duration than common to most dwarf novae.

Figure 1 illustrates a few of the better observed maxima. It should be noted that some show a distinct dip on the rise. The scattered nature of most of the observations prevents the classification of maxima into distinctive types.

5 CONCLUSIONS

AT Ara is characterized by a wide range in amplitude at outburst, and by a predominance of maxima with slow rise and fall. These give a mean width of 15^d.7 at phase 14^m.0I-D. Maximum brightness averages 12^m.4, with a range of 11^m.5 to around 14^m.0. There are probably fainter minor outbursts. Successive outbursts have a mean cycle of 61^d.8, although it is likely that the true mean cycle is shorter than this.

Closer monitoring of AT Ara would enable maxima to be divided into distinctive types. Such monitoring appears warranted as this star differs from most other dwarf novae.

ACKNOWLEDGMENTS.

This work forms part of the research programme made possible by a grant from the Carter Observatory Board. It is a pleasure to thank B. Menzies and N. Vogt for their sequence determinations. I am most grateful to M. V. Jones for his preliminary chart; to all observers for their records, and, especially to A. F. Jones for his extended series of observations.

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TABLE 1.
OBSERVATIONS OF AT ARAE.

<u>J.D.</u>	<u>MAG.</u>	<u>J.D.</u>	<u>MAG.</u>	<u>J.D.</u>	<u>MAG.</u>	<u>J.D.</u>	<u>MAG.</u>	<u>J.D.</u>	<u>MAG.</u>
2436000+		2436000+		2436000+		2436000+		2437000+	
260.02	(13.0	382.21	14.0	604.15	(13.0	747.95	(13.5	075.93	13.2
263.21	(13.0	387.79	(13.5	615.17	(14.1	750.95	(13.5	078.00	(13.5
286.21	13.8	393.98	(13.5	633.20	(13.5	755.99	(14.1	079.98	(13.5
290.22	(13.4	397.99	(14.1	642.23	12.6	758.97	(14.1	081.96	(13.5
292.06	(13.5	398.96	(14.1	646.22	12.7	764.23	(13.5	086.99	(13.5
294.19	(14.1	401.01	(13.5	649.16	13.2	767.23	(13.5	098.92	(13.4
313.20	(13.5	405.96	(14.1	650.18	13.4	770.79	(13.5	101.96	(14.1
315.24	(14.1	411.18	(13.5	661.21	(13.5	777.92	(13.5	111.98	(13.5
316.05	(14.1	416.81	13.8?	665.21	(14.1	781.94	(13.5	112.96	(13.5
321.15	(14.1	418.80	(14.1	671.02	(13.5	784.98	(14.1	113.93	(13.5
322.26	(14.1	420.95	(14.1	688.00	(13.5	786.01	(13.5	116.99	13.9?
324.25	(14.1	423.04	(14.1	696.87	(13.0	788.93	(13.5	126.87	13.7?
333.99	13.7?	425.80	(13.5	697.26	(13.5	791.00	13.9?	128.91	13.5
340.03	(14.1	427.00	13.9?	699.24	(13.5	802.94	12.4	129.91	13.5
341.95	(14.1	428.99	(14.1	702.87	(12.0	803.98	12.5	131.98	13.2
343.24	14.6?	431.97	(14.1	703.25	(13.5	804.94	13.0	132.86	13.6
344.98	(14.6	446.85	12.9	708.26	(14.1	806.86	13.3	133.93	13.5
353.25	(14.1	449.94	13.7	715.95	(13.5	809.93	13.8	134.85	12.8
362.98	(14.1	450.98	13.9	720.99	13.9?	810.89	13.8	137.93	13.1
365.02	13.7?	453.94	(14.1	722.95	(14.1	814.95	(13.5	139.96	13.4
369.98	13.3	455.92	(14.1	723.92	(14.1	817.93	(13.5	143.97	(13.5
370.96	13.5	463.96	(14.1	726.27	(13.5	844.95	(13.5	145.87	(13.5
373.02	13.1	481.90	(14.1	729.00	(13.5	845.89	(13.5	158.94	(13.5
.95	12.9	490.94	(13.5	730.98	(13.5	846.95	(13.5	159.95	(13.5
374.90	12.9	491.90	(14.1	733.23	14.0?	873.93	(13.0	166.00	(13.5
375.97	12.8	506.89	(13.5	735.15	(13.5	2437000+		167.97	(13.5
376.95	12.9	508.91	(13.5	736.25	(13.5	032.21	(13.5	172.98	(13.0
377.96	13.4	510.89	(14.1	737.23	(14.1	059.99	(13.5	173.99	(14.1
381.28	13.7	512.92	(13.5	746.04	(13.5	069.92	(13.0	187.95	13.9?

TABLE 1---continued

J.D.	MAG.	J.D.	MAG.	J.D.	MAG.	J.D.	MAG.	J.D.	MAG.
2437000+		2437000+		2438000+		2438000+		2438000+	
198.93	(13.5	531.11	(13.4	087.19	12.2	433.16	(13.0	931.95	(13.0
204.93	(13.4	539.87	(13.4	095.16	13.5	494.21	(13.4	936.97	(13.5
214.88	(13.4	540.86	(13.5	111.20	(14.1	498.22	(13.4	939.96	(13.5
217.90	(13.5	548.94	(13.5	122.24	(14.1	501.22	(13.0	941.97	(13.5
218.93	(13.5	584.91	(13.5	124.19	(14.1	509.25	(13.0	948.23	(13.5
228.88	(13.5	586.99	(13.4	136.99	(14.1	522.92	(13.0	962.95	(13.5
230.97	(13.4	557.94	(13.4	140.26	(13.5	525.24	(13.5	970.95	13.1
249.93	(13.4	569.87	(13.4	144.20	(14.1	527.23	12.0	974.20	13.1
256.91	(13.4	574.93	(13.5	145.97	13.6	530.22	11.9	975.99	13.3
348.17	(13.5	575.93	(13.4	148.98	13.4	532.22	11.9	992.99	(14.1
377.17	(13.5	579.94	(13.4	149.98	13.4	533.99	12.4	996.91	(13.5
384.20	(13.5	580.91	(13.4	155.24	13.2	536.24	12.7	2439000+	
387.22	(13.5	586.91	13.1	156.25	13.1	537.23	12.9	003.96	(13.5
388.21	(13.5	589.92	12.4?	163.91	(13.5	552.00	(13.5	004.96	(13.5
402.21	(13.5	606.90	(13.4	167.24	(14.1	568.22	(13.4	021.93	(13.5
405.02	(13.4	613.91	(13.0	170.99	(14.1	608.97	(13.5	023.97	(13.5
409.22	(13.5	616.91	(13.0	174.24	(13.5	613.95	(13.5	029.90	13.7
410.20	(14.1	696.15	(13.0	176.97	(14.1	615.99	(13.5	031.90	(13.5
429.25	12.9	701.15	(13.4	178.98	(13.5	634.96	(13.5	032.95	13.3
437.27	(13.5	705.12	(13.5	181.24	(14.1	636.92	(13.5	035.85	12.4
438.98	(13.5	727.13	(13.5	182.21	(14.1	640.90	(13.5	046.91	(13.5
439.94	(13.5	740.17	(13.5	191.92	(13.5	648.93	(13.5	047.93	(13.5
441.26	(13.5	759.22	(13.9	192.95	(13.5	660.83	13.2	052.92	(13.5
442.25	(14.1	762.15	(13.5	193.96	(13.5	664.94	11.9	054.89	(13.5
446.25	(13.5	763.20	(13.4	196.98	(13.5	665.91	12.6	063.91	(13.0
455.96	(13.5	771.24	13.5	202.02	(13.5	666.86	12.8	143.15	(13.0
456.94	(13.5	790.23	(13.5	204.95	(13.5	669.96	13.1	159.16	(13.5
459.97	(13.5	794.98	(13.5	207.98	(13.5	674.90	(13.5	205.21	(13.5
461.01	(13.5	814.23	13.8?	212.24	14.1?	675.89	(13.5	218.19	(13.5
.94	(13.5	821.97	(13.5	219.92	(13.5	678.92	(13.5	232.94	(13.5
462.98	(13.4	823.24	(13.5	221.94	(13.5	694.90	(13.5	256.91	13.7
463.97	(13.5	829.20	(13.4	222.95	(13.5	696.88	(13.5	258.97	13.3
464.99	(13.5	831.22	(13.4	230.95	(14.1	699.89	(14.1	262.94	13.5
465.96	(13.5	838.97	(13.4	232.92	13.9	702.88	(13.5	264.21	14.2
467.94	(13.4	840.00	(13.0	236.93	(13.5	794.17	13.3	265.96	(13.5
468.95	(14.1	846.98	(13.4	251.91	(14.1	800.16	(13.5	269.94	(13.5
469.99	(13.5	847.95	(13.5	252.93	(14.1	804.17	(13.5	271.93	(14.1
471.94	(13.4	852.95	(13.5	253.94	(14.1	819.18	(13.5	274.21	(13.5
474.21	(13.5	853.94	(13.4	254.90	(14.1	826.18	(13.5	283.89	(13.4
476.26	(13.5	864.80	(13.4	255.95	(13.5	851.97	(13.5	284.95	(13.5
478.93	(13.0	867.95	(13.4	259.97	(13.5	855.20	(13.5	287.85	13.8?
479.93	(13.0	869.95	(13.5	263.90	(13.5	877.21	(13.5	290.92	(13.5
480.92	(13.0	875.82	(13.4	282.91	(13.5	880.95	(13.5	292.93	(13.5
482.90	(13.5	876.95	(13.4	284.88	13.1	883.97	(13.5	294.91	(13.5
487.82	(13.4	882.86	13.6	287.00	12.9	885.23	(14.1	295.85	(13.5
488.90	(13.0	883.98	11.9	289.98	12.7	886.21	(14.1	301.94	(13.5
491.94	(13.5	884.94	11.7	293.83	13.3	887.20	(13.5	315.92	(13.5
502.20	13.5	901.96	(13.5	297.96	(13.0	890.26	(13.5	317.93	(13.5
512.95	(13.5	906.00	(13.4	308.85	(13.5	892.22	(13.5	326.94	(13.5
521.94	11.8	.93	(13.4	312.95	(13.4	900.92	12.3	327.92	(13.5
523.99	11.9	908.94	(13.5	314.96	(13.0	903.86	12.5	328.98	(13.5
525.95	12.1	913.98	(13.0	316.87	(13.5	906.96	12.8	330.06	12.8
527.89	13.1	930.95	(13.4	317.90	(13.5	909.17	13.3	344.94	13.2
528.95	13.1	932.92	(13.4	417.15	(13.4	916.22	(13.5	346.93	13.7
		958.90	(13.4						

TABLE 1---continued

J.D.	MAG.	J.D.	MAG.	J.D.	MAG.	J.D.	MAG.	J.D.	MAG.
2439000+		2439000+		2439000+		2440000+		2440000+	
349.09	(14.0	684.12	(14.1	975.21	(13.5	273.16	(13.5	527.89	(13.0
353.97	(14.1	687.14	(13.5	976.23	13.9	276.20	(13.5	531.89	(13.0
355.05	(14.0	698.95	(13.5	980.94	13.1	297.18	13.5	533.90	(13.5
.92	(13.5	707.92	13.2	981.93	12.9	302.23	(13.5	607.15	(13.0
357.90	(13.5	709.96	13.9	985.20	13.3	308.17	(13.4	624.16	(13.5
371.84	(13.5	715.88	(13.4	988.27	(13.0	310.23	13.5	628.17	(13.5
400.85	(13.5	723.84	(13.5	997.91	(14.1	325.25	(13.4	632.18	(13.5
406.92	13.5	731.91	(13.5	998.94	(13.5	326.22	(13.5	633.19	(13.5
409.89	12.7	737.90	(14.1	999.91	14.0?	327.22	(13.5	635.16	(13.5
413.88	13.1	738.93	(13.5	2440000+		333.22	14.3	649.19	(13.5
414.86	13.1	740.94	(13.5	002.94	(13.5	336.19	(14.1	650.18	(13.5
415.92	13.4	756.89	(13.5	007.95	(13.5	338.23	(14.1	661.17	(13.5
417.92	(13.4	759.90	(13.5	008.85	(13.5	349.94	(13.5	664.19	(13.5
429.87	(13.5	763.85	(13.5	009.93	(13.5	352.25	(13.0	681.19	12.4
526.15	(13.5	764.89	(13.5	012.89	(13.5	356.93	(13.5	683.20	12.5
528.15	(13.5	765.88	(13.5	015.25	(13.5	360.90	(13.5	684.23	13.3
533.13	(13.5	767.94	(13.5	027.94	(13.5	366.15	14.3?	685.19	12.8
534.16	(13.4	771.89	(13.5	033.92	(13.5	369.23	(13.5	687.20	13.3
539.16	(13.5	781.90	(13.5	037.79	13.3	376.90	12.8	690.19	14.1
543.17	14.1?	786.90	13.8	040.25	13.0	377.92	12.5	691.19	14.1
563.16	(13.5	791.90	12.5	041.27	12.9	379.93	12.4	704.98	(13.5
564.19	(13.5	792.89	12.4	044.23	13.0	381.87	13.0	710.21	(13.5
567.22	(13.5	793.88	12.4	051.94	13.8	382.94	12.8	711.22	(13.5
585.08	(14.0	794.89	12.2	053.94	(14.1	383.98	12.9	712.21	(13.5
589.24	(13.5	795.88	12.5	054.97	(13.5	384.92	12.9	716.95	(13.5
596.18	(13.5	796.87	12.5	056.84	(13.5	389.93	13.5	720.20	(13.5
597.11	(13.5	801.87	13.7	064.97	(13.5	393.26	(13.5	722.20	(13.5
600.21	(13.5	884.14	(13.0	066.97	(13.5	405.94	(13.5	723.24	(13.5
602.18	(13.5	885.15	(13.5	068.94	(13.5	408.97	(13.5	732.97	(13.5
605.01	(13.5	886.16	(13.5	082.93	(13.5	412.94	(13.5	733.95	(13.5
611.95	(13.5	890.15	(13.5	083.84	(13.5	415.85	(13.5	744.95	(13.5
614.92	(13.5	894.18	(13.5	092.98	(13.5	422.95	(14.1	746.94	(13.5
615.96	(13.5	896.25	(13.5	095.95	(13.5	423.95	(13.5	761.99	(13.4
619.94	13.4	897.17	(13.5	098.95	13.1	424.95	(13.5	762.94	(13.5
621.22	13.3	898.18	(13.5	099.88	13.7	433.83	12.7	764.91	(13.5
622.97	13.0	899.16	(13.5	106.89	(13.5	435.94	13.1	773.93	(13.5
627.02	(13.0	908.17	(13.5	109.95	14.1?	436.85	12.8	775.95	(13.5
.22	12.9	910.17	(13.5	110.93	(13.5	441.94	(13.5	790.94	12.8
628.22	13.2	912.16	(13.5	112.96	14.3?	443.87	(13.5	793.82	12.9
630.23	14.0	913.17	(13.5	113.91	(13.5	446.93	(13.5	794.97	13.3
631.23	14.1	917.16	(13.5	115.88	(13.5	451.90	(13.5	795.94	(13.5
639.97	(13.5	922.18	(13.5	116.91	(13.5	454.93	(13.5	801.97	(13.5
645.94	(13.5	927.16	12.4	132.94	(13.0	463.91	(13.5	807.93	(13.5
647.96	13.8?	939.18	(13.5	140.94	(13.5	477.85	14.0?	816.83	(13.0
648.96	(13.5	941.20	(13.5	143.91	(13.5	482.89	(13.0	821.94	(13.5
650.97	(13.5	943.18	(13.5	155.89	(13.0	495.87	(13.5	822.97	(14.1
651.92	(13.5	953.05	(13.5	168.94	(13.4	498.89	(13.5	823.91	(13.5
661.23	(13.5	959.24	14.1	169.89	13.7	505.93	13.8	831.93	(13.5
668.96	(13.5	963.98	(13.4	179.90	(13.0	506.85	(13.5	832.94	(13.5
671.96	(13.5	970.25	13.9	242.15	(13.5	508.91	(13.5	837.00	(13.5
678.97	(13.5	971.25	(13.5	244.16	(13.5	509.95	(13.0	846.88	(13.5
680.94	(13.5	972.99	(13.5	271.13	13.6	512.90	(13.4	856.88	13.0
682.12	(13.5	974.19	14.3?	272.19	13.8	523.89	(13.5	857.97	13.3

TABLE 1---continued

J.D.	MAG.	J.D.	MAG.	J.D.	MAG.	J.D.	MAG.	J.D.	MAG.
2440000+		2441000+		2441000+		2441000+		2441000+	
863.90	13.5	203.92	(13.5)	474.93	(13.5)	572.90	(14.2)	758.20	13.7
866.94	(13.0)	207.92	(13.5)	475.94	(13.5)	573.94	(13.6)	771.23	12.6
881.86	(13.5)	214.88	(13.5)	477.06	(13.5)	574.90	(13.6)	773.20	12.6
883.91	(13.5)	216.88	(13.5)	478.21	(13.5)	575.90	(13.6)	774.14	13.35
906.90	(13.0)	218.94	(13.5)	479.24	(13.5)	577.92	(14.0)	775.05	13.6
981.15	(13.5)	222.92	(13.5)	479.99	(13.5)	579.92	(13.0)	777.24	(13.5)
990.16	(13.5)	234.90	(13.5)	482.94	(13.5)	582.89	13.0	.95	(13.5)
2441000+		236.96	(13.4)	486.93	(13.4)	583.87	13.4	778.28	14.2
011.18	(13.5)	237.89	(13.5)	487.92	(13.4)	584.88	12.4	779.07	14.00
019.22	(13.4)	243.92	(13.5)	490.25	(13.5)	585.90	12.5	780.06	(13.6)
020.20	(13.5)	249.88	(13.4)	496.81	(13.0)	586.84	12.8	781.07	(13.6)
032.21	(13.5)	268.90	(13.5)	499.82	(13.5)	.92	11.5?	782.21	(13.5)
039.19	(13.5)	335.14	(13.0)	500.92	(13.5)	587.91	12.80	785.21	(13.5)
041.03	(13.5)	339.15	(13.5)	501.97	(13.5)	589.92	13.50	787.26	(14.2)
044.22	(13.5)	360.19	(13.5)	503.93	(13.5)	591.90	14.1	788.22	(13.5)
047.15	13.7	361.17	13.4	506.20	(13.5)	592.91	(13.6)	789.19	(13.6)
050.22	(13.5)	362.16	13.3	513.22	(13.4)	593.91	(13.6)	794.28	(12.6)
064.97	(13.5)	367.19	12.9	515.95	(13.5)	594.89	(13.6)	795.08	14.7
067.18	(13.5)	373.16	(13.5)	525.81	(13.0)	595.90	(13.6)	.99	14.7
069.22	13.9	389.17	(13.5)	527.00	(13.0)	596.90	(13.6)	796.98	(13.6)
070.20	13.8	390.21	(13.5)	528.00	(14.5)	597.90	(13.6)	798.26	(13.6)
078.96	(13.4)	391.18	(13.5)	529.88	(13.4)	598.89	(13.6)	800.03	(12.6)
080.26	(13.5)	393.03	(13.5)	530.95	(13.5)	599.88	(12.6)	.90	15.5
087.97	13.5	394.02	(13.5)	531.98	(13.5)	604.94	(13.0)	801.93	(13.5)
088.95	(13.5)	395.22	(13.5)	533.00	(12.5)	605.88	(13.5)	802.98	(13.6)
089.95	(13.5)	396.18	(13.5)	533.93	(14.2)	606.89	(12.6)	804.28	(14.2)
096.21	(13.5)	409.20	(13.0)	535.00	(14.5)	607.91	(12.6)	805.22	(14.2)
097.21	(13.5)	416.21	13.1	.89	(14.2)	616.90	(14.0)	807.12	(14.2)
098.22	(13.5)	417.22	12.5	536.93	(14.2)	618.94	(13.6)	.95	14.6
099.95	13.5?	418.00	12.5	539.85	(14.2)	619.90	(13.5)	808.08	(14.2)
107.24	(13.5)	419.21	12.7	541.91	(14.2)	622.90	(13.6)	809.03	(14.2)
115.94	(13.4)	422.21	(13.5)	542.92	(13.0)	623.91	(13.6)	811.03	(13.6)
116.97	(13.4)	424.22	(13.5)	543.96	(13.0)	624.89	(12.6)	812.03	(13.6)
117.97	14.0	425.21	(13.5)	544.94	(14.2)	625.91	(12.6)	813.09	(13.6)
118.95	13.9	427.00	(13.5)	545.96	(14.2)	636.90	(12.6)	814.08	(13.6)
122.00	(14.1)	430.15	(13.5)	554.00	(14.0)	637.91	(12.0)	815.00	(15.0)
128.94	(13.5)	433.22	(13.5)	555.90	(13.6)	711.16	(13.0)	.24	14.2
149.95	(13.5)	434.24	(13.5)	556.92	12.6?	717.18	(12.6)	816.14	(13.6)
150.95	(13.5)	440.88	(13.0)	.90	(14.2)	718.16	(13.5)	817.01	(13.6)
151.94	(13.5)	444.24	(13.4)	557.89	(14.2)	719.18	(13.5)	820.00	(13.0)
154.94	(13.5)	444.96	(13.5)	558.90	(14.2)	722.16	(13.5)	823.00	(13.5)
160.93	(13.5)	446.25	(13.5)	559.89	(14.2)	723.24	(14.2)	824.03	(14.2)
174.94	13.2	447.91	(13.5)	560.91	(13.6)	726.17	(13.5)	.87	14.6
176.98	12.2	449.07	(13.5)	561.92	(14.2)	728.16	(13.5)	826.00	(14.2)
182.00	13.1	454.98	13.5	562.90	(14.2)	729.18	(13.5)	828.05	(14.2)
184.92	13.3	455.88	(13.5)	563.91	(14.2)	736.18	(13.4)	829.07	(14.2)
186.92	(13.5)	456.95	(13.5)	564.93	(13.6)	738.17	14.0	830.24	(13.5)
188.93	(13.5)	459.24	(13.5)	565.90	(13.6)	742.25	14.2	.98	(14.2)
191.93	(13.5)	460.25	(13.5)	566.90	(13.6)	745.26	(14.2)	832.00	(14.0)
192.94	(13.5)	462.93	13.3?	567.90	(13.6)	746.26	(14.2)	.89	(13.6)
198.82	(13.0)	468.89	(13.0)	569.92	(13.5)	749.27	(14.2)	833.98	14.0
201.88	(13.5)	470.94	13.5	570.93	(14.2)	751.28	14.2	834.89	(13.6)
202.96	(13.0)	472.92	13.5	571.90	(14.2)	753.25	14.0	835.01	14.0

TABLE 1---continued.

J.D.	MAG.	J.D.	MAG.	J.D.	MAG.	J.D.	MAG.	J.D.	MAG.
2441000+		2441000+		2442000+		2442000+		2442000+	
836.02	14.1	921.93	(13.6	098.14	(13.5	219.95	(13.6	297.91	(13.6
.96	14.0	922.90	(13.6	099.10	(14.5	220.84	(13.5	299.94	14.4
837.87	13.8	923.92	(13.6	102.25	(13.6	221.83	(13.5	301.91	13.8
840.79	13.8	924.92	(13.6	104.10	(14.5	222.87	14.60	302.89	(14.0
841.92	14.4	925.92	(13.6	105.15	(14.5	237.92	(13.6	303.89	14.0
843.07	14.50	926.96	(13.6	106.10	(13.5	240.96	(14.2	304.90	(13.6
844.02	14.9	928.91	(13.6	125.99	13.8	241.93	(14.2	306.92	(13.6
845.00	(13.0	929.92	(13.6	127.07	12.60	242.92	(14.2	307.91	(13.6
.96	(13.6	936.90	(13.5	129.11	12.6	243.89	(13.6	309.93	(13.6
846.89	(12.6	940.91	(13.6	131.13	12.8	244.89	(13.6	310.90	(13.0
847.89	(12.6	941.91	(14.2	133.06	13.5	245.90	(13.6	314.89	(12.6
849.97	(12.6	944.89	(13.6	134.16	13.6	246.89	(14.2	315.93	(13.6
851.98	(14.0	945.90	13.7	137.10	(13.6	247.90	(14.2	317.89	(12.6
853.94	(14.2	946.90	13.7	162.30	(13.6	248.90	(13.6	318.89	(13.6
854.94	(13.6	947.87	(13.5	163.92	(13.5	249.90	(14.2	319.89	(13.6
855.88	(14.2	949.89	13.2	164.20	(14.5	250.89	(14.2	321.89	(12.6
856.93	(13.6	950.87	13.20	166.08	(15.4	251.95	(13.6	322.88	(13.6
857.93	(13.6	951.89	13.2	167.08	(15.0	253.91	(13.6	323.89	(13.6
858.90	(13.6	953.89	12.20	.15	15.2	254.89	(13.6	325.88	(13.5
859.89	(13.6	954.87	12.60	168.14	15.10	255.91	(13.6	327.89	(13.6
861.86	(13.0	955.88	12.45	173.88	(13.5	256.89	(12.6	329.90	(13.6
863.90	(14.5	956.90	11.5	178.89	(13.4	257.93	(12.6	331.90	(13.6
864.92	(13.6	957.88	11.5	180.00	(13.6	258.90	(12.6	336.91	(13.6
866.81	(13.4	958.89	11.7	.96	15.0	259.88	(12.6	337.90	(13.5
870.87	(13.4	965.90	12.9	182.01	(13.6	260.88	(12.6	338.90	(13.6
871.95	(14.9	969.89	13.8	.88	(14.5	261.88	(13.0	339.89	(13.6
873.92	(13.6	970.91	14.6	184.05	15.2	262.88	(12.6	340.88	(13.6
874.92	(12.6	971.90	(13.6	.96	(12.6	263.87	(13.6	348.91	(12.6
875.91	(13.6	973.91	(13.6	186.92	(12.6	264.90	(14.2	350.91	(12.0
877.00	(13.0	974.89	(13.6	187.99	(13.6	265.92	(13.6	351.90	(12.0
.91	(12.6	976.89	(13.6	188.93	(12.6	267.92	(14.2	354.90	(13.6
882.88	(13.4	977.89	(13.6	189.90	(12.6	268.89	(14.0	355.90	(13.6
883.96	13.1	981.89	(13.6	192.03	(12.6	269.90	(14.2	356.90	(13.6
889.89	(13.0	983.90	(13.6	.90	(13.5	270.89	(14.2	360.90	(13.6
890.87	(13.5	989.92	(12.6	194.00	(12.6	271.90	(14.2	361.90	(13.6
892.05	(13.6								
893.94	13.6	2442000+		195.97	(13.6	272.91	14.2	362.90	(12.6
894.92	13.8	000.90	(12.6	197.00	(13.5	273.89	14.1	363.90	(12.6
895.94	(13.6	001.90	(12.6	198.26	(13.5	274.87	14.50	371.90	(12.6
899.96	(13.6	002.89	(12.6	.90	(14.5	275.91	14.7	432.25	(12.6
900.98	13.6	003.89	(12.6	201.25	(13.5	277.90	(14.2	434.24	(13.6
901.94	(12.6	004.90	(12.6	204.89	(12.6	278.89	(14.2	436.15	(13.0
906.95	(11.5	005.90	(12.6	205.88	(12.6	279.92	(14.2	438.24	(13.6
911.88	(13.5	006.90	(12.6	206.92	(14.2	280.92	14.8	452.27	(13.6
912.98	(13.6	007.90	(12.6	207.93	13.6	283.90	(13.5	473.25	(13.6
913.95	13.6	080.20	(13.5	210.90	(13.5	286.92	(13.6	480.20	(13.5
914.90	(13.6	081.20	(14.5	212.96	12.0	289.90	(13.0	494.25	(14.2
915.89	(13.6	088.20	(13.5	213.98	12.6	290.90	(10.0	510.94	(13.6
916.96	(13.5	090.15	(14.0	215.84	12.9	293.91	(13.6	512.10	(13.5
918.92	(13.6	095.16	(13.0	216.82	13.5	294.89	(13.6	515.20	(13.5
919.96	(13.6	096.15	(13.5	217.83	13.4	295.82	(13.5	520.26	(13.6
920.91	(13.6	097.14	(13.5	218.82	(14.0	296.91	(13.6	535.15	(14.0

TABLE 1---continued

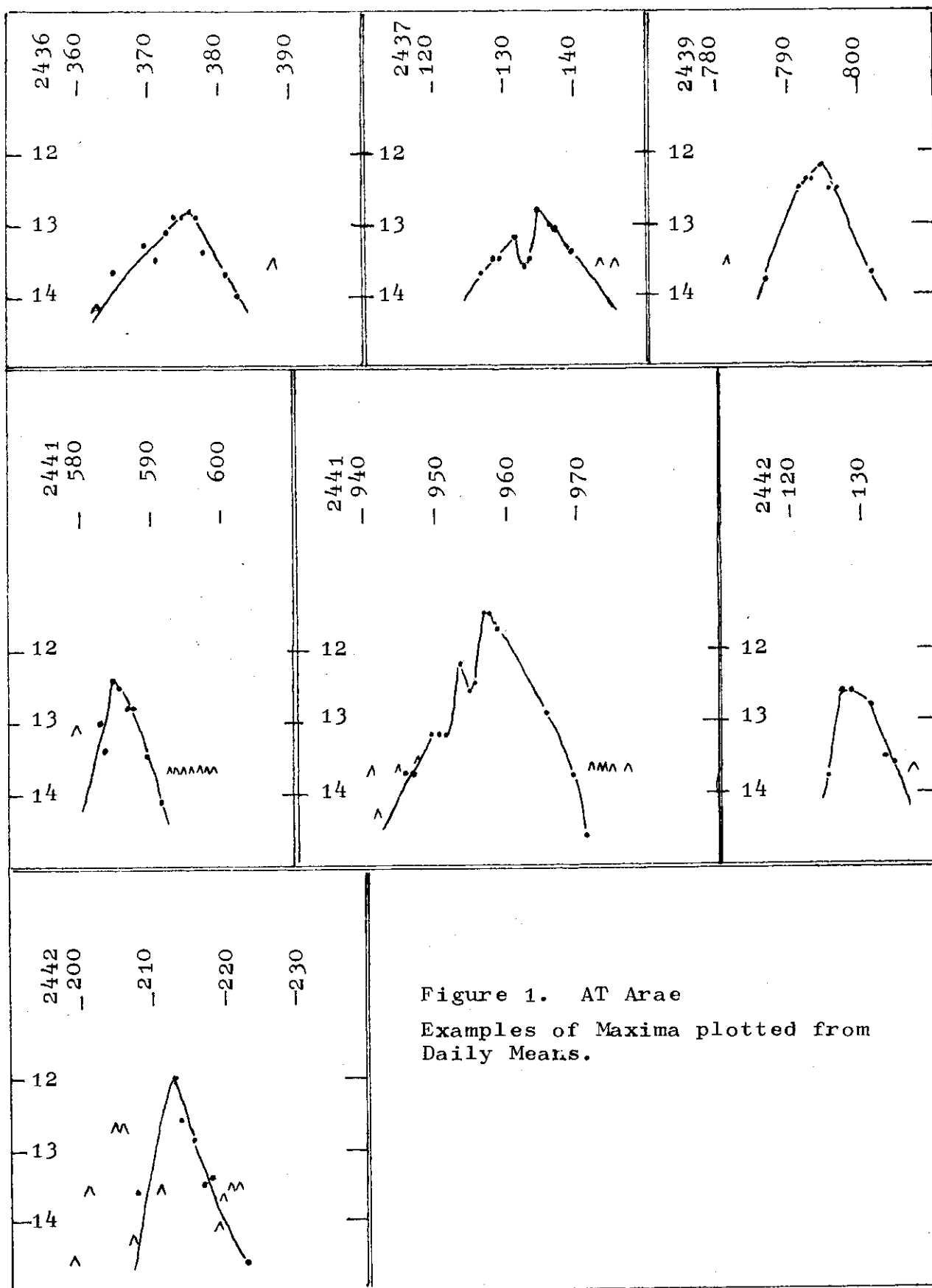
J.D.	MAG.	J.D.	MAG.	J.D.	MAG.	J.D.	MAG.	J.D.	MAG.
2442000+		2442000+		2442000+		2442000+		2442000+	
536.10	(13.5	618.93	(13.6	651.93	(13.6	861.10	(13.5	908.22	(14.1
537.94	(13.5	620.93	(14.2	653.95	(13.6	868.05	(13.5	909.23	(14.1
543.04	(12.6	621.91	(13.6	656.94	(13.6	869.03	(13.5	915.97	(13.6
547.91	13.1	622.96	(14.2	661.95	13.2	870.00	(13.5	916.96	(13.6
554.91	13.4	623.94	(13.5	683.92	(13.5	872.01	(13.5	918.95	(13.5
563.98	(13.6	625.03	(14.2	690.93	(13.5	873.00	(13.5	919.96	(13.5
564.92	(14.5	626.07	(14.2	711.94	(13.6	876.00	(13.5	921.91	13.8?
571.24	(13.5	.95	(13.5	713.88	(13.5	877.00	(13.5	922.02	(13.6
572.08	14.5	629.99	(14.2	714.91	(13.6	883.04	13.0	925.05	(13.6
573.00	14.6	630.96	(14.2	810.20	(13.5	.98	13.2	.95	(13.0
573.93	(13.5	631.94	(13.5	812.20	(13.5	890.01	(13.6	926.93	(13.5
574.90	(13.5	634.03	(14.2	819.20	(13.5	892.00	(13.5	944.92	(13.6
575.93	(13.6	635.03	(13.6	820.19	15.0	.96	(13.6	949.92	(13.6
591.88	13.5	.93	(14.2	835.02	13.0	893.93	(13.5	950.95	(13.5
595.94	(13.5	637.92	(14.2	840.03	14.0	894.94	(13.5	951.90	(13.6
605.09	(14.2	640.92	(13.6			898.96	(13.6	952.91	(13.6
606.17	(13.6	641.91	(13.6			899.93	(13.5	953.91	(13.6
607.01	(14.2	642.91	(13.6			901.93	(13.5		
609.08	(14.2	648.89	(14.2			905.03	(13.6		
614.94	(13.6	649.90	(14.2			906.10	(13.5		

TABLE 2. AT ARAE---OBSERVED MAXIMA.

No.	J.D.	MAG.	INT. d	14.OI	14.OD	WIDTH d	No. Obs.
1	2,436,280?	<u>13.8</u>	...	...	...	...	1
2	334?	<u>13.7</u>	54	...	...	...	1
3	376	<u>12.8</u>	42	364	382	18	11
4	444?	<u>12.9</u>	68	...	...	...	3
5	642	<u>12.6</u>	(198)	634?	653	19	4
6	800	<u>12.2</u>	(158)	791	812	21	7
7	2,437,074?	<u>13.2</u>	(274)	...	...	...	1
8	135	<u>12.8</u>	61	125	144	19	10
9	429?	<u>12.9</u>	(294)	...	...	...	1
10	500?	<u>13.5</u>	71	...	...	...	1
11	522	<u>11.8</u>	22	511?	530	19	5
12	590	<u>12.4</u>	68	...	...	...	2
13	770?	<u>13.5</u>	(180)	...	...	...	1
14	885	<u>11.7</u>	(115)	882	?	...	3
15	2,438,087?	<u>12.2</u>	(202)	...	...	...	2
16	156	<u>13.1</u>	69	145	167	22	5
17	234?	<u>13.9</u>	78	...	...	...	1
18	290	<u>12.7</u>	56	284	296	12	4
19	529	<u>11.6?</u>	(239)	526	541	15	6
20	665	<u>11.9</u>	(136)	659	671	12	5
21	790?	<u>13.3</u>	(125)	...	...	...	1
22	900	<u>12.3</u>	(110)	...	911	...	4
23	972	<u>13.1</u>	72	966	978	12	3
24	2,439,036	<u>12.4</u>	64	...	...	...	3
25	260	<u>13.3</u>	(224)	...	...	...	4
26	334	<u>12.8</u>	74	330	348	18	3

TABLE 2---continued

<u>No.</u>	<u>J.D.</u>	<u>MAG.</u>	<u>INT.</u> d	<u>14.OI</u>	<u>14.OD</u>	<u>WIDTH</u> d	<u>No.</u> <u>Obs.</u>
27	2,439,409	12.7	75	406	419	13	5
28	625?	12.9	(216)	617	631	14	7
29	704?	<u>13.2</u>	79	...	...	...	2
30	795	<u>12.2</u>	91	786	803	17	8
31	927?	<u>12.4</u>	(132)	...	...	...	1
32	983?	<u>12.9</u>	56	976	986	10	5
33	2,440,042	<u>12.9</u>	59	034	052	18	5
34	098	<u>13.1</u>	56	...	...	...	4
35	171?	<u>13.7</u>	73	...	...	...	1
36	269?	<u>13.6</u>	98	...	...	...	2
37	300	<u>13.5</u>	31	...	...	...	2
38	380	<u>12.4</u>	80	368	393	25	9
39	432?	<u>12.7</u>	52	...	441	...	3
40	681	<u>12.4</u>	(249)	676	691	15	7
41	791	<u>12.8</u>	(110)	...	...	...	3
42	853?	<u>13.0</u>	62	...	...	...	3
43	2,441,045?	<u>13.7</u>	(192)	...	...	...	1
44	084?	<u>13.5</u>	39	...	...	...	3
45	120?	<u>13.9</u>	36	...	...	...	2
46	177	<u>12.2</u>	57	174	188	14	4
47	368	<u>12.9</u>	(191)	...	...	...	3
48	418	<u>12.5</u>	50	415	423	8	4
49	466	<u>13.3</u>	48	462	475	13	3
50	585	<u>12.4</u>	(119)	581	591	10	12
51	771	<u>12.6</u>	(186)	755	778	23	11
52	839	<u>13.8</u>	68	836	842	6	9
53	886?	<u>13.1</u>	47	...	...	...	3
54	957	<u>11.5</u>	71	945	970	25	18
55	2,442,128	<u>12.6</u>	(171)	125	135	10	7
56	213	<u>12.0</u>	85	208	220	12	8
57	274	<u>14.1</u>	61	...	...	...	5
58	302?	<u>13.8</u>	28	...	...	...	3
59	552?	<u>13.1</u>	(250)	...	...	...	2
60	589?	<u>13.5</u>	37	...	...	...	1
61	665?	<u>13.2</u>	76	...	...	...	1
62	826?	<u>13.0</u>	(161)	...	...	...	3
63	881?	<u>13.0</u>	55	...	...	...	2



THE DWARF NOVA---FQ SCORPII

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SUMMARY: Visual observations of FQ Sco over an interval of 22yr show that outbursts occur at frequent intervals with a mean cycle of 36^d. Observed maxima have a mean magnitude of 12.8_v and vary widely in width. The rise to maximum brightness is almost always steep, whilst the rate of decline varies. Some falls are almost as steep as the rise. Other maxima have slow declines. The possibility of dips in the light curve being due to some orbital feature can only be determined by photoelectric observations.

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1 INTRODUCTION

Visual observations of FQ Sco from JD 2,434,819 to 2,440,038 were discussed by Bateson & Jones(1970) on the basis of step estimates assigned to the comparison stars. They pointed out the difficulty in observing this star, since it rises not more than 1^m.0 to 1^m.5 above the threshold of the instruments used.

Vogt (1977) published a three colour sequence for the comparison stars. These stars were identified by letters on a preliminary chart produced by M.V. Jones. This chart will appear in a future issue of "Charts for Southern Variables." Vogt's sequence has been used to reduce all observations to V magnitudes. There were a few estimates made using other comparison stars. These were reduced by inter-comparison with the V magnitudes of the stars in Vogt's sequence.

2 OBSERVATIONS

Members of the Variable Star Section, Royal Astronomical Society of New Zealand, made 2,073 observations between JD 2,434,819(1954 March 17) and 2,443,044 (1976 Sept. 22). There were 267 positive observations and 1,709 negative observations, when FQ Sco was invisible. An additional 97 observations recorded the variable as either just visible or as "Trace," usually without it being possible to make a definite estimate of its brightness.

Table 1 lists the Julian Date and magnitude for the positive observations and the immediate preceding and following negative observations, if these were made within 10 days of a positive observation. If the magnitude in column 2 is from a single estimate it is given to tenths, and, if from two, or more, estimates it is given to hundredths.

Table 2 lists the observed maxima derived from the observations in Table 1. The date of maximum in the first column has a question mark after it if the date is considered uncertain. The magnitude in the second column is underlined if it appears probable that FQ Sco attained a brighter magnitude than that shown. The interval, in days, from the previous maximum is shown in the third column, being enclosed in brackets if it appears that the maxima are not successive. The fourth column gives the width, in days, at phase 14.01-D when this could be determined. The final column shows the number of positive observations for each maximum.

Additional possible maxima are listed in Table 3. These are from the 97 observations mentioned in the first paragraph of the section. None of the dates in Table 3 can be considered as definite.

Figure 1 illustrates some of the best observed maxima.

3 FREQUENCY OF OUTBURSTS

The observing season is from April to October inclusive, with few observations in other months. This explains many of the large intervals in column three of Table 2. It is obvious that most of the maxima listed in Table 2 are not successive. If only those maxima are considered that appear to be successive a mean cycle of $37^{\text{d}}.3$ is found.

A mean cycle of $36^{\text{d}}.3$ is found when the possible maxima listed in Table 3 are combined with the definite maxima of Table 2. This appears to be justified as it is probable that Table 3 includes outbursts at the limit of the instruments used. Probably even fainter outbursts occur so that it is likely that the mean cycle is shorter than 36^{d} .

4 DISCUSSION

Visual observations of FQ Sco made with the instruments employed merely result in records of the brightest segment of the outburst curve. For this reason the information that can be derived from them is limited.

The mean magnitude of the best determined maxima is $12^{\text{m}}.8_{\text{v}}$ with a range of $12^{\text{m}}.1$ to $13^{\text{m}}.4$. It is probable that many outbursts do not even reach $13^{\text{m}}.4$. The rise is generally steep, whilst the decline shows wide variation. Some falls are almost but not quite as steep as the rise; others are very slow. Generally maxima of $12^{\text{m}}.6$, or brighter, have the steepest falls. There is a tendency for the fainter maxima to be the broadest.

The width at phase 14.0I-D ranges from 3^{d} to 17^{d} . Maxima appear to be either narrow, with widths less than 9^{d} , or long with widths of 9^{d} or longer. Anomalous maxima apparently do not occur; nor does FQ Sco have supermaxima.

Some maxima appear to show a distinct dip, with an amplitude of $0^{\text{m}}.4$, either between the top of the initial rise and the subsequent maximum brightness, or immediately following maximum. It is difficult to be definite as to whether these dips are real, or due to the nature of visual observing. However similar dips have been well observed in other dwarf novae (Bateson 1974 & 1977). It is only photoelectric observations that can determine whether the dips in the case of FQ Sco are real and allied to some orbital feature.

5 CONCLUSIONS

Subject to the limitations of the observations FQ Sco appears to have either narrow outbursts with widths at phase 14.0I-D of less than 9^{d} , or long maxima having widths greater than 9^{d} . Anomalous maxima and supermaxima have not been recorded. Maximum magnitude ranges from $12^{\text{m}}.1$ to $13^{\text{m}}.4$ with a mean of $12^{\text{m}}.8$. Fainter outbursts probably occur. The mean cycle is no longer than 36^{d} and, if the fainter outbursts suggested occur, then the mean cycle is shorter than 36^{d} .

Attention is drawn to the possibility that FQ Sco may have dips in this light curve, which might be allied to some orbital feature.

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TABLE 1.

OBSERVATIONS OF FQ SCORPII.

J.D.	MAG.	J.D.	MAG.	J.D.	MAG.	J.D.	MAG.	J.D.	MAG.
2434000+		2436000+		2436000+		2437000+		2438000+	
870.21 (13.4		006.88 (13.4		497.88 (12.9		469.99 (13.4		660.83 (13.4	
871.98 13.3		021.79 (13.4		498.87 12.9		471.94 13.2		663.96 13.3	
873.21 13.3		025.21 13.8		499.87 13.2		474.21 13.9		664.91 13.3	
874.21 13.1		026.16 (13.4		506.87 (13.4		478.93 (12.1		665.91 13.8	
875.21 13.0				680.22 (13.4		479.93 (12.9		666.86 (13.4	
877.20 12.1		033.81 (13.4		685.90 13.4		512.86 (13.4		696.87 (13.4	
878.27 13.2		042.91 13.0		688.00 13.2		519.82 13.1		699.87 13.2	
884.86 (13.4		043.81 13.2		.97 13.0		521.93 12.7		702.87 13.3	
887.94 13.8		044.94 13.1		689.99 12.5		522.99 13.0		785.16 13.0	
888.91 (13.4		045.85 13.1		690.96 13.0		523.99 13.1		786.16 13.2	
983.94 (13.4		046.81 13.2		694.96 (12.9		524.98 12.7		787.17 13.2	
984.95 13.05		048.87 13.3		777.93 (13.4		527.88 13.1		794.17 (13.4	
986.90 12.65		049.93 13.3		781.93 12.7		528.94 13.2			
988.01 12.8		050.93 13.7		782.96 12.9		530.93 13.7		937.91 (13.4	
.86 12.8		052.99 (13.4		784.96 12.9		539.87 (13.4		939.96 13.2	
992.93 (13.4		070.98 (13.4		785.95 13.50		814.23 13.3		940.95 13.1	
2435000+		072.85 13.8		787.81 13.1		820.95 (13.4		941.92 13.2	
241.26 (13.4		073.93 (13.4		788.92 13.0				942.91 13.3	
244.91 12.4		257.21 13.0		789.92 13.2		848.81 (13.4		944.93 13.2	
246.87 13.2		260.21 13.2		790.80 13.3		852.95 13.3		949.96 (13.4	
247.93 13.0		261.18 13.2		791.94 13.3		853.88 13.3		2439000+	
248.90 13.1		262.21 (13.4		792.97 (12.9		856.85 (12.9		029.90 (13.4	
250.28 13.3		305.03 13.2		850.87 (13.4		953.88 13.4		032.95 13.1	
.91 (13.4		306.00 13.3		853.88 13.2		958.87 (13.4		033.93 13.1	
251.24 13.9		307.23 (13.4		860.87 13.2				036.86 13.2	
.94 (13.4		334.01 (13.4		863.89 (12.9		2438000+		038.85 13.3	
422.89 12.7		339.99 13.9				156.24 (13.4		046.90 (13.4	
596.02 (13.4		341.26 (13.4		2437000+		163.90 13.0		054.88 (13.4	
.25 13.2		353.18 (13.4		059.98 (13.4		164.96 13.1		064.86 13.4	
597.12 13.10		354.23 13.9		069.91 13.1		167.24 13.0			
602.97 (13.4		355.27 13.3		070.95 13.2		.97 13.2		152.15 (13.4	
642.87 (12.9		356.04 13.1		075.91 (13.4		168.94 13.3		159.16 13.0	
648.78 12.5		361.90 13.2		139.96 (13.4		170.97 (13.4		160.15 13.0	
649.84 12.5		362.98 13.3		143.77 13.2		259.86 (13.4		258.95 (13.4	
650.85 13.2		364.02 13.3		.96 (13.4		263.87 13.3		262.93 13.0	
654.96 (13.4		.94 13.6		158.93 (13.4		264.82 13.1		264.22 13.0	
953.22 13.1		365.87 (13.8		159.93 13.2		265.81 13.3		.95 13.2	
954.22 13.2		417.73 (12.9		165.00 (12.9		266.95 13.2		265.95 13.1	
958.23 (13.4		418.80 13.5		377.14 (13.4		494.21 (13.4		266.95 13.2	
980.94 (12.9		420.03 13.2		384.16 12.7		498.21 13.1		269.93 14.0	
982.90 13.5		.94 13.2		385.20 13.1		501.22 13.0		270.95 (13.4	
983.97 (13.4		421.99 13.3		386.21 13.2		502.21 13.0		355.91 (13.4	
991.97 (13.8		422.89 12.4		387.22 13.5		504.22 13.0		356.00 13.3	
994.91 13.3		431.96 (13.4		388.20 13.9		505.22 13.2		357.03 (12.9	
997.20 13.7						509.25 (13.4		.89 (13.4	

TABLE 1 ---continued

J.D.	MAG.	J.D.	MAG.	J.D.	MAG.	J.D.	MAG.
2439000+		2440000+		2441000+		2442000+	
371.84 (13.4		369.23 (13.4		486.00 (13.4		510.94 13.1	
378.87 13.0		376.88 12.9		.92 13.3		511.85 12.7	
383.89 (13.4		377.92 13.3		488.08 13.10		515.20 13.0	
542.18 (13.4		379.93 13.3		.91 13.2		518.93 13.4	
543.17 13.1		381.87 (13.4		490.10 13.20		520.26 (13.4	
544.18 13.2		477.85 (13.4		496.18 (13.4		617.85 (12.9	
589.24 (13.4		485.89 13.2		597.90 (13.4		618.89 13.5	
594.05 12.9		486.92 13.1		604.85 13.0		620.90 13.30	
595.02 12.9		487.96 13.1		605.87 13.0		621.91 13.5	
596.18 13.3		491.83 13.4		606.89 (13.5		622.96 13.4	
597.25 13.2		495.87 (12.9		753.25 (14.2		623.94 13.0	
599.24 (13.4		498.88 (13.4		756.22 13.3		624.98 13.15	
651.92 (13.4		619.15 (13.4		758.19 13.3		626.06 13.4	
653.98 13.3		624.16 12.8		873.91 (13.4		.94 (13.4	
654.95 13.3		628.17 (13.4		874.97 13.40		627.7 (14.0	
655.93 13.6		823.95 (13.4		882.88 (13.4		867.95 (13.4	
659.91 (13.4		831.94 13.20		920.81 (13.4		870.95 13.3	
707.92 (13.4		832.94 13.0		.90 13.9		872.00 12.7	
708.81 13.2		835.90 13.0		921.93 13.50		874.94 12.9	
709.97 12.80		836.95 13.0		922.91 13.4		887.92 (13.4	
714.91 13.2		838.59 (12.9		923.92 (14.2		888.93 13.9	
722.81 (13.4		841.82 (13.4		956.90 (13.4		890.94 (13.4	
917.12 (13.4		881.86 (13.4		969.89 13.20		984.07 (14.2	
919.21 13.3		883.88 13.3		970.88 13.15		990.94 13.4	
922.18 13.2		884.85 (13.4		971.88 13.40		991.93 13.4	
927.13 13.8		2441000+		972.89 (13.4		993.01 13.4	
963.98 (12.9		060.19 (13.4		2442000+		994.95 13.4	
965.94 13.4		063.93 13.0		201.25 (13.4		2443000+	
968.21 13.3		064.97 12.5		204.89 12.1		004.81 (13.4	
970.25 (13.4		066.25 12.8		205.89 12.80			
2440000+		067.18 12.8		206.90 12.85			
065.95 (13.4		068.19 13.0		207.88 13.07			
066.97 13.0		069.21 13.1		212.95 13.5			
068.94 12.9		070.21 13.1		213.98 (13.4			
071.87 13.2		076.87 (12.9		251.92 (13.4			
074.95 13.4		151.93 (13.4		253.90 13.45			
082.92 (13.4		154.94 12.8		254.90 13.55			
135.86 (13.4		157.80 13.1		255.90 13.5			
138.92 13.4		160.92 12.4		.92 (13.5			
143.91 13.2		162.95 13.2		348.90 (13.1			
150.90 (13.4		163.94 13.5		354.90 12.9			
265.19 (13.4		164.13 13.7		355.90 12.9			
270.15 13.0		174.94 (13.4		356.90 13.1			
271.13 13.1		391.19 (13.4		357.90 (13.4			
272.18 13.2		393.02 (12.7		360.90 13.3			
273.16 13.4		394.10 12.70		361.90 13.5			
275.16 (13.4		395.20 13.1		362.90 (13.1			
		396.18 13.3					
		397.00 13.4					
		398.21 13.3					
		407.21 (12.9					

TABLE 2.

FQ SCORPII---OBSERVED MAXIMA.

<u>J.D.</u>	<u>MAG</u>	<u>INT</u> d	<u>WIDTH 14.0I-D</u> d	<u>No. of</u> <u>OBS.</u>
2,434,877	12.1	...	9	7
987	12.6	(110)	11	6
2,435,245	12.4	(258)	9	6
423?	12.7	(178)	...	1
598	13.0	(175)	7?	3
649	12.5	51	6?	3
951?	13.1	(302)	...	2
981?	13.5	30	...	1
993?	13.3	12	...	2
2,436,022?	13.8	29	...	1
043	13.0	21	10	8
073?	13.8	30	...	1
257	13.0	(184)	10?	3
303?	13.2	46	...	2
337?	13.9	34	...	1
358	13.1	21	11	7
423	12.4	(65)	7?	5
499	12.9	(76)	7?	2
690	12.5	(191)	7	5
782	12.7	(92)	15	10
856?	13.2	(74)	...	2
2,437,068?	13.1	(212)	...	2
142?	13.2	(74)	...	1
162?	13.2	20	...	1
384	12.7	(222)	6?	5
471?	13.2	(87)	...	2
522	12.7	(51)	13	8
814?	13.3	(292)	...	1
852?	13.3	38	...	2
954?	13.4	(102)	...	1
2,438,166	13.0	(212)	12	5
265	13.1	(99)	8?	4
501	13.0	(236)	14	5
664?	13.3	(163)	4?	3
701?	13.2	37	...	2
783?	13.0	(82)	...	3
941	13.1	(158)	14	5
2,439,033	13.1	(92)	14	4
064?	13.4	31	...	1
160?	13.0	(96)	...	2
263	13.0	(103)	10	6
356?	13.3	(93)	...	1
379	13.0	23	...	1
543?	13.1	(164)	...	2
594	12.9	51	9	4
654	13.3	60	6	3
710	12.7	56	17	4
920	13.2	(210)	11	3
969?	13.3	49	...	2
2,440,069	12.9	(100)	14	4

TABLE 2---continued

<u>J.D.</u>	<u>MAG</u>	<u>INT</u> d	<u>WIDTH</u> 14.0I-D d	<u>No. of</u> <u>OBS.</u>
2,440,141?	13.2	(72)	...	2
269	13.0	(128)	11	4
377	12.9	(108)	8	3
487	13.1	(110)	9	4
624?	12.8	(137)	...	1
834	13.0	(210)	11	5
884	13.3	50	...	1
2,441,065	12.5	(181)	15	7
161	12.4	(96)	14	6
394	12.4	(233)	10	7
488	13.1	(94)	6	6
605?	13.0	(117)	...	2
757?	13.3	(152)	6?	2
876?	13.3	(119)	...	2
922	13.4	46	3	4
970	13.0	48	5	6
2,442,205	12.1	(235)	7	9
254	13.4	(49)	4	5
355	12.9	(101)	11	5
512	12.7	(157)	13	4
624	13.0	(112)	10	9
872	12.7	(248)	...	4
991?	13.4	(119)	...	4

TABLE 3.

FQ SCORPII --- POSSIBLE MAXIMA

<u>J.D.</u>	<u>NO. of</u> <u>OBS.</u>	<u>REMARKS.</u>
2,434,826	2	Just visible; about 12.5 -13?
842	3	Suspected on 838;841 & 849 (12.9
893	1	" " 893 (13.4
913	5	" " 905 (13.4; 912 (12.9; 913;916 & 921 (13.4
932	5	Suspected on 928 (12.9; 929 (13.4; 935 (12.1; 945 (13.4; 947 (13.4
962	3	Seen at 13.7 on 962; Suspected on 973 (12.9; 975 (13.4
2,435,016	3	Seen at 13.9 on 016; Suspected on 009 & 017 at (13.4
035	4	Suspected on 030; 031; 038 & 042 at (13.4
137	1	" " 137 (12.9
189	1	" " 189 (13.4
221	6	Seen at 13.8 on 220; 13.7 on 222. Suspected on 217; 218 & 226 at (13.4; 225 (12.9.
273	4	Suspected on 270; 273; 276 & 277 (13.4
307	1	" " 307 (13.4
344	1	" " 344 (13.4
368	2	" " 367 & 369 (13.4
391	1	" " 391 (13.4
540	1	" " 540 (13.4
556	1	" " 556 (13.4

TABLE 3---continued

<u>J.D.</u>	<u>No. of</u> <u>OBS</u>	<u>REMARKS.</u>
2,435,585	1	Seen at 13.8 on 585
688	1	Suspected on 688 at (13.4
760	1	Seen at 13.1 on 760
2,436,090	1	Seen at 13.7 on 090
124	2	Seen at 14.0 on 123; Suspected on 127 at (13.4
406	1	Suspected on 406 at (13.4
440	2	" " 436 at (13.4; 444 (12.9
470	1	" " 470 at (12.9
662	1	" " 662 at (13.4
715	1	" " 715 at (13.4
749	1	" " 749 at (13.4
819	1	Seen at 13.9 on 818
831	1	Suspected on 831 at (12.9
2,437,114	2	Suspected on 114 & 115 at (13.4
250	1	Suspected on 250 at (12.9
410	1	" " 410 at (13.4
489	1	" " 489 at (13.4
502	1	" " 502 at (12.9
555	1	Seen at 13.9 on 555
728	1	Suspected on 728 at (13.4
742	1	" " 742 at (13.4
762	1	" " 762 at (13.4
876	2	" " 876 at (12.9 & on 877 (13.4
933	1	" " 933 at (13.4
2,438,074	1	" " 074 at (13.4
148	1	" " 149 at (13.4
317	1	" " 317 at (13.4
854	1	" " 854 at (13.4
885	1	" " 885 at (13.4
2,439,295	1	" " 295 at (13.4
316	1	" " 316 at (13.4
2,440,244	1	" " 244 at (13.4
350	1	" " 350 at (13.4
442	1	" " 442 at (13.4
710	1	" " 710 at (13.4
802	1	" " 802 at (13.4
2,441,044	1	" " 044 at (13.4
090	1	" " 090 at (13.4
331	1	" " 331 at (12.9
422	1	" " 422 at (13.4
525	1	" " 525 at (13.9
551	1	Seen at 13.0 on 551
583	1	Seen at 13.3 on 583
825	1	Suspected on 825 at (13.4
835	1	" " 835 at (13.4
2,442,131	1	Seen at 14.0 on 131
242	1	Seen at 13.9 on 242
657	1	Suspected on 657 at (13.4

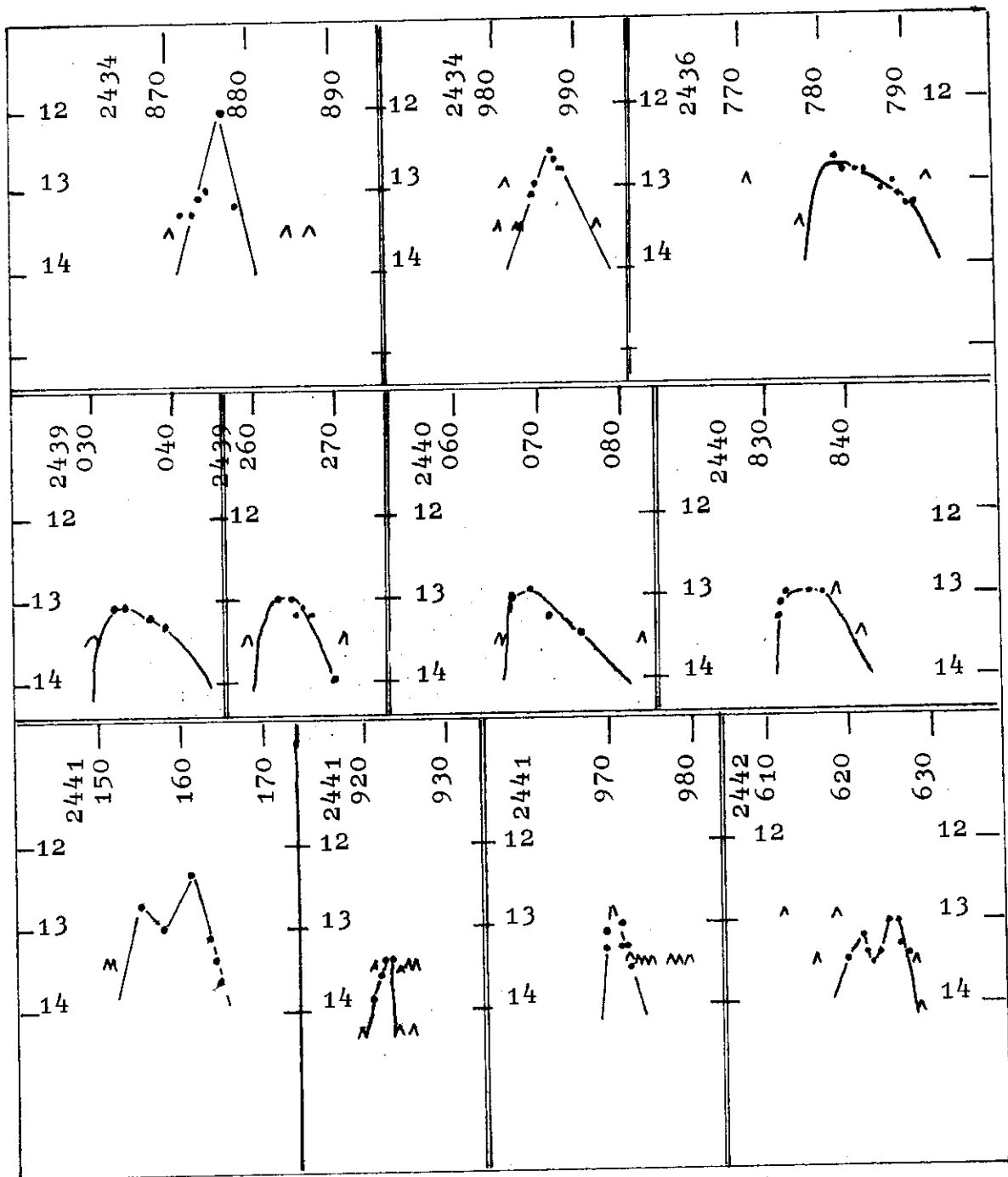


Figure 1/ FQ Scorpii. Examples of maxima, from individual observations.

THE DWARF NOVA-----UZ SERPENTIS.

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SUMMARY: Visual observations over a 21-yr interval show that UZ Ser has four distinct types of maxima-Anomalous; long; short and ultra-short peaks. Mean maxima magnitudes are respectively 12.15; 12.11; 12.67 and 12.96. The average intervals during which UZ Ser is brighter than magnitude 14.0 are respectively $11^d.9$; $7^d.9$; $4^d.3$ and $2^d.6$. The mean cycle from the observations is $20^d.6$, but the true mean cycle is probably less because many maxima have gone unobserved.

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1. INTRODUCTION.

P.P. Parenago (1931) published observations from 83 plates taken from 1908 to 1930. These were widely scattered in time but appeared to indicate that outbursts varied in amplitude and duration. Parenago considered that the rise from minimum to maximum took 4^d and the decline from 7^d to 11^d .

M. Petit (1960) published visual observations from 2,435,244 to 2,436,094. Scattered observations have appeared in a number of other publications but UZ Ser does not appear to have been observed consistently.

2 CHARTS AND SEQUENCE,

A, Brun & M. Petit (1959) published identification charts. A more precise identification chart was published by V.P. Tsessevich and M.S. Kazanasmas (1971). The A.A.V.S.O. issued preliminary charts dated 1969 with a sequence by Herbig. Charts 303 & 304 (Bateson, Morel & Winnett 1976) were copied from the A.A.V.S.O. chart. The observations have been reduced on the basis of Herbig's sequence.

3 OBSERVATIONS.

A total of 1,385 visual observations were made between 2,435,228 (1955 Apr 30) and 2,443,036 (1976 Sept. 14). All observations to 2,439,670 (1967 June 28) have already been published in Circulars of the V.S.S., R.A.S.N.Z. The individual observations since that date are given in Table 1. The majority of the observations are from A.F. Jones.

The observing season is March to October with observations tending to be fewer in both March and October than in other months.

4 DISCUSSION.

The observed dates of maxima are numbered consecutively in the 1st column of Table 2. The Julian Dates of maxima appeared in the 2nd column, followed by a question mark if the date is uncertain. The third column gives the maximum magnitude, which is underlined if it is probable that UZ Ser reached a brighter magnitude than that shown. The fourth column gives the interval, in days, between successive maxima. This interval is enclosed in brackets if it is probable that an intervening maximum has passed unobserved. The next two columns give, where possible, the Julian Dates on which the variable reached magnitude 14.0 on the rise and fall respectively. The width, in days, during which the variable was brighter than $14^M.0$ is shown in the seventh column. The number of positive observations used to determine the data in the previous columns appears in the eighth column.

The final column gives the type for each maximum in accordance with the discussion below.

In general the curves for each outburst are fragmentary since they depend mainly on the records of a single observer. Many dates are merely indicated from one or two observations. The reliability of the data in Table 2 depends, however, more on the spread of the observations than on their number. Even when the positive observations are few in number the curve can be accurately drawn if the observations fall on both branches of the curve and at, or close to, maximum. In many cases the observations fall mainly on one branch of the curve leading to some uncertainty.

After the probable curves had been drawn and Table 2 prepared I searched for other published observations in an endeavour to see whether the data in Table 2 could be substantiated. Petit (1960) confirmed 13 maxima during the interval covered by his records. Fragmentary observations and outbursts given in various publications of the A.A.V.S.O. supported another 17 dates.

Outbursts appear to fall into four distinct types, i.e. anomalous (A); long (L); short (S) and ultra-short peaks (P). The symbols in the final column of Table 2 correspond to these types, when it was possible to definitely assign an outburst to a particular type. If negative observations, or the shape of one branch of the curve suggest that a maximum was of a certain type this is indicated by the appropriate symbol followed by a question mark. When it was impossible to state the type a question mark only is shown.

The main features of the various types are shown below, from the best observed maxima only.

TYPES OF MAXIMA.

TYPE	MEAN MAX.	RISE TIME		FALL TIME		DURATION		RISE	FALL
	MAG. _v	14.0-MAX.	MAX-14.0	MAX-14.0	MAX-14.0	MEAN	RANGE	PER	PER
		d	d	d	d	d		0 ^d .1 m	0 ^d .1 m
A	12.15	5.7	6.2	11.9	9 ^d -15 ^d	0.032	0.030		
L	12.11	2.4	5.5	7.9	6-10	0.079	0.034		
S	12.67	1.4	2.9	4.3	4-5	0.095	0.045		
P	12.96	1.1	1.5	2.6	1-3	0.104	0.076		

Examples of each type are shown in Figure 1.

5 FREQUENCY OF OUTBURSTS.

The mean cycle, derived from the outbursts that appear to be consecutive, is 20^d.6. Successive intervals range from 5^d to 40^d. It is probable that the true mean cycle is shorter than this, because of the strong probability that many of the maxima considered successive are actually separated by intervening maxima, which were not observed. Current observations support this surmise since they generally show two outbursts each month, with both often of the ultra-short peak type.

There are seven complete intervals of one thousand days from the first observation. The total outbursts recorded in any thousand day interval ranges from 20 to 32. These figures merely reflect how closely the variable was monitored in the respective intervals.

6 CONCLUSIONS

UZ Ser is a dwarf nova with a mean cycle no longer than 20^d.6. It does not have supermaxima like a number of dwarf novae with short mean cycles. It has both anomalous and long maxima. These average 0^m.6 to 0^m.8 brighter than the maxima with short durations.

The anomalous maxima have slow rates of rise and fall. Long and short maxima differ in their widths at $14^m.0$ for which the means are respectively $7^d.9$ and $4^d.3$. Both have rises which are twice as fast as the falls. The short maxima can be as bright as the long. However they average $12^m.67$ compared to $12^m.11$ for long maxima. It is possible that this difference is due to the fragmentary nature of the observations, and, with better coverage they may average the same brightness.

Additionally there are faint minor outbursts in the form of brief peaks averaging $12^m.96$ with rapid rises and falls. There is no doubt that many of these have passed unobserved.

Long and short maxima alternate in some observing seasons, but generally there appears to be no definite sequence in which types of maxima occur. There is no semi-regular interval between successive long and anomalous maxima. Closer monitoring may reveal any such pattern if it exists. Obviously UZ Ser requires monitoring at closer intervals than has been done in the past. A considerable gain in coverage would be made if all observations were pooled at a single centre.

ACKNOWLEDGMENTS.

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TABLE 1.

OBSERVATIONS OF UZ SERPENTIS.

2439000+	2440000+	2440000+	2440000+	2440000+
677.95 13.3	008.97 (13.6	310.22 13.1	506.86 (13.6	805.94 13.5
678.97 (13.6	013.22 12.2	321.23 (13.6	507.91 (12.6	807.96 13.4
680.96 (13.6	027.94 13.9	325.25 (13.6	508.89 (13.1	814.85 (12.6
682.15 (13.6	033.92 (13.6	333.25 13.6	512.90 (12.6	816.82 (12.6
683.14 (13.6	036.94 (13.6	336.19 13.9	513.87 (12.6	821.98 13.2
684.13 (13.6	041.00 (13.6	338.26 13.9	523.87 (13.1	822.98 13.1
687.15 13.1	043.92 12.9	340.24 13.2	527.87 13.1	823.90 13.2
695.85 12.4	044.20 12.4	341.25 13.4	528.86 12.5	.95 13.1
698.95 (13.6	050.95 (13.1	353.00 12.8	531.89 12.6	831.94 13.2
700.97 (13.6	051.93 (13.6	356.94 12.8	632.19 13.9	832.94 13.0
707.98 12.1	052.92 13.4	360.99 (13.1	662.22 (13.6	835.90 13.4
708.97 12.4	053.94 12.9	366.25 13.5	664.23 (12.6	836.98 13.4
715.91 (13.6	054.98 14.1	369.25 (13.6	681.20 12.5	838.90 (12.6
731.91 (13.6	056.84 (13.6	376.90 (12.6	683.20 13.4	846.88 13.3
732.97 (13.6	060.94 (13.6	377.92 (13.6	684.24 13.5	856.88 13.1
736.91 12.8	065.00 12.5	379.99 (13.6	685.23 (13.6	857.98 13.1
737.94 12.8	.97 12.1	382.95 (13.6	687.21 (13.6	863.91 12.9
738.93 13.4	066.97 12.1	384.00 (13.6	690.24 (13.6	881.85 12.1
740.94 (13.6	068.95 12.8	.92 (12.6	691.22 (13.6	883.93 11.9
756.92 (13.6	071.89 (13.6	386.25 (13.1	696.18 (13.6	884.87 12.1
759.94 12.9	082.94 (13.6	389.95 13.5	710.21 (13.6	2441000+
760.96 12.7	083.84 (13.6	391.26 12.8	711.24 (13.6	020.19 13.9
763.88 (13.6	086.85 13.7	393.26 12.8	712.25 (13.6	032.19 (13.6
764.90 (13.6	087.95 13.4	.96 13.0	718.21 (13.6	037.19 12.1
767.94 (13.6	091.94 (13.6	394.99 13.2	719.21 (13.6	038.24 12.2
781.90 (14.1	093.96 (13.6	397.93 (13.6	722.23 (13.6	039.19 12.1
786.88 (12.6	095.92 13.1	405.95 (12.6	723.25 12.5	044.22 (13.6
788.89 12.2	099.88 (13.1	409.00 (13.6	724.18 12.7	047.16 (13.6
791.88 12.0	106.87 (12.6	.96 (13.6	726.18 (13.6	050.22 (13.6
793.88 12.1	109.95 13.9	410.97 (13.6	728.19 (13.6	066.25 (13.6
795.86 12.2	110.94 (13.6	412.93 13.4	729.18 (13.1	068.20 13.5
796.87 12.9	112.96 (13.6	415.93 (13.6	732.95 (13.6	069.22 12.5
910.10 (12.6	113.95 (13.6	422.95 13.1	733.97 (13.6	079.20 (13.6
917.20 12.8	115.91 (13.6	423.96 (13.6	736.19 13.2	087.95 (13.1
919.20 12.1	116.91 (13.6	424.95 (13.6	739.17 (13.1	090.25 13.0
938.18 (13.6	119.95 12.3	433.85 12.2	744.95 (13.6	093.21 (13.6
942.18 14.0	126.90 (12.6	435.95 12.7	746.17 14.1	094.22 (13.6
943.20 13.1	135.94 13.2	436.97 12.5	749.21 (13.6	097.21 (13.6
953.19 (13.6	138.95 (13.6	441.95 (13.6	758.20 14.1	098.23 (13.6
959.24 12.2	140.93 12.4	443.87 14.1	761.95 (13.6	099.95 13.1
968.21 (13.6	143.91 (13.6	444.95 13.3	762.94 13.2	107.24 13.1
970.24 12.8	150.90 12.3	446.95 13.8	764.24 (12.3	115.94 13.1
971.25 13.2	169.87 (12.6	451.95 (13.6	.99 (12.6	116.94 (13.6
974.23 (13.6	172.88 12.5	454.94 12.6	771.20 12.2	117.97 (13.6
975.25 (13.6	271.19 13.9	461.83 (12.6	772.97 13.4	118.95 (13.6
981.24 (14.1	276.19 (13.6	464.94 13.2	773.94 13.2	121.21 (13.6
984.22 (13.6	297.22 (12.6	477.85 (13.6	775.94 (13.2?	.99 (13.6
985.26 (13.6	302.22 13.6	491.85 13.2	788.89 (13.6	123.01 (13.6
988.26 12.8	303.22 (13.6	492.93 13.2	.89 13.9?	124.91 13.4
998.22 13.0	304.19 (13.6	495.87 (13.6	790.93 13.8	128.95 (13.6
999.26 13.1	305.23 (13.6	498.90 (13.6	794.99 13.4	131.97 (13.6
	308.17 (13.6	502.89 12.4	795.95 13.8	132.93 (13.6
	309.23 13.4	505.90 (13.6	801.96 13.9	146.97 (13.6

TABLE 1---continued.

2441000+	2441000+	2441000+	2441000+	2442000+
149.95 (13.6	423.24 (13.6	545.95 (13.6	899.83 (13.1	254.92 13.2
150.96 13.5	425.22 (13.6	550.84 (12.6	900.93 (13.1	265.82 (12.6
151.95 13.4	429.22 13.4	556.06 13.0	911.88 (13.6	267.82 (13.6
154.94 (13.6	430.15 11.7	557.94 (13.6	916.96 13.4	268.28 (13.5
160.92 13.4	433.25 13.0	563.93 12.2	917.87 14.1	269.25 (13.5
162.99 13.4	434.23 13.4	564.93 12.4	919.87 13.9	272.82 (13.6
164.13 (13.6	444.24 13.4?	566.92 (13.6	920.82 (13.6	277.81 (13.6
174.95 12.2	,96 (13.1	567.86 (13.6	925.82 13.4	278.92 (13.6
176.98 12.4	446.25 (13.1	569.93 (13.6	929.82 (12.6	279.91 (13.6
178.90 (13.6	449.07 (13.6	570.91 (13.6	930.85 (12.6	280.26 13.8
182.00 (13.6	454.98 13.9	571.91 (13.6	934.87 (12.6	289.91 (11.9
185.97 12.8	457.21 (13.6	573.94 (12.6	938.81 (12.6	295.82 13.0
186.92 13.3	459.24 (13.6	579.92 (12.6	950.84 (13.6	296.95 12.2
188.95 (13.6	460.26 (13.6	583.84 (12.6	951.84 (13.6	299.32 12.7
191.92 (13.6	470.93 (13.6	584.86 (12.6	954.86 (13.6	300.30 13.2
192.97 (13.1	472.94 (13.6	586.85 (13.6	955.87 (12.6	302.00 13.0
195.87 (12.6	474.94 (13.6	587.95 12.7	970.86 (13.6	.28 13.5
198.82 (12.6	475.94 (13.6	594.90 12.8	971.88 (13.6	303.30 (13.5
199.82 (12.6	477.06 (13.6	604.92 12.9	974.87 12.5	.89 (13.6
201.88 (13.6	478.22 (13.6	605.89 (12.6		304.89 (13.6
202.95 (12.6	479.24 (13.6	612.86 12.4	2442000+	306.26 (13.5
203.92 12.3	.99 (13.6	618.91 (12.6	099.? (14.0	307.27 (13.0
206.86 13.4	482.95 (13.6	619.87 (12.6	104.? (14.5	.83 (13.6
207.92 13.9	485.22 (13.6	774.22 13.1	127.? (14.5	308.22 (13.7
210.02 (12.6	486.00 13.2	777.20 (13.6	128.? (14.0	310.86 (13.6
214.89 (13.6	486.92 12.5	779.22 (13.6	131.14 12.2	313.23 (12.6
216.88 (13.6	487.25 11.9	782.21 (13.6	133.08 12.6	317.23 (13.3
218.94 (13.6	.93 12.5	785.21 (13.6	.20 12.6	324.88 (13.6
222.92 12.2	488.25 12.1	788.21 13.2	134.17 13.7	325.27 (13.3
229.84 (13.1	.91 12.2	800.9 12.7	182.93 13.1	.88 (13.6
233.88 (13.6	489.95 12.2	813.24 (13.0	184.20 13.8	331.22 13.3
234.86 (13.6	490.25 12.2	817.21 (13.6	185.24 14.1	334.23 12.8
237.90 12.5	493.95 (12.6	824.91 (13.1	193.27 (13.0	336.88 13.4
240.88 (12.6	500.00 (12.6	830.24 12.2	198.25 (13.6	337.90 (13.6
243.91 (12.6	.92 (13.6	833.24 12.1	198.? (13.5	339.22 (13.5
249.87 13.1	501.97 13.4	833.98 12.2	200.28 (12.6	496.21 13.1?
361.18 (12.6	503.93 14.0	835.24 12.2	201.24 (13.6	511.55 13.6
362.19 (13.6	506.20 (13.6	844.25 13.1	216.25 12.4	515.20 (13.6
373.18 (13.6	513.83 (12.6	854.90 (13.6	217.6 13.4	538.44 (13.5
374.20 (13.6	.92 13.1?	859.89 12.8	218.0 (13.5?	542.42 12.9
388.15 (12.6	515.95 (13.6	861.86 12.4	218.25 12.5	544.62 13.3
390.20 13.5	527.90 12.3	862.87 12.1	219.8 13.4	546.23 13.2
391.19 12.4	528.88 12.5	863.87 12.9	227.23 (13.6	.56 13.5
394.18 12.0	529.87 13.1	864.83 13.0	239.95 13.4	547.40 (13.6
396.21 12.4	530.95 13.6	865.88 14.0	240.93 13.2	549.61 13.8?
398.21 14.0	531.98 14.1	870.88 13.8	241.88 13.7	554.64 13.5
407.21 12.5	534.93 (13.6	874.85 13.0	245.26 (13.7	555.66 13.7
408.20 13.1	535.9 (14.0	882.88 (13.6	247.25 (13.5	571.24 12.5
409.20 (12.6	.92 (13.6	887.83 (13.6	249.95 (13.6	572.97 (13.6
410.20 (13.6	536.93 (13.6	889.88 12.3	250.25 (13.5	573.93 (13.6
416.22 (13.6	539.85 12.8	890.87 12.4	251.27 13.5	574.95 (12.6
417.21 12.4	542.05 (12.6	894.90 14.0	.90 13.1	575.95 13.4
419.20 14.0?	.94 (13.6	895.94 (13.6	252.23 13.2	582.93 (12.6
422.21 (13.6	544.91 (13.6	897.84 (13.6	253.90 12.4	590.96 13.1

TABLE 1---continued.

2442000+	2442000+	2442000+	2442000+	2442000+
591.88 (13.6	629.35 13.6	686.22 (13.3	950.95 (13.6	980.95 (14.1
592.32 (13.3	630.24 13.6	687.21 (13.5	951.32 (14.1	981.86 (14.1
593.35 (13.5	631.94 (13.6	688.28 (13.5	.96 (13.6	982.92 (14.1
595.94 (13.6	632.21 13.7	689.22 (13.5	952.30 (14.1	985.23 (13.7
597.97 12.5	.98 (13.6	690.92 12.1	.94 (13.6	986.27 (14.1
598.29 13.0	633.97 (13.6	694.92 12.1	953.34 (14.1	988.30 (14.1
598.84 12.9	634.24 (13.5	712.24 (13.5	953.89 (13.6	989.26 (14.1
601.27 13.0	.93 (13.6	713.88 (13.0	.93 (14.1	992.22 (14.1
602.24 13.4	635.22 (13.6	714.23 (13.5	954.94 (13.6	994.99 (12.6
603.94 13.4	.96 (13.6	720.24 (13.5	955.98 (13.6	2443000+
604.26 13.1	636.25 (13.5	721.22 (12.6	957.26 (13.5	001.24 (13.5
605.44 13.9	638.24 13.1	866.58 13.5	959.26 13.5	003.22 13.5
.92 (13.6	639.21 (13.5	874.59 (13.5	.61 13.0	004.25 14.0
606.26 (13.3	649.84 13.9	903.54 13.6	.93 13.4	.81 14.4
.97 (13.6	650.24 13.6	906.10 (13.6	960.33 13.5	005.21 (14.1
607.31 (13.6	651.24 13.1	908.21 (13.6	.94 (13.6	007.29 (14.1
608.26 (13.3	653.21 12.7	909.23 (13.6	961.24 13.7	007.95 (14.1
609.27 (13.3	654.23 13.5	918.95 (13.6	.93 (14.1	010.21 (14.1
610.95 (12.6	655.24 (13.5	919.06 (14.1	962.36 14.1	011.81 (14.1
619.22 (13.5	.84 13.6?	919.95 (13.6	963.24 (13.5	012.94 13.6
620.24 (13.5	656.22 (13.5	924.94 (12.6	.96 (14.1	013.22 13.5
620.92 (13.6	656.83 (13.6	925.96 (13.6	964.27 (14.1	015.02 12.8
621.26 (13.5	657.22 (13.5	926.93 13.9	.93 (13.5	019.93 (14.1
622.23 13.9	661.95 12.8	934.36 13.5	965.28 (13.5	.97 (13.7
623.23 (13.5	662.56 13.6	936.30 13.0	966.32 (13.5	021.29 (14.1
.94 (13.6	678.25 (13.5	937.28 13.0	.59 (13.5	022.22 (13.7
624.24 (13.5	679.22 (13.3	946.36 (14.1	972.80 14.6	026.19 (13.5
.94 (13.6	680.92 12.2	947.35 (14.1	977.90 (14.1	031.22 (13.5
625.24 (12.6	681.21 (13.3	948.30 13.2	978.93 (14.1	033.94 (14.1
626.23 (13.5	683.93 (13.6	.96 14.0	979.92 (14.1	.95 (13.7
626.95 (13.6	685.94 (13.0	949.95 (13.1	.95 (13.5	034.96 12.9
627.29 14.0?				035.93 13.4
628.23 13.1				036.93 13.5

TABLE 2.

UZ SERPENTIS---OBSERVED MAXIMA.

No.	J.D.	MAG. _v	INT. _d	14.OI	14.OD	WIDTH _d	No. of Obs.	TYPE.
1	2,435,228	12.2	...	227	231	4	3	S
2	255	12.9	27	255	...	..	2	S
3	270	12.5	15	...	...	..	1	S?
4	288	12.9	18	287	289	2	4	S
5	297	13.0	9	296	299	3	2	S
6	309	12.6	12	306	314	8	5	L
7	329	12.4	20	328	333	5	2	S
8	341?	13.1	12	...	...	..	2	S
9	361	12.2	20	...	...	..	2	S
10	394	12.4	33	389	399	10	4	A
11	545?	13.0	(151)	...	...	..	1	?
12	556?	12.9	11	...	...	..	2	S
13	588	12.7	32	...	...	..	2	S
14	613	12.4	25	610	619	9	2	L
15	633	13.4	20	...	...	..	1	S

TABLE 2---continued

No.	J.D.	MAG. v	INT. d	14.OI	14.OD	WIDTH d	No. of OBS.	TYPE
16	2,435,659	12.0	26	656	665	9	4	L
17	684	12.7	25	682	687	5	4	S
18	695	13.1	11	...	...	..	2	S
19	710?	13.3	15	...	...	..	2	P?
20	715?	13.0	5	...	...	..	2	P?
21	729?	13.1	14	...	...	..	2	S?
22	741?	13.1	12	...	...	..	2	S?
23	772	12.3	31	...	...	..	1	L?
24	933	13.3	(161)	...	...	..	5	L?
25	958	12.5	25	952	966?	14?	3	A
26	988	12.1	30	982	997	15	6	A
27	2,436,014	12.2	26	011	021	10	7	L
28	043	13.0	29	...	...	..	4	S?
29	063	12.3	30	...	...	..	4	L?
30	098	12.1	35	095	103	8	4	L
31	115?	13.1	17	...	...	..	1	S?
32	131	12.1	16	...	135	..	3	S
33	267?	12.8	(136)	...	...	..	1	?
34	285?	13.8	18	...	...	..	1	?
35	317	13.1	32	...	...	..	5	?
36	334	12.2	17	...	340	..	3	L?
37	364	12.2	30	361	368?	7?	4	L
38	404	12.0	40	398	407	9	4	A
39	421	12.5	17	419	422	3	2	P
40	445	12.9	24	...	447	..	3	S
41	466	12.0	21	464	...	..	3	L
42	489?	12.4	23	...	...	..	2	?
43	508?	12.9	19	...	...	..	2	S?
44	622?	12.5	(114)	...	...	..	1	?
45	661	12.4	(39)	...	...	..	3	?
46	708	12.0	(47)	...	...	..	2	A?
47	729	13.0	21	728	732	4	3	S
48	752	12.1	23	749	758	9	4	L
49	777?	12.3	25	...	...	..	1	S
50	793	12.1	16	791	...	..	3	L?
51	813	13.8	20	...	...	..	1	P?
52	835	12.0	22	833	843	10	4	L
53	2,437,024	12.4	(189)	021	027	6	3	L
54	035?	13.0	11	...	...	..	1	?
55	061?	12.8	26	...	...	..	2	?
56	076	12.2	15	...	...	..	2	L?
57	113	13.0	37	112	117	5	5	S
58	131	13.4	18	...	...	..	3	P?
59	163?	13.4	32	...	...	..	4	L?
60	182?	12.4	19	...	...	..	2	?
61	197?	13.4	15	...	...	..	1	S?
62	348?	13.0	(151)	...	...	..	1	?
63	379?	13.4	31	...	...	..	2	S
64	387	13.0	8	385	390	5	4	S
65	409	12.2	22	408	414	6	5	L
66	447	12.1	38	441	...	..	4	A?
67	463	13.0	16	460	465	5	3	S
68	483	12.1	20	...	...	..	2	L?

TABLE 2---continued

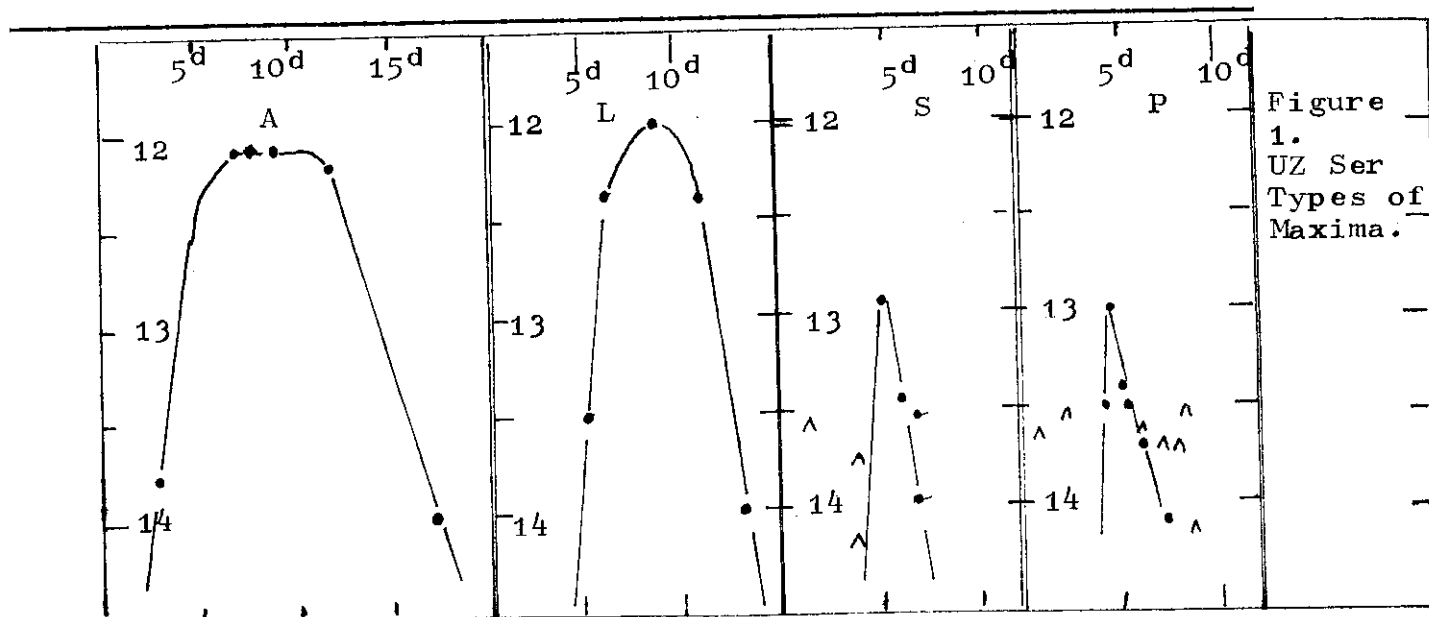
No.	J.D.	MAG. v	INT. d	14.OI	14.OD	WIDTH d	No. of OBS.	TYPE
69	2,437,555	<u>12.9</u>	(72)	...	...	..	2	S
70	586?	<u>12.3</u>	31	...	...	..	1	?
71	764?	<u>13.2</u>	(178)	...	...	..	2	P?
72	798	<u>12.1</u>	34	...	...	..	4	L?
73	831?	<u>12.8</u>	33	...	...	..	2	S
74	849?	<u>13.4</u>	18	...	...	..	1	P?
75	865?	<u>12.9</u>	16	...	...	..	3	L?
76	884?	<u>13.2</u>	19	...	...	..	2	S?
77	905?	<u>13.4</u>	21	...	...	..	2	P?
78	923?	<u>12.2</u>	18	...	...	..	2	L?
79	2,438,091?	<u>13.4</u>	(168)	...	...	..	1	?
80	114?	<u>13.1</u>	23	...	...	..	1	S
81	127	<u>12.1</u>	13	...	...	..	2	?
82	169	<u>12.8</u>	(42)	168?	171	3?	2	P
83	178?	<u>13.2</u>	9	...	...	..	1	P?
84	199	<u>12.1</u>	21	196	204	8	3	L
85	230?	<u>13.1</u>	31	...	...	..	1	S?
86	253	<u>13.0</u>	23	252	254	2	2	P
87	282	<u>12.1</u>	29	...	...	..	2	L?
88	312?	<u>12.9</u>	30	...	...	..	1	?
89	520?	<u>12.7</u>	(208)	...	...	..	1	?
90	537	<u>12.1</u>	17	...	...	..	2	?
91	616	<u>12.3</u>	(79)	...	...	..	4	S?
92	646?	<u>13.5</u>	30	...	...	..	2	?
93	660	<u>12.8</u>	14	...	...	..	3	L
94	696?	<u>12.4</u>	36	...	...	..	2	?
95	853	<u>12.1</u>	(157)	...	...	..	2	L?
96	883?	<u>13.0</u>	30	...	...	..	1	P?
97	894	<u>12.2</u>	11	...	...	..	2	A?
98	912	<u>13.4</u>	18	...	...	..	1	S
99	925?	<u>12.5</u>	13	...	...	..	1	?
100	941	<u>12.1</u>	16	939	946	7	4	L
101	995	<u>12.5</u>	(54)	...	...	..	3	?
102	2,439,026?	<u>12.5</u>	31	...	...	..	4	L
103	047?	<u>12.3</u>	21	...	...	..	1	?
104	204?	<u>13.1</u>	(157)	...	...	..	1	?
105	239?	<u>12.2</u>	35	...	...	..	1	L?
106	293	<u>13.5</u>	(54)	...	...	..	1	P?
107	320?	<u>13.1</u>	27	...	...	..	2	L?
108	351?	<u>13.6</u>	31	...	...	..	1	?
109	407	<u>12.0</u>	(56)	...	...	..	1	L?
110	568	<u>12.2</u>	(161)	563	...	..	3	A?
111	594?	<u>13.4</u>	26	...	...	..	1	?
112	618	<u>12.7</u>	24	...	...	..	2	L?
113	630	<u>13.1</u>	12	...	...	..	2	P
114	647	<u>13.1</u>	17	...	...	..	1	P
115	658	<u>12.9</u>	11	...	...	..	1	S
116	668	<u>12.4</u>	10	666	671	5	4	S
117	691	<u>12.4</u>	23	...	...	..	2	L?
118	707	<u>12.1</u>	16	...	...	..	2	L?
119	737	<u>12.8</u>	30	...	740	..	3	S
120	761	<u>12.7</u>	24	...	...	..	2	S
121	792	<u>12.0</u>	31	788?	798?	10?	5	L
122	920	<u>12.1</u>	(128)	...	...	..	2	?
123	944?	<u>13.1</u>	24	...	...	..	2	?

TABLE 2---continued

No.	J.D.	MAG. v	INF. d	14.OI	14.OD	WIDTH d	No.of OBS.	TYPE
124	2,439,959	12.2	15	...	...	..	1	?
125	970	12.8	11	...	...	..	2	S
126	991	12.8	21	...	...	..	3	L?
127	2,440,013	12.2	22	...	...	..	1	?
128	045	12.4	32	...	...	..	2	S
129	054	12.9	9	052	055	3	3	P
130	066	12.1	12	065	071	6	4	L
131	089?	13.4	23	...	...	..	2	P?
132	097?	13.1	8	...	...	..	1	S
133	120?	12.3	23	...	...	..	1	?
134	141?	12.4	21	...	...	..	1	S
135	152?	12.3	11	...	...	..	1	?
136	174?	12.5	22	...	...	..	1	?
137	313?	13.1	(139)	...	...	..	2	?
138	336?	13.2	23	...	...	..	3	L?
139	354	12.8	18	...	...	..	2	?
140	392	12.8	38	389	398	9	5	L
141	413?	13.4	21	...	...	..	1	P?
142	422	13.1	9	...	...	..	1	S
143	433	12.2	11	...	...	..	3	L?
144	445	13.3	12	444	448	4	3	S
145	458?	12.6	13	...	...	..	2	L
146	502?	12.4	(44)	...	...	..	1	S
147	529?	12.5	27	...	...	..	3	L?
148	680?	12.5	(151)	...	685	..	3	L?
149	723?	12.5	(43)	...	...	..	2	S
150	768	12.2	(45)	...	...	..	5	L? or A?
151	792?	13.4	24	...	...	..	3	S
152	804?	13.4	12	...	...	..	3	L?
153	823	13.1	19	...	...	..	4	P?
154	835?	13.0	12	...	...	..	4	S?
155	859?	12.9	24	...	...	..	3	L?
156	883	11.9	24	...	...	..	3	?
157	2,441,038	12.1	(55)	...	...	..	3	?
158	070?	12.5	32	...	...	..	2	?
159	089?	13.0	19	...	...	..	1	S
160	101?	13.1	12	...	...	..	2	L
161	126?	13.4	25	...	...	..	1	S
162	153?	13.4	27	...	...	..	2	P?
163	162?	13.4	9	...	...	..	2	S?
164	174	12.2	12	...	...	..	2	L
165	185	12.8	11	...	...	..	2	S
166	204	12.3	19	203	208	5	3	S
167	223?	12.2	19	...	...	..	1	?
168	237?	12.5	14	...	...	..	1	S
169	252?	13.1	15	...	...	..	1	?
170	394	12.0	(142)	390	398	8	5	L
171	407	12.5	13	...	...	..	2	S
172	417	12.4	10	416?	419	3?	2	P
173	430	11.7	13	429	436	7	4	L
174	487	11.9	(57)	486	494	8	8	L
175	502?	13.4	15	...	...	..	2	P?
176	526	12.3	24	...	532	..	5	L

TABLE 2---continued

No.	J.D.	MAG. v	INT. d	14.0I	14.0D	WIDTH d	No. of OBS	TYPE
177	2,441,540?	<u>12.8</u>	14	...	...	..	1	S
178	563?	<u>12.2</u>	23	...	...	..	2	?
179	590?	<u>12.7</u>	27	...	...	..	2	L?
180	609?	<u>12.4</u>	19	...	...	..	2	A?
181	773?	<u>13.1</u>	(164)	...	...	..	1	?
182	789?	<u>13.2</u>	16	...	...	..	1	?
183	803?	<u>12.7</u>	14	...	...	..	1	?
184	832	<u>12.1</u>	29	...	...	..	5	L
185	863	<u>12.1</u>	31	...	866	..	6	A?
186	872?	<u>13.0</u>	9	...	...	..	2	S
187	889	<u>12.3</u>	17	888	895	7	3	L
188	913	<u>13.4</u>	24	...	...	..	3	S
189	975?	<u>12.5</u>	(62)	...	...	..	1	?
190	2,442,130	<u>12.2</u>	(155)	129?	135	6?	4	L
191	180?	<u>13.1</u>	(50)	...	186	..	3	?
192	215?	<u>12.4</u>	35	...	221	..	4	L?
193	241	<u>13.2</u>	26	...	242	..	3	P?
194	254	<u>12.4</u>	13	250	256	6	5	L
195	297	<u>12.2</u>	43	295	305	10	6	L
196	332?	<u>12.8</u>	35	...	...	..	3	L?
197	495?	<u>13.1</u>	(163)	...	...	..	1	?
198	542?	<u>12.9</u>	(47)	...	...	..	5	S?
199	569?	<u>12.5</u>	27	...	...	..	1	L?
200	597?	<u>12.5</u>	28	...	...	..	4	S
201	604	<u>13.1</u>	7	...	606	..	4	P?
202	628	<u>13.1</u>	24	627	630	3	4	P
203	638?	<u>13.1</u>	10	...	...	..	1	S
204	652	<u>12.7</u>	14	650	655	5	4	S
205	661?	<u>12.8</u>	9	...	...	..	2	S
206	680	<u>12.2</u>	19	...	...	..	1	S
207	691	<u>12.1</u>	11	...	...	..	2	L?
208	935	<u>13.0</u>	(244)	...	...	..	3	S
209	948	<u>13.2</u>	13	948	949	1	2	P
210	960	<u>13.0</u>	12	959	962	3	6	P
211	2,443,003?	<u>13.5</u>	43	...	...	..	3	P
212	014?	<u>12.8</u>	11	...	...	..	3	S
213	035	<u>12.9</u>	21	034	038	4	3	S



THE JOYS OF VISUAL OBSERVING

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Auckland Astronomical Society

(Delivered at the 1977 Annual Conference, R.A.S.N.Z.)

SUMMARY: A light-hearted account of the frustrations and joys of visual observing.

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Thomas Fuller said, "All things are difficult before they are easy." Anyone who has observed variable stars visually will know that this is very true. There are many difficulties to overcome, but with perseverance you can overcome all obstacles and find that you really enjoy observing.

Several years ago, I obtained a 150mm reflector on a wooden alt-azimuth tripod, and I decided I had better do something with it. Since I am an Aucklander, the only thing I could possibly consider was variable star observing. I obtained a set of Series one charts and I was ready. I doubted my ability to make useful observations, but at least I would find some fields. It should not be too difficult. After all, there on the finder chart for R Car was ℓ Car. I knew where that was in the sky, so I found it in the finder and then looked in the eye-piece. But there were so many stars there. Was that bright star in the centre of the field ℓ Car or m Car, and which way did I hold my chart? Did I move the telescope up or down or sideways to find the pair of 76s, and which of the numerous pairs of stars in the field were the 76s, and how bright did a 76 look anyway? After much trial and error, most of it error, I eventually found R Car, but it was so bright I gave up and decided I would have been better using binoculars.

This sort of thing happened with nearly every chart in Series 1. It took literally hours to find each field. I found the VW Hydri field three times before realizing I had found it, because my scale was wrong. I was looking for a big field, and it was only a little one, and, of course VW Hydri was not visible. I looked for that star regularly for three years before I saw it.

During those early months of frustration and disappointment and bafflement, I was very lucky to have many friends in the Auckland Astronomical Society who had been through it all before. With a few words of encouragement they let me know that I was not as stupid as I was beginning to think I was, and persuaded me to start observing again.

Each time I found a field it was easier, until I could find it by star hopping without a chart, and instead of one observation an hour, I gradually increased to about 15 observations an hour. If I can do it anyone can. All it takes is perseverance.

Because I live in the city, light was a problem. I started by moving the telescope each time I observed a different field—first behind the garage, then around the side of the house. I hung old Holland blinds in the plum tree, and sheets on the clothesline. Every time I moved the telescope I had to adjust the legs of the tripod and it took me ages to observe each field. I eventually found a corner at the back of the garden with a good view of the Southern sky and enclosed it on three and a half sides with a two metre fence. This kept the light out, but the tripod kept collapsing on the uneven ground. I would just get a field into view, a leg of the tripod would slip, and the telescope would swing slowly around on its own. There were times when tripod and telescope collapsed on the ground in a heap.

So I had a 120mm pipe set in concrete sunk one metre into the ground with a solidsteel altazimuth mounting on top. This was ideal and made observing much more pleasant. I also had a cupboard built into the corner of the fence to house the telescope and charts, and I now feel I have a perfect set-up - almost as convenient as an observatory, but without the closed in feeling produced by a dome.

When you compare visual observing with photo-electric observing there is no comparison. I have tried both and decided that, for me, visual observing gives a great deal more satisfaction. I find photometry too mechanical. The equipment is all important. There are buttons to be pushed, switches to be switched, knobs to be turned, calculations to be made, co-ordinates to be set, and there in the finder is your field, so mechanical. Then your star, a small point of light in the aperture, so impersonal.

It is much more pleasant to line your telescope up on, say Gamma Hydri, slowly sweep towards the bright star followed by two faint stars, move in the direction of the faint stars, and there you have the VW Hyi field. If VW Hyi is visible, the magnitude you estimate for it is decided by you, yourself, without the aid of electronic equipment. It may not be quite as accurate as a photoelectric observation, and it is only in one colour, but it is your own personal achievement.

Visual observing is instant. At the end of an evening's observing you can compare your observations with previous night's values and see how each star has varied in brightness. No waiting for cards to be punched and computers to compute.

If you are a member of the Variable Star Section, there is the feeling of being one of a team, even if you never meet other members of the Section. One observations of, say, RY Sgr a month by each member means about 60 observations a month on that star, and your observation is useful. If you observe less popular stars, your results can be very important in building up complete light curves of those stars.

I realize that photoelectric observers make a great contribution to astronomy, and I felt very humble when I read the papers presented at the photoelectric conference. I have nothing against photometry, in fact, some of my best friends are photoelectric observers, it is just that I happen to prefer visual observing.

One of the best things about observing down in the garden is the peace. With five children in the family, our home is anything but peaceful in the evenings, but I can escape down to my corner leaving my husband to settle disputes and advise on homework problems. After I have been inside all day, the fresh air is marvellous, especially in Spring and Autumn. I come inside after a night's observing freezing, but glowing. The garden smells lovely at night - freesias, honeysuckle, jasmine - each season has its own perfume. Even in a city garden, Nature is out in force at night. Noises are magnified --- fruit dropping off a tree, hedgehogs shuffling through dead leaves, mosquitos buzzing, crickets chirruping.

There are many things which cannot be seen by torchlight, which is just as well, because my telescope cupboard has become a home for all sorts of creepy crawly things, but as long as I cannot see them, they don't bother me. One evening, using only a dim red torch, I opened my folder of charts, and the stars seemed to stand up and walk off the page. I grabbed my bright torch and there were hundreds of ants scurrying off the charts. I finally got rid of them, and when I looked into the eyepiece of the telescope I could see nothing. Further investigation showed that a colony of ants had built their nest on the mirror. There was no observing done that night.

I suppose the best way to describe the pleasure of observing in the open, is to say that you have the feeling of being one with Nature. The stars are so far away, and the Universe is so enormous that you feel small and insignificant, and all your problems and worries seem so trivial that you can see them in perspective.

After all, in 100 years it won't matter anymore, but the stars will still be there. At the same time you feel important, just to be part of it all.

The sky is beautiful on a dark night, and with no dome to obstruct the view, the whole sky can be seen. Venus setting brilliantly in the West, the planets moving, month by month, through the constellations, the Milky Way stretching in a bright band across the sky, the occasional fireball and meteor shower. Many of these things are lost when the sky is reduced to a small slit in a dome.

But whatever field of astronomy we choose to pursue, I like to believe the words of Matthew Prior when he said, "At night astronomers agree."

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PERIODOGRAM ANALYSIS OF S CARINAE

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and

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New Zealand).

SUMMARY: Visual observations of S Car covering the interval JD 2,426,350 to 2,442,990 were analysed by the periodogram method, giving a main period of 149.43 days. No evidence was found of a systematic change in period over this interval. However two other periodic components were found to be significant and to be harmonics of the main period. An estimated regression equation representing the mean light curve is given, and from this equation the mean maximum and minimum magnitudes were estimated as 5.984 and 8.584 respectively.

INTRODUCTION

The light variations of Mira type red giant variable stars are caused by temperature fluctuations of about 600°K as a result of pulsations in the star (Strohmeier 1972). These pulsations which originate in the core of the star will be complicated by the pressure waves which spread through the extensive atmosphere. The pulsations of stars with deep convective atmospheres are not well understood despite a recent attempt (Wood 1976) to produce a theoretical model for S Car and other stars.

The determination of the period of long period variable stars is of some interest. Five Mira variables have been shown to undergo long term alterations in period (Sterne and Campbell 1936) and any detectable change would have consequences for the astrophysical model of the star. The light curves change, however, from cycle to cycle, particularly for stars with periods of less than 200 days (Campbell and Jacchia, 1941) which makes the detection of real period changes more difficult. In this situation the periodogram method can be used to determine the period and to produce a regression equation of the light variation over time. Visual observations of S Car by the Variable Star Section of the Royal Astronomical Soc. of N.Z. and covering a 45-yr interval were analysed in this way.

STATISTICAL ANALYSIS. The data analysed consisted of the means of the raw observations over consecutive ten day intervals from J.D. 2,426,350 to 2,442,990. Because of the large number of missing observations between JD 2,428,900 and 2,431,100 the main analysis was carried out on the 1189 ten day means between

JD 2 431 110 and JD 2 442 990. However, to investigate the possibility of the main period being dependent on time, three subsidiary analyses were carried out on the ten day means between JD's 2 426 350-2 428 900, JD's 2 433 350-2 435 900 and JD's 2 440 350-2 442 900 respectively. The underlying stochastic model assumed was

$$x(n) = \mu + \sum_{j=1}^p \rho_j \cos(n\theta_j - \phi_j) + \epsilon(n) \quad (n=0, \pm 1, \dots)$$

where μ , $\rho_j (>0)$, θ_j and ϕ_j ($j=1, 2, \dots, p$) are unknown parameters, $x(n)$ is the n th ten day mean (e.g. in the case of the main analysis $x(n)$ is the ten day mean for JD 2 431 100+10n) and $\epsilon(n)$ is a zero mean stationary stochastic process with absolutely continuous spectrum. The statistical analysis of such models is covered in Walker (1971) and Hannan (1973).

The periodogram function

$$I_N(\lambda) = \frac{1}{2\pi N} \left| \sum_{n=1}^N \tilde{x}(n) e^{in\lambda} \right|^2$$

was computed for angular frequencies $\lambda = \frac{2\pi j}{N}$ ($j=0, 1, \dots, [\frac{1}{2}N]$; N the sample size) where $[\frac{1}{2}N]$ denotes the integral part of $\frac{1}{2}N$ and

$$\tilde{x}(n) = x(n) - \bar{x}, \quad \bar{x} = \frac{1}{N} \sum_{n=1}^N x(n) \quad (n=1, \dots, N).$$

Following Hannan (1973) and Walker (1971) the estimators of θ_j ($j=1, 2, \dots, p$) are the values $\hat{\theta}_j$ ($j=1, 2, \dots, p$) of λ at which the periodogram takes on its p largest local maxima and the estimators of ρ_j and ϕ_j ($j=1, 2, \dots, p$) are given by

$$\begin{aligned} \hat{\rho}_j &= \frac{2}{N} \sqrt{2\pi N I_N(\hat{\theta}_j)} \\ \hat{\phi}_j &= \arctan \left\{ \frac{\sum_{n=1}^N \tilde{x}(n) \sin n\hat{\theta}_j}{\sum_{n=1}^N \tilde{x}(n) \cos n\hat{\theta}_j} \right\} \end{aligned} \quad (j=1, 2, \dots, p)$$

respectively. Since the period (in days) corresponding to the angular frequency λ is $20\pi/\lambda$, estimators of the periods $P_j = 20\pi/\hat{\theta}_j$ ($j=1, 2, \dots, p$)

are given by $\hat{P}_j = 20\pi/\hat{\theta}_j$ ($j=1,2,\dots,p$). The (asymptotic) distribution of these estimators follows from a slight modification of Theorem 2, Hannan (1973). This yields the result that, under certain general conditions, the vectors

$$\begin{bmatrix} \sqrt{N}(\hat{\rho}_j - \rho_j) \\ \sqrt{N}(\hat{\theta}_j - \theta_j) \\ N^{3/2}(\hat{\theta}_j - \theta_j) \end{bmatrix} \quad (j=1,2,\dots,p)$$

are asymptotically independent normal random vectors with zero means and covariance matrices given by

$$\frac{4\pi f(\theta_j)}{\rho_j^2} \begin{bmatrix} \rho_j^2 & 0 & 0 \\ 0 & 4 & 6 \\ 0 & 6 & 12 \end{bmatrix} \quad (j=1,2,\dots,p).$$

Here $f(\lambda)$ is the spectral density of the $\epsilon(n)$ process. The tests described in Hannan (1970) pp471-473 were used to detect the non-zero ρ_j .

Results

The graph of the periodogram for the 1189 ten day means between JD 2 431 110 and JD 2 442 990 is given in Fig.1. The hypothesis that at most three of the ρ_j were non zero was accepted at the 5% level, the relevant peaks in the periodogram being at $\lambda = 0.4205$, 0.8408 and 1.2618 , i.e. periods of 149.43, 74.73 and 49.79 days respectively. Thus it was concluded that these three peaks arise principally from periodic components $\rho_j \cos(n\theta_j - \phi_j)$ with $\rho_j > 0$ ($j=1,2,3$) and not just from the error process $\epsilon(n)$.

Estimates and (approximate) 95% confidence intervals for ρ_j , θ_j , ϕ_j and P_j ($j=1,2,3$) together with estimates of the standard deviations of $\hat{\rho}_j$, $\hat{\theta}_j$, $\hat{\phi}_j$ and $\hat{P}_j$ ($j=1,2,3$) are given in Table 1. The test of the hypothesis that $\theta_j=j\theta_1$ and $\phi_j=j\phi_1$ ($j=1,2,3$) was accepted at the 5% level thus indicating that the second and third periodic components are harmonics of the main periodic component. From Table 1 the estimated regression function representing the mean light curve of S Carinae is

$$7.009 + 1.208\cos(0.4205n-1.098)+0.275\cos(0.8408n-2.169) \\ + 0.092 \cos(1.2618n+2.518) \quad (n=1,2,\dots,1189).$$

The estimated spectral density of the $\epsilon(n)$ process after removal of the regression function is given in Fig.2 and indicates that the $\epsilon(n)$ process has dominant low frequency components in the range $\lambda = \frac{\pi}{40}$ to $\lambda = \frac{\pi}{25}$ (i.e. with periods between 500 and 800 days).

A plot of the regression equation and the deviations from the regression equation is given in Fig.3 for the data in the interval JD 2 439 400 to JD 2 440 600. For the major portion of this interval the star is undergoing regular cycles but towards the end of the interval several more irregular cycles are apparent with consequent larger deviations from the regression equation.

From the regression equation the mean maximum and minimum magnitudes were estimated as 5.984 and 8.584 respectively.

Estimates and approximate 95% confidence intervals for the main period P_1 determined from each of three intervals in the course of the observations are given in Table 2. It would seem that the estimate of P_1 from the interval JD 2 433 350-2 435 900 differs significantly from that for

the interval JD 2,440,350 - 2,442,900. However the sample size (256) on which the estimates and their estimated standard deviations are based may well be too low for the asymptotic theory described previously to be a good approximation in practice. In this regard the confidence intervals given in Table 2 are almost certainly too small and, as such, Table 2 should be interpreted with caution. There appears to be little evidence to suggest any permanent long term changes in the main period.

CONCLUSION.

The average magnitudes of maxima and minima of 5.984 and 8.584 can be compared with the previously published values (Bateson 1944) of 5.49 and 8.76 respectively. The main period of 149.4 days can be compared with the previously accepted value of 149.3 days (Bateson, 1944). Moreover, within the limits of error of the analysis, the second and third periodic components are harmonics of the main vibration. The amplitudes of these harmonic components are therefore determined by the deviation of the shape of the observed light curve from that of a simple sinusoid.

These results constitute a preliminary statistical analysis of the observations of S Carinae. Further investigations need to be carried out using, perhaps, more specific models (autoregressive models for example) for the error process $\varepsilon(n)$.

ACKNOWLEDGMENTS.

Acknowledgment is made of the help of F.M. Bateson (Director VSS RASNZ) and R.G. Gibb (Carter Observatory, Wellington) in the preparation of this manuscript.

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Table 1

Estimates and approximate 95% confidence intervals for $\rho_j, \theta_j, \emptyset_j$ and P_j ($j=1,2,3$) together with estimates of the standard deviations of $\hat{\rho}_j, \hat{\theta}_j, \hat{\emptyset}_j$ and $\hat{P}_j$ ($j=1,2,3$) determined from the ten day means between JD 2 431 110 and JD 2 442 990.

Parameter	Estimate	Estimated Standard Deviation	Approximate 95% Confidence Interval
ρ_1 (mag.)	1.208	0.0425	(1.125 , 1.291)
ρ_2 (mag.)	0.275	0.0244	(0.228 , 0.323)
ρ_3 (mag.)	0.092	0.0156	(0.061 , 0.122)
θ_1 (radians)	0.4205	0.000103	(0.4203 , 0.4207)
θ_2 (radians)	0.8408	0.000258	(0.8403 , 0.8413)
θ_3 (radians)	1.2618	0.000495	(1.2609 , 1.2628)
$\emptyset_1$ (radians)	1.098	0.0704	(0.960 , 1.236)
$\emptyset_2$ (radians)	2.169	0.1771	(1.822 , 2.516)
$\emptyset_3$ (radians)	-2.518	0.3396	(-3.184 , -1.853)
P_1 (days)	149.43	0.038	(149.36 , 149.50)
P_2 (days)	74.73	0.024	(74.68 , 74.77)
P_3 (days)	49.79	0.020	(49.76 , 49.83)

Table 2

Estimates and approximate 95% confidence intervals for P_1
determined from the ten day means between
JD's 2 426 350-2 428 900, JD's 2 433 350-2 435 900
and JD's 2 440 350-2 442 900 respectively.

Data	$\hat{P}_1$	Approximate 95% confidence interval for P_1
J.D. 2 426 350-2 428 900	148.84	(148.13, 149.55)
J.D. 2 433 350-2 435 900	148.27	(147.57, 148.98)
J.D. 2 440 350-2 442 900	150.04	(149.32, 150.76)

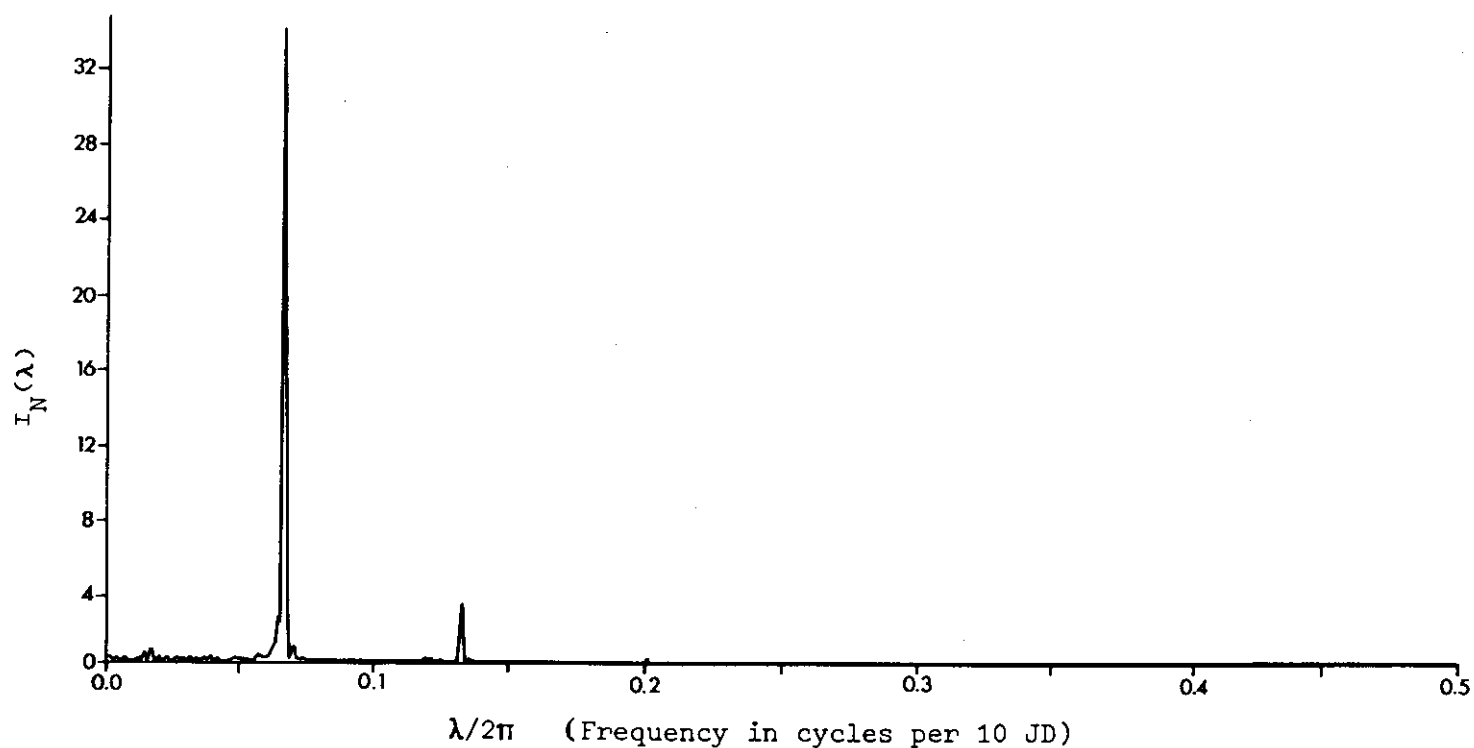


Fig.1 Periodogram for S. Carinae between JD 2 431 110 and JD 2 442 990.

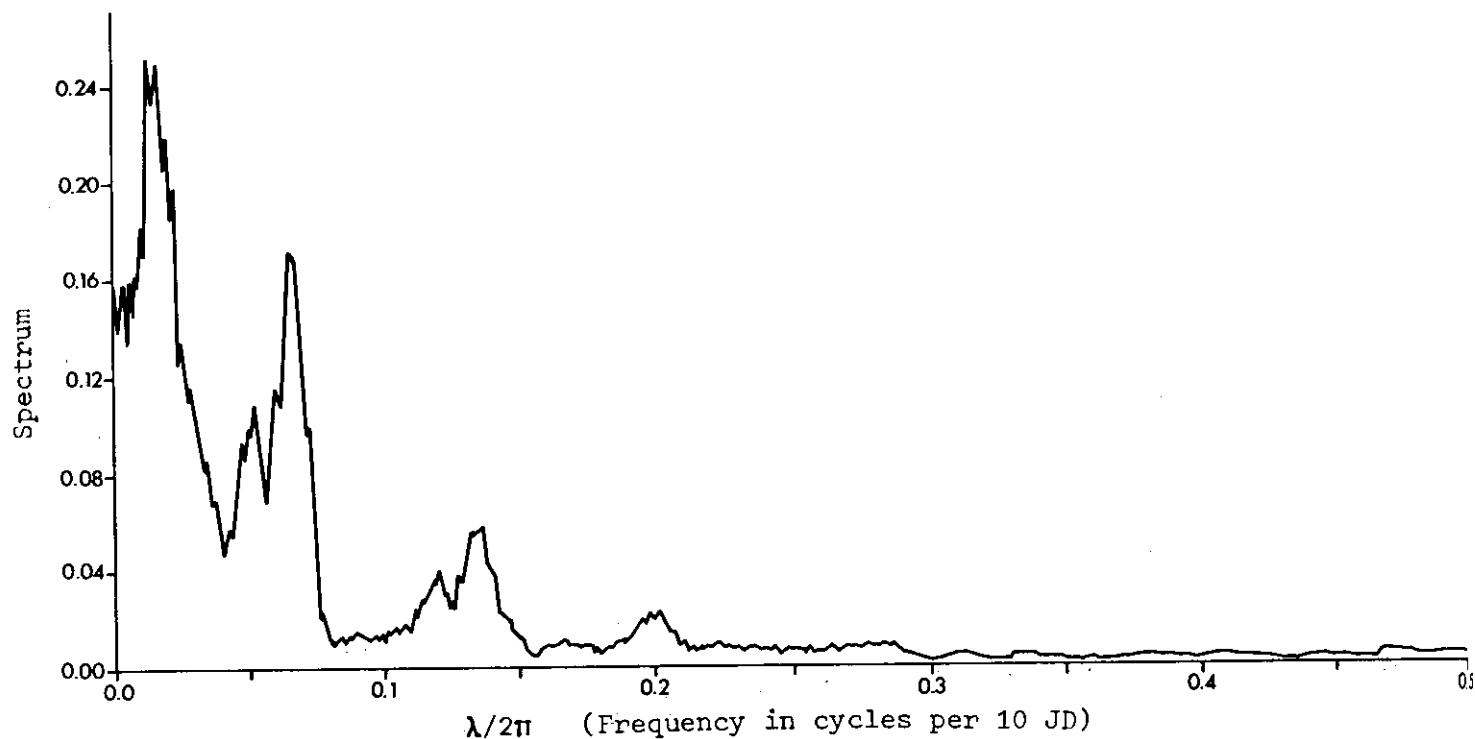


Fig.2 The estimated spectral density of the residuals after removal of the regression function for S. Carinae between JD 2 431 110 and JD 2 442 990.

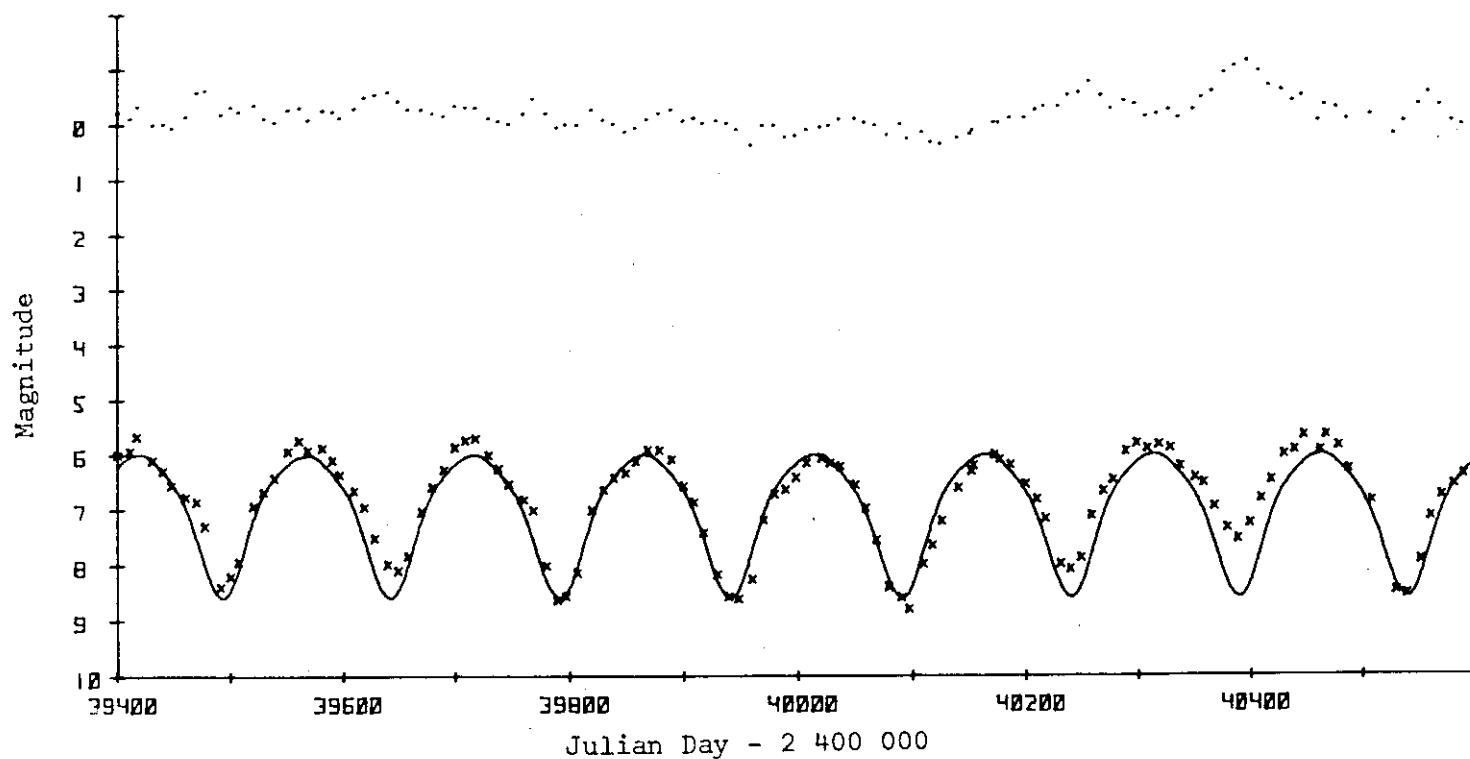


Fig.3 Regression equation of the magnitude of S. Carinae over time for the interval JD 2 439 400 to JD 2 440 400. The 10 day means (x) and the deviations (.) of the 10 day means from the regression equation are also plotted.

OBSERVATIONS OF SOME SOUTHERN VARIABLES OF R CrB TYPE.

Frank M. Bateson

SUMMARY: Light curves are reproduced for 12 southern R CrB type variables. These extend the observations previously published. The results for each star are discussed.

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INTRODUCTION

Bateson(1975)published light curves for UW Cen; DY Cen; AE Cir; S Aps; RZ Nor; WX CrA; VZ Sgr; RS Tel; V CrA; GU Sgr and RY Sgr. These are now extended to more recent dates using the visual observations by members of the Variable Star Section, R.A.S.N.Z. In addition a light curve is given for V504 Cen, for which no results have been previously published. The observations of V618 Sgr are summarised.

LIGHT CURVES

The curves for UW Cen; DY Cen; S Aps; GU Sgr and RY Sgr are all from ten day means. The majority of these means are derived from a large number of observations, but where means depend on only 1 or 2 observations these are shown on the curves by crosses. Most of these instances occur when the star concerned was unfavourably placed. The curves for the remainder of the stars have been drawn from individual observations, as they are mainly from a single observer.

It should be noted that the magnitude scale used is not the same for each curve as some have been expanded to show more clearly the semi-regular variations.

UW CENTAURI.

Figure 1 shows the light curve from 2,442,500 to 2,443,334. UW Cen was well observed, with an average of 11 observations in each mean. A total of 919 observations were recorded. UW Cen has remained at maximum with a semi-regular variation, very small in amplitude, and with a period of about 40 days. This is the same period as previously found.

DY CENTAURI

Figure 1 shows the light curve from 2,442,490 to 2,443,290. The average number of observations in each mean is six. DY Cen has remained at maximum. Bateson (1975) pointed out that there had been a gradual overall fading in brightness during the observations from 2,437,017 to 2,442,480. This appears to have continued with DY Cen now being 0.31 fainter than when originally observed.

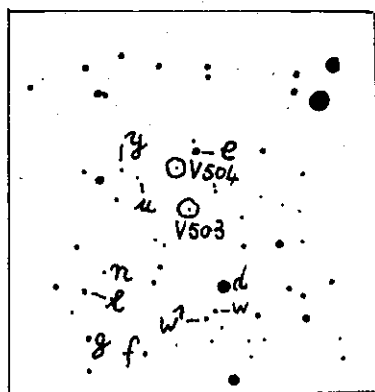
There appears to be a weak semi-regular variation of 0.^m1 to 0.^m2 in approximately 55 days. This is superimposed on a longer wave with a period of around 120 days, and on the very slow, irregular overall decrease in brightness. No deep minima have occurred in the past 17 years.

V504 CENTAURI

In 1956-60 a total of 69 observations were made. No observations were made in 1961-63 and in 1965, whilst there was a single observation in 1964. V504 Cen has been better observed since 2,439183 (1966 Feb 26) to 2,442,631 (1975 Aug. 6).

No magnitudes are available for the comparison stars. A magnitude of 12.0^v was assigned to comparison star "e", and the magnitudes for the remaining comparison stars determined from step estimates from "e". The resultant light curve appears in Figures 1, 2 and 4. This magnitude scale may well be in error and could have the effect of enlarging the variations of V504 Cen. However, these results are only preliminary to draw attention to this star. They should be treated with caution. V504 Cen faded around 2,439,370 to below 13.4^m , and again become visible on 2,439,527 at 13.9^m . There was another deep minimum between 2,441,780 and 2,442,133 when the star was invisible and fainter than 13.5^m . There appears to be an approximate semi-regular variation with a period of 130^d superimposed on a longer cycle of around 411^d . An identification chart from Tseovich and Kazanasmas (1971) appears below on which the comparison stars are shown by letters. An enlarged chart will be published later. V503 Cen also appears on the chart. This star is a faint RR Lyr type variable.

IDENTIFICATION CHART FOR V504 Cen.



AE CIRCINI

Observations from 2,442,037 to 2,442,977 show that AE Cir was invisible, below 13.3^m , until 2,442,422 when it was recorded at 14.2^m . Subsequent observations were few in number and scattered in time. The light curve appears in Figure 4.

S APODIS

Figure 2 shows the light curve from 2,442,545 to 2,443,354. The average number of observations in each ten day mean is 14. The only means derived from less than 5 observations were when S Aps was faint.

S Aps commenced to decline on 2,442,830, decreasing 3.6^m in 28 days to 13.95^m . There are 33 positive observations over the following 150^d , suggesting that S Aps may have fluctuated around 14.0^m for that time. However, as this magnitude represents the threshold of most instruments employed, it is possible that a faint star in close proximity to S Aps was mistaken for the variable. It seems unlikely that S Aps would be "hung up" at 14.0^m for so long. It certainly fell below 15.0^m on 2,443,044, remaining invisible till 2,443,184 when it was seen at 14.40^m . Thereafter it continued to brighten, at first steeply, and then gradually.

RZ NORMAE.

This star was near maximum from 2,442,290 to 2,442,730 as shown in Figure 2. It then faded to below 13.^m0 and became invisible. Between 2,442,860 and 2,443,075 and 2,443,210 to 2,443,280 it was placed as between 12.^m5 and 13.^m5 by some observers. It is probable that these refer either to the companion to RZ Nor (Circ. M.77/10 V.S.S., R.A.S.N.Z.), or to the comparison star "p". It is also probable that this confusion with faint nearby stars when RZ Nor is faint affected previous observations (Bateson 1975). I am indebted to I.S.Glass (1977) for drawing my attention to the close companion to RZ Nor. Also for his advice that RZ Nor was invisible in the 188cm telescope on 1977 June 27.

V618 SAGITTARII

Observations from 2,441,726 to 2,442,691 showed that V618 Sgr was invisible and fainter than 13.^m5, except on 2,441,771 and 917 when it was possibly visible at around 14.^m0. These observations were considered doubtful by the observer. There are only 25 observations, all negative of this star. These were all made by A.F. Jones and are scattered in time.

WX CORONAE AUSTRINAE

The light curve from 2,440,970 to 2,442,909 appears in Figures 2 and 3. The gaps in the curve occur when the variable was unsuitably placed for observation. WX CrA faded below 14.^m0 on 2,441,085 and reached this magnitude again on the rise on 2,441,206. There was another fading to below 14.^m0 on 2,442,746. Apparently it then made a partial recovery during the time the star was unfavourably placed. The first observation thereafter on 2,442,871 was at 13.^m1 and over the next 38 days it decreased to 13.^m9. There are definite fluctuations on the rise from a deep minimum. These have an amplitude of up to one magnitude at first, becoming smaller once the star reaches magnitude 12.^m0. The semi-regular period of 60^d, previously noted (Bateson 1975) again prevails. It is no more than a quasi-period which is departed from at times. The observations have been reduced by using step estimates to determine preliminary visual magnitudes because of the lack of any well determined sequence magnitudes.

VZ SAGITTARII

Figure 3 shows the light curve from 2,441,710 to 2,442,655. A decrease to a deep minimum commenced on 2,441,835. The fall was very steep and probably reached just below 15.^m0. VZ Sgr was seen again at 14.^m9 on 2,441,900 making this minimum very short. The rise was steep, although not as steep as the fall. There appears to have been little variation when the star was near maximum.

RS TELESCOPII

The light curve from 2,442,291 to 2,442,500 is shown in Figure 3, and that from 2,442,867 to 2,443,080 in Figure 4. RS Tel fell slowly from 2,442,380 to 2,442,450 and then dropped very sharply from 11.^m0 to fainter than 13.^m5. The rise commenced somewhere between 2,442,740 and 2,442,840, at a time when no observations were possible. It was first seen at 2,442,868 at 12.^m5 and a slow, erratic recovery to maximum followed.

GU SAGITTARII

This star has been well observed. The light curve in Figure 4 is in two parts. The first shows the irregular recovery from the previous deep minimum; the second part shows a well observed dip to 12.0^m at 2,443,009 with a rapid recovery to 11.0^m .

V CORONAE AUSTRINAE.

The light curve is illustrated in Figure 4 for such times as V CrA was visible. A fall to a deep minimum commenced around 2,441,736. It was observed again at a low altitude on 2,442,009 at 13.1^m . There was a third class observation of 11.1^m on 2,442,148. If these observations are correct then the star made a short recovery, but immediately declined to fainter than 13.5^m afterwards. It was invisible for the next 450^d. It then rose, steeply at first, and then slowly.

RY SAGITTARII.

Figure 4 shows the light curve from 2,442,515 to 2,443,394. RY Sgr was very well observed with an average of 19 observations for each mean. It was only when the star was close to the Sun that any mean depends on less than three observations. The semi-regular variation in a period of about 40 days was quite marked. The amplitude of these variations is from 0.2^m to 0.5^m . A fall to a deep minimum commenced on 2,443,362. On this part of the curve the two open circles represent photoelectric V magnitudes.

ACKNOWLEDGMENTS

My appreciation is expressed to all observers for their observations which are of a very high standard. In particular I would like to thank A.F. Jones for his records of the less well observed stars of this group. I urge all observers to continue to monitor these most interesting stars closely.

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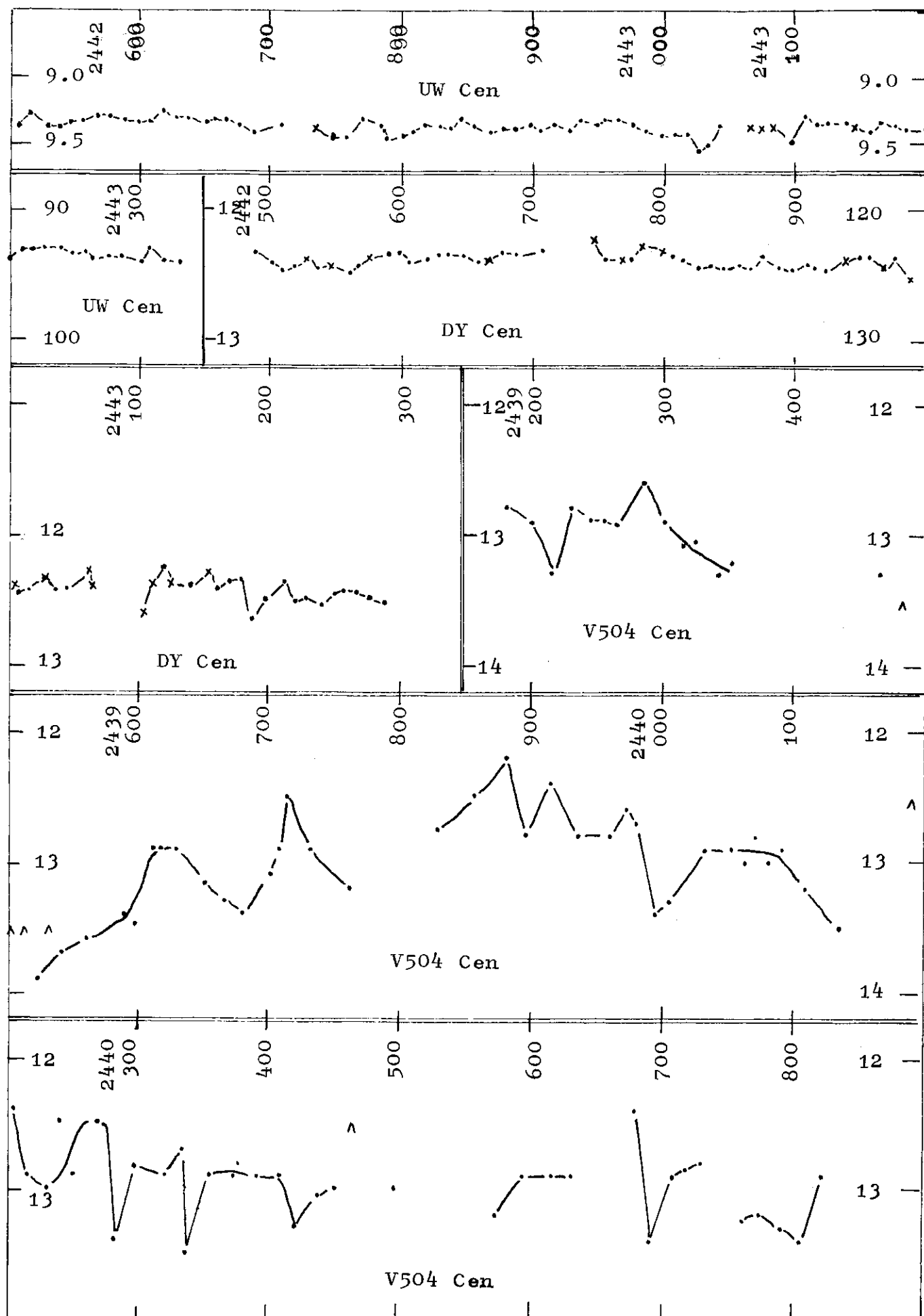


Figure 1. Light Curves--UW Cen and DY Cen from ten day means.
V504 Cen from individual observations.

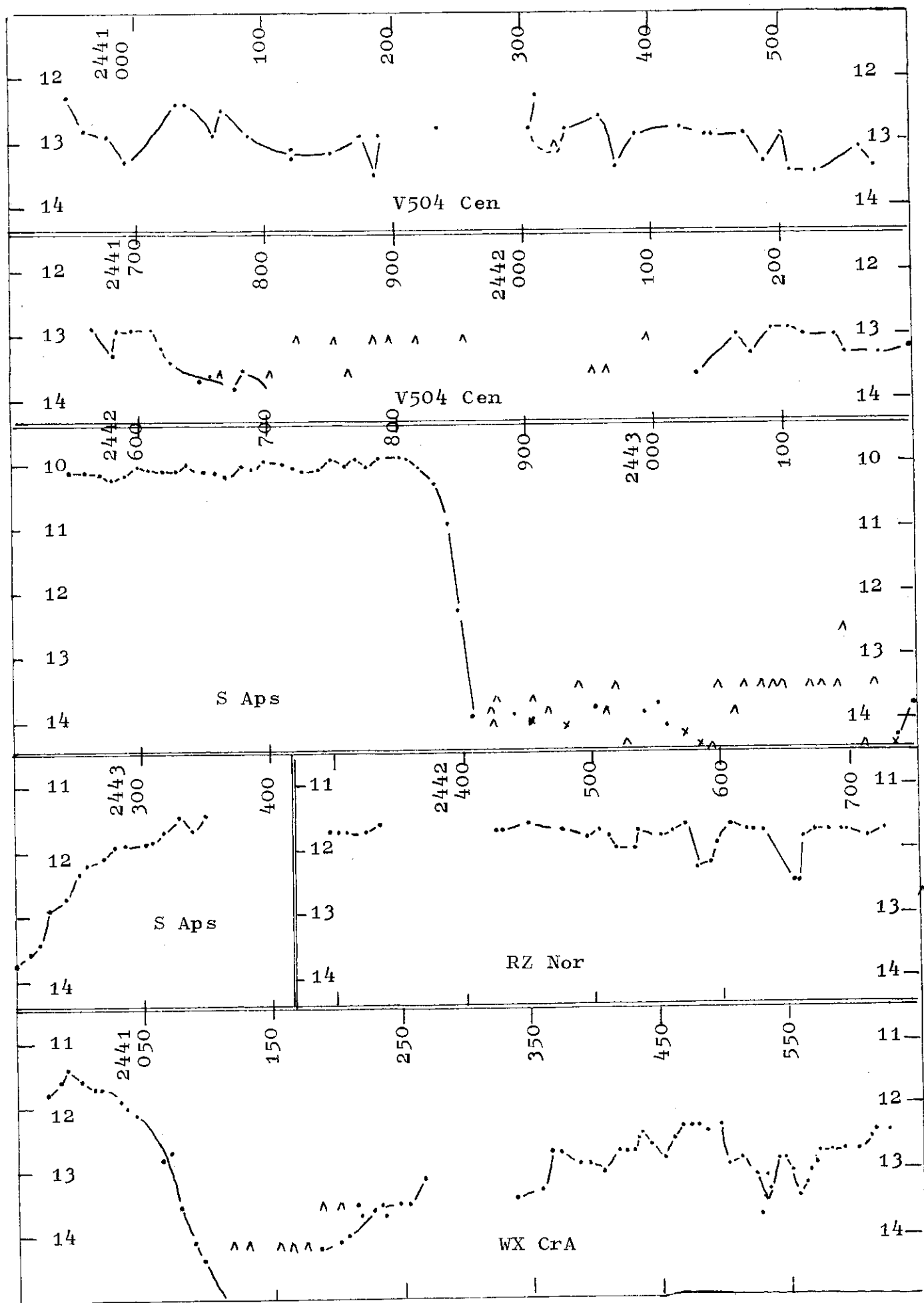
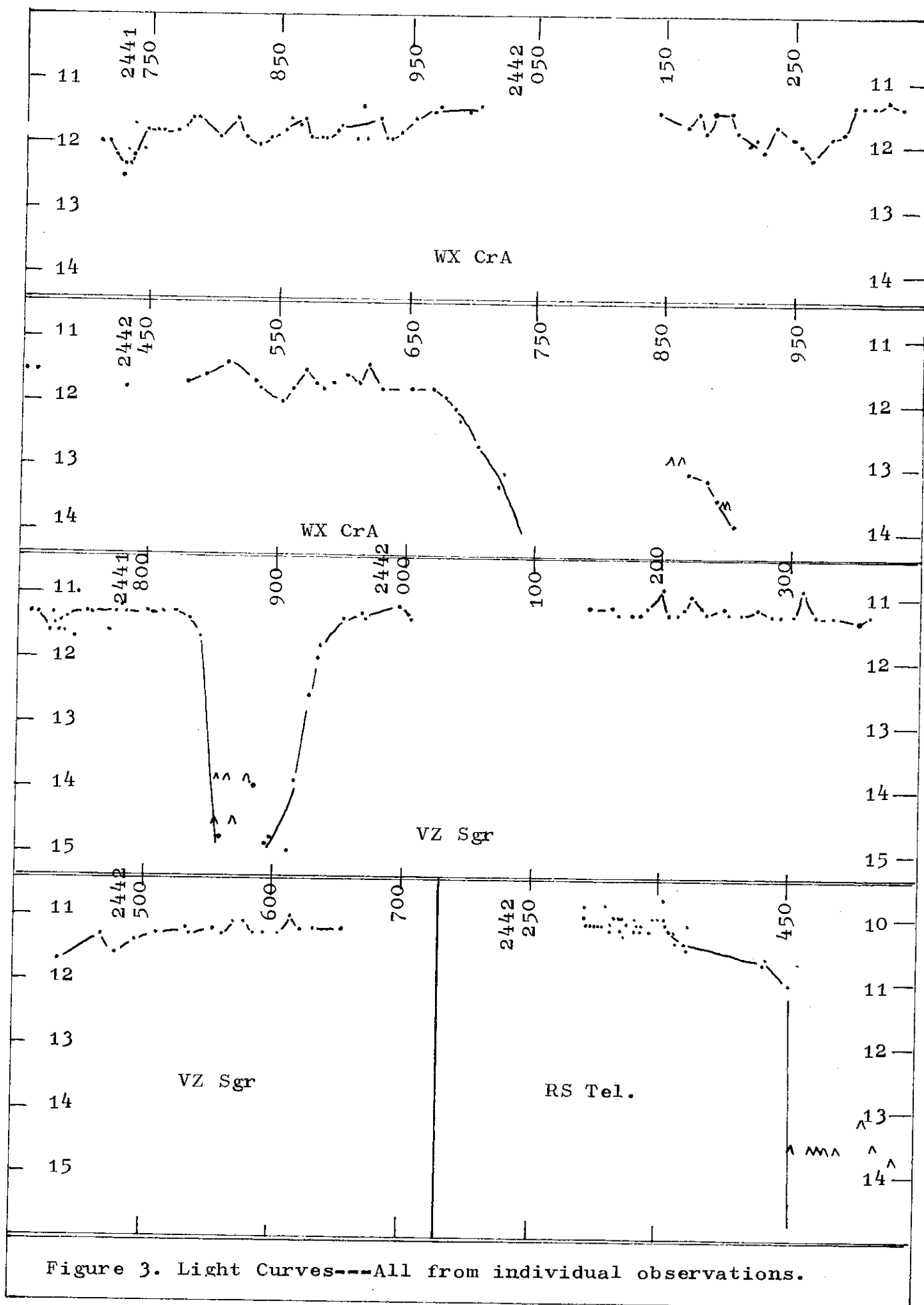


Figure 2. Light Curves--S Aps from ten day means.
V504 Cen; RZ Nor & WX CrA from
individual observations.



THE SEMI-REGULAR VARIABLE--SW SCULPTORIS

Frank M. Bateson

SUMMARY: SW Scl is a semi-regular variable with a mean cycle of 146^d . The mean visual amplitude is 7.9^m to 9.0^m , with an extreme range 7.3^m to 10.3^m . The amplitude and period both vary within wide limits, as illustrated in the light curve. The interval covered by the observations is from JD 2,437,554 to 2,442,744.

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1 OBSERVATIONS

Observations from 2,437,554 to 2,440,954 have been published in Circulars 120, 133 and 186, V.S.S., R.A.S.N.Z. Additionally some observations from 2,440,954 to 2,442,744 are unpublished, making a total of 347 observations in all. Apart from those intervals when SW Scl was unfavourably placed for observations, it has been, at times, poorly observed.

All observations have been plotted in Figures 1 and 2 from ten day means. Dots represent means in which there was only a single observation; crosses means from two or more observations. The fragmentary nature of the observations is apparent from the plotted light curves.

2 CHARTS AND SEQUENCE.

SW Scl is CoD -33°16843; CPD -33°6441; HV 6423. Bateson, Jones & Stranson (1966) published chart 54, which has been used by all observers. This gave a sequence with SP_v magnitudes extracted from Annals, Cape Observatory, XV11.

3 DISCUSSION

Observed maxima and minima are listed in Table 1. Maxima are numbered in the first column consecutively from the first observed on 2,437,735. Missing numbers represent those maxima that were not observed. The usual details are given in the remaining columns. The low weight assigned to most dates reflects the lack of consistent attention to SW Scl.

The mean cycle is 146^d , but the intervals between successive maxima and minima vary widely as is usual for stars of this type. A period of 144^d was found by Shapley & Hughes (1934), from 240 observations over 108 epochs. They gave the epoch of maximum as JD 2,425,550. When the present observations are referred to this epoch the O-C residuals have a mean of -70^d . Actually this epoch now fits the observed minima better, giving O-C residuals of $+14^d$ if the original epoch is taken as minimum.

There is little doubt that both amplitude and period are subject to considerable variation as is usual for stars of this class.

The current observations give the following elements:

EPOCH MAXIMUM: J.D. 2,440,037 $\pm 146^d$
 MINIMUM to Maximum: Mean 67^d (Extremes 35^d to 111^d)
 MAXIMUM to Minimum: Mean 75^d (Extremes 34 to 107)
 MAXIMUM MAGNITUDE : Mean 7.9_v (Range 7.3_v to 8.2_v)
 MINIMUM MAGNITUDE : Mean 9.0 (Range 8.5_v to 10.3)

The above epoch is merely the date of the best observed maximum, and gives O-C residuals of $+20^d$. The differences between observed and calculated, however, vary within wide limits, as usual for semi-regular variables when the mean cycle does not hold for long.

ACKNOWLEDGMENTS

I am indebted to the observers for their observations.

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TABLE 1.SW SCULPTORIS---OBSERVED MAXIMA & MINIMA.

<u>No.</u>	<u>MAXIMA</u>				<u>MINIMA</u>			
	<u>J.D.</u>	<u>MAG.</u> _v	<u>Int</u> _d	<u>Wt</u>	<u>J.D.</u>	<u>MAG.</u> _v	<u>INT</u> _d	<u>Wt.</u>
					2,437,680?	9.1?	...	1
1	2,437,735?	8.1?	...	1	815	8.9	135	4
2	884	8.1	149	3	928	9.3	113	3
3	988	8.2	104	4	2,438,095	9.8	167	4
4	2,438,169	7.5	181	3	228	10.0	133	2
5	295?	8.1?	126	1	383	10.1	155	2
6	434?	8.2?	139	1				
7	590	8.0	156	2	663	9.4	(280)	3
8	720?	8.0	130	2	795	10.3	132	4
9	895	8.2	175	4	953	9.1	158	5
10	2,439,016	8.2	121	4	2,439,108	8.8	155	3
12	300	8.0	(284)	4	390?	9.0?	(282)	1
13	450?	7.7?	150	1	525	9.2	135	3
14	580	7.9	130	2	646	8.8	121	4
15	725	8.1	145	4	818	8.6	172	3
16	876	7.9	151	4	945?	9.0?	127	1
17	2,440,037	7.8	161	5	2,440,120	8.7	175	4
18	155	7.4	118	4	238	8.6	118	3
21	572	8.0	(417)	4	649	8.7	(411)	3
22	700?	7.8?	128	1	780?	8.6	131	1
23	891	7.3	191	3	925	8.5	145	4
					2,441,280?	8.5	(355)	1
26	2,441,349	7.7	(458)	2				
28	622?	7.8	(273)	1	704	8.7	(424)	1
					2,442,019	8.6	(315)	4
31	2,442,060	7.7	(438)	4				
					314	8.7	(295)	3
33	390	7.7	(330)	5	450?	9.0?	136	3
					630	9.6	180	2
35	712	7.8	(322)	3				

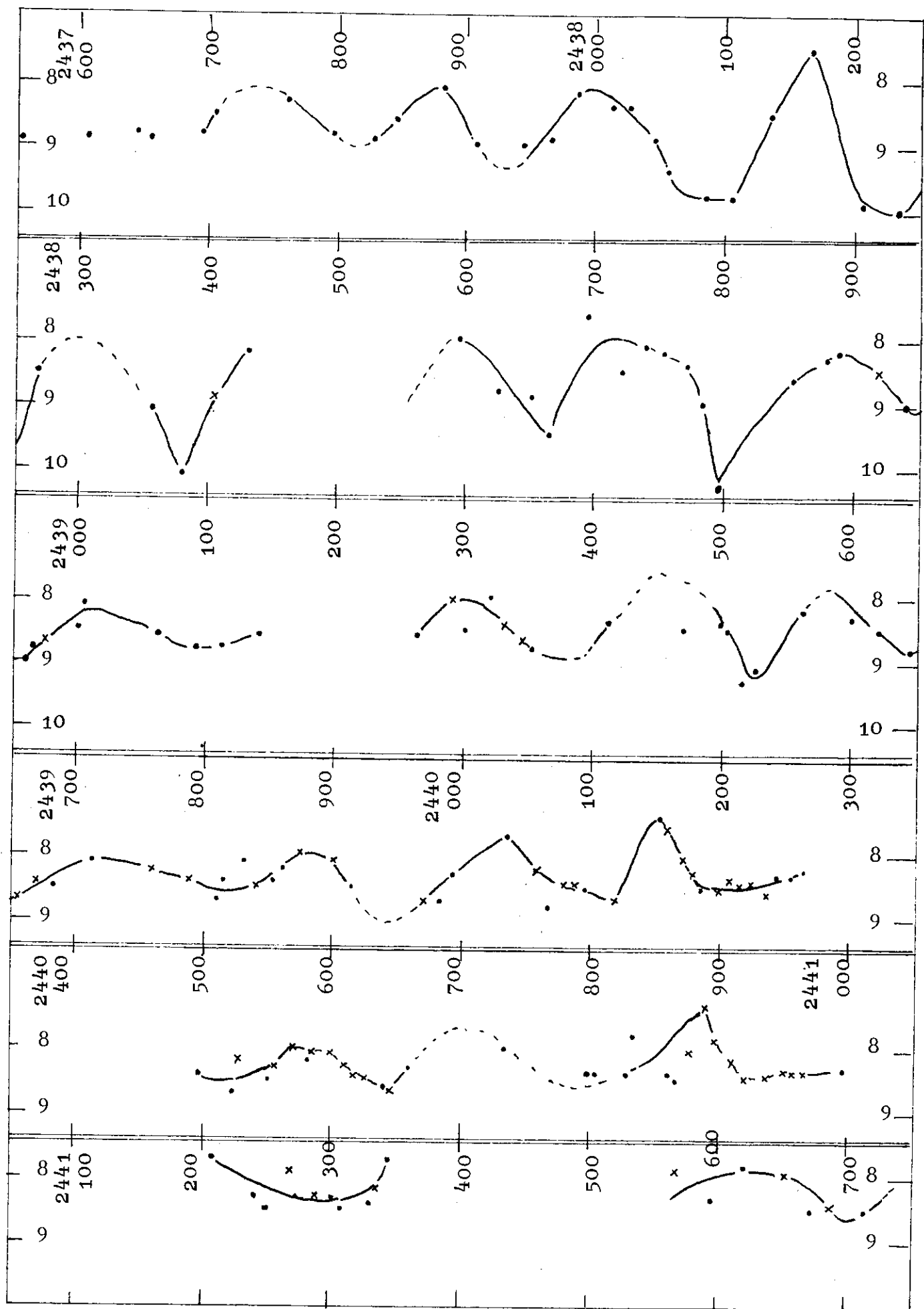


Figure 1. SW Scl. Light curve 2,437,550 to 2,441,750 from ten day means. Dots single observations; crosses means from two or more observations

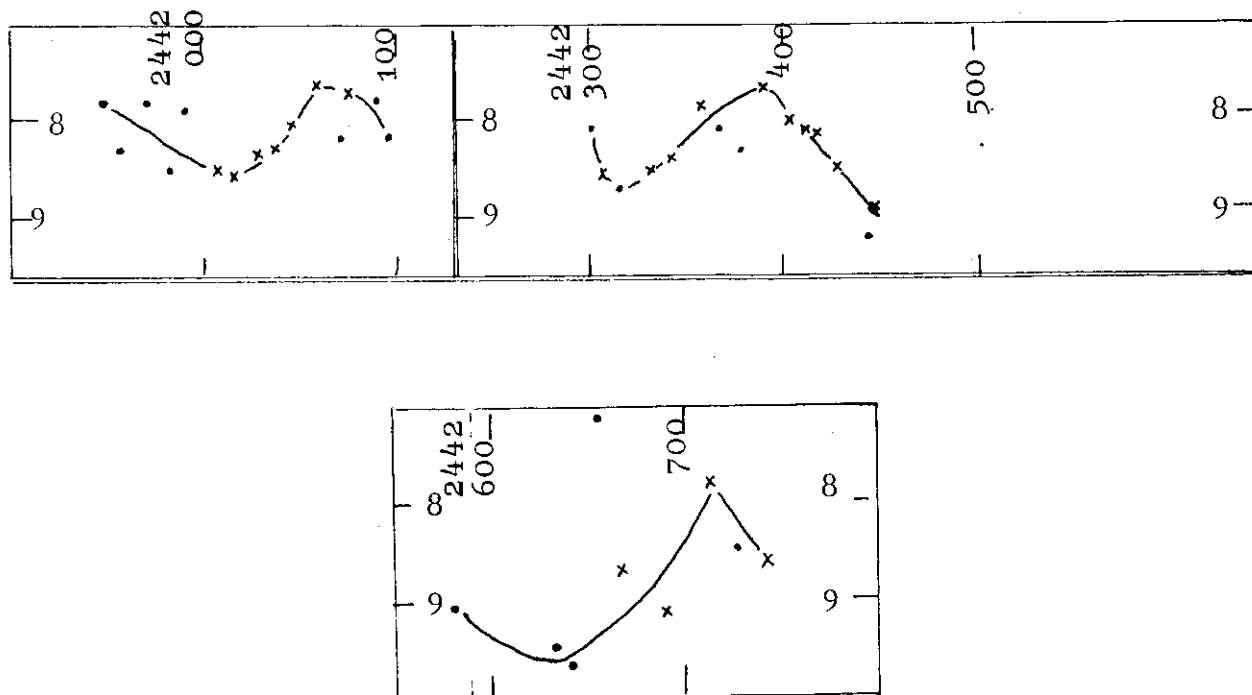


Figure 2. SW Scl. Light Curve 2,441,950 - 2442,100
 2,442,300 - 2,442,450
 and 2,442,550 - 2,442,750

from ten day means. Dots single observations;
 crosses means from two or more observations.

A SOUTHERN HEMISPHERE RV TAURI STAR PROJECT

Jeremy Bullivant

North Western Association of Variable Star Observers.

SUMMARY: In 1974, a Northern Hemisphere RV Tauri star project was set up and many previously under-observed stars were well observed for the two years duration of the project. It is now proposed to start a Southern Hemisphere RV Tauri star project to run from January 1978 to December 1980.

.....

INTRODUCTION

The stars on the programme are listed in Table 1. Charts have been published for a number of the stars listed, and charts will be available shortly for the remainder.

DISCUSSION

The RV Tau class of variable star is one of the most interesting and rewarding to observe. The light curve of this type of variable is characterised by double waves with alternating main and secondary minima of variable depth.

Two sub-classes exist: i) RVa:- RV Tau stars with a constant mean brightness, e.g. AC Her and R Scu and ii) RVb:- RV Tau stars with a periodically varying mean brightness, e.g. RV Tau and U Mon.

Some of the stars on the programme have been observed for many years, and records of the British Astronomical Association observations of R Scu go back into the 1890's (Gore 1896). But many of

the stars on the programme cannot be classified into either of the two sub-classes due to lack of observation. It is hoped that this project will allow at least some of these stars to be designated into one or other of these groups, as well as permitting the elements in the GCVS to be checked (Kukarkin et al, 1969).

The observations should be submitted in the usual manner for the duration of the project. Reports from these observations will be prepared during 1981.

The frequency of observation will be different for various stars on the programme. Stars like SX Cen should be observed as often as possible, whilst at the other end of the scale, stars such as R Scu and RY Ara should only be observed once every five days or so.

The success of this project depends upon the interest which is built up. All observations will be of use in improving the elements of this underobserved group of stars.

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TABLE 1.

STARS ON PROPOSED PROGRAMME.

<u>STAR</u>	<u>RANGE</u>	<u>PERIOD</u>	<u>TYPE</u>	<u>R.A.---1950</u>	<u>DEC--1950</u>
DS Aqr	11.1 - 11.9 B	78 ^d	RV	22h 50m 37s	- 18° 51.5
AD Aql	8.83 - 13.42V	65	RV	18 56 25	- 08 14.4
DY Aql	10.2 - 12.9 p	131	RV	19 43 45	- 11 04.3
RY Ara	9.2 - 12.1 p	144	RV	17 17 10	- 51 04.2
UY Ara	11.1 - 12.2 p	57	RV	17 25 00	- 59 51.7
UY CMa	10.8 - 12.8 p	115	SRd	06 16 04	- 17 01.3
RX Cap	11.6 - 13.7 p	68	RV	20 12 09	- 13 05.8
IW Car	7.70 - 8.47V	68	RVb	09 25 43	- 63 24.7
RU Cen	8.7 - 10.7 p	65	RV	12 06 48	- 45 08.8
SX Cen	9.6 - 12.5 p	33	RVb	12 18 31	- 48 56.0
BT Lib	11.5 - 13.1 p	75	RV	15 28 18	- 23 11.4
U Mon	6.1 - 8.1 p	92	RVb	07 28 24	- 09 40.2
AR Pup	8.7 - 10.9 p	75	RVb	08 01 10	- 36 27.3
AR Sgr	9.1 - 13.5 p	88	RV	18 56 40	- 23 46.6
AZ Sgr	11.4 - 12.2 p	114	RV	18 20 59	- 30 37.4
AI Sco	9.5 - 12.7 p	71	RVb	17 53 00	- 33 48.4
R Scu	4.45 - 8.20V	140	RVa	18 44 49	- 05 45.6

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AN UPDATED VISUAL SEQUENCE FOR ETA, RT AND BO CARINAE

Mati Morel

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

SUMMARY: A modern sequence of visual magnitudes is presented for a region of the sky 1° square centred on Eta Carinae, based on UBV data published by other authors. This will enable visual observers to make more accurate estimates of the stars Eta, RT and BO Car. Four new standard format charts are published to display the magnitudes to be used by visual observers, as well as identifying other variable stars. A list of all CoD stars within the field, for whom V and B-V magnitudes are known is also presented.

...

1. INTRODUCTION.

The remarkable variable star Eta Carinae is part of a large complex, comprising the emission nebula NGC 3372, the open clusters Trumpler 14, Trumpler 16 and Collinder 232. These, together with dark interstellar dust lanes comprise a single structure (Feinstein 1973). The future evolution of Eta Car is far from clear, and its behaviour in the coming years and decades is something that only continued observation will reveal. The introduction of a comparison sequence on the International System will provide observers with a sequence of the highest quality.

2. OBSERVATIONAL HISTORY.

Throughout its history Eta Car has been a difficult star to classify. At various times it has been described as a nova, or even a slow supernova. However its intrinsically high luminosity and the unique form of its light curve and spectral changes weigh against either classification.

Eta Car is described as "probably a supernova, because its absolute magnitude in max. is close to -14^m ..." (Kukarkin et al 1969). On the other hand the suggestion has been raised of Eta Car being a future supernova, and we are presently witnessing its pre-explosion ejection (Walborn & Ingerson 1977). Probably a more accurate appraisal is given by C. Payne-Gaposchkin (1957) thus: "Certainly not a conventional nova, Eta Carinae is the best observed representative of a small group of ejection variables that attain very high luminosity, perhaps intermediate between those of novae and supernovae."

Kukarkin et al (1976) reclassify Eta Car as being of 'S Dor' type. S Doradus is one of the most luminous stars known and is now the prototype of a class of variables, whose members are high luminosity stars of spectral classes Bpeq - Fpeq showing considerable irregular light variations (Kukarkin et al 1974). An additional note (Kukarkin et al 1976) describes Eta Car as a "very massive young star surrounded by expanding gaseous and dust shell". A summary of observations of Eta Car over nearly three centuries, compiled from several sources (Aller 1970; Lovi 1972; Webb 1917; Campbell and Jacchia 1941) appears as follows:

1603 (Bayer)	m_v	+ 4
1677 (Halley)		+ 4
1751		+ 2
1811-15		+ 4
1822-26		+ 2
1827		+ 1
1828-33		+ 2

1834-37	(Herschel)	$m_V + 1$
1837 Dec. 16	(Herschel)	0
1838-43		+ 1
1843 March		- 1
1857		+ 1
1860		+ 3
1866		+ 6

After the great outburst of 1843 Eta Car declined slightly, but remained a first magnitude star until 1857. Thereafter a steady decline set in, it reached magnitude 7 by 1870. For the next 80 years it hovered between magnitudes 7 and 8, apart from a brief rise to 6.8 in 1889. A light curve for the interval 1836-1902 was reproduced by Campbell and Jacchia (1941). A light curve from 1670 to 1974 has been published by Feinstein and Marraco (1974).

After shining quietly near magnitude 8 for many decades Eta Car began to increase in light in 1951 and in 1952 reached 6^m. Afterwards it faded, with fluctuations, to 7^m (Kukarkin et al 1969).

That Eta Car does not have the sharp pinpoint image of a normal star, but is enveloped in a tiny elongated nebula, has been the subject of considerable study. The nebula (described as like a homunculus or manikin in form) measures 11" (major axis) by 6" (minor axis). Photographs and isophote maps may be found in SKY & TELESCOPE (Gehrz & Ney 1972; Walborn & Ingerson 1977).

3. CHARTS AND SEQUENCES.

The chart and sequence presently in use by the VSS, RASNZ were published by Bateson and Jones (1960). The magnitudes on the chart are of much earlier vintage, and noticeable differences can be found between them and modern values in the UBV System. Also, one comparison star (HD 93206, m_V 6.4) has now been found to be a variable star of small range, and is now known as QZ Car. For these reasons a new set of completely updated charts are considered desirable. The vast amount of reliable UBV photometry which has been carried out for stars in the region of Eta Car in the last ten years has made the preparation of a new sequence fairly easy.

4. THE REVISED CHARTS.

Four charts are published with this paper. These are numbered 460, 461, 462 and 463 as they will appear in Series 11, "Charts for Southern Variables". All show V magnitudes of a large number of suitable comparison stars rounded off to the nearest tenth of a magnitude with the decimal point omitted. Chart 460 covers slightly more than 1 square degree and is on the scale 20" = 1mm. The following table summarizes the variables shown on Chart 460.

TABLE 1. DESIGNATED VARIABLES ON CHART 460.

STAR	R.A. 1950	DEC. 1950	TYPE	RANGE	PERIOD	SPEC.
Eta Car	10 ^h 43 ^m 07 ^s	-59°25'.2	SD	-0.8 -+7.9 v		Pec.
RT Car	10 42 50	-59 09 .0	Z And?	+8.2 - 9.9 v		M2 ⁺ Ia-0
BO Car	10 43 54	-59 13.5	Lc	9.3 -10.4 p		M4Ib
BR Car	10 46 00	-59 53 .2	cst	11.4 p		-
DW Car	10 41 15	-59 46 .4	EA	9.6 -10.2 p	1.3277504 ^d	cB5
QZ Car	10 42 27	-59 43 .8	EB	6.22 6.49V	6.000	09.5Ib

Only the first three variables are suitable for visual observers. Chart 461 shows the region of Eta Car on the scale 10" = 1mm, and a significant number of faint comparison stars are identified to 12.7^m. Note the tight cluster TR 14 around "70". Chart 462 shows the region of RT and BO Carinae on the scale 10" = 1mm. Note the overlap with Chart 461.

Trumpler 14 and Trumpler 16 are both tight clusters, and since

extensive photometry has been done in both cases which may in the future be useful to variable star specialists, I have decided to include charts for the central regions of both clusters, on the scale $2'' = 1\text{mm}$. These two charts together form chart 463. The upper half of Chart 463 shows Tr 14 (the group of stars around "70" = HD 93129), and reaches magnitude 13.6. Four variables of small range have been found in the region of this cluster (Feinstein 1973) and have been identified accordingly. The lower half of Chart 463 shows the part of Tr 16 in the immediate vicinity of Eta Car. One of two small range variables observed by Feinstein (1973) has been shown. This chart reaches to magnitude 14.3.

It must be pointed out that though the magnitudes shown on the charts are numerous, they do not include all of those available. For more complete data observers are directed to the papers by Feinstein and his co-workers, in particular.

5. LIST OF CoD STARS.

It would not be practicable, nor really necessary, to list in tabular form all stars whose magnitudes have been included on the charts 460-463. However, it would appear to be convenient to have a list of the brighter stars (say, brighter than 10.0v) for whom V and B-V are known. A listing of stars having numbers in the Cordoba Durchmusterung (whose limiting magnitude is close to 10.0 in this region) satisfies the requirement admirably. This list appears below as Table 2. A number of stars have been determined by several different observers, and one can compare their values at a glance.

In Table 2 the first four columns give respectively HD or HDE number; CoD number in zones -58° or -59° ; V and B-V magnitudes and references to the source for these magnitudes. The final column contains additional remarks and references to suspected variables or with the designation 'LS' to stars in the Catalogue of Luminous Stars in the Southern Milky Way (Stephenson and Sanduleak 1971). Three CPD stars which are not in the CoD are included for completeness.

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TABLE 2.

V and B-V MAGNITUDES FOR CoD STARS IN FIELD OF ETA CARINAE.

HD/HDE	CoD	V	B-V	REF.	REMARKS
92725	-58 ⁰ 3489	8.23	+0.09	5	
92739	3490	8.61	+0.06	5	
303202	3497	9.77	+0.13	5	LS 1771
92852	3498	10.28	+0.05	5	LS 1774
92875	3502	9.16	+0.30	5	LS 1777
303297	3503	9.55	+0.04	5	
92894	3505	9.40	+0.12	5	LS 1783
303296	3508	9.60	+0.06	5	
92964	3513	5.36	+0.27	1	SVS 101155
303299	3516	9.38	+0.22	5	
303312	3523	10.00	+0.34	5	LS 1807
	3524	10.08	+0.50	3	
	3526	9.61	+0.28	3	
93128	3527	8.84	+0.25	3	HD 93160 Sp = 07 (Heuk)
93129	3528	6.97	+0.16	3	
	(7.03	+0.24	8		HD 93161 Sp = A5/FO(m) "
	3529	9.40	+0.17	3	
93160	3531	7.82	+0.17	3	Pre Tycho-2 data.
93161	3531	7.82	+0.21	3	Fol
93190	3532	8.57	+0.32	2	
303311	3534	9.05	+0.13	3	HD 93160 V = 7.87 B-V 0.09
93250	3537	7.38	+0.15	2	
	(7.37	+0.16	3		HD 93161 8.58 0.04 } Comb.
	(7.36	+0.18	8		8.64 0.02 } V = 7.81
	3538	.....	.....	.	RT
93268	3539	9.32	+0.10	3	
93342	3542	9.10	+0.60	2	2" double a/c to Tycho-2.
	(9.08	+0.63	7		
93403	3545	7.28	+0.21	2	
	(7.29	+0.22	6		
93420	3547	.....	.....	.	B0 Carinae

TABLE 2 (continued)

HD/HDE	CoD	V	B-V	REF.	REMARKS
303304	-58 ^o 3554	9.66	+0.42	5	LS 1897
93723	3565	8.55	+0.03	2	
93795	3570 (	8.56	+0.79	7	LS 1929
	(	8.51	+0.76	5	
93873	3575	7.82	+0.46	7	
	-59 3212	9.84	-0.08	5	LS 1745
92741	3219	7.26	-0.01	2	
92740	3221 (	6.41	+0.08	1	SVS 101151
	(	6.45	+0.07	5	
303225	3225	9.94	+0.03	5	LS 1767
305452	3232	9.49	+0.04	5	LS 1776
305439	3236	9.13	+0.51	5	LS 1780
	3239	10.80	+0.05	4	
305451	3240	10.21	+0.07	4	
305438	3243 (	8.80	-0.01	4	
	(	8.80	-0.04	8	
305437	3244 (	9.06	+0.02	4	
	(	9.08	-0.01	8	
305544	3246	8.59	+0.66	4	
305535	3248	9.39	+0.04	4	
305515	3249	10.35	+0.09	4	
305543	3251	....	....	.	DW Carinae
305516	3253	9.87	+0.06	4	
93027	3255	8.72	0.00	4	
93056	3257	8.97	-0.06	4	
	3263	11.71	+0.31	4	
	3265	10.40	+0.22	4	
305518	3266 (	9.78	+0.33	3)	See footnote
	(	9.71	+0.38	4)	
93097	3267	9.76	-0.02	4	Companion V 10.76; B-V+0.86 lies 11" SW.
305521	3268	9.81	+0.06	4	
	3270	9.56	+0.07	4	
	3271	10.94	+0.10	4	
93131	3272	6.48	-0.02	4	
	3274	9.31	+0.02	4	
	3277	8.77	0.00	4	
93146	3278 (	8.44	+0.02	4)	Companion V 9.79; B-V+0.02
	(	8.45	+0.03	8)	lies 5" SW. See footnote
93130	3279 (	8.06	+0.22	2	
	(	8.04	+0.27	4	
305520	3281	8.68	+0.17	4	
93162	3282	8.10	+0.41	3	
305519	3283	9.86	+0.09	4	
305536	3284	8.94	+0.05	4	
	3285	9.44	+1.64	3	
305522	3286	9.69	+0.06	4	
93206	3287	....	....	.	QZ Carinae
	3288	9.86	+0.14	3	
93191	3290	8.48	-0.02	4	
305523	3291 (	8.50	+0.14	2	
	(	8.49	+0.18	4	
93204	3293 (	8.42	+0.10	3	
	(	8.47	+0.11	8	

TABLE 2 (continued).

HD/HDE	CoD	V	B-V	REF.	REMARKS.
93205	-59°3294	(7.75	+0.08	8	
		(7.75	+0.05	3	
93222	3295	(8.11	+0.05	2	
		(8.08	+0.08	4	
	3296	10.18	-0.01	4	North component
	3296	10.23	+0.10	4	South component
	3297	9.47	+0.82	4	
	3299	9.40	+1.87	4	
	3300	8.61	+0.21	3	
305524	3301	9.28	+0.30	4	
305534	3302	9.67	+0.13	4	
	3303	8.77	+0.14	3	
	3304	9.92	+0.32	4	
93281	3305	7.74	+1.77	4	
93308	3306	....	....	.	Eta Carinae
303308	3307	(8.17	+0.12	3	
		(8.14	+0.16	8	
93343	....	( 9.47	+0.29	2)	CPD -59°2633. See footnote.
		(9.57	+0.26	8)	
	....	( 9.31	+0.23	2)	CPD -59°2635. See footnote.
		(9.24	+0.26	8)	
	3308	(9.31	+0.31	3)	CPD -59°2636. See footnote.
		(9.26	+0.36	8)	
	3310	9.29	+0.32	3	
305528	3311	10.28	+0.13	4	
	3312	10.15	+0.16	3	
305532	3314	10.20	+0.34	4	
305525	3316	10.00	+0.68	4	
93501	3319	9.08	+0.10	4	
305539	3322	(9.93	....	1	
	.	(9.90	+0.27	4	
93576	3325	9.57	+0.25	4	
93620	3326	9.15	+0.12	5	LS 1905
93632	3328	(8.31	+0.24	5	LS 1907
		(8.34	+0.32	8	
		(8.39	+0.29	4	
93695	3336	6.49	-0.11	2	SVS 101161
93737	3339	(6.00	+0.28	1	
		(6.03	+0.28	7	
303413	3349	9.73	+0.23	5	
305602	3350	10.20	+0.26	5	LS 1941
93911	3351	(8.40	+0.23	7)	LS 1944. See footnote.
		(8.32	+0.23	5)	
305599	3355	10.00	+0.34	5	LS 1947
305606	3356	10.48	0.00	5	LS 1949
305601	3357	10.23	+0.32	5	LS 1956

ADDITIONAL REMARKS.

HDE 305518. No magnitude placed on charts as the two published values differ by more than 0.05 in V.

HD 93146. This star and its 9.79V companion will be seen as one in many observers' instruments. The integrated magnitude is 8.16, which is shown as 8.2 on charts.

CPD -59°2633, 2635, 2636. Feinstein's magnitudes adopted.

HD 93911. As for HDE 305518 above.

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104159 Eta CARINAE

(1900): 10h41m11s -59°09.5

(1950): 10 43 07 -59 25.2

SD. -0.8-+7.9v. Pec

104058 RT CARINAE.

(1900): 10h40m54s -58°53.3

(1950): 10 42 50 -59 09.0

Z And?. 8.2-9.9v. M2⁺Ia-0.

ALSO SHOWN; QZ; BR; DW Car.

SEE also charts 461 & 462.

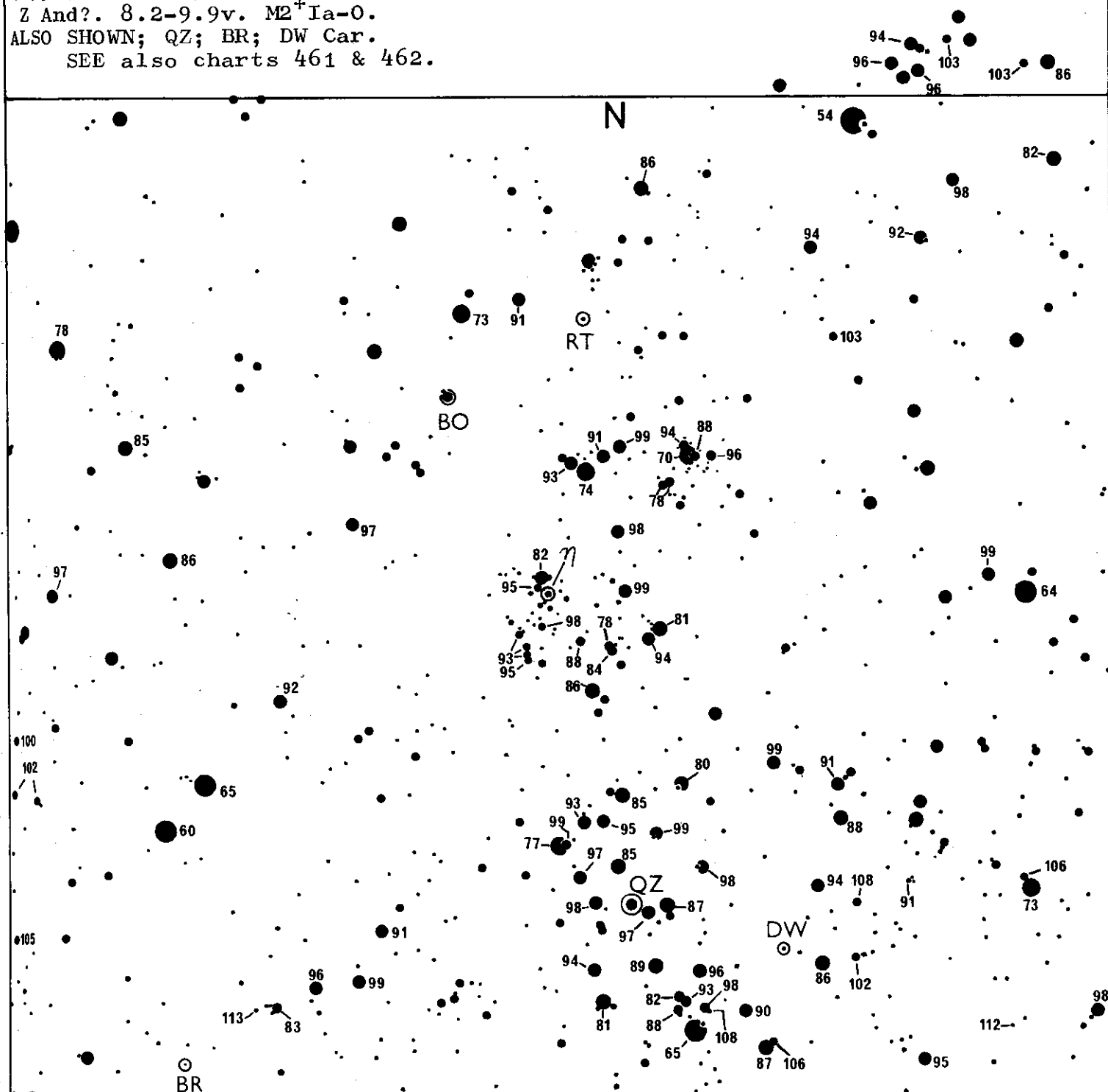
104258 BO CARINAE

(1900): 10h 41m57s -58°57.7

(1950): 10 43 54 -59 13.5

Lc. 9.3-10.4p. M4Ib.

Scale: 20" = 1mm



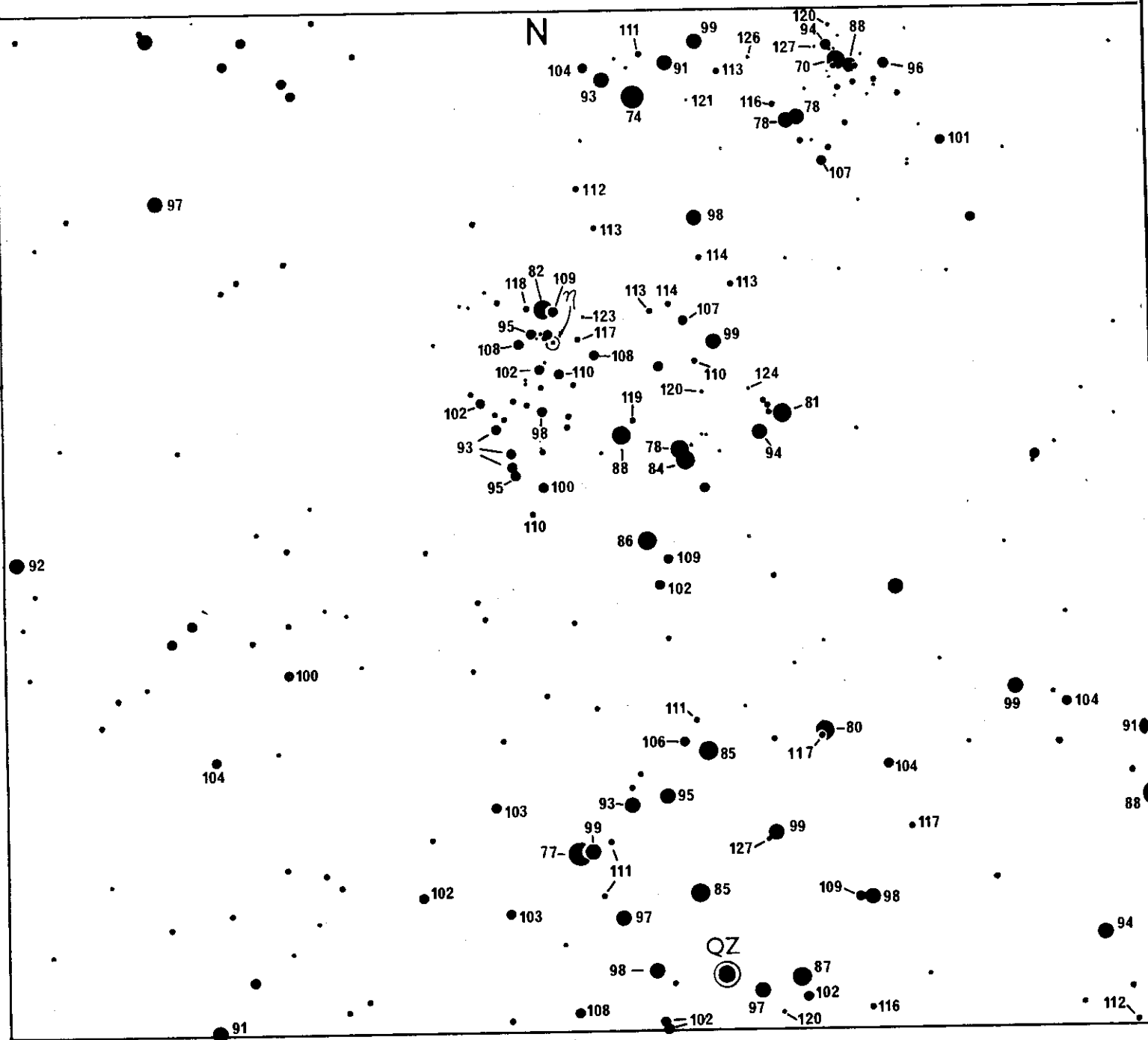
Plotted by M. Morel from Sydney Astrographic Catalogue, Plate 2271s;
 1895 Feb. 12. (plate centre 10h 42m -59°).
 MAGNITUDES: V (Rfer. Pub. 6, VSS, RASNZ 1978).

F.M.B. 1978 March 1.

104159 Eta CARINAE
 (1900): $10^{\text{h}}41^{\text{m}}11^{\text{s}} -59^{\circ}09'.5$
 (1950): $10^{\text{h}}43^{\text{m}}07^{\text{s}} -59^{\circ}25'.2$
 SD. $-0.8 - +7.9\text{v. Pec.}$
 SEE ALSO CHART 460.

ALSO SHOWN: QZ Car.

Scale: $10'' = 1\text{mm}$



Plotted by M. Morel from Sydney Astrographic Catalogue, Plate 2271s;
 1895 Feb. 12 (plate centre $10^{\text{h}}42^{\text{m}}-59^{\circ}$).
 MAGNITUDES: V (Refer Pub. 6, VSS, RASNZ 1978).
 F.M.B. 1978 March 1.

104058 RT CARINAE

(1900): 10h 40m 54s -58° 53.3

(1950): 10 42 50 -59 09.0

Z And?. 8.2 - 9.9v. M2⁺Ia=0

104258 BO CARINAE

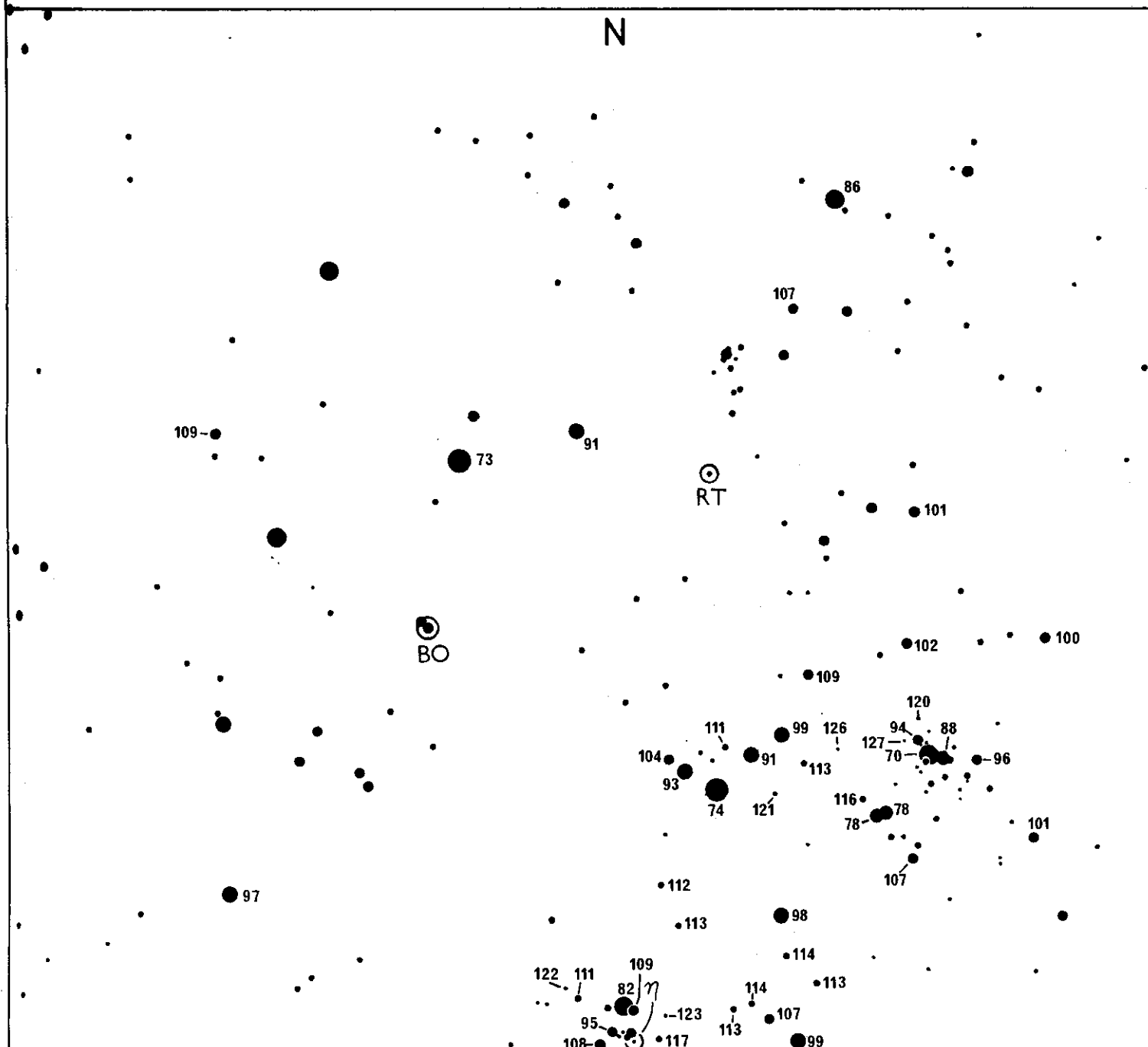
(1900): 10 41 57 - 58 57.7

(1950): 10 43 54 - 59 13.5

Lc. 9.3 - 10.4p. M4Ib.

SEE ALSO CHART 460

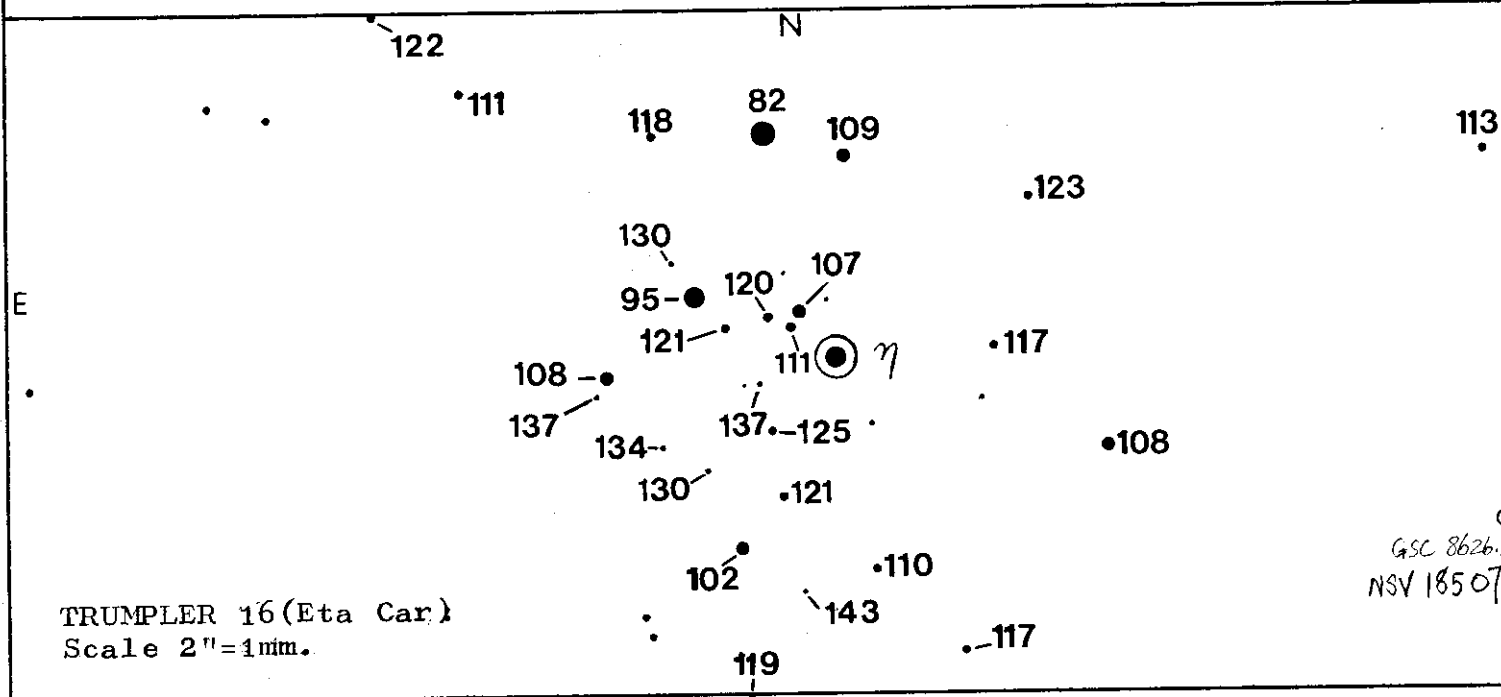
SCALE: 10" = 1mm



Plotted by M. Morel from Sydney Astrographic Catalogue, Plate 2271s;
 1895 Feb. 12 (plate centre 10h 42m -59°).
 MAGNITUDES: V (Refer Pub. 6, VSS, RASNZ 1978).

F.M.B. 1978 March 1.

Four variables of small range shown in vicinity of Tr 14.
Part of Tr. 16 in immediate vicinity of Eta Carinae shown.



Plotted by M. Morel from Sydney Astrographic Catalogue, Plate 2271s;
1895 Feb. 12 with some faint stars added from published charts and
photographs.
MAGNITUDES: V (Refer Pub. 6. VSS, RASNZ 1978), F.M.B. 1978 March 1.

NOVAE IN THE MAGELLANIC CLOUDS

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SUMMARY: The search for novae in the Magellanic Clouds which is being carried out at Cerro Tololo Inter-American Observatory is described. The need for observations of these transient variable stars is outlined and their significance in extragalactic studies is briefly discussed.

Novae are among the most spectacular of the variable stars. Recent research has shown that most, if not all of them are close binary stars made up of a dense white dwarf and a faint main sequence star, each having a mass slightly less than that of the Sun. During the long quiescent period, probably of many thousands of years, material flows steadily towards the white dwarf from its companion star. Eventually, hydrogen rich material accumulates on the white dwarf in a quantity sufficient for a violent nuclear explosion to take place which increases the luminosity of the faint, inconspicuous pair by more than 9 magnitudes within a few days. Temporarily such a pair will shine as bright as the brightest stars known, only to fade after a few weeks slowly back to its former obscurity. With modern spectroscopic instrumentation and large telescopes it is now possible to study novae from maximum magnitude down to the faint quiescent stage and during the last 20 years there has been great progress in the understanding of physical processes involved in the outburst. An excellent review of the current state of our knowledge is given by Gallagher and Starrfield (1978).

It is believed that 25 to 50 novae erupt each year in the Milky Way system but the majority of these are obscured by intervening clouds of interstellar dust and escape discovery. Some advantages are gained by looking for similar variables in other galaxies, where the path-length through absorbing clouds is much less. Additionally, it can be assumed that all stars in the galaxy are at effectively the same distance thus making comparisons possible between rare stars like novae and more common stable stars of similar brightness. An important study was made 20 years ago by H.C. Arp (1956) of the novae in the Andromeda galaxy. During an extensive observing run of 290 nights over a 2 year period, he detected 30 novae and was able to obtain photographic light curves. The principal results of the study were that the maximum brightness of a nova is strongly correlated with the apparent rate of decline of its brightness and that the frequency distribution of the novae is strongly peaked towards the central bulge of the galaxy. Both of these properties had already been found among novae of our own Galaxy. The brightest novae observed by Arp reached maximum at photographic magnitude 16 making them difficult objects for detailed observation even with very large telescopes.

Nearer to hand, novae have been recognized in the Magellanic Clouds since 1926. The two Magellanic Clouds are each much less massive than either the Milky Way and the Andromeda galaxies and the lower frequency of novae does not come as a surprise. However, at a distance of only one tenth that of the Andromeda galaxy, these few novae appear much brighter. In the Large Magellanic Cloud, maxima as bright as magnitude ten have been observed making the novae

* Cerro Tololo Inter-American Observatory, supported by the National Science Foundation under Contract No. AST 74-04128.

quite accessible to detailed spectroscopic and photometric study. Until recently, the frequency of novae in the Clouds was not known well. Since 1970, however, a systematic search has been carried out at the Cerro Tololo Inter-American Observatory. The observing season is from July to January for the Small Cloud and September to April for the Large Cloud. In our survey, 8 novae have been discovered in the Large Cloud but none in the Small Cloud. One in the Small Cloud in 1974 escaped our attention but was noted by D. J. MacConnell and N. Sanduleak. Viewed at present, frequencies of 2 or 3 per year in the Large Cloud and 1 every 2 or 3 years in the Small Cloud are becoming likely figures.

The discovery technique used at CTIO is to compare plates taken at intervals of approximately two weeks with the Curtis Schmidt 60/90 cm telescope. The Schmidt plates cover a field of $5 \times 5^\circ$ and it is possible to include the Small Magellanic Cloud on 1 plate although 4 are needed for the Large Cloud. From a practical point of view, it is important to limit the search to star of 14th magnitude or brighter. Fainter than this, the numerous cepheid variable stars in each cloud are frequently observed and much time would need to be spent in checking each rediscovery individually. To reach 14th magnitude very short exposures of less than a minute are required with the Schmidt. This is much less than the time taken to set the telescope and valuable additional information can be obtained with only a small amount of extra effort by placing the 4° objective prism in front of the correcting plate of the telescope. With this arrangement, a limiting magnitude close to 15.0 is reached in 10 minutes. On the photographic plate, each star is spread out into a small spectrum about 4mm long. The comparison between the two plates is made with a blink comparator. A nova is conspicuous not only because of its presence on one plate and absence on the other, but also because of the strong emission lines which are generally seen in its spectrum. Nevertheless, on the rare occasion that the nova is caught just before maximum light, the spectrum can appear featureless.

Following discovery a routine check is made to see if the star is a known variable. The Hodge-Wright Atlases of the Large and Small Magellanic Clouds (1967, 1975) are ideal for this purpose as they contain charts on which nearly all known variables are marked. A rough position is then determined using the Uppsala-Mount Stromlo Atlas of the Magellanic Clouds (Gascoigne and Westerlund, 1961). Telegrams are sent off giving adequate identification information to the Smithsonian Astrophysical Observatory and to interested observers in the Southern Hemisphere. Post-discovery observations are difficult to make at Cerro Tololo because of advance scheduling of telescopes and sometimes neither telescope time nor suitable instrumentation is available for this purpose at short notice.

Several of the challenges encountered in obtaining data for Magellanic Cloud novae are illustrated in the cases of the two novae most recently discovered (IAU Circulars 3049, 3204). The first of these novae was discovered just before reaching maximum on March 12, 1977. Despite this, it was not possible to get a direct photograph at Cerro Tololo to accurately locate the star for future study. Fortunately, photographs were taken both in New Zealand by Lewis and in Australia by Page and these have been made available for measurement in Chile by F.M. Bateson. Some of the photometric observations were discussed by Canterna and Schwartz (1977). Interpolation between available observations showed that a maximum visual magnitude probably occurred on March 14. Ten days later, the nova had faded by 2 magnitudes and its identification in the rich star field had already become difficult. In Canterna and Schwartz's analysis, photoelectric magnitudes and colours made at Auckland

Observatory by Walker and at the South African Astronomical Observatory by Bywater covered an important part of the light curve.

It cannot be overemphasized that photographic and visually estimated magnitudes may become critical observations for the assignment of basic parameters to a nova despite their lower accuracy. An example for which even a rough photographic magnitude would have been extremely useful is the nova which was discovered on March 29, 1978. At the time of discovery, the 13th magnitude nova was already well past maximum and was fading rapidly by about 0.5^m per day. On the previous survey plate taken on March 17, a faint but definite image is seen which corresponds to a star of 15th magnitude. Unfortunately, this image was so faint that it was missed when the March 17 plates were checked. At the time, it seems likely that the nova was brightening rapidly and it is probable that a maximum of about 10.0^m was reached on March 19 or 20. It would have been an easy event to photograph but there exists no direct record of it, as far as I know.

There are two main applications of the discovery and observation of novae in the Magellanic Clouds towards the solution of broader problems in astronomical research. The first is a comparative study of the novae themselves with respect to those in other star systems. We can further check the relation between maximum luminosity and the rate of decline to see if it is the same as in the much larger Milky Way and Andromeda galaxies. If this is so, we can use the novae as reliable indicators of the distances of other stellar systems and thus improve our knowledge of the distance scale of the Universe as a whole. A second use is to employ the novae as probes of the overall distribution of low mass stars in the Magellanic Clouds. They are clearly the brightest representatives of this population group. In the Large Magellanic Cloud, one characteristic is already remarkable. The novae do not show any concentration towards the crowded central region of this star system. This contrasts strongly with the situation which applies to both the Milky Way and the Andromeda galaxies. Because of their low mass and advanced evolutionary state, novae are almost certainly amongst the oldest of stars and their unusual distribution in the Large Cloud is almost certainly telling us that the overall history of star formation in this small galaxy differs in important respects from the sequence of events which has taken place in more massive galaxies like our own.

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PHOTO-ELECTRIC OBSERVATIONS OF THE DWARF NOVA WX HYDRI
J.D. 2,441,093 to J.D. 2,443,144

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SUMMARY: Photoelectric observations in three colour UBV sets and unfiltered white monitoring obtained at Auckland Observatory during the interval J.D. 2,441,093 to 2,443,144 are presented. Times of superhump maximum light and details of intensity changes observed during the 1976 September supermaximum are listed. The time interval between supermaximum outbursts is discussed and predictions are made for future supermaxima during the next two observing seasons.

1. INTRODUCTION.

Visual observations of WX Hyi covering the interval J.D. 2,441,066 to 2,442,743 have been summarised by Bateson (1976).

We have previously drawn attention to the presence of repetitive superhumps on one supermaximum outburst (Walker et al, 1976) and determined for them a period of 0.0783 days. An orbital period for the system of 0.0749 days was suggested from the superhump period and from a limited number of observations at minimum.

We present here a summary of these photo-electric data, obtained at the Auckland Observatory during the interval J.D. 2,441,093 to 2,443,144.

2. OBSERVATIONS

The observations were made using the Auckland Observatory 50cm Cassegrain telescope with the Mark 1 photoelectric photometer and an EMI 9502 phototube.

Three colour magnitudes for the comparison stars, shown on charts 313 and 314 (Bateson, et al, 1976) were published (Marino and Walker, 1977). N. Vogt (1977) also published three colour measurements for four stars of this sequence. The two sets of measurements are in good agreement for those comparison stars common to both. Star 'f' has been used as the main comparison star for our photo-electric observations.

3. THREE COLOUR OBSERVATIONS.

The three colour observations are set out in Table 1. Column 5 gives the outburst number and type, using the classification described by Bateson (1976) for the visual data. Observations were made during sixteen of the visually observed outbursts. In addition five outbursts, marked P1 to P5 in the fifth column of Table 1, were not observed visually. A further two (possibly three) outbursts were observed during the interval J.D. 2,442,745 to J.D. 2,443,144 for which the visual data have yet to be published.

4. MONITORING OBSERVATIONS

Monitoring data in unfiltered white light were obtained on ten nights and are summarised in Table 2 and Figures 1 to 3. Sky and comparison star measurements were taken at frequent intervals during each observing period and reductions to net intensities were made using the methods described for RS Columbae (Marino, 1971).

The intensity scale in all figures is net white photons detected per second after deriving an outside atmosphere value of 9000 detected white photons per second for the comparison star.

In Figure 1 observations are presented for three nights when the star was at quiescent brightness. On the night of 1976 October 19 it was particularly faint, being $V = 15.10$ at $10^h 23^m$ UT.

In Figure 2 observations during the 1976 September supermaximum are presented showing well defined repetitive superhump structure on the first two nights.

Figure 3 shows monitoring observations for the four remaining nights when the star was at various outburst levels. The outburst at 1974 January 14 U.T. was not observed by the visual observers. The remaining 3 nights are on the declining curves of outbursts 47, 48 and 59.

5. DISCUSSION

At minimum magnitude WX Hyi is close to the observable limit of the Auckland equipment. Whilst photoelectric observations extend over a similar time interval to those reported by Bateson (1976), the number of observations is not large.

In Figure 4 we have plotted from Table 1 the V magnitudes against $B-V$ colour. At minimum the system fluctuates between 14.2^m and 14.8^m . A comparison of histogram plots of the photoelectric and visual magnitudes shows visual observers tend to estimate the star too bright when quiescent. Bateson (private communication) has found individual visual observations to be too bright by a mean of 0.25^m when compared with photoelectric magnitudes measured at the same time.

During outburst, clustering of observations suggests three outburst levels: between 13.1^m and 13.4^m V; between 12.4^m and 12.8^m V; and between 11.8^m and 12.0^m V. All observations in the last range have been obtained during supermaximum outbursts. An inspection of the visual data indicates a similar frequency distribution, but at slightly different magnitude levels. There are no major colour differences between outburst types, although there is some evidence of a reddening from 14.6^m to 14.0^m .

The light-curve in Figure 1 show bright humps similar to those observed with orbital aspect changes of a disc 'hot spot' and typical of this type of variable star. Whether these humps are repetitive on WX Hyi and, if so, what the orbital period is, cannot be determined with certainty from the data presented here. On each of the first two nights brightenings appear to be separated by intervals well in excess of the superhump period determined previously (Walker et al, 1976). By overlaying the general light curve shapes, depressions in the humps at points marked A are found to closely coincide. Times for these events fit a period of approximately 0.15 days, close to double the superhump period. This does not, however, fit the earlier hump on the second night. Bringing the depression marked B into coincidence with both points A yields a common period for the three points of 0.105 days.

Superhumps previously published in IBVS 1185 are reproduced here in Figure 2 and were first observed during the 1976 September supermaximum. A linear fit of times of superhump maxima yields a period 0.0782 ± 0.002 . Figure 5 plots the light-curve for the outburst from visual observations of the Variable Star Section, kindly supplied by F.M. Bateson. The position of the photoelectric magnitudes and the interval of monitoring for each night are indicated on the figure. The times of superhump maxima, the intensity rise and fall, and the maximum intensity level are summarised in Table 3. The small peak on September 28 is too far separated in time from the earlier observations to be certain that it is a true superhump.

6. SUPERMAXIMUM PREDICTION

As this system has very frequent outbursts, and in many of its features is similar to VW Hydri, we are particularly concerned to observe it as frequently as possible during future maxima. With WX Hyi, (Bateson(1976) found the interval between successively observed supermaxima, averaged 195.4 days, but fell between wide limits. This is illustrated in Table 4 where the times of supermaxima from the visual data are set out in the first nine lines of column 1, and O-C residuals from this average interval are shown in column 3. Bateson stated that one or two supermaxima had probably been missed.

From an inspection of the intervals between successive observed supermaxima we have made the assumption that double intervals occur between supermaxima numbers 19 and 38; 38 and 43; 55 and 70. Using this assumption a linear regression fit was applied to the visual data times of all supermaxima to obtain a epoch and period which might be used for prediction. This yields the ephemeris, Epoch = J.D. 2,441,090 and period = 140.2 days, for which the O-C values are tabulated in column 4 of Table 4.

The visual data has been inspected at the predicted times of the three missing supermaxima. In one case near J.D. 2,441,791.2 breaks in the observations are long enough (13 days) to allow a supermaximum to have occurred undetected. It is possible that a supermaximum occurred near J.D. 2,441,510. The observations are consistent with a supermaximum showing a large drop in brightness after 2-3 days, as observed occasionally with VW Hyi and Z Cha. A third supermaximum should have occurred near J.D. 2,442,350. A small gap in observations and one brighter than normal observation do not appear adequate support for the occurrence of this supermaximum.

In the last three lines of Table 4 we have included approximate times and O-C values for more recently observed supermaxima, all of which fit the above ephemeris. (Note that they do not immediately follow the last published visual observations). We thus propose that while supermaxima may miss any particular predicted date when they do occur it is within 30 days of the time predicted by the ephemeris. If this holds true supermaxima, when they occur, should be within 30 days of the following dates: 1977 November 26, 1978 April 16, September 3; 1979, January 21, June 10 and October 29, and 1980 March 17.

7. CONCLUSIONS

The photoelectric observations complement well the previously published visual data, and indicate that this is a very active system warranting much closer study by both visual and photoelectric observers. Magnitude changes occur very rapidly at times and particularly at outbursts several visual observations per hour are required to correctly describe the events taking place.

ACKNOWLEDGMENTS

We gratefully acknowledge the following assistance; The Auckland Observatory and Planetarium Trust Board for the use of the Edith Winstone Blackwell telescope; F.M. Bateson for helpful discussions and for supplying copies of the visual observations for the light curve in Figure 5. We are indebted to the members of the Variable Star Section, Royal Astronomical Society of New Zealand, who made these observations; the Physics Department, University of Auckland for assistance in the construction and maintenance of the photon detection equipment used for obtaining these observations; O.R. Hull and B. Menzies for early advice that an outburst was taking place;

J. Beuning, G. O'Connor, G. Freeth, B. Wild, and E. Dunsbee for assistance with the observing.

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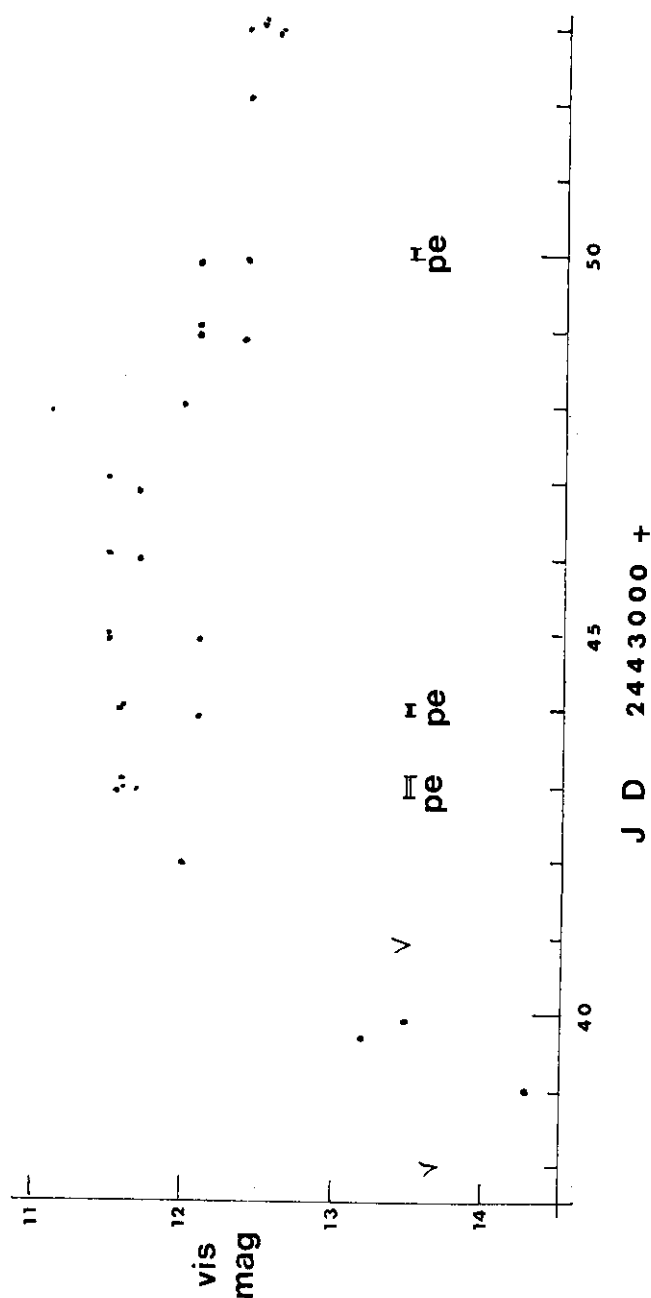


Figure 5. Visual light curve for 1976 September supermaximum from VSS records.

TABLE 1

THREE COLOUR OBSERVATIONS OF WX HYDRI

<u>J.D. 2,440,000 +</u>	<u>V</u>	<u>B - V</u>	<u>U - B</u>	<u>Outburst</u>		<u>Comments</u>
1093.23	14.75	0.04	-1.14			mean of 3 sets
1100.79	13.13	0.21	-0.45	3	B	
1109.17	13.25	-0.28	-0.42	new	P1	mean of 2 sets
1119.03	12.80	0.02	-0.59	4	A	
1130.04	12.74	0.09	-0.74	new	P2	mean of 2 sets
1149.15	14.69	0.34	-1.38			
1149.23	14.70	0.20	-1.33			mean of 2 sets
1151.03	14.82	0.07	-0.93			
1152.02	12.47	0.00	-0.42	5	B	mean of 2 sets
1156.22	14.79	0.24	-1.04			
1163.04	14.26	0.40	-1.06			
1163.20	14.41	0.31	-1.06			
1177.95	12.49	-0.26	-0.66	7	B	
1178.17	12.55	-0.05	-0.68	7	B	
1183.01	14.65	0.21	-0.91			
1209.93	12.20	-0.04	-0.45	10	S	mean of 2 sets
1212.08	11.71	0.11	-0.77	10	S	
1212.93	12.13	0.05	-0.62	10	S	
1213.06	12.00	-0.05	-0.77	10	S	
1262.97	14.55	0.21	-1.19			
1262.99	14.73	-0.10	-1.01			
1265.93	13.36	0.03	-0.75	new	P3	
1265.94	13.34	-0.02	-0.95	new	P3	
1267.94	14.46	0.19	-0.98			
1280.05	14.35	0.30	-1.09			
1295.90	12.60	0.03	-0.53	14	A	
1295.99	12.49	0.07	-0.59	14	A	
1296.00	12.62	-0.05	-0.58	14	A	
1296.96	13.09	-0.38	-0.67	14	A	
1331.89	12.38	-0.18	-0.56	16	A	
1345.88	13.68	0.03	-1.10	new	P4	
1352.88	14.78	-0.21	-1.12			
1357.90	14.39	-0.04	-1.10			
1390.93	12.76	-0.07	-0.91	19	S	
1483.06	14.69	-0.12	-			
1829.13	12.80	0.07	-0.56	40	B	
1983.17	13.10	-0.13	-0.62	44	A	
2043.88	14.73	-0.19	-1.20			
2044.88	14.29	0.48	-1.34			
2048.93	12.51	-0.04	-0.44	47	D	
2049.98	12.79	0.10	-0.82	47	D	
2061.89	13.25	-0.03	-0.73	new	P5	
2062.00	13.67	0.32	-0.98	new	P5	
2071.93	13.45	0.07	-0.54	48	B	mean of 2 sets
2072.91	13.20	0.11	-0.68	48	B	
2083.97	12.25	-0.08	-0.66	49	S	mean of 2 sets
2084.89	12.27	0.07	-0.85	49	S	
2099.90	13.80	0.18	-0.89	50	B	
2304.06	13.33	0.02	-0.58	59	A	
2304.18	13.35	0.14	-0.60	59	A	
2488.84	11.92	-0.17	-0.79	70	S	
3042.93	11.65	-0.03	-0.55	new	S	} visual data not yet published
3042.98	11.76	-0.09	-0.59	new	S	
3043.05	11.80	-0.05	-0.65	new	S	
3043.12	11.82	-0.03	-0.61	new	S	

TABLE 1 (Cont'd)

<u>J.D. 2,440,000 +</u>	<u>V</u>	<u>B - V</u>	<u>U - B</u>	<u>Outburst</u>	<u>Comments</u>
3043.17	11.64	-0.07	-0.63	new S	} May be new max. or end of previous S
3043.99	11.79	-0.18	-0.78	new S	
3050.06	12.34	-0.02	-0.61		
3050.07	12.27	-0.02	-0.64		
3051.99	12.65	-0.22	-0.79		
3070.93	15.10	-0.25	-1.05		
3097.91	13.47	0.06	-0.63	new	

TABLE 2

WHITE-LIGHT MONITORING TIMES FOR WX HYDRI

<u>J.D. 2,440,000 +</u>	<u>At Start</u>	<u>At Finish</u>	<u>Ref</u>	<u>Outburst Status</u>	<u>Observers</u>	<u>Comments</u>
2043.88	2044.00	Fig 1	Faint	MA, Ft.		
2044.88	2045.10	Fig 1	Faint	MA, Ft.		Just prior max. 47
2049.98	2050.03	Fig 3	Maximum 47	Ft.		
2061.89	2062.00	Fig 3	Maximum P5	MA, Wk.		
2073.90	2073.98	Fig 3	Maximum 48	Wild, Dunsbee.		
2304.06	2304.14	Fig 3	Maximum 59	Wk, Ft, Bj, Oc.		
3042.93	3043.17	Fig 2	New Supermax.	Wk, MA, Ft.)		Superhumps observed
3043.98	3044.02	Fig 2	New Supermax.	Wk, MA.)		
3050.02	3050.09	Fig 2	New Supermax.	Wk, MA.)		
3070.93	3071.05	Fig 1	Faint	Wk, MA.)		

TABLE 3

SUPERHUMP TIMES AND INTENSITY DETAILS FOR WX HYDRI

<u>H.J.D.</u> <u>2,440,000 +</u>	<u>Peak White Intensity</u>	<u>Intensity Rise</u>	<u>Intensity Fall</u>	<u>Comments</u>
3043.00054	4600	1500	1400	sharp peak
3043.07736	4600	1400	1400	flat top
3043.15487	4700	1500	not observed	flat top
3044.01581	3000	700	not observed	cloud on descent
3050.05954	1800	200	200	may not be superhump.

TABLE 4

SUPERMAXIMA TIMES AND O-C VALUES FOR WX HYDRI

<u>Maximum Ref No.</u>	<u>J.D.</u> <u>2,440,000 +</u>	<u>O-C</u> <u>Period 195.4 d</u>	<u>O-C</u> <u>Period 140.2 d</u>	<u>Comments</u>
1	1069.0	0	-21.0	} Times from Bateson (1976).
10	1216.9	-47.5	-13.3	
19	1382.5	-77.3	12.1	
38	1667.1	11.9	16.2	
43	1917.8	67.2	-13.4	
49	2076.9	30.9	5.5	
55	2241.8	0.4	30.2	
70	2487.9	51.1	-4.1	
72	2632.0	0	-0.2	
-	2914	86	1	
-	3048	25	-5	} Approximate times from recent Auckland data.
-	3175	-43	-18	

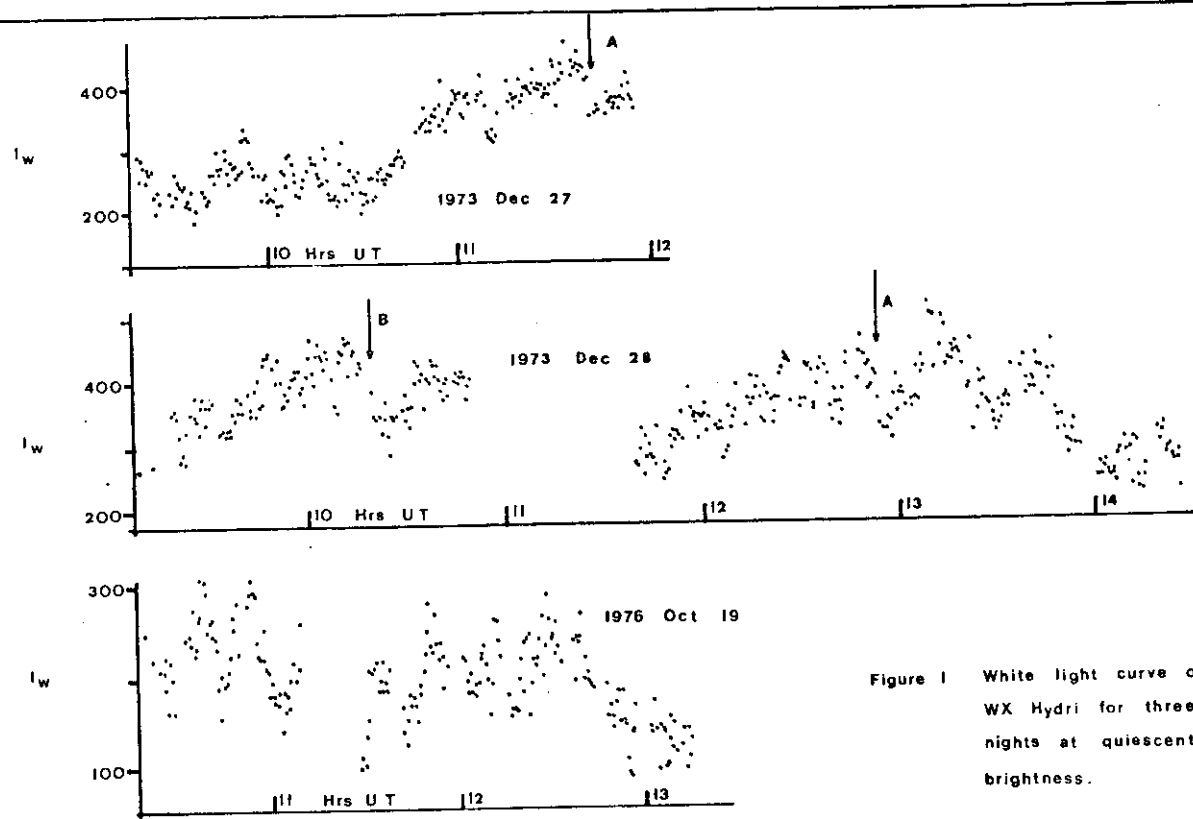


Figure 1 White light curve of WX Hydri for three nights at quiescent brightness.

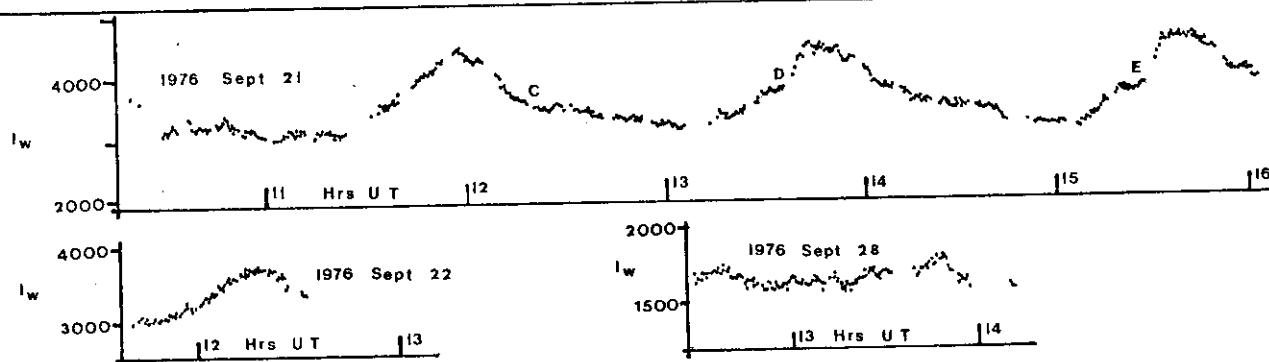


Figure 2. White light curves of WX Hydri during the 1976 September supermaximum.

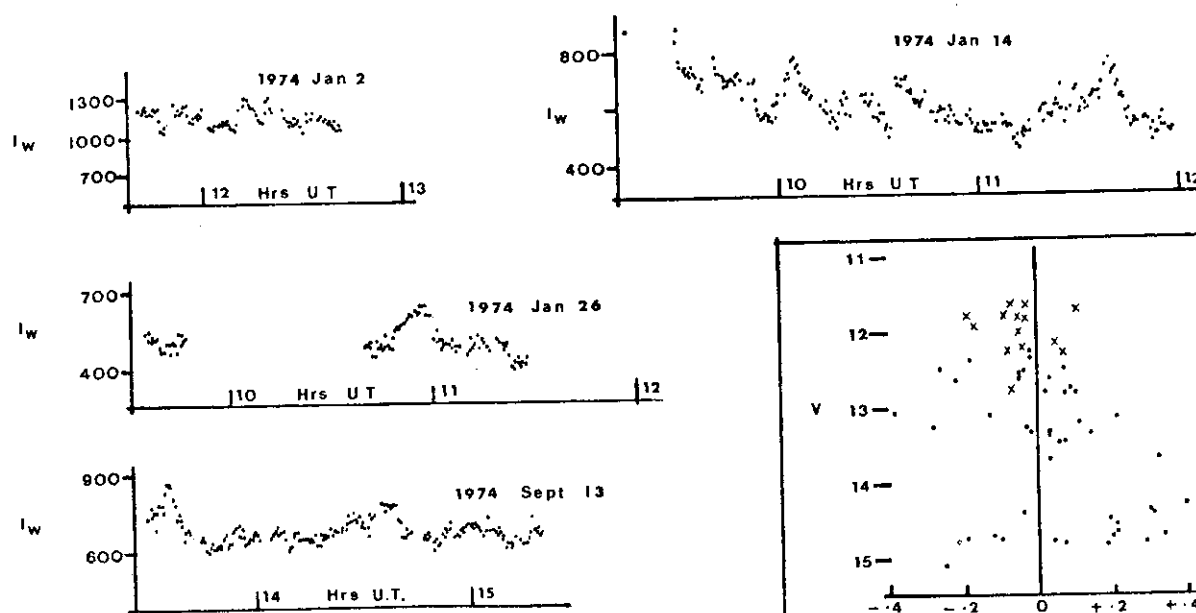


Figure 3. White light curves of WX Hydri for 4 nights during various outbursts.

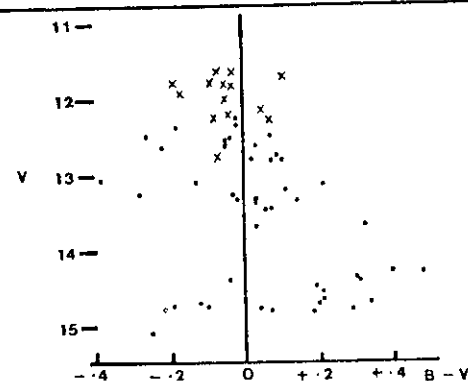


Figure 4. B-V Colour Variations with Changing V Magnitude of WX Hydri.

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SUMMARY: UBV and unfiltered photometry of the dwarf nova VW Hydri during normal outbursts is presented. These outbursts show consistent colour changes and a pause on the rise to maximum brightness.

A standard light curve representative of the brighter outbursts is presented and compared with outbursts of lower amplitude.

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1. INTRODUCTION

The dwarf nova VW Hydri has been observed extensively at the Auckland Observatory using the 50cm Edith Winstone Blackwell Telescope and associated photo-electric equipment. In this paper we present a summary and analysis of observations of the normal short outbursts made during the period 1969-1977.

The photometer uses an unrefrigerated EMI 9502 photomultiplier tube and standard UBV filters. The signal is transformed to a digital output and recorded manually. A capacitor - integrating system was used up to 1974, when the present pulse counting system was installed. For calibration we use the standard stars in the E regions Cousins and Stoy, (1963) Cousins (1973) and the techniques outlined by Hardie (1962).

The main comparison star is that marked 'e' on chart number 350 of Bateson et al (1976) for which we have derived values of:

$$V = 9.40; \quad B-V = +0.69; \quad U-B = +0.30$$

All UBV observations are reduced to the standard system using the method outlined by Hardie, and the unfiltered white observations have been corrected for first order extinction effects.

Some residual extinction effects still remain in the latter but these should not affect our conclusions. Unless stated otherwise the accuracy of a single observation can be expected to be:

$$\delta V = \pm 0.02; \delta B-V = \pm 0.02; \delta U-B = \pm 0.03; \delta \text{unfiltered} = \pm 0.02$$

The general behaviour of VW Hyi has been outlined by Bateson (1977) from an analysis of the visual observations. In this paper we are concerned only with the normal outbursts, which reach a peak magnitude between $V=9.0$ to $V=10.5$ and last 4 days. All of our observations have been compared with the visual data to ensure that no supermaximum observations have been included.

2.0 COMPOSITE LIGHT CURVES

At best we can observe $\sim 30\%$ of any one outburst from Auckland. A composite light curve constructed from observations of all normal outbursts might be expected to overcome this problem. However it encounters difficulty with the differing amplitudes and varying rates of evolution of the outbursts.

To avoid this difficulty we have selected a number of the brightest normal maxima, which appear to be very similar in behaviour, and constructed a composite light curve from observations made during these outbursts. The selection criteria are:

(1) The peak brightness must lie within the range $V=9.2$ to $V=9.5$. Of the 4 outbursts selected, the visual observations of the V.S.S. R.A.S.N.Z. indicate a peak magnitude of 9.3v in three cases. The reasons for including the fourth outburst, that of 1969 December 6 peaking at 8.8v, are discussed in Section 3.2.

(2) Observations must have been made on two or more nights during the outburst to allow a sufficiently accurate determination of the state of evolution of the outburst at the times when individual observations were made.

Although 80-90% of our observations are excluded by these criteria, a check of the remainder, using the visual observations to determine the approximate state of evolution of the outburst, indicates that none conflict with the standard light curve presented. Positions determined in this way are subject to an error of $\pm 3-9$ hours, which is insufficiently accurate for anything other than a general check of the standard light curve.

3.0 THE GENERALISED LIGHT CURVE OF VW HYDRI

Those observations which comply with our selection criteria are listed in Table 1. They are also shown graphically in Figure 1, which presents the standard light curve which we believe is representative of the fast, bright normal outbursts of VW Hyi. The main features are discussed in the following sections.

3.1 COLOUR CHANGES AND THE EVOLUTION OF THE OUTBURST

At minimum light the magnitude and colours show continuous small variations. Approximate mean colours and magnitude derived from several hundred observations are:

$$V = 13.7 \text{ to } 14.3 \quad B-V = +0.1 \quad U-B = -0.9$$

Onset of the outburst appears to be sudden, with a rise of two magnitudes in eight hours or less. During this initial brightening the system becomes redder in both colours. The rise terminates just below twelfth magnitude, when typical measures of VW Hyi show:

$$V = 12.15 \quad B-V = +0.45 \quad U-B = -0.35$$

There is a pronounced pause in the brightening at this stage. In the bright maxima this lasts about 2 hours, during which time the system continues to redden slowly. The pause appears to begin fairly abruptly. The second rise, which terminates the pause, is quite sharp and its beginning can usually be determined to ± 10 minutes. Apart from the observations presented parts of the pause have been observed on 6 other occasions photo-electrically. Once the second rise begins B-V rapidly becomes bluer, but the U-B colour continues to redden for several more hours. Peak brightness of the system is reached in a little more than 24 hours. Colours and magnitudes at maximum are:

$$V \sim 9.45 \quad B-V \sim -0.05 \quad U-B \sim -0.55$$

There is no indication of any pronounced stay at maximum and the rise appears to slow, then go through a smooth transition into decline. The system is bluest 18 - 30 hours after maximum, when B-V reaches ~ -0.12 . The U-B colour recovers more slowly from the initial reddening and an intensity of $U-B \sim -0.80$ is reached 24-36 hours after maximum. This colour becomes even more intense in the late stages of the outburst before returning to normal. Whilst the declining light curve has not been observed in as much detail as the rise none of the observations indicate that the decline is anything other than a smooth fade to normal brightness.

3.2 THE BEGINNINGS OF THE INITIAL RISE

We have not been able to observe this in much detail and only the observations of 1969 December 6 and 1976 April 1 allow us to set an upper time limit of 8 hours for the duration of the initial rise.

The former observations lie outside our first criterion, but comprise the only occasion when we have observed VW Hyi at minimum and on the rise during the one night.

The initial rise has been very poorly observed by the visual observers and we strongly suspect that a rise time considerably less than 8 hours may be more correct.

3.3 THE PAUSE ON THE RISE.

Using Bateson's (1977) value of ~ 0.9 days for a rise of five magnitudes we derive an average rate of rise of ~ 0.4 magnitude/hour.

During the initial rise the system brightens by 0.25 magnitudes/hour or more. In the region between magnitudes 11 and 10 rise rates of up to 0.5 magnitudes/hour have been observed. Near twelfth magnitude these rates do not hold true and there is a quite definite pause, which separates the reddening of the system from the subsequent 'blueing'. In Figure 2 there is no increase in brightness between 1045 UT and 1200 UT. In Figure 3 the V light curve shows no increase in brightness for a period of 1.3 hours.

We have not been fortunate enough to observe the star on a continuous run up to, through, and away from this pause. Apart from the photo-electric observation mentioned in Section 3.1 it has been observed visually on several occasions. We also present an analysis of the visual observations of the rising part of 17 well observed outbursts between JD 2,438,300 and 2,440,755.

Magnitude Interval	13.0 -12.1	12.5-12.1	12.0-11.6	11.5-11.1
No. Observations	14	35	10	9

These appear to indicate that the star takes $3\frac{1}{2}$ times as long to transverse the half-magnitude interval centred upon 12.3 as each of the next two brighter half-magnitude intervals.

3.4 DEPARTURES FROM THE STANDARD LIGHT CURVE

The standard light curve is a good fit to the brightest normal maxima. The behaviour of the fainter ones is less consistent but can be generalised to some extent. The main features remain but the time scales and amplitudes vary considerably. As a function of decreasing peak brightness it appears that:

(1) The pause after the initial rise occurs at a fainter level, as low as $V = 12.8$. The amplitude of the initial rise appears roughly proportional to the final peak brightness.

(2) The pause lasts longer, in some small amplitude outbursts well over 12 hours.

(3) The system takes rather longer to reach peak brightness. The rate of decline may not be greatly affected.

3.5 COLOUR CHANGES IN FAINTER OUTBURSTS

The colours at peak brightness differ little between outbursts, although there is a spread of $1\frac{1}{2}$ magnitudes in brightness. The colours on the pause are also similar.

There appears to be some tendency for the brighter outbursts to be fractionally bluer at peak, and a little less red at the pause.

The intermediate colour changes are proportional to the scale of the outburst, which means that a low amplitude outburst will be more highly evolved and thus bluer at $V=11$ than a bright outburst.

4.0 THE REMAINING OBSERVATIONS.

Apart from the UBV observations used to determine the standard light curve we have made a large number of UBV observations, often in the form of monitoring runs, and more than 50 hours of monitoring in unfiltered white light. In most cases where we have been monitoring in white light UBV observations have been interspersed at regular intervals. There is far too much data to present in this publication. We present the following:

Random UBV observations and UBV observations during monitoring runs not shown in the figures are presented in Table 2. Representative monitoring runs are shown in Figures 2-5 (Note that the scales differ considerably).

Figure 2 shows two hours' observations in white light obtained during the medium brightness outburst. VW Hyi has brightened and reddened, but an orbital hump with the correct phase is observed. The star was observed as the initial rise lost impetus and the pause began.

On 1976 April 1, VW Hyi was detected at dusk (0730 UT) and estimated visually at thirteenth magnitude and presumably rising. Cloud interfered before darkness allowed a measure but cleared again at 1045 UT. At this stage the star was visually estimated at ~ 12 magnitude. Figure 3 shows four hours' monitoring in white light and UBV following this.

The main features include a well defined departure from the pause at 1220 UT. The B-V colour begins to become bluer shortly after this. U-B, however, continues to redden during the whole period. The observations show more than normal scatter due to the low altitude of the star, and possibly some atmospheric instability. There is some evidence of the orbital hump, both on the pause and rise, but the shape is unusual.

In Figure 4 we show observations in white and UBV obtained during $4\frac{1}{2}$ hours on 1975 January 6. There is a gap of $1\frac{1}{2}$ hours due to cloud. The vertical scale in white only has been compressed by a factor of 10. The small amplitude outburst followed immediately the 1974 December supermaximum. Observations commence just after the final rise had begun and continued until B-V had recovered substantially. At this time the U-B colour had only just passed its most red stage.

Figure 5 shows four series of white light observations near maximum. The horizontal scale differs from Figure 4 by a factor of 2. On 1974 August 30, the star rose from $V = 9.89$ to $V = 9.59$ during the observing period and on 1975 October 31 from $V = 9.61$ to $V = 9.50$. The peak had been reached in V on this latter night, although the white light curve continued to rise because of the increasing blueness of the system. The next curve shows observations from the following night, when VW Hyi declined from $V = 9.85$ to $V = 10.05$. Finally we present observations on 1977 June 6 in the magnitude range $V = 10.72$ to $V = 10.90$.

This series of observations shows that the brighter parts of the normal outbursts are relatively smooth, with no indications of the normal orbital humps or the enigmatic humps associated with supermaxima.

5.0 CONCLUSION

In this paper it has been our intention to define the general behaviour of VW Hyi during a normal outburst in the hope that it may provide a better observational test for models of dwarf nova outbursts. This behaviour comprises -

An initial rise of ~ 2 magnitudes with accompanying reddening, terminated by a pause near twelfth magnitude.

A subsequent rise to final peak brightness, during which the system becomes very blue.

A smooth transition into the decline, and a gradual return of both B-V and U-B colours to normal.

The rise to maximum is complex and appears to comprise two different stages. Most observations are made in white light and often do not begin until the star has reached magnitude 12, which explains why these features have remained undetected.

The existence of two distinct stages in the brightening, suggest a cause-effect relationship and may help determine the controversy relating to the nature of the event which initiates the dwarf nova outbursts. Of particular interest is the mass flow instability model summarised by Bath (1975). Are we seeing, in the initial brightening of VW Hyi, the observational effects of the sudden loss of material by the red component of the system?

Unfortunately Bath's model does not discuss the colour changes in the initial stages of an outburst. The writers would hesitate to suggest that VW Hyi offers conclusive proof of this model. It does indicate, however, that the most important time to observe these outbursts may be in the first few hours of the rise, or perhaps even before the system begins to brighten.

Krzeminski (1965) noted a 'total reddening of the system' in the early stages of the outbursts of U Gem. No similar comments appear to have been made about other dwarf novae. Perhaps studies of some of the more active stars such as VW Hyi would show that the initial features of the outburst of this star are not confined to this system alone.

ACKNOWLEDGMENTS.

We wish to thank the Trustees of the Auckland Observatory for the use of the Edith Winstone Blackwell telescope and associated equipment; the University of Auckland for the use of computer facilities and C. Venimore, O.R. Hull and B. Menzies for early advice of the start of outbursts on many occasions; J. Beuning, S. Clements, G. Freeth and Mesdames J. Aldiss, L. Beuning and D. Paterson for assistance with the observations; and G. Christie for help with the computer reductions.

We are deeply indebted to F.M. Bateson and J.A.J. Whelan for discussions and advice.

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TABLE 1

UBV OBSERVATIONS SHOWN ON STANDARD LIGHT CURVES

<u>J.D.</u>	<u>Elapsed</u> <u>Time</u>	<u>V</u>	<u>B-V</u>	<u>U-B</u>	<u>J.D.</u>	<u>Elapsed</u> <u>Time</u>	<u>V</u>	<u>B-V</u>	<u>U-B</u>
2440000+					2440000+				
0561.9347	0h 00	14.00	+0.08	-1.04	2869.9910	9.17	12.13	+0.49	-0.32
.9368	0 03	13.86	+0.06	-0.93	2870.0125	9.48	12.13	+0.45	-0.36
0562.1431	5 00	12.79	+0.30	-0.50	.0208	10 00	11.98	+0.50	-0.26
2351.9590	22 01	9.61	+0.00	-0.41	.0417	10 30	11.88	+0.44	-0.25
2352.0028	23 04	9.57	-0.02	-0.44	2870.0635	11 00	11.86	+0.49	-0.32
2352.0431	24 02	9.53	-0.02	-0.48	2870.0833	11 30	11.79	+0.47	-0.26
.0653	23 34	9.52	-0.01	-0.50	.1042	12 00	11.70	+0.39	-0.24
.0840	25 01	9.50	-0.02	-0.53	.1181	12 20	11.58	+0.36	-0.06
.1035	25 29	9.51	-0.02	-0.52	2871.8033	52 54	10.29	-0.12	-0.82
2352.1167	25 48	9.50	-0.03	-0.51	2891.8160	29 35	9.48	-0.14	-0.62
2353.0319	47 46	10.02	-0.14	-0.78	2891.8736	30 58	9.50	-0.09	-0.66
.0486	48 10	10.03	-0.10	-0.77	.8944	31 28	9.50	-0.09	-0.56
.0660	48 35	10.05	-0.11	-0.79	2892.8194	53 40	10.39	-0.14	-0.81
2354.9313	93 21	13.33	+0.01	-0.82	.8632	54 43	10.43	-0.20	-0.83
2869.9542	8 24	12.13	+0.49	-0.47	2892.9188	56 03	10.45	-0.11	-0.81
2869.9722	8 50	12.19	+0.46	-0.24					

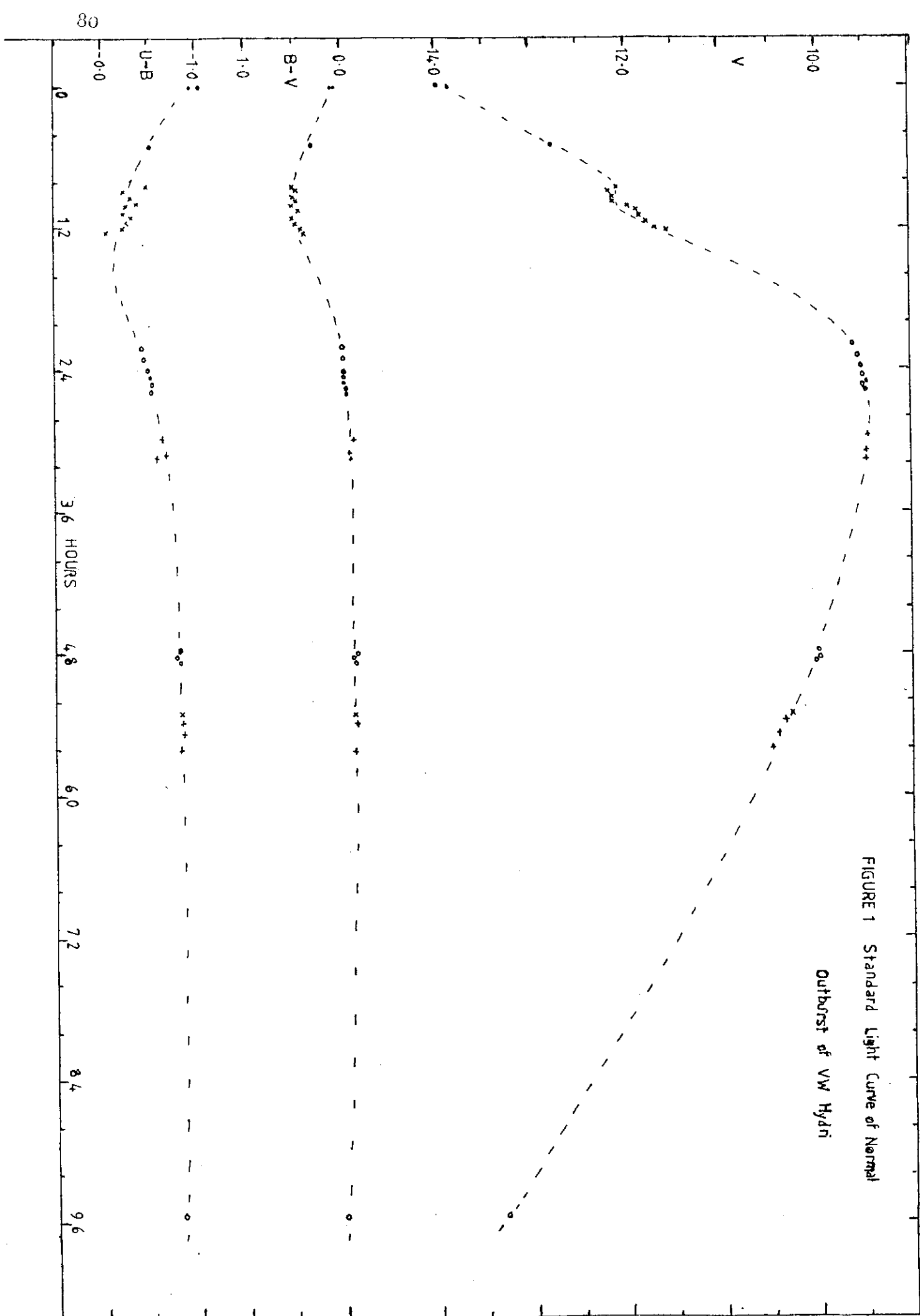
- NOTES :** (1) The column 'Elapsed Time' shows in hours and minutes the estimated elapsed time since the beginning of the outburst. We estimate that this is accurate to ± 1 hour, subject to the uncertainty discussed in Section 3.2.
- (2) The observations on JD 2240561 - 562 were part of a very bright outburst. Other observations on JD 2440562-563 are not included.
- (3) Observations were made on JD 2442890 when VW Hydri was on the pause, later rising. They are not plotted but are listed in Table 2.

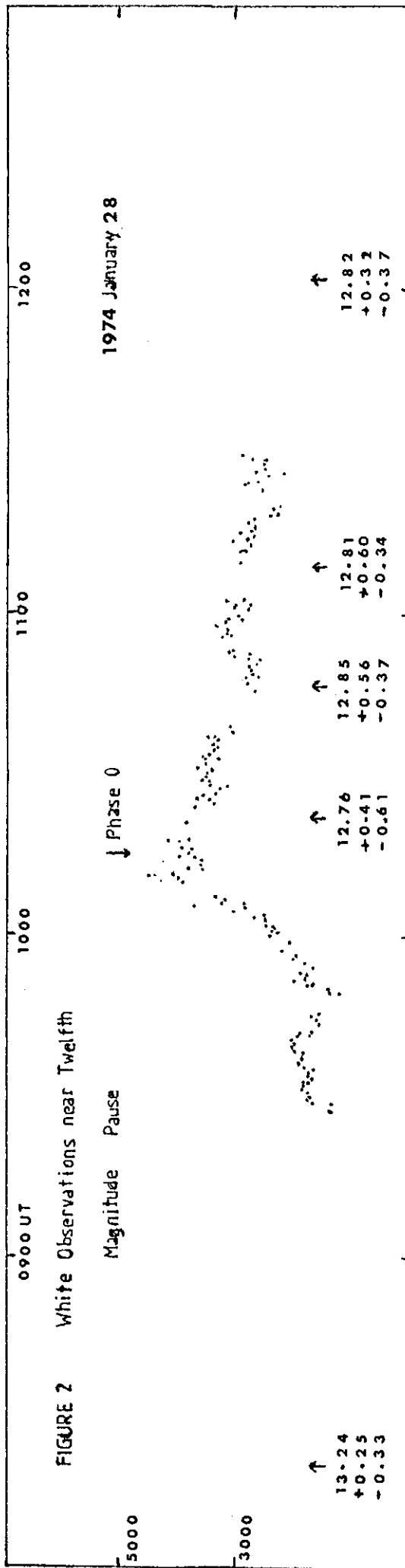
TABLE 2
RANDOM UVV OBSERVATIONS OF VW HYDRI

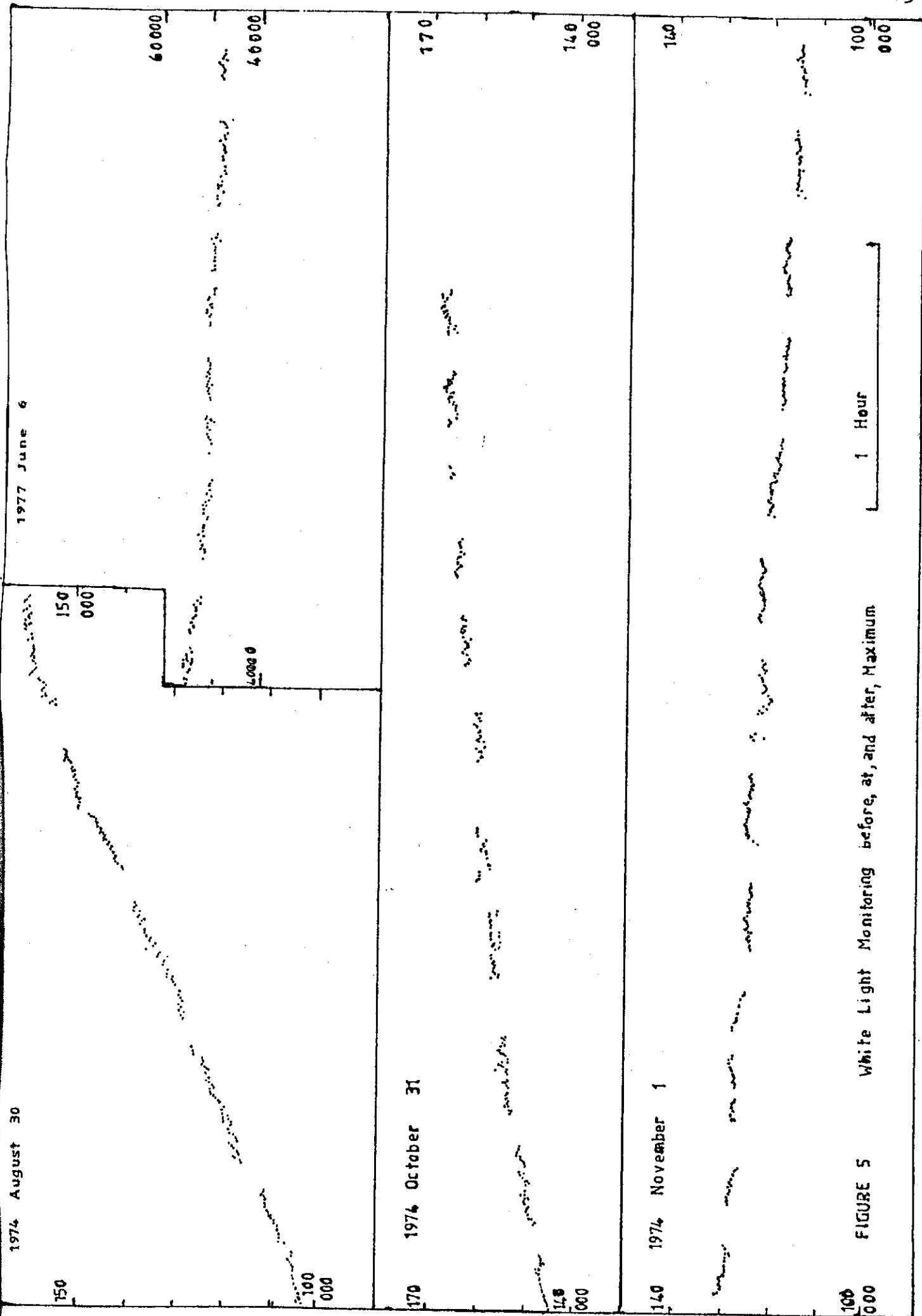
<u>JD</u>	<u>V</u>	<u>B-V</u>	<u>U-B</u>	<u>Notes</u>	<u>J.D.</u>	<u>V</u>	<u>B-V</u>	<u>U-B</u>	<u>Notes</u>
2441081.8243	10.57	-0.07	-0.77		2442377.9924	10.43	+0.01	-0.36	2
1258.0139	12.49	+0.50	-0.38		2378.0063	10.40	+0.01	-0.39	2
1259.0000	9.23	-0.11	-0.71		.0188	10.38	-0.00	-0.41	2
1610.8771	9.43	-0.11	-0.80	1	.0313	10.34	-0.00	-0.41	2
1610.8813	9.44	-0.11	-0.81	1	2378.9201	11.12	-0.11	-0.80	3
1610.9563	9.49	-0.12	-0.78	1	2378.9368	11.14	-0.12	-0.81	3
.9667	9.49	-0.12	-0.79	1	2535.8424	12.85	+0.54	-0.24	4
1610.9757	9.49	-0.13	-0.78	1	2535.8493	12.93	+0.62	+0.54	4
1611.0056	9.50	-0.13	-0.82	1	2536.7882	12.10	+0.21	-0.06	4
1611.0118	9.51	-0.13	-0.82	1	2536.7972	12.06	+0.16	-0.04	4
1611.0736	9.57	-0.13	-0.79	1	2536.8042	12.04	+0.19	-0.10	4
.0813	9.58	-0.13	-0.78	1	.8094	11.99	+0.19	-0.19	4
.1069	9.60	-0.12	-0.82	1	.8118	12.02	+0.14	-0.17	4
1611.1146	9.60	-0.13	-0.81	1	.8132	11.99	+0.19	-0.15	4
2051.8861	9.91	-0.04	-0.45		2536.8743	11.55	+0.07	-0.18	4
2107.9194	9.59	-0.13	-0.81		2890.9076	12.31	+0.49	-0.09	5
2330.9840	11.76	+0.37	-0.09		2890.9646	12.08	+0.51	-0.33	5
2377.9215	10.66	+0.08	-0.26	2	2891.0035	11.89	+0.51	-0.33	5
.9375	10.62	+0.03	-0.27	2	3079.8451	9.92	-0.04	-0.32	
2377.9535	10.60	+0.03	-0.31	2	3079.8965	9.61	-0.02	-0.42	
2377.9792	10.50	+0.02	-0.35	2					
2377.9660	10.55	+0.04	-0.32	2					

- NOTES : (1) A bright outburst not shown in the figures. Means of 5 observations.
 (2) A medium amplitude outburst not shown in the figures. Means of 5 observations.
 (3) As for 2, but means of 3 observations.
 (4) A very slow, low amplitude outburst. Note the unusual colours.
 (5) See Note 3, Table 1.

FIGURE 1 Standard Light Curve of Normal
Outburst of VW Hydri







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SUMMARY: A summary of 1300 visual observations of *ℓ* Car for the interval 1970-1976 is presented. The mean light curve gives a range of 3.4^m_v to 4.3^m_v ; M-m 0.34^p . Compared to the epoch of 2435619.7 + 35.5412 (Kukarkin 1969) the O-C residuals are essentially zero.

...

1. INTRODUCTION

According to Kukarkin (1969) *ℓ* Car is a classical Cepheid of the C type with a period of 35.5412 days; a magnitude variation in (B) of 4.33 to 5.51, with a M-m (the time of brightness increasing) of 0.38 P ($13\frac{1}{2}$ days), and a spectral range from F8 to K0.

2. OBSERVATIONS

This paper is a summary of some 1300 visual estimates of Car obtained between 1970 and 1976 by members of the Variable Star Section of the R.A.S.N.Z. The distribution of the estimates in date was rather asymmetric as seen in the following table:

Year	No. of est.	Year	No. of est.
1970	60	1974	222
1971	85	1975	409
1972	74	1976	333
1973	165	Total	1348

Since more than 50% of the estimates were made during the last two years, most of the summary conclusions must reflect this distribution.

During the observed interval, 67 maxima were predicted. Of these 47 were observed, but only 18 well enough for useful period analysis.

3. DISCUSSION

Figure 1 is a light curve for the interval covered by these data. The dotted part of the curve contains too few estimates to determine the curve; the thin solid line contains enough to get a fair idea where the curve should be, while the heavy solid line contains enough estimates for most of the analysis of interest. The numbered maxima are those used for a period analysis. The numbered maxima; the JD of that maximum; the number of maxima since the epoch given by Kukarkin (1969), and the indicated period are listed in the following table:

Max	JD	N	Period	Max	JD	N	Period
1	2440631.5	141	35.5447^d	10	2442549.5	195	35.5374^d
2	1775	172	35.5541	11	2622	197	35.5447
3	2123	183	35.5371	12	2659	198	35.5520
4	2159	184	35.5397	13	2696.5	199	35.5618
5	2268	187	35.5524	14	2730	200	35.5515
6	2301	188	35.5338	15	2765	201	35.5488
7	2445	192	35.5484	16	2835	203	35.5433
8	2479	193	35.5404	17	2872	204	35.5505
9	2515	194	35.5428	18	2907	205	35.5478
					MEAN		35.5465

Assuming equal weights: S.D. = 0.007

From these data it is difficult to determine a maximum date with an accuracy of better than the nearest day. The three maxima (Nos. 1, 10, and 13) given to 0.5 means merely that the star was at the same magnitude on two adjacent dates rather than they were known to a higher accuracy than the rest.

The mean curves were treated in the following manner. All estimates were phased in both "days before" and "days after" the nearest maximum as predicted from the epoch given by Kukarkin (1969): $2435619.7 + 35.5412E$. All estimates thus phased were collected by date in the following one day groupings: 0.0 to 1.0; 1.1 to 2.0; 2.1 to 3.0, etc., and 0.0 to -1.0; -1.1 to 2.0; -2.1 to 3.0, etc. Each estimate is therefore used twice, once for the "plus" curve and once for the "minus" curve. Comparing the "plus" and "minus" curves thus becomes an internal consistency check. The sums of all the data in "each day" were taken and an arithmetic mean derived assuming equal weight to all estimates. Table 1 lists the derived means "M" followed by the number of estimates "n" going into each mean. To check for a possible O-C shift (observed date of maximum minus calculated date of maximum) during the interval covered by the observations, a weighted daily mean of the 1970-1973 data was derived and compared to a similarly derived weighted mean of the 1974-1976 data. This is illustrated in Figure 2 where "o's" indicate 1970-73 weighted means and "x's" indicate 1974-76 weighted means, and both are tabulated in Table II. An example of how one was derived follows: For +2.5 days, 1970-73 one has $(3.68 \times 4) + (3.55 \times 2) + (3.45 \times 2) + (3.60 \times 4) = 43.12/12 = 3.59$. The "total" mean curve (Figure 3) is a weighted mean of the two (1970-73 and 1974-76) weighted means, derived in the same manner as the above illustration, and represents a weighted average curve for the whole data set. Because of the assymetric data distribution this curve reflects largely what the star did during the last part of the observed interval.

It is interesting to note in Figure 2 that the maximum indicated by "o's" comes one day earlier than that indicated by "x's". This is indicative of a slight lengthening of the period during the observed interval. However, before making grandiose conclusions about this, other easily obtainable references should be checked. Note from the earlier period analysis we derived a mean period of 35.5465. Kukarkin (1958) gives 35.556; Kukarkin (1969) 35.5412; Tsarevsky (1966) 35.5354; radial velocities by Kucwicz and Jaschek (1960) 35.5374 and Kukarkin (1974) 35.5225. Ample evidence exists that period fluctuations of the order of 0.02 are rather common in Car so little importance should be attached to period changes significantly less than 0.02.

4. CONCLUSIONS.

The total mean curve of this data set yields a M-m of ~ 12 days (0.34P); a range of 3.4v to 4.3v, and an O-C of essentially zero. Kukarkin (1969) gives M-m of 0.38P, but Kukarkin (1974) gives 0.26P. Our data tends to confirm the former. Also Kukarkin (1974) gives a range in V of 3.38 to 4.10. One must be very careful comparing (v) to (V) as they are not equal at all (contrary to the belief of many). Large variation in colour sensitivity exists between individual observers, so our (v) must be a function of several variables (observers' colour factor, how many data points were contributed by what observers on what part of the curve, the observers' colour equation with spectral class, etc.). Photoelectric (V) is much better standardised and less prone to these problems.

ACKNOWLEDGMENTS

Many thanks are due the observers whose contributions made this report possible. Thanks are also due to the Director for making the material available as well as stimulating discussions on the findings.

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- Kucewicz, B., and Jaschek, C., 1960. Argentina Bull. 2.
 Kukarkin, B.V., Parenago, P.P., Efremov, V.I. & Kholopov, P.N. 1958. General Catalogue of Variable Stars. (Moscow: Nauka).
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 Kukarkin, B.V. et al. 1974. Second Supplement to the Third Edition of the General Catalogue of Variable Stars. (Moscow: Nauka).
 Tsarevsky, G.S. 1966. Inf. Bull. Var. Stars. No. 176.

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NOTE BY DIRECTOR ON PERIOD OF ℓ CAR.

Additional to the period determinations listed by Cragg the following notes will be of interest:

- Period 35.^d523 (1907; Cannon, A.J., Ann. Harv. Coll. Obs. 50, part 1)
 35.52 (1932: Prager, R., Katalog und Ephemeriden Veranderlicher Sterne fur 1933 (Berlin; F. Dummlers)
 35.57 $\pm$ 0.^d05 (1924; Cousins, A.W.J., Monthly Notices Roy. Astron. Soc., 84, 620)
 35.491 (1944; Bateson, F.M., Bull No. 1, V.S.S., R.A.S.N.Z.) This value from visual observations 1927-1940.
 35.493 (1940: Campbell, L. Popular Astron. 48, No. 6--Harv. Coll. Obs. Reprint 212)
 (This value is from visual observations of V.S.S., R.A.S.N.Z. plus those from Cousins and Baldwin and covers the years 1935-1939 but Campbell also gives the following periods:
 35.527 From observations by Innes in 1896 & Cousins in 1920.
 35.554 Period 1920 to 1934.
 35.5323 Mean period from 1896 to 1939.
 35.537 (1958. Parenago, P.P. Variable Stars 11, No. 4, p. 248.) Parenago gives Epoch Max. = J.D. 2,404,632.5 and lists the following:

E.	ΔE	O-C	P	ΔP
-350		+0. ^d 5		
	(870)		(35. ^d 536)	
+520		-0.4		^d
	100			(+ 0.011)
+620		+0.6	35.547	
	110			- 0.027
+730		-1.3	35.520	
	75			+0. 036
+805		+0.1	35.556	
	100		35.540	$\pm$ 0.031

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Figure 1

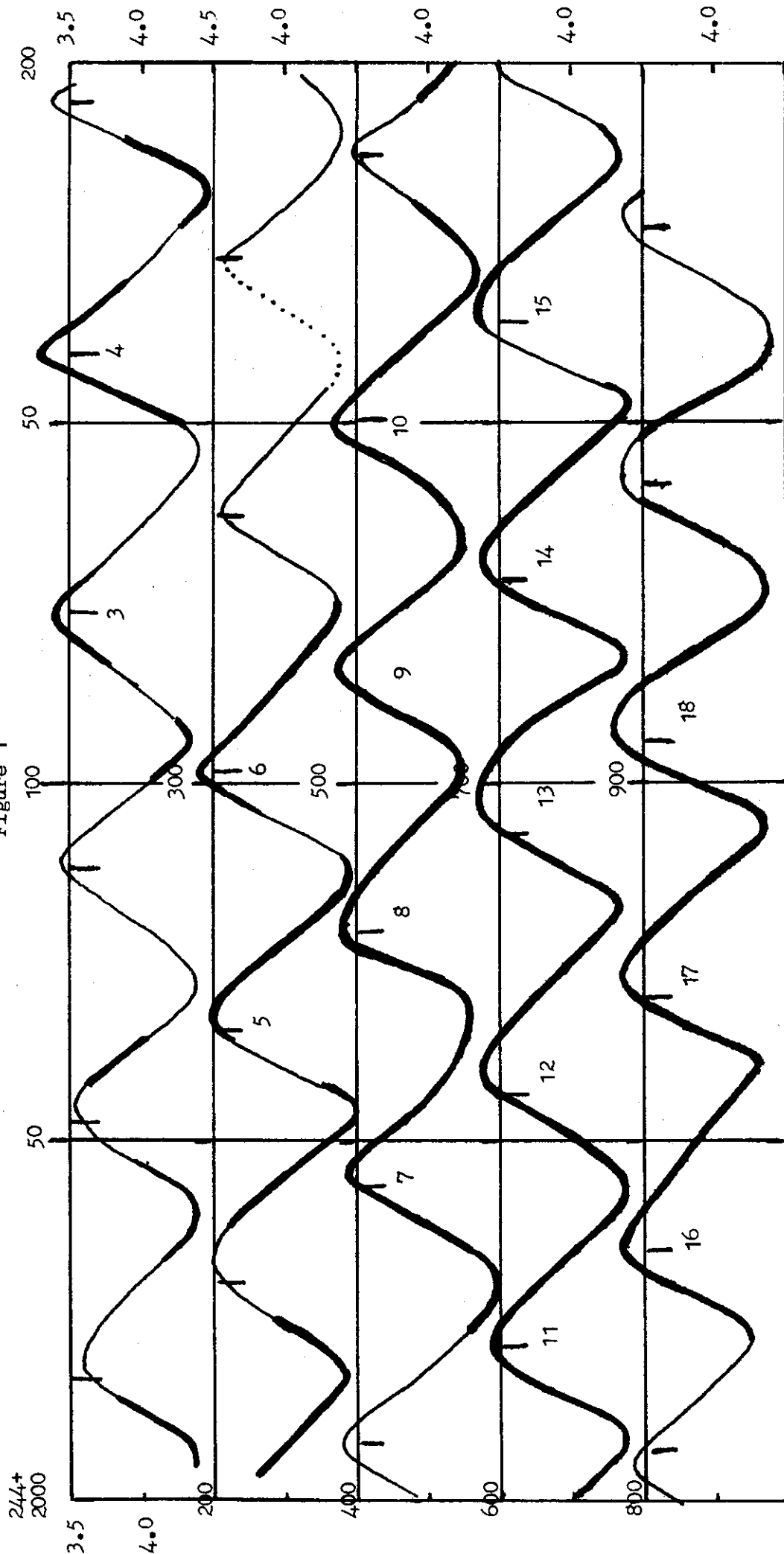
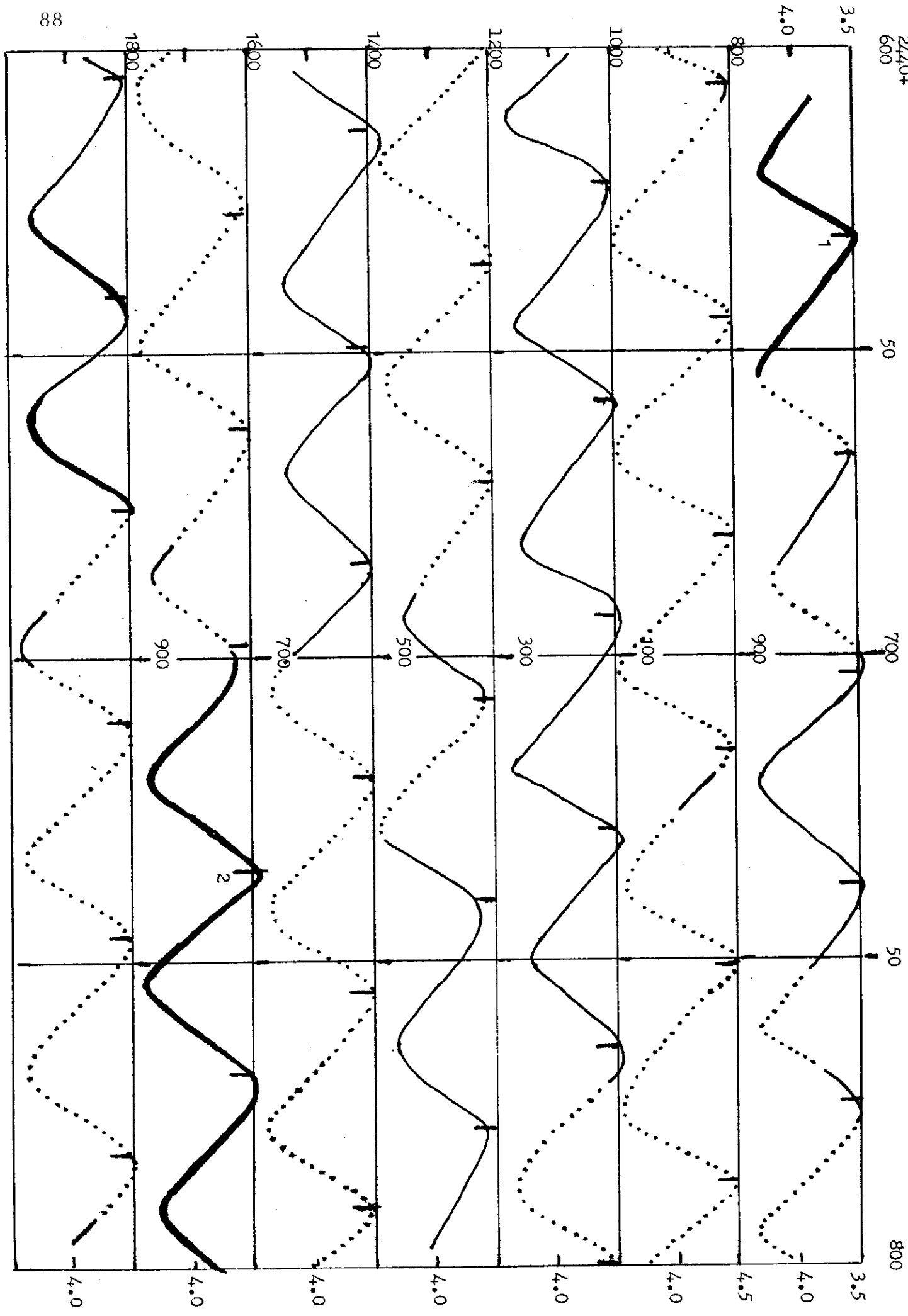


Figure 1. Light curve of 1 Carinae derived from visual observations made by members of the Variable Star Section of the RASNZ during 1970-76. A heavy line indicates a well determined part of the curve, a light line less well defined, and a dotted line too few estimates to judge. The numbered maxima were used for period analysis. Tick marks indicate predicted maxima according to GCVS (1969).

244,0+
600

Figure 1 (cont)



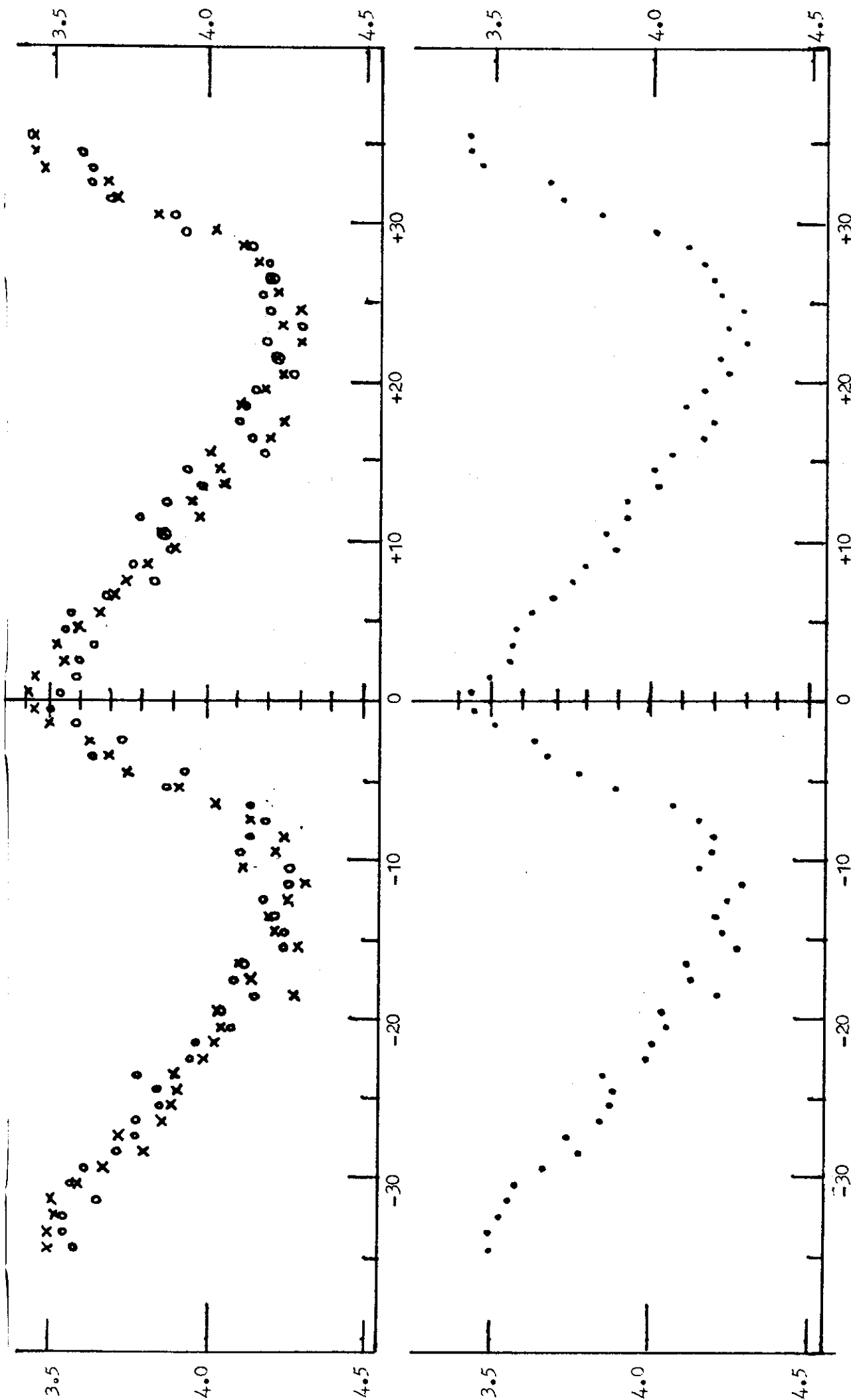


Figure 2. Weighted means light curves for 1 Carinae with "o's" indicating the 1970-73 means, and "x's" the 1974-76 means. Note the maxima of the two curves differ by one day.

Figure 3. A weighted means light curve of 1 Carinae from 1970-76. A mean range of 3.4 to 4.3 (v) with an M-m of about 12 days (0.34p) is indicated.

TABLE I (+)

	1970		1971		1972		1973		1974		1975		1976	
Days	M	n	M	n	M	n	M	n	M	n	M	n	M	n
+ 0.5	--	0	3.45	2	3.58	4	3.50	2	3.50	6	3.39	13	3.42	11
+ 1.5	3.60	2	3.50	3	3.62	5	3.60	2	3.42	4	3.48	15	3.46	10
+ 2.5	3.68	4	3.55	2	3.45	2	3.60	4	3.62	4	3.54	11	3.52	6
+ 3.5	3.70	2	3.45	2	3.50	2	3.71	7	3.48	5	3.45	11	3.64	10
+ 4.5	3.60	2	3.57	3	3.50	2	3.53	6	3.70	3	3.58	9	3.58	4
+ 5.5	3.8	1	3.58	5	3.50	2	3.53	3	3.66	7	3.90	4	3.60	14
+ 6.5	3.75	2	3.64	5	3.60	3	3.70	4	3.71	11	3.71	15	3.68	5
+ 7.5	3.75	2	3.7	1	3.85	2	3.95	2	3.89	8	3.74	7	3.52	5
+ 8.5	3.85	2	3.70	2	3.82	4	3.70	3	3.84	5	3.82	16	3.77	9
+ 9.5	3.90	2	3.9	1	3.7	1	3.90	4	3.97	11	3.83	10	3.89	9
+10.5	3.85	2	3.75	2	3.75	2	3.98	4	3.73	6	3.96	8	3.87	9
+11.5	3.8	1	3.80	4	3.67	3	3.85	4	4.00	8	4.01	7	3.96	17
+12.5	3.85	2	4.05	2	3.80	4	3.87	3	3.96	7	3.92	15	4.02	5
+13.5	3.75	2	3.9	1	3.87	3	4.13	6	3.97	12	4.08	13	4.10	11
+14.5	3.95	2	3.75	2	3.83	3	4.08	4	3.79	7	4.09	24	4.12	6
+15.5	4.32	4	3.7	1	4.1	1	4.18	5	3.84	7	4.10	6	4.09	8
+16.5	4.08	4	4.07	3	3.90	2	4.30	6	4.15	2	4.16	8	4.25	8
+17.5	3.9	1	4.0	1	--	0	4.15	6	4.38	4	4.26	12	4.02	4
+18.5	4.20	2	4.28	5	3.78	4	4.25	4	4.45	2	4.16	12	3.99	11
+19.5	4.15	2	4.20	2	4.10	2	4.15	4	4.12	4	4.16	11	4.22	12
+20.5	4.2	1	4.15	2	4.20	2	4.32	8	4.15	2	4.28	12	4.21	12
+21.5	--	0	4.3	1	4.13	3	4.30	2	4.24	9	4.30	9	4.12	10
+22.5	4.15	2	4.25	2	4.25	2	4.12	4	4.26	5	4.27	6	4.36	7
+23.5	4.2	1	4.37	6	4.4	1	4.10	2	4.37	3	4.21	7	4.23	9
+24.5	4.2	1	4.30	2	4.1	1	4.17	6	4.32	12	4.28	12	4.25	10
+25.5	--	0	4.28	4	4.1	1	4.10	5	4.23	7	4.26	18	4.10	6
+26.5	--	0	4.25	2	4.1	1	4.18	8	4.36	10	4.08	10	4.16	8
+27.5	3.4	1	4.17	3	4.0	1	4.28	11	4.17	6	4.21	14	4.04	5
+28.5	4.25	2	3.95	4	4.0	1	4.21	10	4.18	4	4.17	13	4.01	7
+29.5	4.0	1	3.85	2	3.9	1	3.94	7	4.17	6	3.93	12	4.08	4
+30.5	3.83	3	3.70	2	3.8	1	4.00	6	3.73	6	3.86	14	3.89	9
+31.5	3.6	1	3.7	1	3.68	4	3.70	3	3.73	12	3.73	10	3.70	12
+32.5	3.60	2	3.5	1	--	0	3.70	2	3.50	8	3.59	14	3.79	15
+33.5	3.6	1	3.6	1	3.70	3	3.55	2	3.44	5	3.53	13	3.39	7
+34.5	3.50	2	3.50	2	3.5	1	3.68	5	3.48	4	3.41	12	3.42	6
+35	3.4	1	3.4	1	--	0	3.4	1	--	0	3.47	6	3.30	2

TABLE I (-)

	1970		1971		1972		1973		1974		1975		1976	
Days	M	n	M	n	M	n	M	n	M	n	M	n	M	n
-35	--	0	3.4	1	3.63	3	3.6	1	3.60	3	3.39	9	3.35	6
-34.5	--	0	3.50	3	3.67	3	3.55	2	3.50	4	3.50	9	3.47	11
-33.5	3.70	3	3.50	2	3.50	3	3.45	2	3.46	5	3.50	21	3.47	6
-32.5	3.7	1	3.50	3	3.45	2	3.60	4	3.50	4	3.50	3	3.54	8
-31.5	3.65	4	3.50	2	3.45	2	3.78	6	3.64	5	3.48	15	3.48	6
-30.5	3.5	1	3.55	4	3.63	3	3.56	5	3.53	3	3.40	3	3.66	11
-29.5	3.8	1	3.63	3	3.50	2	3.62	4	3.69	10	3.73	13	3.58	8
-28.5	3.75	2	3.63	3	3.82	4	3.65	2	3.82	9	3.87	7	3.70	4
-27.5	3.77	3	3.70	2	3.73	3	3.88	4	3.76	7	3.79	11	3.62	10
-26.5	3.83	3	3.80	3	3.83	3	3.60	2	3.94	10	3.80	15	3.98	4
-25.5	4.0	1	3.8	1	3.75	2	3.90	4	3.90	6	3.88	8	3.89	12
-24.5	3.85	2	3.80	3	3.60	2	3.95	6	3.83	6	3.95	10	3.92	17
-23.5	3.80	2	3.75	2	3.70	3	3.87	3	3.98	12	3.98	4	3.73	7
-22.5	3.85	2	4.05	2	3.87	3	4.00	4	3.90	9	3.99	21	4.14	7
-21.5	3.87	3	3.9	1	3.80	3	4.12	6	3.87	7	4.07	16	4.09	8
-20.5	4.33	3	3.73	2	4.0	1	4.10	4	3.85	6	4.08	16	4.18	5
-19.5	4.20	2	3.9	1	4.1	1	4.00	4	3.90	5	4.04	5	4.10	11
-18.5	4.06	5	4.10	3	3.90	2	4.35	6	4.27	3	4.31	10	4.32	4
-17.5	4.1	1	4.15	4	3.85	2	4.12	6	4.33	3	4.18	14	4.04	8
-16.5	4.20	3	4.37	3	3.90	4	4.15	4	4.32	5	4.14	9	3.98	8
-15.5	--	0	4.1	1	4.4	1	4.25	4	4.57	3	4.27	12	4.26	16
-14.5	4.2	1	4.25	2	4.17	3	4.28	8	4.29	7	4.26	14	4.13	12
-13.5	4.15	2	4.25	2	4.13	3	4.32	4	4.26	8	4.15	4	4.14	5
-12.5	--	0	4.27	3	--	0	3.9	1	4.05	2	4.24	9	4.32	10
-11.5	4.2	1	4.40	4	4.15	2	4.17	3	4.33	6	4.46	5	4.25	13
-10.5	4.3	1	4.37	3	4.30	2	4.18	6	4.35	10	4.02	19	4.02	4
-9.5	--	0	4.20	3	4.1	1	4.06	5	4.26	9	4.23	17	4.14	8
-8.5	3.4	1	4.25	2	4.1	1	4.20	9	4.37	6	4.21	8	4.19	7
-7.5	4.2	1	4.10	4	4.0	1	4.24	11	4.22	8	4.14	18	4.06	7
-6.5	--	0	3.90	3	4.0	1	4.22	10	4.03	6	4.07	11	3.87	3
-5.5	3.90	3	3.73	3	3.9	1	3.90	8	4.20	2	3.84	13	3.98	8
-4.5	3.8	1	--	0	3.75	2	4.05	4	3.67	10	3.84	12	3.73	11
-3.5	3.60	3	3.60	2	3.68	4	3.65	2	3.76	10	3.57	13	3.85	6
-2.5	--	0	3.6	1	--	0	3.77	3	3.54	7	3.58	13	3.71	15
-1.5	3.53	3	3.50	2	3.70	2	3.65	2	3.40	4	3.53	15	3.44	10
-0.5	3.4	1	3.45	2	3.5	1	3.54	5	3.48	4	3.44	10	3.35	4

TABLE II
WEIGHTED MEANS

Days	1970 - 73		1974 - 76		Total	
	M	n	M	n	M	n
+ 0.5	3.53	8	3.42	30	3.44	35
+ 1.5	3.58	12	3.46	29	3.50	41
+ 2.5	3.59	12	3.55	21	3.56	33
+ 3.5	3.65	13	3.53	26	3.57	39
+ 4.5	3.55	13	3.60	16	3.58	29
+ 5.5	3.57	11	3.66	25	3.63	36
+ 6.5	3.68	14	3.71	31	3.70	45
+ 7.5	3.83	7	3.74	20	3.76	27
+ 8.5	3.77	11	3.81	30	3.80	41
+ 9.5	3.88	8	3.90	30	3.90	38
+10.5	3.86	10	3.36	23	3.86	33
+11.5	3.78	12	3.98	32	3.93	44
+12.5	3.87	11	3.95	27	3.93	38
+13.5	3.98	12	4.05	36	4.03	48
+14.5	3.93	11	4.04	37	4.01	48
+15.5	4.18	11	4.01	21	4.07	32
+16.5	4.14	15	4.20	18	4.17	33
+17.5	4.10	8	4.24	20	4.20	28
+18.5	4.12	15	4.11	25	4.11	40
+19.5	4.15	10	4.18	27	4.17	37
+20.5	4.27	13	4.24	26	4.25	39
+21.5	4.22	6	4.22	28	4.22	34
+22.5	4.18	10	4.30	18	4.26	28
+23.5	4.30	10	4.24	19	4.26	29
+24.5	4.19	10	4.29	34	4.27	44
+25.5	4.17	10	4.22	31	4.21	41
+26.5	4.19	11	4.20	28	4.20	39
+27.5	4.19	16	4.17	25	4.18	41
+28.5	4.14	17	4.12	24	4.13	41
+29.5	3.93	11	4.02	22	3.99	33
+30.5	3.89	12	3.84	29	3.85	41
+31.5	3.68	9	3.72	34	3.71	43
+32.5	3.62	5	3.68	32	3.67	37
+33.5	3.63	7	3.47	25	3.50	32
+34.5	3.59	10	3.43	22	3.48	32
+35	3.40	3	3.43	8	3.42	11

TABLE II
WEIGHTED MEANS

Days	1970 - 73		1974 - 76		Total	
	M	n	M	n	M	n
-35	3.58	5	3.41	18	3.45	23
-34.5	3.58	8	3.49	24	3.51	32
-33.5	3.55	10	3.49	32	3.50	42
-32.5	3.55	10	3.52	15	3.53	25
-31.5	3.66	14	3.51	26	3.56	40
-30.5	3.57	13	3.59	17	3.58	30
-29.5	3.62	10	3.68	31	3.67	41
-28.5	3.72	11	3.81	20	3.78	31
-27.5	3.78	12	3.72	28	3.74	40
-26.5	3.78	11	3.87	29	3.85	40
-25.5	3.86	8	3.89	26	3.88	34
-24.5	3.85	13	3.41	33	3.89	46
-23.5	3.78	10	3.90	23	3.86	33
-22.5	3.95	11	4.00	37	3.99	43
-21.5	3.97	13	4.03	31	4.01	44
-20.5	4.08	10	4.05	27	4.06	37
-19.5	4.05	8	4.04	21	4.04	29
-18.5	4.16	16	4.31	17	4.24	33
-17.5	4.09	13	4.15	25	4.13	38
-16.5	4.14	14	4.11	22	4.12	36
-15.5	4.25	6	4.29	31	4.28	37
-14.5	4.25	14	4.22	33	4.23	47
-13.5	4.22	11	4.20	17	4.21	28
-12.5	4.18	4	4.26	21	4.25	25
-11.5	4.26	10	4.31	24	4.30	34
-10.5	4.26	12	4.12	33	4.16	45
- 9.5	4.11	9	4.22	34	4.20	43
- 8.5	4.14	13	4.25	21	4.21	34
- 7.5	4.19	17	4.14	33	4.16	50
- 6.5	4.14	14	4.03	20	4.08	34
- 5.5	3.87	15	3.92	23	3.90	38
- 4.5	3.93	7	3.75	33	3.78	40
- 3.5	3.64	11	3.69	29	3.68	40
- 2.5	3.73	4	3.63	35	3.64	39
- 1.5	3.59	9	3.48	29	3.51	38
- 0.5	3.50	9	3.43	18	3.45	27

REPORT OF SECTION FOR YEAR ENDED 30th SEPTEMBER 1977.

OBSERVATIONS: The following visual observations have been received since the last report:

<u>OBSERVER</u>	<u>No. of OBS.</u>	<u>No. of STARS.</u>	<u>OBSERVER</u>	<u>No. of OBS.</u>	<u>No. of STARS.</u>
Adams, M.	6	6	Lumley, E.	858	27
Adcock, B.S.	554	35	Marino, B.F.	44	12
Aldam, K.	7	3	Marino, A.	1	1
Ashdown, M.	5	3	Matchett, (Dr). V.L.	542	53
Ashley, M.	66	35	Menzies, B.	513	93
Baldwin, A.J.	68	16	Morel, M.	376	33
Barsby, J.	64*	6	Moyles, (Miss) K.	51	8
Beuning, J.	9	5	Mundt, F.	15	3
Bird, R.	11	5	McKenzie, T.	6	6
Bowler, M.	8	4	Nikolau, B.	34	25
Blow, G.L.	31	24	N.W. Assn of VSO.	847	9
Bryant, K.	31	3	Overbeek, M.D.	1280*	203
Clements, S.	4	2	Paterson, (Mrs) D.	128	60
Campos, J.	86*	14	Pleever, N.	128	34
Cragg, T.	1270*	366	Prosser, G.	47*	7
Cramb, P.	14*	2	Pycroft, R.	10	2
Crossley, G.	10	8	Rowe, G.	1304	97
Curnick, (Dr). C.L.	307	54	Salisbury, J.V.	21	11
Dodson, A.W.	199	43	Searle, G.	23	5
Diefers, S.	98	12	Sharp, S.	5	2
Doran, A.	18	8	Sherman, C.	2	2
Dowle, G.	15	3	Shinkfield, R.C.	280	34
Dukes, M.	13	6	Smith, K.	9	4
Evans, R.W.	115	18	Stephenson, S.	753	49
Field, R.	86*	14	Stewart, M.	54	12
Freeth, G.	47	11	Stewart, T.	9	6
Granc, (Rev). A.A.	38	30	Sumner, B.	376	151
Giller, R.	275	65	Taylor, (Dr). N.	1719	122
Harries-Harris, E.	1046	77	Trainor, J.	34	1
Hayward, G.	108	27	Tregaskis, T.B.	993	225
Heath, D.	108	12	Tripp, H.	38	11
Hers, J.	266	151	Venimore, (Rev). C.W.	1241	80
Hull, O.R.	1253	114	Walker, W.S.G.	108	20
Johns, B.	3	2	Walmsley, J.	10	3
Jones, A.F.	1699	57	Walmsley, M.	30	5
Kent, (Mrs). K.	67	12	Williams, P.	708	57
Komorous, M.	289*	11	Wilson, A.G.	144	25
Kopinsky, M.	29	4	Winnett, R.D.	210	62
Leslie, (Mrs) A.	615	13			

* = Results also communicated to AAVSO.

TOTAL OBSERVATIONS 21,889

PUBLICATIONS: Issues during the year consisted of:

Monthly Circulars Nos. M76/9-M76/12; M77/1-M77/8

Publications No. 5 (C77)

Charts: Series 9.

Memoir No. 2 VW Hydri.

GENERAL: M.D. Overbeek moved to U.S.A. on transfer and his contribution will be missed. However, T.A. Cragg moved to Australia and will undoubtedly increase his observations of southern variables. He made far more observations than recorded above as the total of 1,270 is merely of the stars he observes specially for the Section.

A valuable contribution was made by the South African observers, who, through the co-operation of J. Hers and R. Field have made available copies of their observations communicated to the A.A.V.S.O.

During the past year, considerable attention has been given to monitoring dwarf novae, irregular and unusual variables. This has been necessary because of the current professional interest in these particular classes for which a number of investigators have specially requested our light curves. The reason for these requests is that it is necessary to have visual data for comparison and correlation with observations at other wavelengths.

To a certain extent this has meant that Mira variables have not had the same degree of attention as in the past. This position is steadily being remedied through the acquisition of a number of new members.

There is a backlog of observations awaiting publication. This is largely due to the Director devoting a considerable amount of his time to supplying visual data and light curves in response to special requests. The position will not improve during 1978 owing to the time that will be required in organisation for the IAU Colloquium No. 46, to be held at the University of Waikato at the end of November 1978. This meeting will be of great benefit to the Section by providing an opportunity for members to hear professional papers. It is a tribute to the Section that this meeting is being held in our Golden Jubilee year.

In an Annual Report it is not possible, nor desirable, to report on all activities of the past year. Some are summarised below and provide some idea of the varied work of the Section.

MONTHLY CIRCULARS: These have been issued promptly each month. They continue to provide prompt preliminary information on the behaviour of eruptive and other important variables. They are also used to keep observers informed on programmes, and advice on the stars requiring special attention. Preliminary photoelectric observations from the Auckland group have been a valuable addition to these Circulars.

PUBLICATIONS: This year's issue contained further papers on dwarf novae. The records for CU Vel; V436 Cen and V442 Cen were discussed. It also contained very valuable photoelectric UBV sequences for 17 southern dwarf novae communicated by N. Vogt. These will enable observations of several more dwarf novae to be reduced. In fact a number of these papers have already been completed for the special Golden Jubilee issue (Publications No. 6) to be published in 1978.

Publications 5, also contained a paper by R.F. Webbink, "Recurrent Novae, Symbiotic Variables and Binary Evolution". The attention of all members is drawn to this paper, especially in relation to the work that can be done on these stars. We are again indebted to B. Menzies for a number of sequences in Publications 5, and to B. F. Marino and W.S.G. Walker for their sequence for WX Hyi.

MEMOIR: Memoir No. 2 on VW Hyi appeared in the N.Z. Journal of Science, and reprints are available at cost. A Memoir on Z Cha has been submitted to the Royal Astronomical Society, London and has been accepted for publication.

CHARTS: Series 9 appeared during the year. Its high standard is due to the skilled work of M. Morel and R. Winnett. They have also completed sufficient charts for Series 10 and a number for Series 11. It is hoped to publish at least one additional issue during 1978, provided the Director can complete the checking.

SEQUENCES: Two colour sequences by B. Menzies, and his assistants have also appeared in "Charts for Southern Variables", Series 9. A number are available for publication in Series 10. There are still many fields for which reliable sequences are required. These would enable accumulated observations to be reduced.

COMPUTER PROGRAMME: A.J. Baldwin and P.J. Thomson have completed the first paper from this programme. This deals with S Car. The paper appears in Publications 6. We are indebted to the University of Waikato's computer department for storing this data on magnetic tape. P. Cain continues to prepare data on R Car. Assistance is needed in punching records although it is hoped that arrangements can be made to have data placed directly on to tape.

RECORDS: Gordon Smith has continued to take charge of all routine checking and entering of the observations. His painstaking work is reflected in the excellent manner in which the records are maintained. He also prepares the quarterly lists of observations of selected Mira type variables for use by the A.A.V.S.O. This enables them to be used in their predictions.

INSTRUMENTS: A pleasing feature this year has been the use of the larger telescopes available to members. A number of other telescopes of larger aperture are under construction. Already it is reflected in the fainter limits being observed.

COOPERATION WITH OTHER ORGANISATIONS: J. Hers, Director, A.S.S.A. Variable Star Section and R.K. Field, Natal Centre, A.S.S.A. have supplied copies of their members' observations. These have proved to be extremely useful. Close contact has been maintained with our South African colleagues to our mutual advantage.

There is now a frequent exchange of information on sequences and charts with the Chart Curator, A.A.V.S.O., Clint Ford. There is also close cooperation with the Variable Star Section, B.A.A., U.K. by way of exchange of papers, charts and other material. There has been considerable exchange too with the North Western Association of Variable Star Observers (U.K.). Publications are also exchanged with the Association Francaise des Observateurs d'Etoiles Variables; K. Locher (BBSAG Bulletin) and several other organisations. This continual exchange of information benefits all organisations and I would ultimately like to see the reduction of all observations of certain stars at one particular centre. This applies particularly to those stars in the band between declinations $+20^{\circ}$ and -20° , where there is, at the moment, considerable overlapping with no organisation able to produce complete records. The pooling of such results would benefit everyone. Close cooperation has continued with the A.A.V.S.O. through their Director, J.A. Mattei. They find that our observations of Mira stars assist in their plotting of light curves. We benefit from this in the predictions received, enabling us to concentrate on other work.

INTERNATIONAL COOPERATION: We have continued to supply visual data, and light curves, to a number of investigators. The light curves of dwarf novae have been supplied to several centres where they have been used for correlation with satellite observations. A cable service has continued providing notification of outbursts of these stars.

Close cooperation has been established with N. Vogt, E.S.O., for the production of an atlas of identification charts of dwarf novae. The charts in use are inadequate for use with large instruments, because they do not show the fainter stars. Thus the variable is easily confused with faint nearby stars. To overcome this problem photographs of various fields will be obtained down to a limiting magnitude of about $16^m.0$. These will make the identification of the variables on the ESO Sky Survey plates easier.

W.S.G. Walker has undertaken to obtain the magnitudes for the comparison stars in the field of T Pyx referred to in last year's report. This will enable R.F. Webbink to reduce all observations of this recurrent nova to the one magnitude system.

NOVAE: During the past year several novae have been discovered. These have been well observed by members. A.A. Page and R. North secured photographs of the two Magellanic Cloud novae. We are also indebted to the Carter Observatory for a photograph. These have enabled the position of one of these novae to be accurately determined.

D. Hoffleit has supplied identification photographs of several old suspected recurrent novae from the Harvard plate collection. The resultant charts have been completed by M. Morel and these will appear in "Charts for Southern Variables" Series 10.

R CORONAE BOREALIS TYPE VARIABLES: Observers have continued to monitor many southern variables of this class. The observations for 12 of these stars will appear in Publications No. 6.

FINANCE: The production of many of the results have been due to a grant from the Carter Observatory Board. It was necessary to increase subscription rates due to inflation. These will remain steady, it is hoped, for the next year mainly owing to assistance from the Low Estate and a family trust. Consideration has been given to provision for the future and the New Year will see steps taken to make such provision. It will be possible to expand the Publications in 1978.

ACKNOWLEDGMENTS: The success of the Section depends entirely upon the contributions of the observers. I am deeply indebted for their observations to all observers. In particular the accuracy of these is due to the skill and care of the more experienced observers. Their guidance and advice to the new members has meant a great deal in maintaining interest in the Section.

T.B. Tregaskis and O.R. Hull have provided a valuable contribution by checking the observations of those in their respective centres. This has saved valuable time in handling these records.

N. Taylor has continued to provide valuable observations of the eclipses of Z Cha, as well as submitting excellent records of a large number of variables. Many members have contributed early advice of the outbursts of dwarf novae, enabling our prompt cable service to operate efficiently.

I am grateful to the Director and staff of the Carter Observatory for their assistance. In particular the grant from the Carter Observatory Board has made possible the reduction and publication of the results on dwarf novae.

The continued support from individual astronomers and observatories through subscriptions has greatly helped the Section. Allied with this has been their keen interest in our activities. This interest has manifested itself in so many ways, but especially in assisting with the supply of photographs for our Charts. This help would, however, be lost without the practical skill that both M. Morel and R. Winnett bring to the accurate drawing of the charts.

Space limitations precludes mention of all those who have helped the Section either through observations; guiding and leading the various associated groups; assisting with the "desk" routine and by providing data or exchanging records. I thank them all. The flourishing state of the Section is the real tribute to their work and help.

NOTICES.CHANGE OF ADDRESS.

All members and correspondents are requested to note that the postal address of the Section is now:

VARIABLE STAR SECTION,
ROYAL ASTRONOMICAL SOCIETY OF NEW ZEALAND
P.O. BOX 3093,
GREERTON, TAURANGA.
NEW ZEALAND.

CHARTS FOR SOUTHERN VARIABLES.

Supplies of Series 3 and 4 are now exhausted after several printings. It is not proposed to reprint these numbers again. A number of the charts that have appeared in these issues will, however, be up dated and new charts for the variables concerned will appear in a later series.

Stocks are available of all other issues. All orders should be sent to the address above.

THE OBSERVATION OF VARIABLE STARS.

Supplies of this booklet are again available and can be obtained at \$N.Z. 3.20 each from Headquarters.

MONTHLY CIRCULARS--A REQUEST.

These Circulars are compiled early in each month. All observers are requested to mail their observations from the previous month to reach Headquarters by the 5th of each month. A number of records reach us after this date and it is usually not possible to include them in the preliminary results published in the Monthly Circulars. It is a great help to have all records at the same time and the cooperation of members in this regard will make life easier at Headquarters.

PUBLICATIONS.

Issue No. 7 will be published in 1979. Members' attention is drawn to the Notice to Contributors on the inside back cover of this issue. Contributions for Publications No. 7 should reach the Director by March 31, 1979.

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