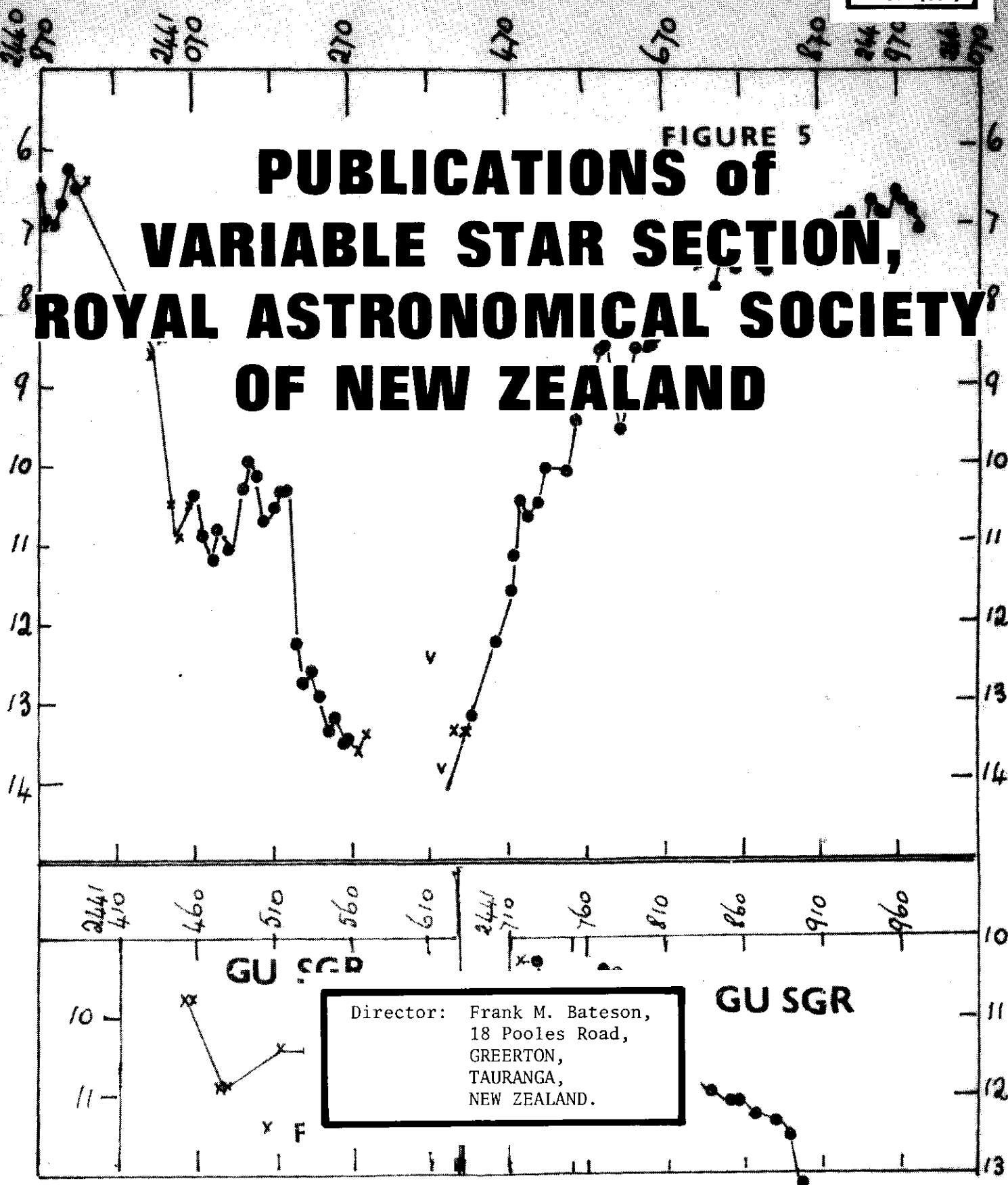


FIGURE 5

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



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1974 December 10

THE LIGHT CURVE OF 132554 BV CENTAURI

Frank M. Bateson

SUMMARY: Observations of BV Cen are presented as a light curve for the interval J.D. 2,434,855 to 2,442,189. It is shown that outbursts fall into at least eight types, differing from one another by the shape of the curve at maximum, as well as by the presence, or absence, of standstills and dips on the rise.

The average cycle between successive outbursts is 149.4 days, which is probably longer than the true cycle because of maxima that have gone unobserved. Tables summarise the data for each observed outburst, and give information on the different types of maxima. At minimum BV Cen fluctuates irregularly with a range of 0.2 to 0.5 magnitudes, with a suggestion that eclipses may be present. BV Cen is of the U Gem type with an extreme range of 10.7_v to 13.6_v.

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INTRODUCTION:

A light curve for the interval J.D. 2,434,855 to 2,435,685 (Bateson & Jones 1956) indicated that BV Cen had an average cycle of 99.3 days. The same paper summarised previous investigations, and gave a visual sequence and chart, which were also published elsewhere (Bateson & Jones 1960). Observations from 2,435,685 to 2,440,860 have been published in the Circulars of the Variable Star Section, Royal Astronomical Society of New Zealand.

OBSERVATIONS:

There are available some five thousand visual observations between 2,434,855 and 2,442,189, which fall into the following distinct divisions:-

- (i) 2,434,855-2,435,901. About 500 observations by A.F. Jones.
- (ii) 2,435,902-2,437,300. About 720 observations by Bateson & Jones.
- (iii) 2,437,301-2,438,820. A total of 1,120 observations from a number of observers, with the majority from Bateson & Jones.
- (iv) 2,438,821-2,442,189. About 2,700 observations from many observers, with those from Bateson and Jones forming a much smaller percentage than in (iii).

The observations (i) and (ii) form a homogeneous series of a high degree of accuracy with very little scatter. There is more scatter amongst the observations in (iii). However, it is possible to use the records by Bateson and Jones to obtain a light curve strictly comparable with those from (i) and (ii).

When all individual observations in (iv) are plotted there is a fair amount of scatter. This is due to the nature of the systematic deviations of many of the observers, and because of the inexperience of others. Normally such deviations can be corrected for each observer by applying the necessary correction as obtained either from a mean light curve, or one derived from records made by those observers whose systematic deviations are small and known. Whilst tedious in procedure, such deviations can be obtained fairly readily for regular variables, such as those of Mira type. Values, so obtained, cannot be transferred with accuracy to other stars, particularly to those of the U Gem type. It was found, however, that six observers had small systematic deviations that differed very little from those of Bateson and Jones. The records from these selected observers were combined with those from Bateson and Jones in the interval (iv) so that this portion of the light curve would be strictly comparable with those for the other three intervals.

It should be stressed that the value of visual observations of U Gem variables lies in obtaining as complete a coverage as is possible in order to obtain a curve showing the gross variations, enabling the mean cycle to be determined. It was found that the outbursts of BV Cen fall into distinct types. The evidence appears conclusive that for each type the differences are real and not the result of the observational methods used.

DISCUSSION:

The light curve, on a small scale, is reproduced in Figures 1-5. Outside of outbursts BV Cen fluctuates almost continuously. The amplitude of such fluctuations is from 0.2 to 1.0 magnitudes. Possibly the larger amplitudes are minor outbursts, whilst the fluctuations of 0.2 to 0.5 are variations in minimum brightness. Whether these smaller fluctuations are real, or merely the effect of the lower accuracy of visual observing, only photoelectric observations can reveal. Their continual repetition, cycle after cycle, strongly suggests that they are real, and that the star is rarely constant at minimum.

The main outbursts have been divided into the following types:-

- "A". Maxima very sharp, following a prolonged standstill, of about 12 days duration, at magnitude 12.1 to 12.3. The rise from 13.0 to maximum averages 29.2 days, compared to 16.2 days for the fall from maximum to 13.0.
- B. Maxima generally sharp, but not always so. There is a short standstill of about 4 days on the rise. This usually occurs around magnitude 12.1, but occasionally at other phases. The standstill is nearly always followed by a dip of 0.3-0.4 magnitudes. The reality of this decrease might be questioned were it not for the fact that it persists in almost every maximum of this type.

- "C". Maxima sharp, with short standstill on the rise. This lasts 3 days and occurs anywhere between 11.8 and 12.6. There is no dip on rise.
- "D". Rounded maxima; no standstill or dip on rise.
- "E". Sharp peak at maximum. Dip after rising but before a short standstill. There is only one example of this type, and possibly it should be considered as type "B", or a subdivision of that type.
- "F". Flat maxima with short standstill on rise. This occurs at any phase. Only one example has a dip on the rise.
- "G". Flat maxima. No standstill or dip on rise.
- "H". Sharp peak at maximum; no standstill on rise, but a dip of 0.3 to 0.7 magnitudes occurs on rise.
- "I". Sharp peak at maximum; no standstill or dip on rise.

There appears to be more activity following maxima with sharp peaks than after those with flat maxima. In two instances a dip occurs at maximum, giving these maxima the appearance of being double. As might be expected, the maxima with a standstill on the rising branch have longer rise times, and greater widths at magnitude 13.0, than those with no standstills. The former are also, on the average, brighter. Typical examples, on a large scale, of the various types of maxima appear in Figure 6.

The falling branches of the curves do not show such distinct differences, although some do show standstills.

Table 1 lists the observed maxima, numbered consecutively in the first column commencing with the first maximum observed. This is followed by the J.D. of maximum, visual magnitude, the interval, in days, between successive maxima and the weight assigned to each date determined on the usual scale of 1 being poorly determined and five well determined. The sixth and seventh columns give respectively, in days, the time taken to rise from magnitude 13.0 to maximum, and the time required to decline from maximum to magnitude 13.0. The next three columns show the type of peak; whether there was a standstill on the rise; the presence, or absence, of a dip on the rise. The final column shows the type of maximum according to the descriptions given earlier.

Table 2 lists the means for data derived for each type of maxima. The type appears in the first column, followed by the mean maximum magnitude. The third and fourth columns give the mean rise and decline time between magnitude 13.0 and maximum. The third and fourth columns give the means of the widths at magnitudes 13.0 and 12.0 respectively. Naturally for the latter only maxima

brighter than 12.0 are included. The final column gives the number of examples assigned to each type.

The average interval between successive maxima, listed in Table 1, is 149.4 days. Two facts make it probable that the average cycle is less than this. Firstly there are gaps during which it is probable that outbursts have gone unobserved. Secondly there must be some doubt as to which of the minor increases in brightness should be regarded as minor outbursts and not merely fluctuations in the minimum magnitude. It may well be that these fluctuations are partly due to eclipses and partly to small, irregular variations. Whenever observations from the selected observers fall close together in time on any one night the observations suggest that there is an eclipse. However, as monitoring continuously was not attempted it is impossible to be definite on this point. Such eclipses would not be very deep and probably do not exceed 0.5 magnitudes. It is all too easy to try and read too much into the records. For BV Cen questions as to the precise nature of these small changes are ones that can only be solved by photoelectric observations.

CONCLUSIONS:

BV Cen has an extreme visual range of 10.7 to 13.6 with outbursts having a mean cycle of 149.4 days. The true cycle is probably shorter than this if allowance is made for outbursts that have gone unobserved and other factors. Maxima can be divided into at least eight distinct types, differing from one another by the shapes of the curve at maxima, and the presence, or absence, of a standstill or a dip on the rise. There is a definite correlation between the standstills, rise times, magnitudes at maxima and the time BV Cen remains brighter than magnitude 13.0.

It appears that either the system is eclipsing, or that it varies continuously in an irregular manner within a range of 0.2 to 0.5 outside of outbursts. Probably both types of variations are superimposed on the outbursts.

BV Cen warrants closer attention by all observers in the same manner as they do with other members of the U Gem type.

ACKNOWLEDGEMENTS:

My appreciation is extended to all observers for their observations, and particularly to A.F. Jones for his long and carefully made records. I am grateful to the Carter Observatory Board, whose support made this discussion possible.

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TABLE 1.

OBSERVED MAXIMA OF 132554 BV CENTAURI.

No.	J.D.	MAG.	INT.	WT.	RISE.	FALL.	PEAK.	ON RISE		TYPE.
								STAND- STILL	DIP	
1	2,434,875	11.0	...	3	...	12	ROUND	No	No	D
2	989	10.7	114	5	15	13	SHARP	Yes	Yes	B
3	2,435,088?	11.8?	99	1	6	7	?	...	...	D
4	178	11.4	90	5	13	19	ROUND	Yes	Yes	B
5	344	11.4	166	5	21	14	SHARP	Yes	No	A
6	441	11.8	97	3	11	11	?	No?	No?	D
7	536?	11.8?	95	3	28	13	SHARP?	Yes	Yes	B
8	565	12.2	29	3	12	19	SHARP?	No	Yes	H
9	591	12.3	34	2	3	3	SHARP	No	No	I
10	709	11.1	118	5	13	25	ROUND	YES	No	C
11	947	11.5	238	3	13	15	ROUND	No	No	D
12	2,436,089	10.7	142	5	25	15	SHARP	Yes	Yes	E
13	231	11.1	142	4	51	27?	SHARP	Yes	No	A
14	354	11.1	123	5	24	19	FLAT	Yes	No	F
15	628	11.1	274	4	13	22	ROUND	No	No	D
16	762	12.1	134	4	8	15	FLAT	No	No	G
17	873?	11.6?	111	1	18?	17?	SHARP	Yes	No	C
18	2,437,043	12.0	170	4	14	9	SHARP	Yes	Yes	B
19	056	11.0	13	4	4	14	SHARP	No	No	I
20	224	11.4	168	3	22	18	SHARP	No	No	D
21	341	12.0	117	3	31	29	SHARP	Yes	Yes	B
22	472	11.1	131	5	20	12	SHARP	Yes	Yes	B
23	812	11.0	340	4	21	16	FLAT	Yes?	No	F
24	994?	11.6?	182	1	?	10	?	?	?	?
25	2,438,137	11.6	143	3	19	13	SHARP	Yes	Yes	B
26	227	11.7	90	4	5	9	SHARP	No	Yes	H
27	491	11.2	264	5	17	12	FLAT	Yes	Yes	F?
28	561	11.9	70	4	3	15	SHARP	No	No	I
29	648	12.2	87	2	7	6	SHARP	No	No	I
30	746?	11.8?	98	2	12	22	ROUND	?	?	D
31	962	12.4	216	4	2	2	SHARP	No	No	I
32	998	12.3	36	5	10	9	SHARP	Yes	No	C
33	2,439,178	10.8	180	5	20	14?	SHARP	Yes	No	C
34	349	12.0	171	5	4	5	SHARP	No	No	I
35	485	11.7	136	2	17	11	SHARP	Yes	No	A
36	725	10.8	240	4	13	19?	ROUND	No	No	D
37	904	11.1	179	5	26	18	SHARP	Yes	Yes	B
38	2,440,097	10.8	193	5	13	15	SHARP	No	Yes	H
39	302	11.1	205	5	18	15	SHARP	Yes	No	C
40	494	11.1	192	3	17	14?	FLAT	Yes	No	F
41	641	11.7	147	5	13	21?	DOUBLE	YES	Yes	B
42	847	11.5	206	5	22	9?	SHARP	Yes	Yes	B
43	918	12.2	71	1	6	24	DOUBLE?	No	No	?
44	2,441,060	11.5	142	4	16?	26	FLAT	Yes	No	F

TABLE 1 (cont).

<u>No.</u>	<u>J.D.</u>	<u>MAG.</u> v	<u>INT.</u> d	<u>ST.</u>	<u>RISE.</u> d	<u>FALL</u> d	<u>PEAK</u>	<u>ON RISE</u>		<u>TYPE.</u>
								<u>STAND-</u> <u>STILL</u>	<u>DIP.</u>	
45	2,441,183	12.0	123	3	30?	32	SHARP	No	Yes	H
46	433	12.2	250	4	7	21	ROUND	No	No	D
47	506	11.7	73	3	7	19	FLAT	No	No	G
48	696	12.2	190	1	9	?	SHARP?	?	?	?
49	825	11.9	129	4	8	6	SHARP	Yes	No	C
50	2,442,188	11.4	363	4	18	?	SHARP	Yes	Yes	B

TABLE 2.

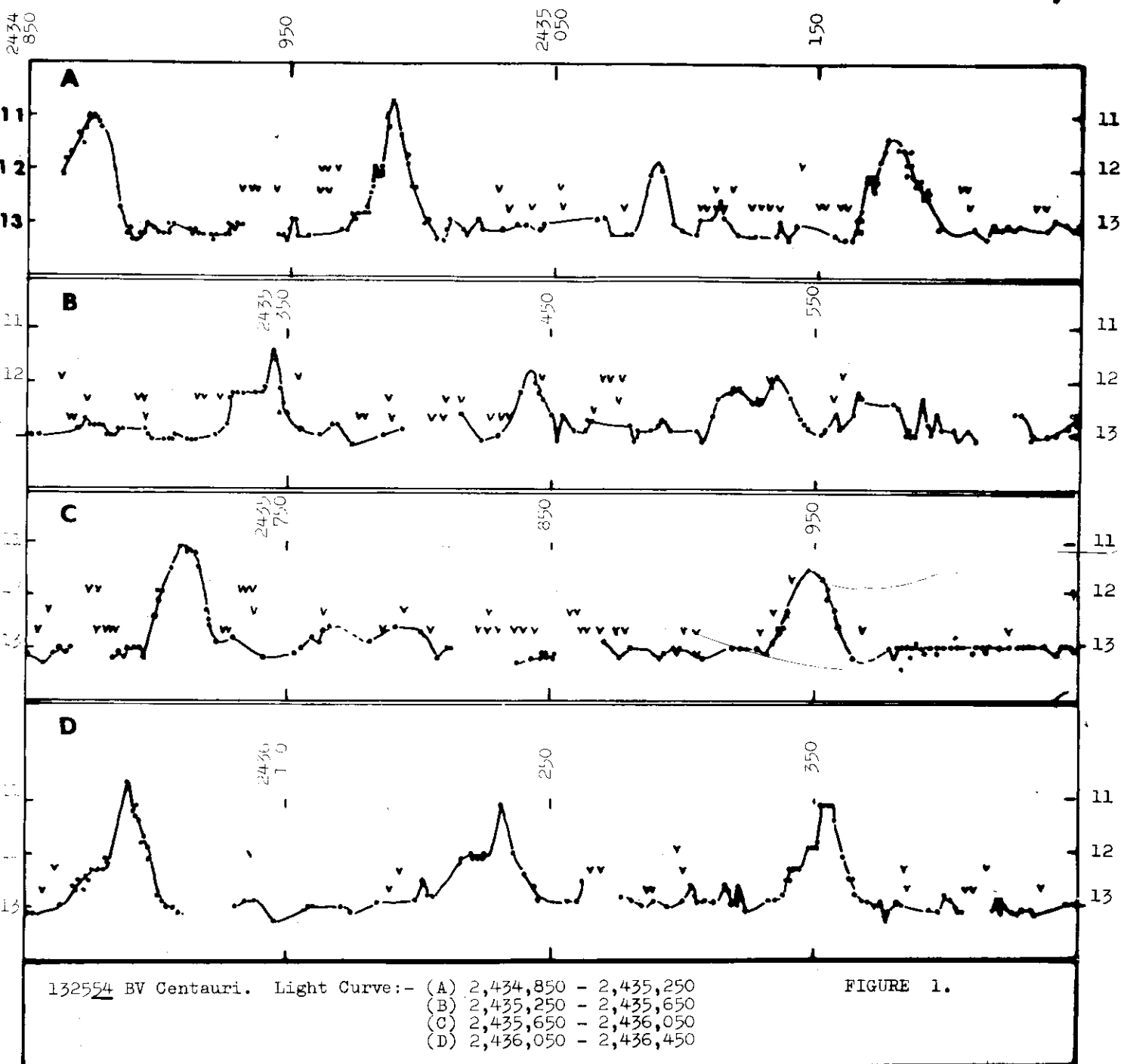
TYPES OF MAXIMA OF 132554 BV CENTAURI.

<u>TYPES OF</u> <u>MAXIMA.</u>	<u>MEAN.</u> <u>MAG</u> v	<u>RISE 13.0</u> <u>TO MAX.</u> d	<u>FALL MAX</u> <u>TO 13.0</u> d	<u>WIDTH</u> <u>AT 13.0</u> d	<u>WIDTH</u> <u>AT 12.0</u> d	<u>No.</u>
A	11.40	29.7	17.3	47.0	5.7	3
B	11.48	19.9	15.6	35.5	9.0	11
C	11.47	14.5	14.3	28.8	12.2	6
D	11.50	12.1	16.3	28.4	12.1	9
E	10.7	25	15	40	13	1
F	11.18	19.0	17.4	36.4	12.6	5
G	11.90	7.5	17.0	24.5	10.0	2
H	11.67	15.0	13.7	33.7	7.0	4
I	11.97	3.8	7.5	11.3	7.5	6

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 Bateson, F.M.; Jones, A.F. 1960 Charts for Southern Variables,
 Series 11, published by F.M.
 Bateson.



8

2436
550

650

750

E

-11

-12

-13

F

2436
9502437
050

-150

-11

-12

-13

G

2437
350

450

550

-11

-12

-13

H

2437
750

850

950

-11

-12

-13

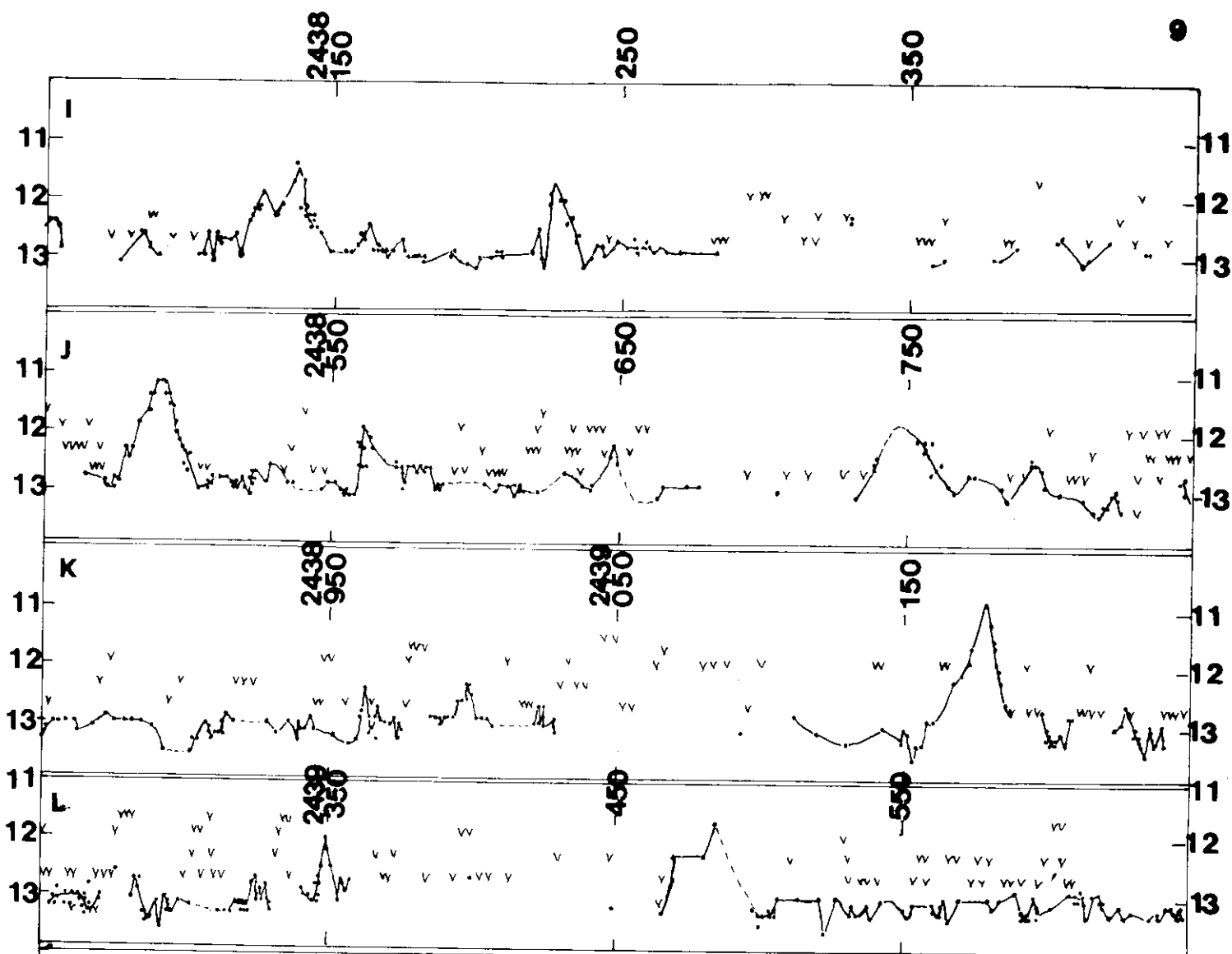
132554 BV CENTAURI. LIGHT CURVE. (E) 2,436,450-2,436,850

FIGURE 2

(F) 2,436,850-2,437,250

(G) 2,437,250-2,437,650

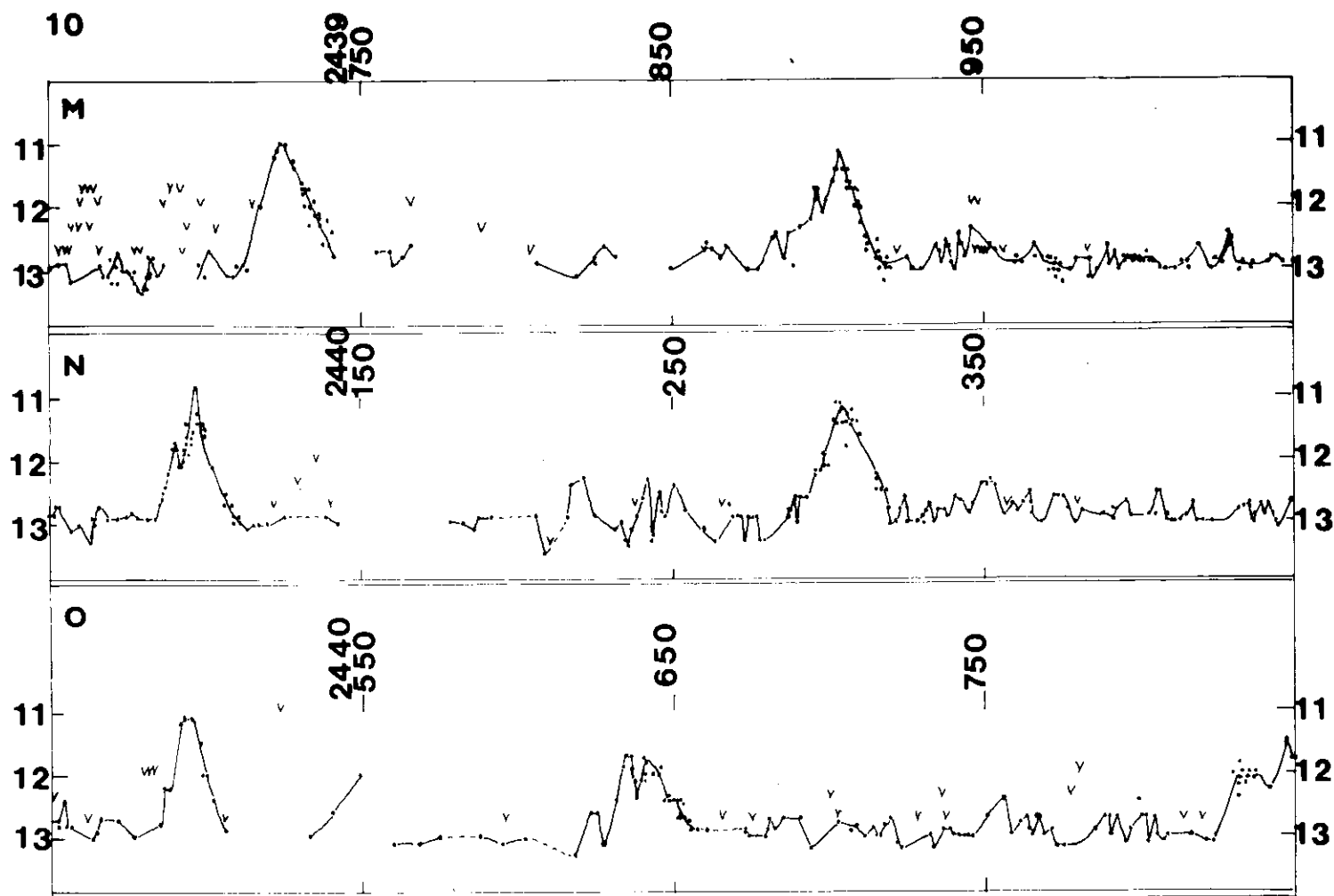
(H) 2,437,650-2,438,050



132554 BV CENTAURI, LIGHT CURVE.

FIGURE 3

- (I) 2,438,050 - 2,438,450
- (J) 2,438,450 - 2,438,850
- (K) 2,438,850 - 2,439,250
- (L) 2,439,250 - 2,439,650



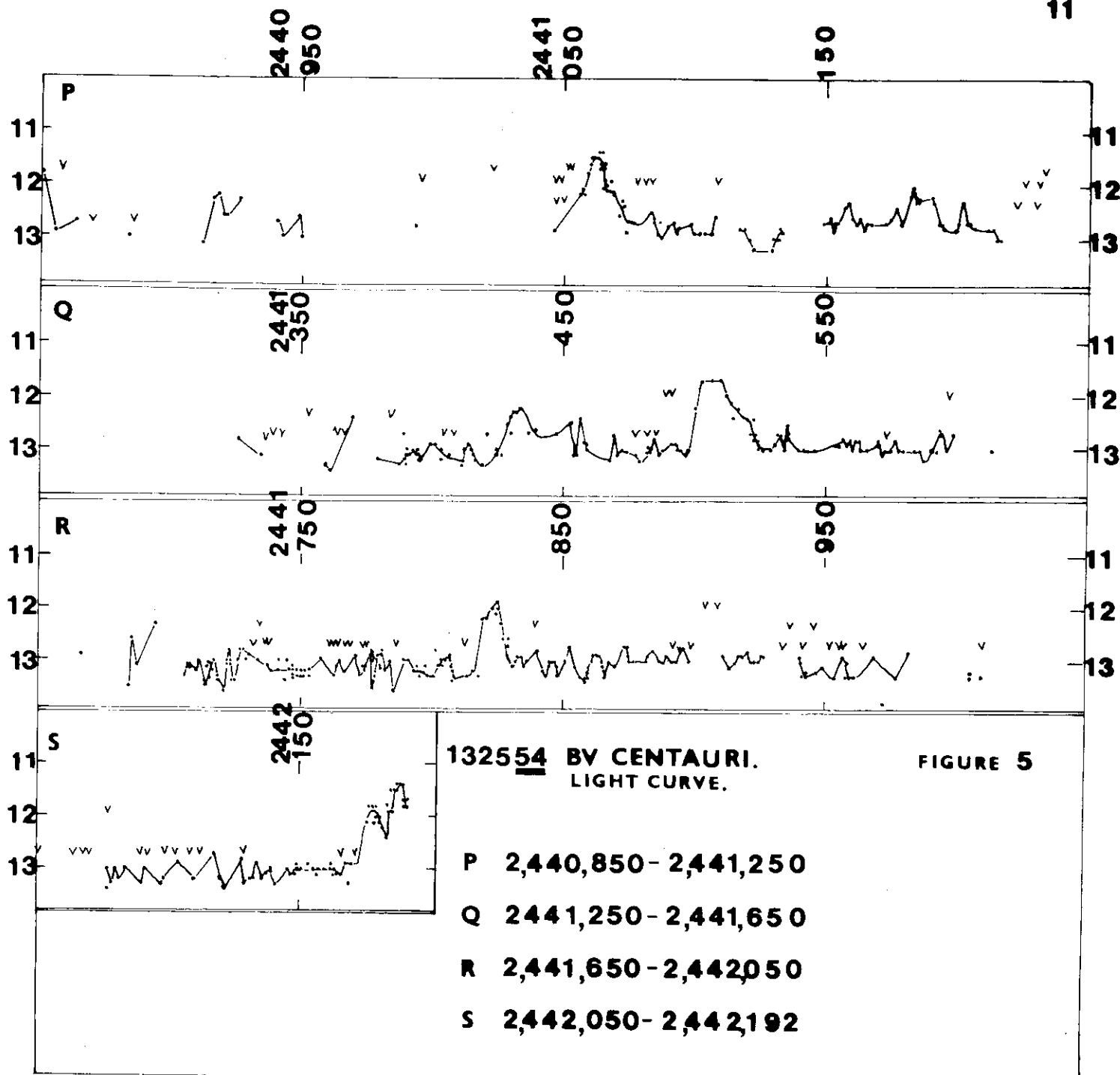
132554 BV CENTAURI. LIGHT CURVE.

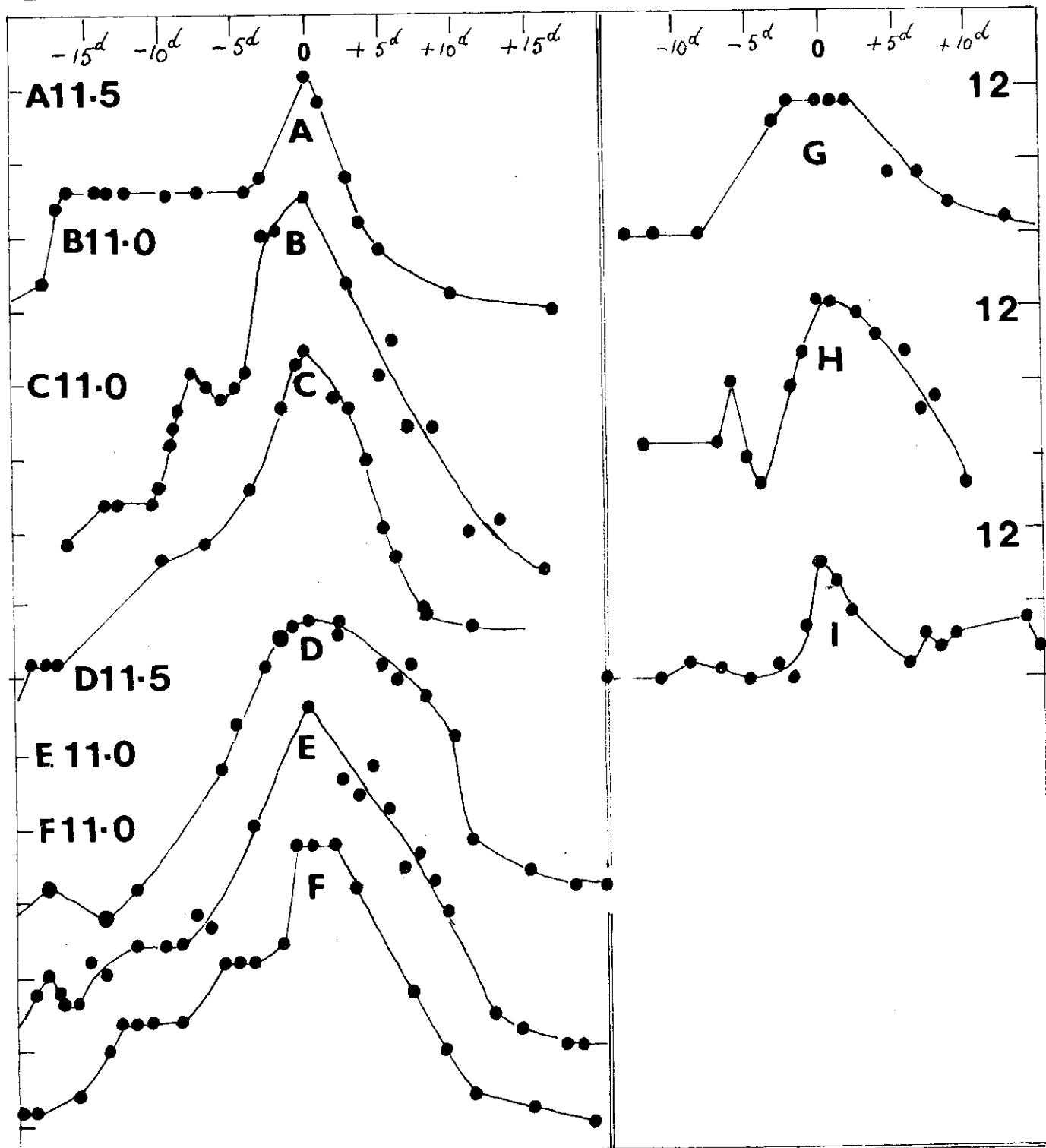
FIGURE 4

(M) 2,439,650 - 2,440,050

(N) 2,440,050 - 2,440,450

(O) 2,440,450 - 2,440,850





132554 BV Centauri. Examples of typical maxima types. Magnitudes are shown near the peak for each type and the unlabelled marks are at half magnitude intervals.

FIGURE 6

AMATEUR PHOTOGRAPHIC ASTRONOMY

A Personal View.

M.B. Ward.

The aims and objects of the amateur photographic astronomer, hoping to do useful work of scientific value, would be to collect data, which could be passed on to other astronomers, amateur and professional, for further reduction by them, or application to their current programmes.

There is basically only one field in which the amateur photographic astronomer can perform a useful service, and this is nova patrol work within our own galaxy and two or three of the nearer galaxies. Beyond this programme the data collected is of doubtful value to other astronomers.

The limitations imposed by available equipment justifies the last paragraph, and the following points are made. The types of camera lenses normally available are such that plate scale is restricted to seldom better than one degree equals 0.5 to 1.5cm., and, through a combination of other factors, the limiting magnitude is seldom fainter than 13th photographic. The focal length finally settled on is determined, firstly, by the quality of the drive, and, secondly by the resolution obtained from the lens. Most lenses available to amateurs tend to have rather poor definition off-axis so some compromise between image quality and field coverage is required, and, as time is usually in short supply, a rather large area cover is more important than perfect images right out to the corners of the negative.

There seems little point in extended exposure times, certainly not more than half an hour, and probably not more than quarter of an hour. The usual types of films available for amateur use have very high reciprocity failure and little or no gain in data is obtained by exposing any longer than half an hour.

In fact, practical experience has shown that the problems of driving accurately beyond this length of time are without practical solution for the amateur. As the added complication of manual guiding is of doubtful value, exposures should be kept short enough to avoid the need to guide at all. Commercially available driving systems are capable of fulfilling the required 30 minute exposure, unguided, with cameras of focal lengths up to 50 cm.

The use of other than fast panchromatic films which are readily available is of very doubtful value. Storage difficulties

and cost are added problems with spectroscopic emulsions. With even the fastest of these panchromatic emulsions the limiting factor in resolution of nova patrol photographs is certainly not the film "grain", but rather seeing, driving system and lens faults. Film "graininess" can therefore be ignored for our purpose.

To summarise we therefore require the following parameters for our camera, mounting and drive system. The camera should have a focal length of 25 to 50 cm. and an aperture of perhaps 5.0 to 7.5cm that will cover, with reasonable images, a 10 x 12.5 cm negative. The drive system must be of such accuracy as to permit unguided exposures, with a camera of the before-mentioned focal length, of approaching half an hour. It must also be free from short-term variations in the driving rate to enable exploitation of as much resolution as the lens system and seeing will permit, and one should aim at an overall resolution of somewhere in the vicinity of 15 to 20 seconds of arc with the faintest images.

An astrograph is only as good as its mounting, which brings us to the next point. Unless one is prepared to spend a fair amount of money on, or time building, a high class mounting, a good camera and drive is a complete waste of time and money. The mounting must be very solid and well designed, bearing in mind the purpose for which it is to be used, mounting a camera not a telescope. It must also be anchored to a very heavy base (at least 500kg) of concrete which is embedded well in the ground.

To be of use this equipment must be permanently set up in a suitable building. A small shed with a slide-off roof is probably better than a dome, unless the dome has a very wide shutter opening, at least 0.75 metre. The former is very much easier to construct, although perhaps not as pleasing to the eye. The building must be well constructed and completely weatherproof if it is to effectively protect the valuable equipment housed within it. It must be of a convenient size to allow for a small bench, and, perhaps a small cupboard as well. A power supply of some sort will be required for the drive.

Having defined the objects, and outlined the equipment required to obtain these objects, let us now look at the ways of procuring this equipment and the costs in terms of money and time involved.

Firstly the camera to be used. Many suitable lens systems are available ex war surplus at prices ranging from 25 to 100 dollars. Some are large and heavy; others more suitable are lighter and easier to build into camera bodies. Check this aspect carefully as it will save expense and effort later. Most lenses found in this way are of the four element Tessar design, for example aero-ektar, aero-tessar, aero-stigmat, anastigmat and serrac. Some are five element lenses and this class would include the Ross Xpress design. Most of these four element lens

systems were designed as aerial lenses and are thus corrected for yellow-green light, but are nevertheless still quite suitable for the mainly blue sensitive films used. Before buying a lens have an optical expert check it for you and advise on its usefulness for the work intended and thereby avoid disappointment later. There are many of these lenses lying around not being used, so a careful hunt may turn one up very cheap.

I would stress at this point that the lens should, if at all possible, conform with the following specifications. It should be able to cover a 10 x 12.5cm cut film or plate format, as this size has been decided on as standard for the New Zealand nova patrol. In fact this size is used in overseas programmes as well. The focal length is rather less rigid, but 35 and 60cm focal length cameras are being used by several photographic astronomers in this country and have been found quite suitable; 35cm for galactic nova patrol and 60cm for the Magellanic Clouds.

Most of these lenses will not be anti-reflection coated and to have them so coated usually means repolishing first. Repolishing and coating could cost several times as much as the lens so it is hardly worth the expense. Some gain in limiting magnitude would no doubt be obtained in having a coated system but sufficient limiting magnitude can be obtained with uncoated lenses so why bother.

Site conditions, that is background fogging from stray light, may impose strict limitations on the focal ratio of lenses for city dwellers. A fair value for the focal ratio would seem to be F 5.6 to F8. Bear in mind that most of the lenses mentioned will give a better performance stopped down slightly. Too fast a lens will only fill the negative with useless unresolved star images, especially in the Milky Way regions, thus lowering resolution and making positive identification of the individual stars difficult. Superior site conditions may enable one to gain some benefit from faster lenses but these lenses are expensive and difficult to obtain.

Once the lens has been obtained it has to be mounted in a camera body. This structure is very important and its design should include at least the following details. Some provision for accurate fine focusing must be made. Focusing will have to be better than 0.25mm. There must also be a means of "squaring-on" provided. The film holders must fit snugly and, of course, be completely light proof.

Aluminium plate is a good light material to build the camera body out of, although it is fairly expensive, but easy to cut and work. The camera must be provided with a suitable lens hood to prevent, or at least reduce, dewing and the effect of stray light. The camera must be designed to attach firmly to the mounting, and a small sighting scope should also be attached to the mounting with its optical axis parallel with that of the camera.

Having sorted out the lens and completed the camera, we must now focus our attention on the mounting. There are many elaborate designs about and they are all expensive if properly made. For our purpose there are only two worth considering. The first is the common German equatorial and the other a modified German equatorial with the polar axis extended towards the pole by an amount sufficient to allow the camera to pass under the polar axis after crossing the meridian. The modified German equatorial would also allow two cameras to be used, one at each end of the declination axis, and thus eliminate the need for counterweights.

Whichever design is chosen it should have a polar axis diameter of at least 2.5-3.0cm with high quality bearings at each end. No effort should be spared to ensure a high quality mounting. There is no need for slow motion controls or setting circles, since the provision of these would add unnecessary cost. From my experience you could expect to pay \$200 to \$300 minimum if an engineer builds this mount for you. Unless you have machine shop facilities and the necessary skill, don't be tempted to do it yourself or you will almost certainly be disappointed with the result. My present mounting was constructed four years ago for a cost of \$200 and, with counter weights weighing over 150 kilograms. It is of the common German equatorial type.

Many years of frustration with an inferior drive can be solved in an instant by purchasing a very high quality drive built by a company that specializes in astronomical drive systems, such as Edward Byers of Barstow, California, U.S.A.

The cost is considerable but the benefits high. Some \$250 will buy a complete drive suitable for the astrograph outlined. From my experience with several drives made from junk and two drives made by so called precision engineers I would not consider anything other than a Byers drive or its equivalent. It is very important that the drive be carefully matched to the mounting if its full benefits are to be realised.

To summarise at this point, one could expect to spend about \$500 to \$600 to obtain a camera, mounting and drive of sufficiently high quality.

Having obtained the camera, mounting and drive, and having set them up with the polar axis aligned to within fifteen minutes of arc of the celestial pole there comes the choice of suitable film. I will not dwell on this at all as there has been much said, mainly by way of pure speculation, about the benefits of various emulsions. I have used Kodak Tri-X with reasonable success for seven years and would not change. Others have used other types of films and likewise would not change. The main point is to choose a film and, after perhaps a little experimenting, stick to it. This is

very important if consistent results are to be obtained.

The actual taking of the photographs is an art learned by practice and will be found fairly straightforward. It is important that a set routine is worked out carefully to avoid such things as---forgetting to turn the drive on; taking a whole night's photographs with no film in the holders; double exposing and many other stupid errors.

The negatives should be processed as soon as possible, even if there is only one to be done. It may show a nova and it is too late if you wait a couple of weeks till you have some more photographs to make the processing worth while. Ideally negatives should be processed within 24 hours of taking them and every effort should be made to ensure this is done.

The processing of the films is of great importance if consistent quality is to be obtained. Whatever method is used it must be carried out with meticulous care. Particular attention should be paid to fixing and washing if the negatives are to have lasting properties. For what it is worth, I have developed my Tri-X film in Kodak D.76 for 15 minutes at 20°C, and fixed them in fresh Kodak Unifix for ten minutes at the same temperature. Careful washing must always be carried out.

At this point storage of processed negatives should be mentioned. After washing and drying they should be transferred to suitable envelopes. These envelopes should have the following information printed on them. A negative code number, camera type, film type, length of exposure, time photograph was taken, approximate co-ordinates of photograph centre and some details of development. The negative itself must be marked with the same code number as its envelope, as they will sooner or later become separated. The negative should then be filed away in some suitable order for future reference.

Now having in our possession consistently high quality photographs of selected fields, we are confronted with the formidable and important task of extracting useful data from these photographs. Unless this problem is successfully solved there seems to be little point in investing a large amount of money and effort in taking these photographs.

The problem is attacked in one of two possible ways. Firstly, get someone else to extract the data, or secondly, do it yourself. Both ways have their problems. We shall consider firstly the situation when it is decided to have someone else extract the data. Most importantly you must satisfy yourself from the outset that the person, to whom the negatives are sent, has the necessary equipment and must be willing and able to do the job. Having spent much time, effort and money to get the photographs you must be sure that they will be examined carefully and quickly. The negatives

should be examined within twenty-four hours, or at the most forty-eight hours of being taken, as their value rapidly diminishes as the time between taking and examining lengthens.

Obviously there are serious limitations on the number of people who have the necessary equipment to do this job, and their willingness to do it. To the best of my knowledge there are only two, or possibly three, people in New Zealand who have the facilities. Because of these problems one must work towards being completely self contained, or better, completely self contained within a small group of no more than four or five.

We will now consider methods of examining these photographs. Many methods have been tried, most with very limited success. With the number of images that will appear on the negatives, superimposing two negatives one on top of the other, and slightly off-setting, is not very convenient or satisfactory. From my experience many interesting objects are likely to be missed. This method is also far too time consuming, and, for this reason, if nothing else, a very limited coverage could be obtained with any degree of completeness.

For several years I used a method of direct examination of positive prints. One first examined a small section of the print, memorised it, and then transferred to the corresponding area of the other print looking for any change. I would like to point out that, at this stage I was photographing only on 35mm format with very limited field areas (about 8%) of the 10 x 12.5cm film now used. On changing to the new size it was immediately obvious that this method was not good enough. It was far too tiring and many objects were being missed. A 10 x 12.5 cm negative was taking up to ten hours to examine.

A limited number of people are able to use a stereo-comparator, notably Ron Welch. Without doubt a blink-comparator is by far the most reliable and least troublesome machine to use. As most readers will have a fair idea of how this works I will not go into details of its construction, but will outline the costs of materials and time needed to make one of these machines.

The machine is built out of aluminium plate and, at current prices, \$100 would cover the amount needed. It has been suggested that castings could be used. I very much doubt, after having checked on costs, if any savings could be made by using this method of construction, as castings have to be made in fairly large numbers to be cheap per unit.

Each carriage of the comparator runs on ball bearings, sixteen in all, costing perhaps \$25. About two metres of stainless ground rod will be needed to support these ball bearings and this will cost about \$10. Assorted brass rod,

threaded rods and fine adjusters will add at least another \$20. Optics can be readily obtained costing in total about \$50. If the blinking is to be done electronically then perhaps another \$20 should be allowed for parts. If it is done mechanically, then an electric motor will be needed and some sort of gearing for the shutter. An electric windscreen wiper motor comes complete with its own gearing and its output speed is just what is needed, about 1 RPS.

As you can see one would have to allow at least \$200 for parts, but this is far from your total cost. The first blink comparator I built took about fifty hours to design and 130 hours to build. The second one, although modified and with some improvements, required about the same time. A precision engineer could well save time in some processes but not much, as each component still has to be made. At current rates one hundred hours of engineer's time would cost \$800. The machine would therefore cost in excess of one thousand dollars if built this way.

It is up to the individual concerned to decide how much he is prepared to spend on his hobby. In terms of saving in both time and effort I think a blink-comparator is a worthwhile investment for anyone wishing to examine his own negatives.

The skill required to use a blink-comparator is quickly learnt. Three or four hours practice will eliminate most of the common pitfalls. After some further practice a 10 x 12.5cm negative or plate can be examined for novae in fifteen to twenty minutes, and more carefully examined for variables in perhaps thirty to forty-five minutes. If something of interest is found then many hours of checking may be needed.

The importance of consistently high quality negatives is immediately obvious when using a blink-comparator, as great difficulty is experienced in comparing negatives of differing limiting magnitude and image quality. Having now, by a combination of good luck and good management, found something of interest, what is the next step? Firstly one must confirm that the suspected object is the image of a star, and not just an emulsion fault or dust particle of some sort. This is easier said than done! There is one way of being fairly sure, if not completely sure, and that is having for comparison another photograph of the area taken at the same, or nearly the same, time. If the image is on both negatives then it can be considered real and worthy of further investigation.

Unless one is in the habit of taking the field twice each night, or using two cameras at once, generally a confirmation negative will not be available for checking. The use of two cameras exposing on the same field at the same time has obvious advantages in time saving, but, of course, the added

cost of another camera. In the event of no confirmation negative being available then one must decide on the next step to confirm the reality of the image. Check the shape of the star images nearby and compare. An odd shaped image is always suspect unless it appears comet-like. The brighter and rounder the image is the more likely it is to be genuine, providing all the nearby images are round too.

Having decided that the image is real then one must obtain its co-ordinates and magnitude as accurately as possible. For the co-ordinates I use Becvar's Atlases and find them quite satisfactory for the initial position. As for magnitude, that is more difficult, but with experience an estimate within 0.3 magnitude can be obtained. Once the position and magnitude are known then a check with the General Catalogue of Variable Stars, and its supplements, will often show it to be a known variable. If it does not then the co-ordinates should be checked **in** further publications. If the image is as bright as magnitude eight and not listed in the G.C.V.S. then there is a fairly good chance that you have found a nova.

At the earliest possible opportunity another photograph of the area should be obtained to see if the image appears on it. If it does then its position and magnitude should be checked again for variation, and the information passed to the Director, Variable Star Section, R.A.S.N.Z.

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BH CRUCIS

Frank M. Bateson.

SUMMARY:- Visual estimates of the extremely red variable, BH Cru, are compared with photoelectric V magnitudes to determine systematic deviations for individual observers. It is found that, especially for the lesser experienced observers, visual estimates are too faint. A corrected light curve is reproduced and compared to the uncorrected curve. Observed dates for maxima and minima are listed. From the corrected curve a period of 421 days is determined, with the Epoch of Primary Minimum C.D. 2,440,858.

INTRODUCTION:- The variability of BH Cru was discovered by R.G. Welch (Bateson 1970). From observations over a limited interval Bateson (1970) tentatively placed the period at 217 days.

Subsequently it was shown that BH Cru resembled R Cen and R Nor (Walker et al 1972), in having double maxima and minima with a period of 420.25 days.

VISUAL ESTIMATES:- The publication (Walker et al 1972) of an extensive series of photoelectric observations enabled visual estimates to be compared with the V magnitudes during the interval J.D. 2,440,590 to 2,441,357. When the ten day means from the visual estimates were plotted it was found that the resultant light curve followed the form of the V curve closely, but was consistently fainter than the V curve. The difference depended on which observer was dominant in each mean.

Individual estimates were then tabulated for each observer and compared with the magnitude from the V curve at the same phase. The differences found are given in Table 1 for each observer. The first two columns give respectively the name of the observer and his abbreviation. The third column gives the number of estimates, whilst the fourth column gives the average difference between the observer's visual estimates and the V magnitudes with the sign + indicating that the visual estimates were fainter than the corresponding V magnitudes. The final column provides an idea of the scatter in the estimates from each observer.

It is unfortunate that the visual estimates are not numerous, and that, in general, the observations within the interval considered are dominated by records from the less experienced observers.

TABLE 1

AVERAGE DIFFERENCE V MAGNITUDES AND VISUAL ESTIMATES.

<u>OBSERVER</u>	<u>ABBREVIATION</u>	<u>NO.</u>	<u>AVG.DIFF.</u>	<u>EXTREME RANGE.</u>
			Mag.	MAG.
GRUNDILL, J.C.	G1	9	+ 0.07	-0.1 to +0.1
TAYLOR, N.W.	Ty	35	+ 0.16	(Class 1. -0.1 to +0.1 (" 2. -0.2 to +0.2 (" 3. -0.3 to +0.6
HUNTER, K.	Hn	6	+ 0.17	-0.1 to + 0.3
MARINO, B.F.	MA	15	+0. 33	(Class 1 +0.1 to +0.5 (" 2 ±0.0 to +0.7
HULL, O.	H1	5	+0.44	+ 0.0 to + 0.8
JONES, M.V.	Jn	16	+0.47	(Class 1. +0.4 to +0.5 (" 2. +0.1 to +0.8
MITCHELL, A.B.	MB	19	+0.67	+0.3 to + 1.1
WELCH, R.G.	Wc	9	+0.68	+0.3 to + 1.0
MEADE, R.H.	Mp	2	+0.70	+0.6 to + 0.8
CROMPTON, A.	Cm	19	+0.71	+0.2 to +1.2
PATERSON, (Mrs) D.	Ps	6	+0.75	+0.2 to +1.0
STRANSON, I.	Sr	47	+0.76	+0.4 to +1.2

Whilst the sample is limited, both in numbers for each observer and in the number of observers concerned, it is apparent that estimates from G1., Ty. and Hn. all fall within the limits normal for the best visual observers. It is also obvious that Ty correctly classifies his observations in

accordance with the seeing conditions. Another experienced observer, Jn, also correctly interprets seeing conditions, but his class 1 estimates are consistently too faint by 0.45 magnitudes.

As one would expect the internal consistence of the lesser experienced observers is poor with a wide scatter in their estimates. There is a tendency for their largest differences to occur when sky conditions are poor. However the sample is too small to trace any tendency towards the errors being dependent on the brightness of the variable.

Since the records are dominated by records from the less experienced observers it makes it difficult to apply corrections because of the scatter. The best that can be done is to correct each estimate by the observers average difference and then to form new ten day means.

Figure 1 shows two curves, of which the lower is derived from uncorrected observations and the upper from the corrected ten day means. For the last 210 days of the curves no photo-electric observations have been published but the same average corrections have been applied to the individual estimates.

Table 2 gives the dates for maxima and minima derived from the corrected curve. This is in the usual form with two intervals given for each maximum or minimum. The first of these is the interval between successive maxima, or minima. The second the interval between successive maxima or minima of the same type.

TABLE 2.

OBSERVED MAXIMA AND MINIMA.									
TYPE.	MAXIMA.				TYPE	MINIMA			
	J.D.	MAG	INT	INT		J.D.	MAG	INT.	INT
		v	d	d			v.	d	d
Max.11	2,440,683	7.1	...	...	Min 11	2,440,618	8.2	...	...
1	972	7.4	289	...	1	858	9.6	240	...
11	2,441,099	7.1	127	416	11	2,441,030	7.9	172	412
1	398	7.6	299	426	1	274	9.4	244	416
11	525	7.4	127	426	11	457	8.3	183	427

The interval covered by the observations is short; much too short to derive reliable elements for a star of this class. The following appear to fit the observations best:-

EPOCH (Minimum 1)	2,440,858	±	421.0
Minimum 1 to Maximum 1			119
Maximum 1 to Minimum 11			58.5
Minimum 11 to Maximum 11			68.5
Maximum 11 to Minimum 1			175

On the foregoing basis the observations give the O-C residuals as shown in Table 3.

TABLE 3.
O-C RESIDUALS.

<u>TYPE.</u>	<u>OBSERVED J.D.</u>	<u>O-C</u> d
Min. 11	2,440,618	+ 3.5
Max. 11	683	+ 0.0
Min. 1	858	+ 0.0
Max. 1	972	- 5.0
Min. 11	2,441,030	- 5.5
Max. 11	099	- 5.0
Min. 1	274	- 5.0
Max. 1	398	+ 0.0
Min. 11	457	- 0.5
Max. 11	525	+ 0.0

Walker placed the Epoch of Minimum 1 at 2,440,827 and the period as 420.25 days, (Walker et al 1972). He showed that photographic observations supplied by Sonneberg Observatory indicated a maximum at about 2,428,910 and at 2,434,350. Both these dates refer to Maximum 11 and give a period of 419 days, but subject to some uncertainty since the first date is somewhat uncertain.

My epoch of 2,440,858 is 31 days later than Walker's and is based on corrected visual observations in a gap of 58 days during which there were no photoelectric observations. The curve from the photoelectric results can also be drawn to support my Epoch. When the Epoch and period found in the present paper are extended backwards the O-C residuals for the two dates from Sonneberg observations are respectively +15 and -15 days.

Landolt (1974) suggests a possibly improved period of 419.27 days but concludes that his new data are too few to be conclusive.

Differences of a few days in the period found by different investigators are to be expected, especially when the star has only been observed over a short interval. They are due to the difference in personal interpretation by the investigators.

CONCLUSIONS:- BH Cru is an extremely red star as shown by the photoelectric results. This makes it a very difficult star for observation by visual observers, especially those that lack extensive observational experience. Means derived from visual observations reproduce the form of the light curve but at magnitudes several tenths fainter than that indicated by V magnitudes.

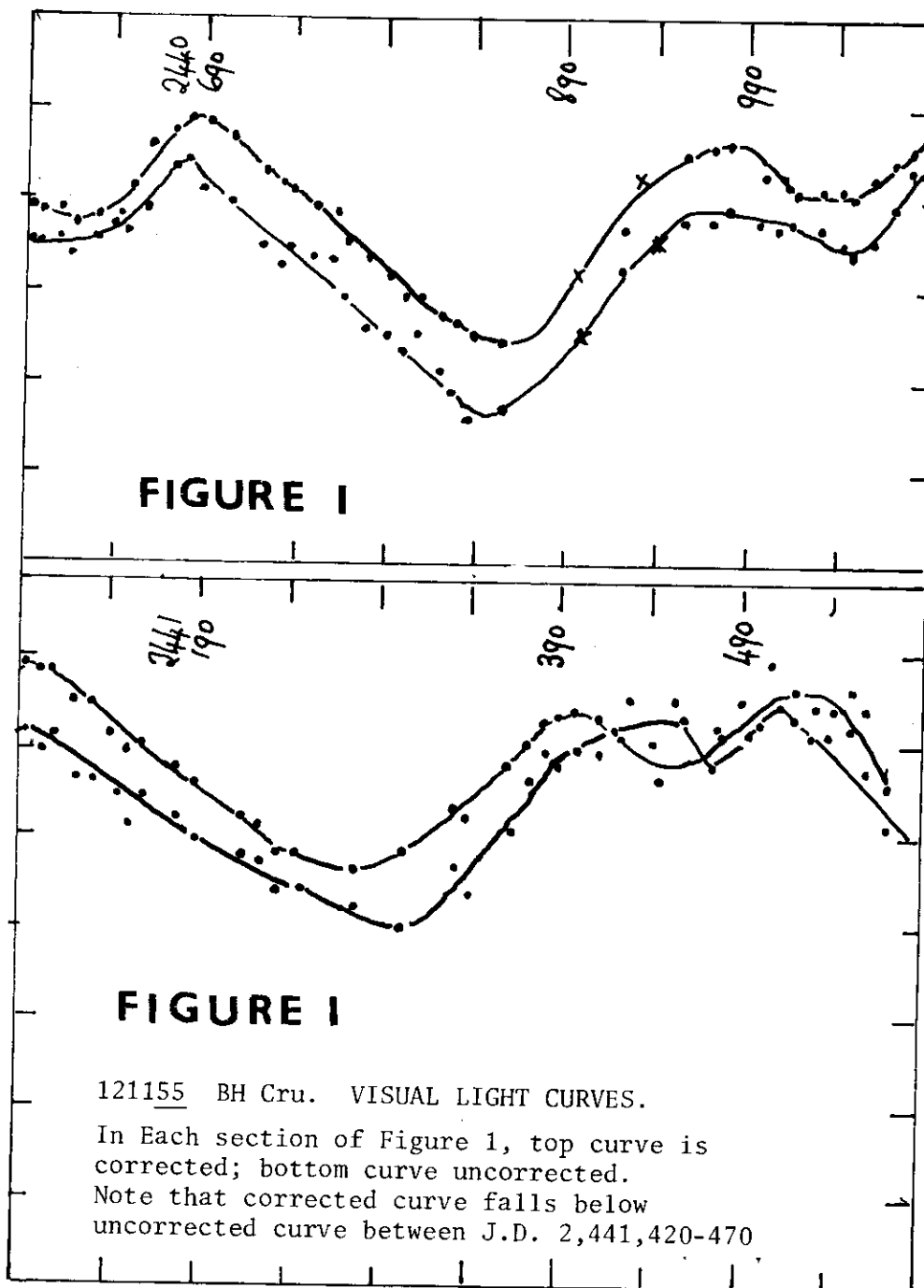
It is essential that in observing such stars instructions to visual observers (Bateson 1973) are carefully adhered to at all times. It is desirable that in using visual results these be corrected for systematic deviations whenever possible.

A sequence and chart for BH Cru (Bateson 1970) is being reproduced in a forthcoming series of "Charts for Southern Variables--Series 3". Experienced observers are requested to pay close attention to this interesting variable since results over several years are necessary to ascertain its true elements. It can, however, be concluded that it has double maxima and minima as Walker pointed out, and that the period is around 421 days.

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|---|--|
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STAR		OBSERVED MAXIMA AND MINIMA.									
		J.D.	MAG _v	INT _d	WT	O-C _d	J.D.	MAG _v	INT _d	WT	O-C _d
133155	RV Cen	2439,616	7.5	459	5	- 2	2439,833	10.8	474	4	+19
		2440,051	7.8	435	5	-13	2440,284	10.7	451	4	+23
		508?	7.6?	457	1	- 2	728	10.6	444	3	+21
		959	7.8?	451	1	+ 2	2441,183	10.6	455	1	+30
		2441,416?	8.2	457	1	+13					
133633	T Cen	2440,876	6.4	88	1	- 7	2440,920	8.2	93	1	-11
		978	6.4	102	3	+ 4	2441,018	7.7	98	5	- 4
		2441,065	6.1	87	5	+ 1	109	7.8	91	5	- 3
		159	6.0	94	5	+ 4	197	7.9	88	3	- 6
		252?	6.2?	93	1	+ 6	298?	8.2	101	1	+ 4

TABLE 1 (cont).

133633	T Cen	2441,343?	5.9?	91	1	+	7	2441,385	8.1	87	3	+	1		
		430	5.9	87	3	+	3	477	7.8	92	5	+	2		
		517	6.0	87	5	±	0	569	8.7	92	3	+	4		
		620?	6.0?	103	1	+	12	656?	8.0?	87	1	±	0		
		695?	5.8?	75	1	-	4	747	8.5	91	3	±	0		
		785	6.1	90	5	-	4	835	8.0	88	4	-	2		
		882	6.0	97	4	+	2	926	7.9	91	5	-	2		
		970?	6.1	88	1	±	0	2442,013?	7.9	87	1	-	5		
		2442,061	6.0	91	2	±	0	112	7.7	99	4	+	3		
		152	6.0	91	4	±	0	191	6.8	79	3	-	9		
		238	5.9	86	3	-	6								
134236	RT Cen	2439,791	9.3	255	2	-	1	2439,687	13.6	246	5	-	2		
		2440,035	9.3	244	4	-	14	936	12.6	249	4	-	10		
		299	9.4	264	3	-	6	2440,194	12.9	258	3	-	8		
		550	9.5	251	2	-	11	438	13.2	244	3	-	20		
		813	9.4	263	3	-	5	698	12.8	260	4	-	17		
		2441,057	9.3	244	3	-	17	960	13.0	262	1	-	11		
		330?	9.0?	273	1	-	1	2441,230?	12.6?	270	2	+	3		
		589	8.4?	259	2	+	2	477	12.4	247	3	+	7		
		836	9.2	247	3	-	7	746	12.8	269	2	+	6		
		2442,104	9.1	268	5	+	4	998	12.6	252	2	+	2		
		2439,942	6.2	385	3	-	19	2439,759	9.8	404	3	-	3		
134327	W Hya	2440,336	6.0	394	3	-	23	2440,153	10.1	394	3	-	7		
		134536	RX Cen	2439,806	9.4	324	2	±	0	2440,012	<14.0	339	1	-	1
		2440,110?		9.5?	304	1	-	24	350	<14.0	338	1	+	10	
		461		10.2	351	3	-	1	670	14.2	320	1	+	2	
		797		9.2	336	3	+	8	2441,005	14.4?	335	1	+	9	
		2441,126		9.2	329	3	+	9	340?	<14.0	335	1	+	14	
		458		9.0	332	4	+	13	670	<14.0	330	1	+	19	
		784		9.1	326	3	+	11	996?	<14.0	326	1	+	17	
		2442,115		9.2	331	4	+	15							
		2439,799		9.4	265	5	±	0	2439,677	14.3	-	4	-	10	
		2440,057		9.9	258	4	-	3	953	14.7?	276	3	+	5	
321	8.7	264		5	±	0	2440,190	14.6?	237	3	-	19			
134677	T Aps	570	9.4	249	3	-	12	465?	14.5?	275	2	-	5		
		834	9.4	264	4	-	9	710?	<14.0	245	1	-	21		
		2441,096	9.1	262	1	-	8	963?	<14.0	253	1	-	29		
		355?	9.6?	259	1	-	10	2441,252	<14.0	289	1	-	1		
		610?	9.3?	255	1	-	17	505	<14.0	253	1	-	9		
		140959	R Cen	2440,992	6.4	565	5	-	2(1)	2440831	10.8	511	5	-	40(1)
		2441,175		6.5	531	5	-	18(11)	1110	8.3	556	5	-	3(11)	
		530		6.4	538	4	-	5(1)	414	11.0	583	5	+	2(1)	
		716		6.2	541	5	-	18(11)	633	7.8	523	4	-	21(11)	
		2442,054		5.8	524	5	-	22(1)	944	11.0	530	5	-	9(1)	
									2442,182	7.9	549	5	-	13(11)	
2439,933	9.8	393		4	-	1	2439,785	<14.0	396	1	-	5			
2440,338	10.1	405		4	+	7	2440,191	<15.0	406	1	+	6			
729	9.8	391		4	-	3	578	14.8?	387	1	-	2			
2441,123	10.0	394		4	+	1	962	<14.5	384	1	-	13			
520	10.0	397		3	+	3	2441,344	<14.0	382	1	-	27			
145254	Y Lup	905	8.8	385	4	-	7	750	14.8?	406	1	-	16		
								2442,175	14.5	425	1	+	14		

TABLE 1 (cont).

152849	R Nor	2,439,689	9.4	510	5	+ 1(1)	2,439,565	13.6	509	5	+ 0(1)
		854	7.6	532	3	+ 2(11)	767	11.1	511	4	+ 5(11)
		2440,186	9.6	497	2	-15(1)	2,440,078	13.2	513	5	+ 0(1)
		376	7.6	522	4	+11(11)	250	10.0	483	1	-24(11)
		706	8.0	520	4	- 7(1)	591	13.5	513	3	+ 1(1)
		861	7.2	485	2	-16(11)	777	9.0	527	3	-10(11)
		2,441,194	8.5	488	2	-31 (1)	2,441,083	13.5	492	2	-19(1)
153654	T Nor	2,439,758	7.8	227	4	- 2	2,439,663	13.2	237	5	- 2
		993	7.3	235	5	-10	898	12.8	235	4	- 9
		2,440,242	7.2	249	4	- 3	2,440,161	13.0	263	4	+11
		488	7.5	246	4	+ 0	387	13.0	226	5	- 6
		740	8.7	252	5	+ 9	648	13.3	261	3	+12
		976	7.2	236	3	+ 3	879	13.6	231	3	+ 1
							2,441,140	13.4	261	3	+19
154736	R Lup	2,439,660	9.7	238	5	+ 0	2,439,786	14.0	232	3	+ 9
		906	9.9	246	3	+10	2,440,010	14.0	224	4	- 3
		2,440,131	10.0	225	3	- 1	249	14.3	239	1	+ 0
		375	9.9	244	3	+ 8	487	14.0	238	1	+ 2
		615	10.0	240	1	+12	720	14.0	233	1	+ 0
		841	10.1	226	1	+ 2	964	14.4	244	1	+ 8
		2,441,063	10.0	222	1	-12	2,441,192	14.1	228	1	+ 0
155823	RZ Sco	2,440,310	8.9	..	1	...	2,440,413	11.2	...	1	...
		465	8.4	155	1	...	725	12.4(312)	1	...	
		784	9.4(319)	3	...	2,441,178	12.8(453)	1	...		
		2,441,090	8.5(306)	1	...						
164844	RS Sco	2,440,868	7.4	305	3	- 5	2,441,054	12.0	312	3	- 4
		2,441,190	6.9	322	4	+ 3	363	12.0	309	3	- 9
		501	6.9	311	5	+ 0	683	12.0	320	4	- 3
		815	6.9	314	5	+ 0	2,442,008	12.0	325	4	+ 8
		2,442,126	6.9	311	4	- 3					
165030aRR	Sco	2,440,640	6.4	288	3	+ 2	2,440,792	11.8	269	5	- 2
		933	6.2	293	1	+15	2,441,085	12.1	293	4	+11
		2,441,205	6.5	272	4	+ 8	350?	11.8?	265	1	- 3
		477	6.3	272	5	+ 0	639	11.8	289	2	+ 6
		764	6.4	287	4	+ 7	914	11.4	275	5	+ 1
		2,442,034	6.4	270	3	- 2	2,442,194	11.6	280	5	+ 2
		310?	6.2	276	3	- 6					

TABLE 2.

REMARKS.

133155 RV Cen Epoch (Maximum) 2,437,387 +446^d.2; M-m 249^d.87.
 Requires more attention. Observations must be made in accordance with the Instructional Manual as its redness makes RV Cen a difficult star to observe. A number of observations have been rejected because they had large deviations and were obviously discordant.

TABLE 2 (cont).

- 133633 T Cen. Epoch (Maximum) $2,434,813 + 90^d.60$. M-m $42^d.582$.
The observations give a period of $90^d.57$ from maxima; $90^d.61$ from minima. Gaps in the observations are due to lack of records in October-December. Morning observations are required, when possible, in these months; otherwise the star is well observed.
- 134236 RT Cen. Epoch (Maximum) $2,439,536 + 256^d.36$. M-m $103^d.2$.
Period from Max. $256^d.28$; from Min. $256^d.44$. Using the elements in the G.C.V.S. the O-C residuals for maxima average -62 days. RT Cen requires more attention.
- 134327 W Hya. Epoch (Maximum) $2,439,563 + 398^d.0$. M-m 199^d .
Poorly observed and results discordant at times. Deserves much more attention as both the period and form of curve vary strongly.
- 134536 RX Cen. Epoch (Maximum) $2,437,512 + 327^d.74$. M-m $121^d.26$.
Individual estimates plotted; requires more attention. Minima not observed being below threshold of the instruments used, but dates inferred from shape of curve. Observations give, from maxima, a period of $329^d.36$ but G.C.V.S. elements used.
- 134677 T Aps. Epoch (Maximum) $2,437,710 + 261^d.11$. M-m $112^d.28$.
Observations now presented give periods of $259^d.4$ from maxima; $260^d.6$ from minima. Dates for minima are dependent on shape of curve as minima not observed.
- 135870 Z Aps. Observations are not reproduced here as they will form a separate paper. Preliminary results give:-
Epoch (Maximum) $2,440,788.5 \pm 19^d.1$ (Mag. 10.7-11.0)
(Minimum) $2,440,798.0 \pm 18^d.1$ (Mag. 12.0-12.7)
The star is certainly not of long period as classified in G.C/V.S. as our observations from 2,434,840 (1954 April 7) indicate a period of about 19 days has persisted throughout the past two decades. These results appear to confirm Swope's (HB 883, 1931) suggestion of such a period. The curve is often Cepheid-like but the rapidity of the variations at some minima suggest eclipses. A complete investigation is being carried out.
- 140959 R Cen. Epoch (Primary Minimum 1) $2,437,625 + 541^d.0$.
Using the same Epoch and a period of 548.0 days as given in G.C.V.S. the O-C residuals average

TABLE 2 (cont).

-60 days for the last few primary minima observed by the Section. This compares with O-C residuals of -14.2 days for period of 541.0 days. It is possible that the period has decreased in recent years.

Minimum 1 (Primary) to Maximum 1.	123 ^d .5
Maximum 1 to Minimum 11	119
Minimum 11 to Maximum 11	79.3
Maximum 11 to Minimum 1	218

R Cen is an example of a star that is being well observed. A portion of the light curve from observations already published was reproduced in error.

145254 Y Lup. Epoch (Maximum) 2,437,960 + 395^d.2. M-m 146^d.2
The minima recorded have a very low weight and have been inferred from the shape of the curve.

145471 V Aps. Variations are slow and irregular, despite some indication of a small, regular variation at times.

152849 R Nor. Epoch (Primary Maximum 11) 2,438,315 + 512^d.4.
Maximum 11 (Primary) to Minimum 1 = 44% of period
Minimum 1 to Maximum 1 24%
Maximum 1 to Minimum 11 13.2%
Minimum 11 to Maximum 11 18.8%

GCVS gives Epoch of Primary Maximum 11 as 2,434,314 + 490.24 days which does not appear to fit observations, giving average O-C residuals of +130 days, with an increasing difference between each successive observed and calculated primary maximum.

153654 T Nor. Epoch (Maximum) 2,440,488 ± 242^d.7; M-m 95^d.1.

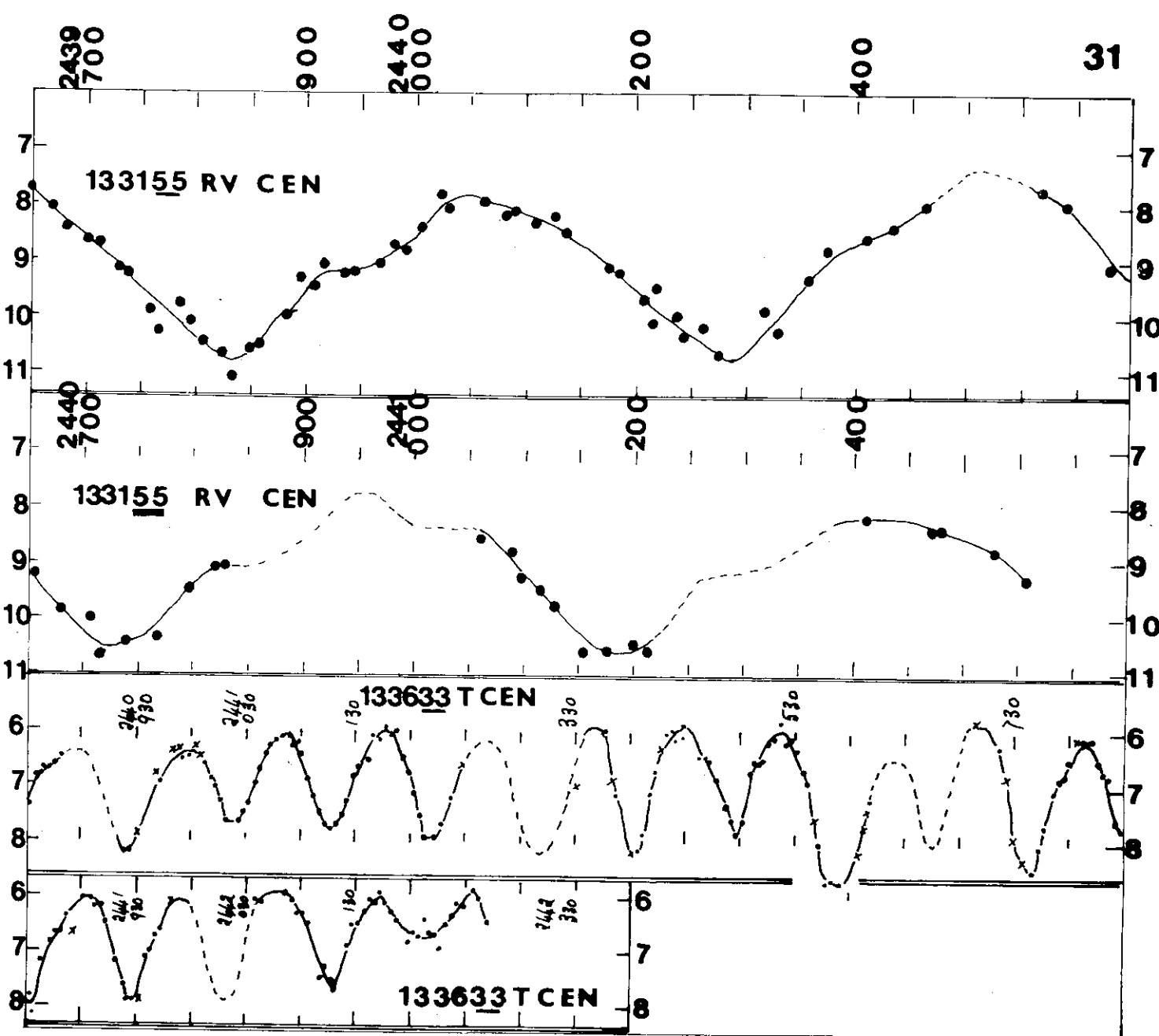
154736 R Lup. Epoch (Maximum) 2,439,660 ± 235^d.79; M-m 118^d.60.

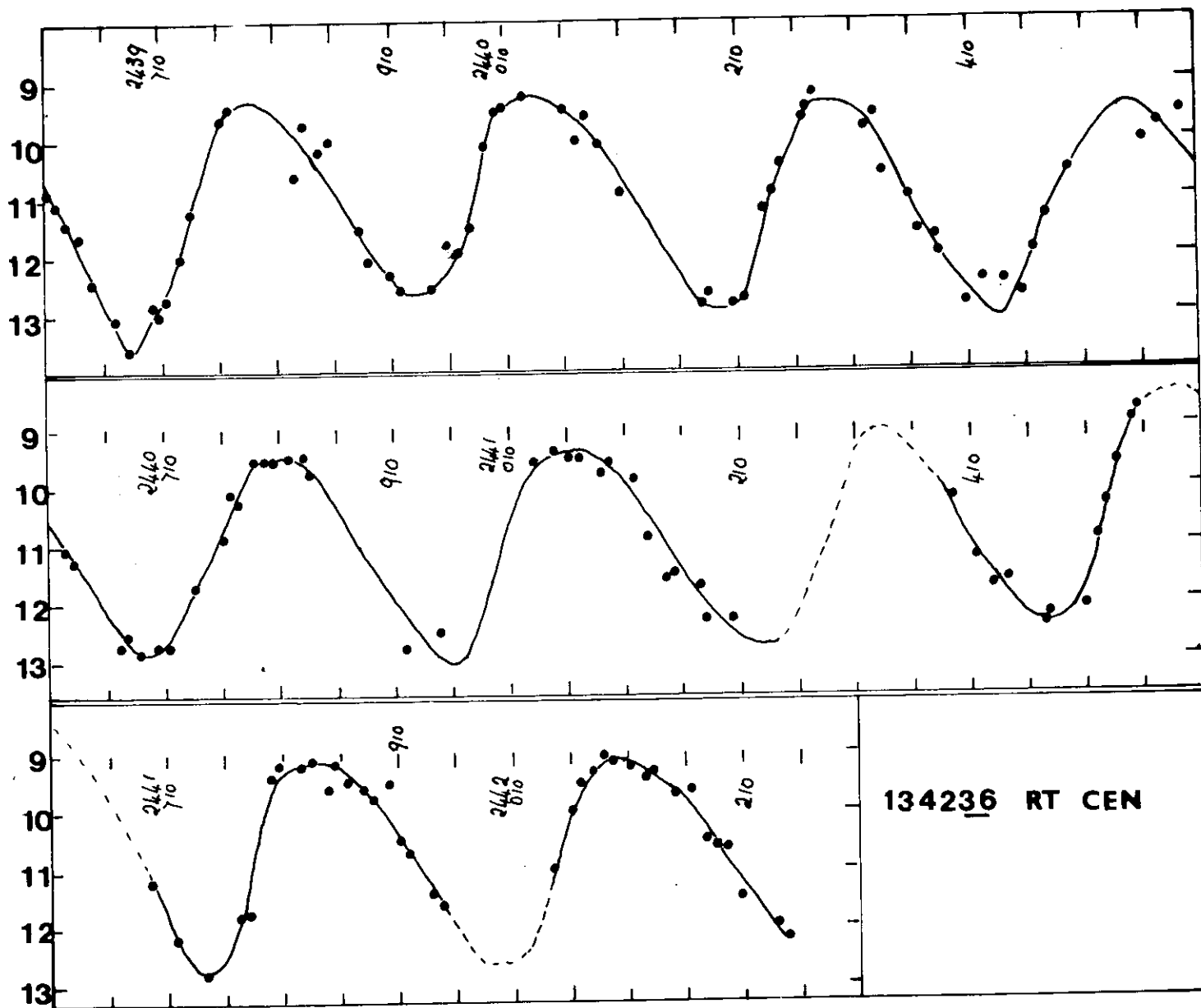
155823 RZ Sco. The observations are fragmentary and almost all by one observer. Average period from observed maxima and minima is 154.9 days. The data is insufficient to provide reasonable predictions of future maxima and minima, especially as both amplitude and period vary/ No O-C residuals determined as fit with Epoch and period in GCVS poor.

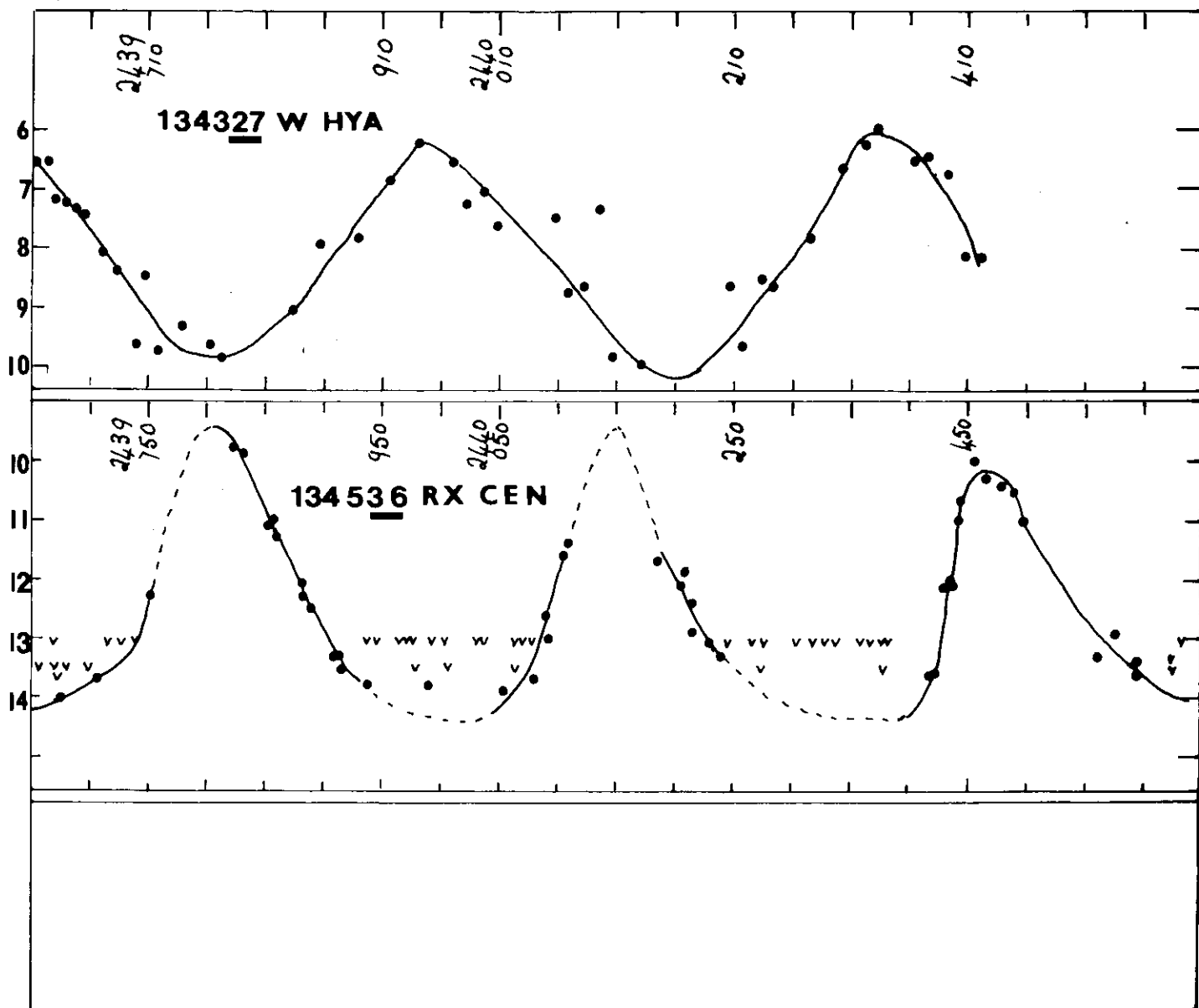
164844 RS Sco. Epoch (Maximum) 2,441,501 ± 313^d.9; M-m 129^d.2.

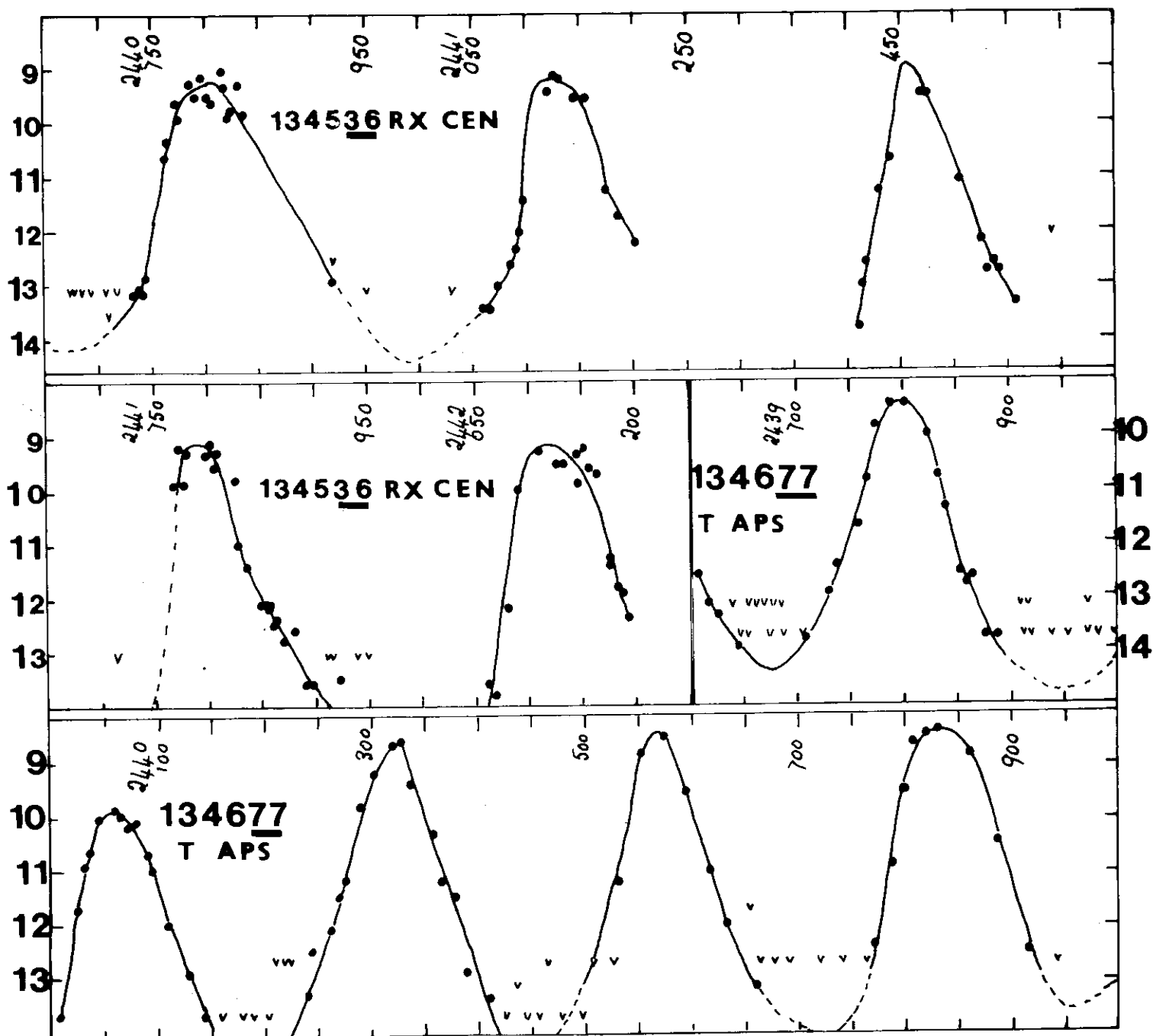
165030aRR Sco. Epoch (Maximum) 2,441,477 ± 279^d.71; M-m 123^d.7

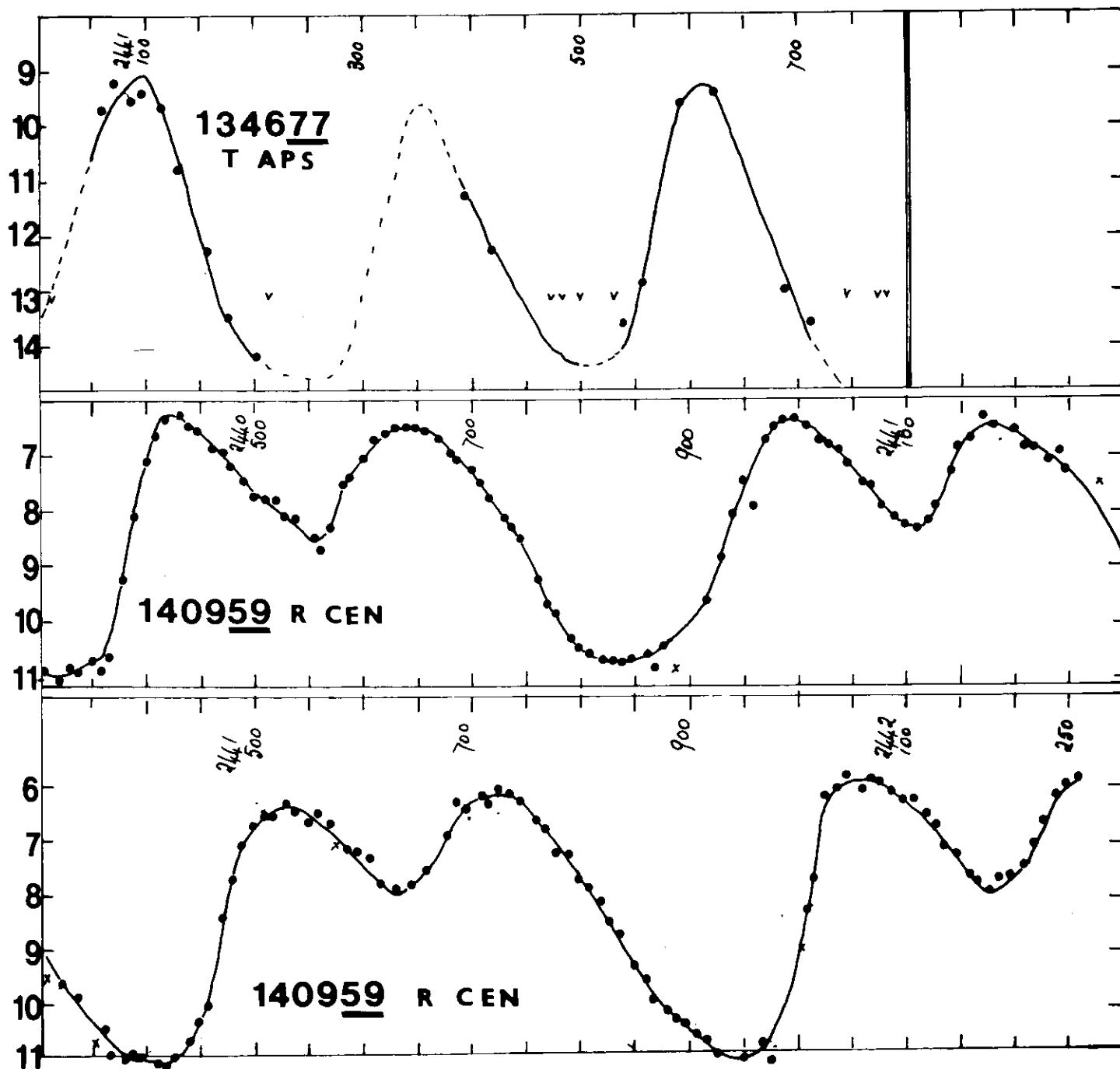
N.B. In the above Table the interval (M-m) refers to the time of brightness increasing.

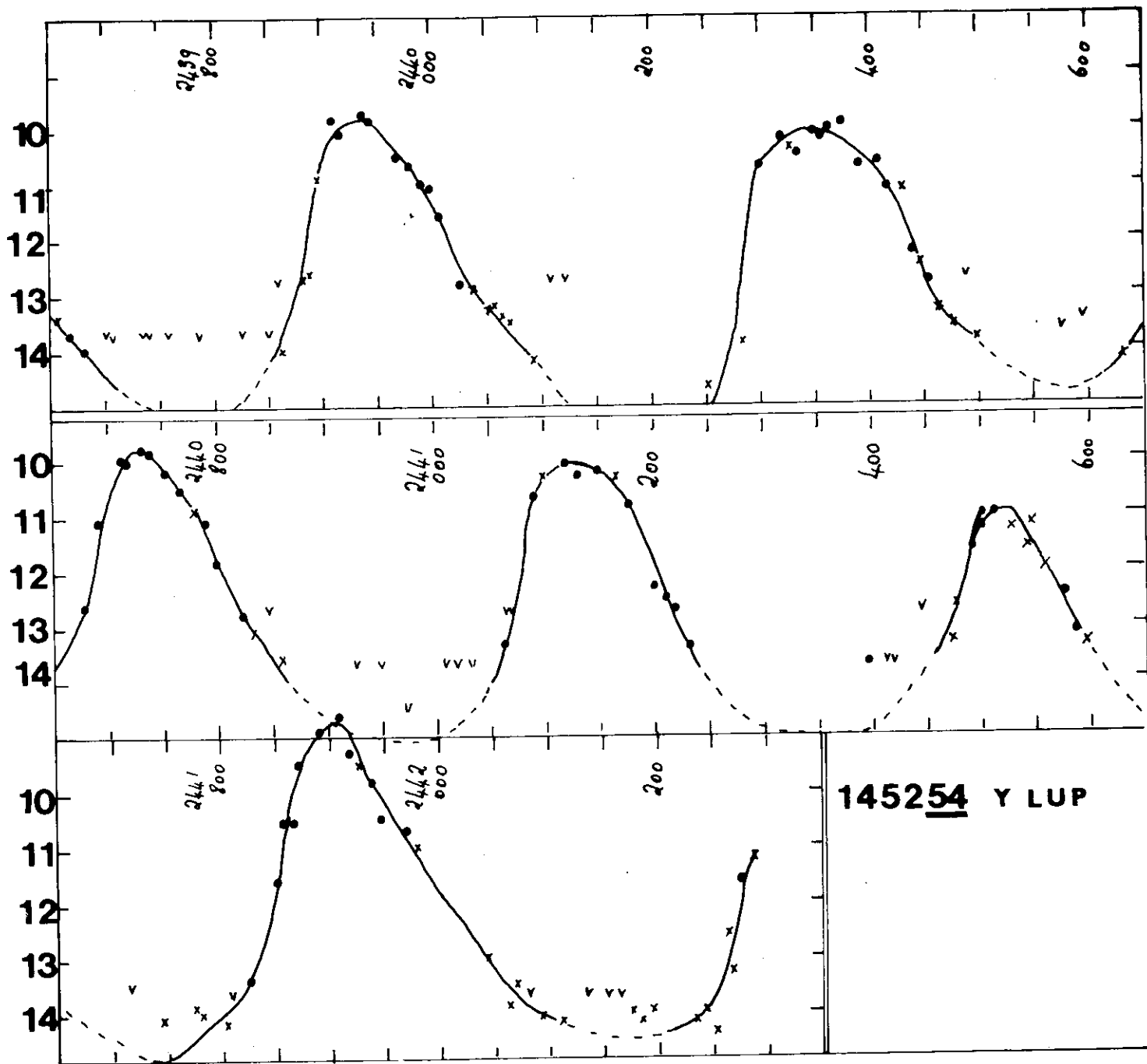


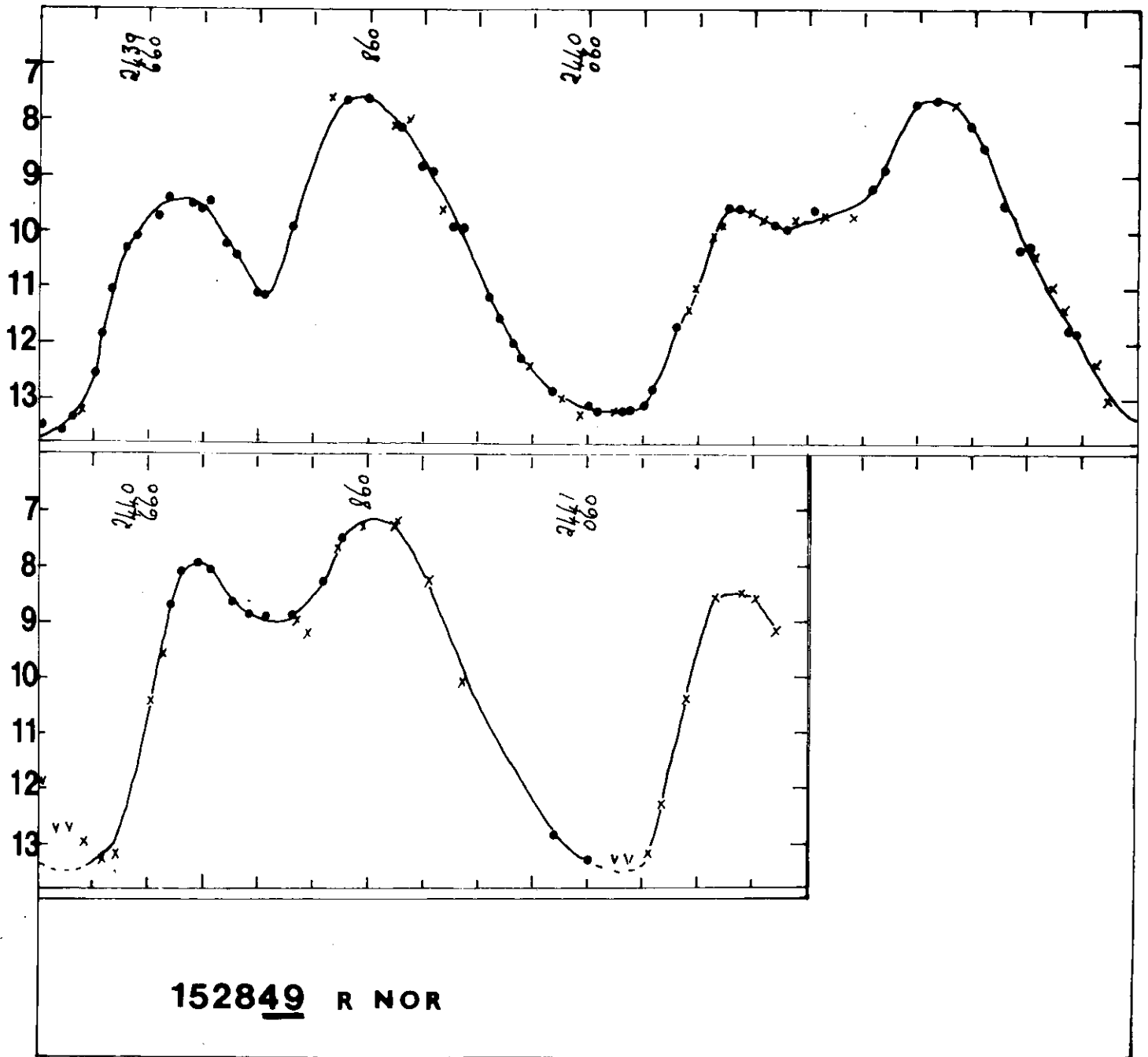


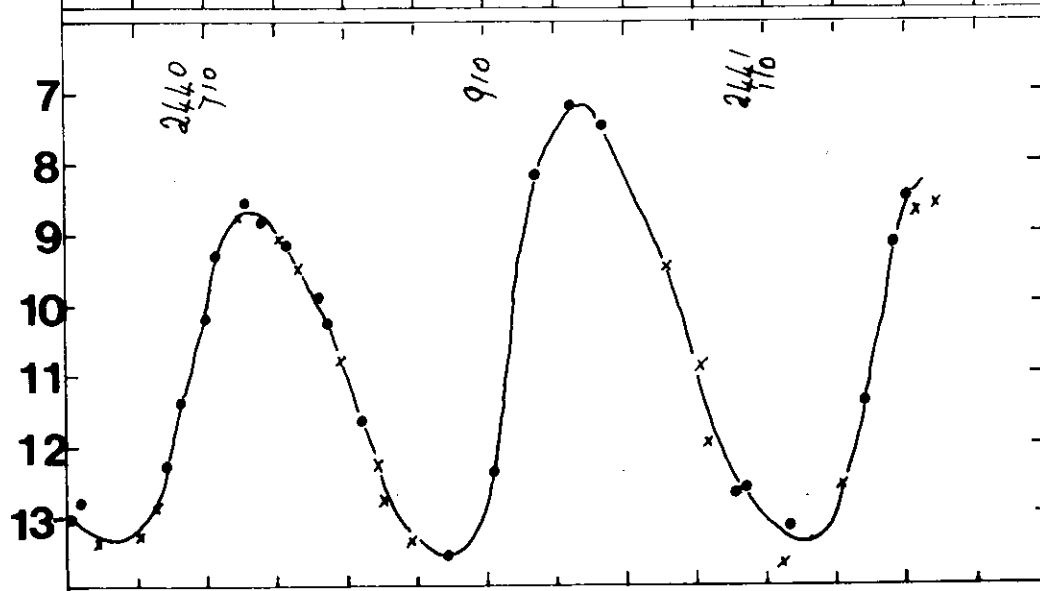
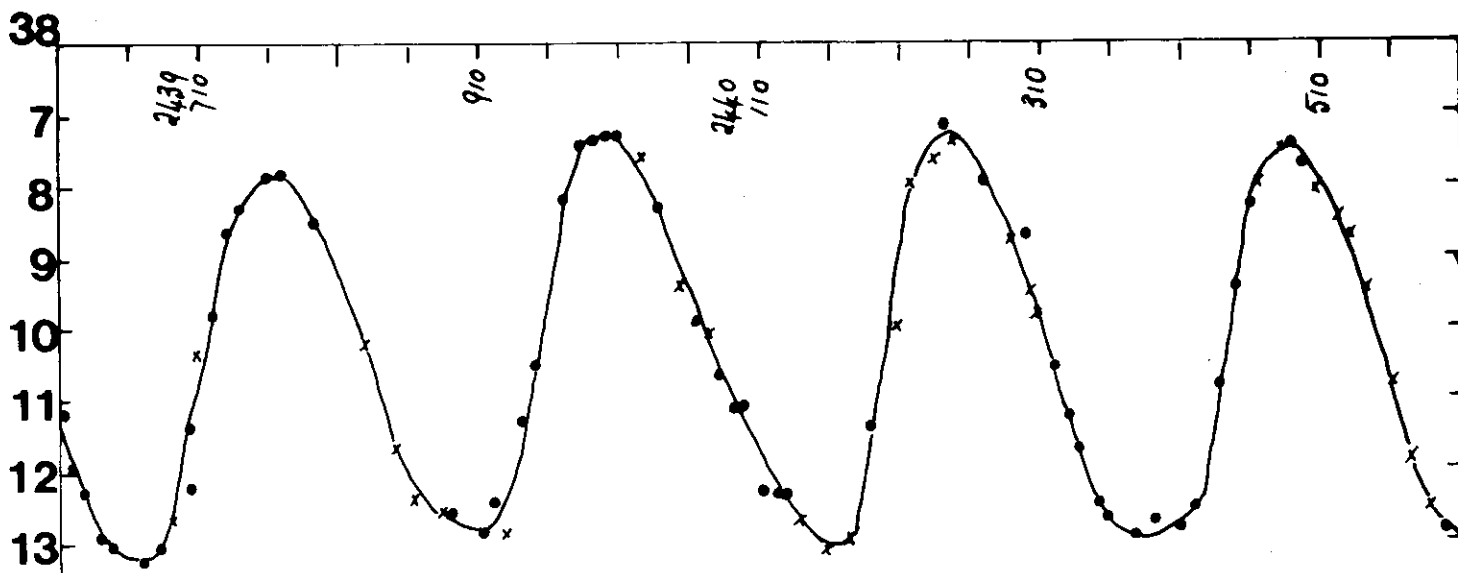




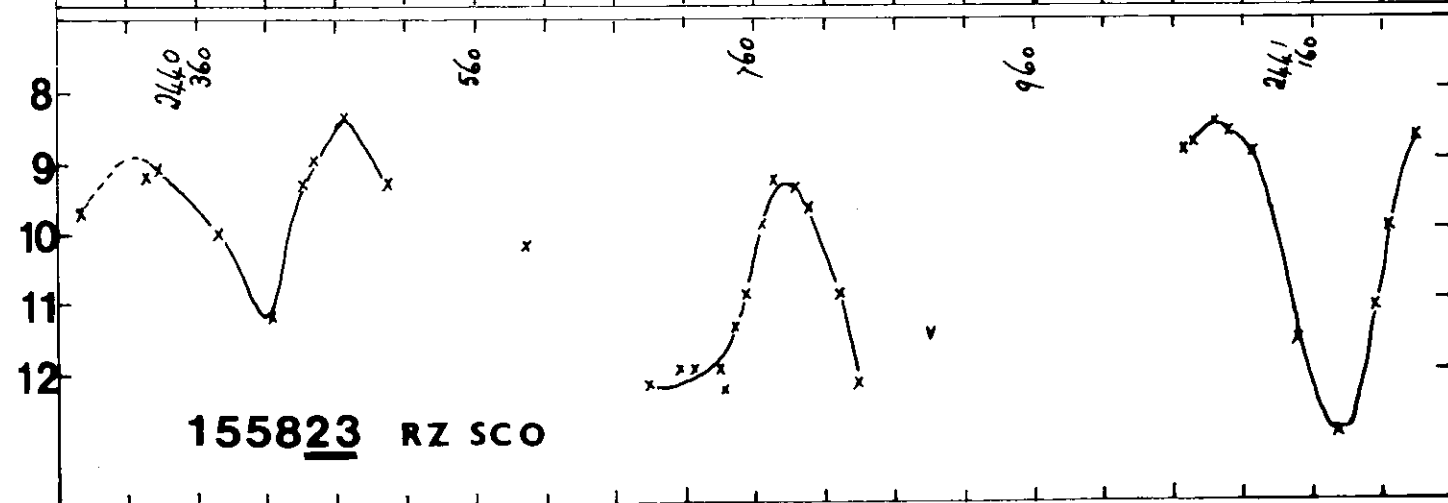
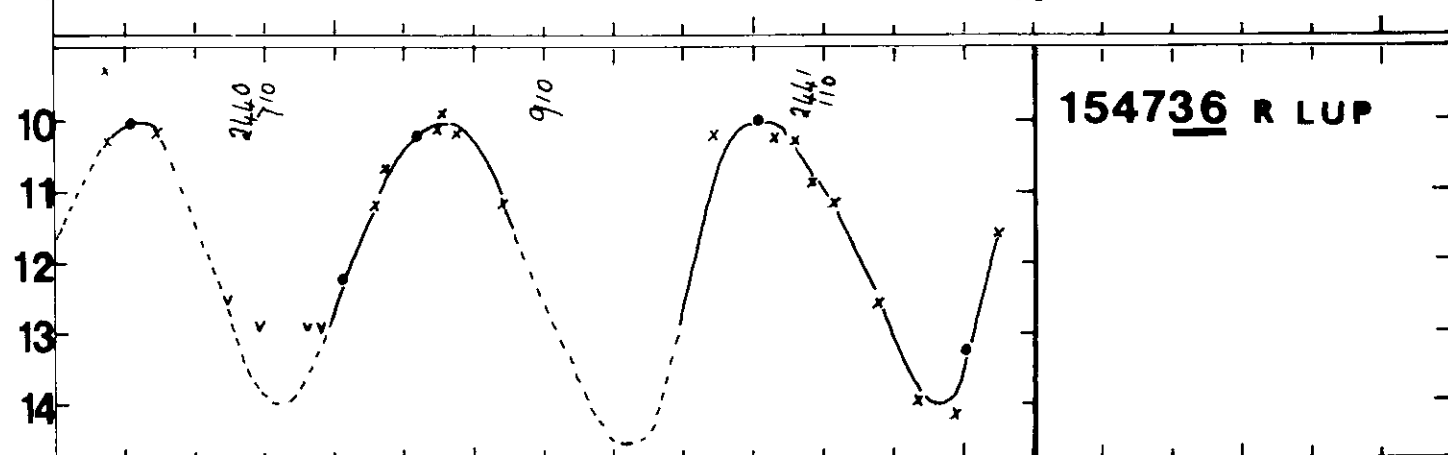
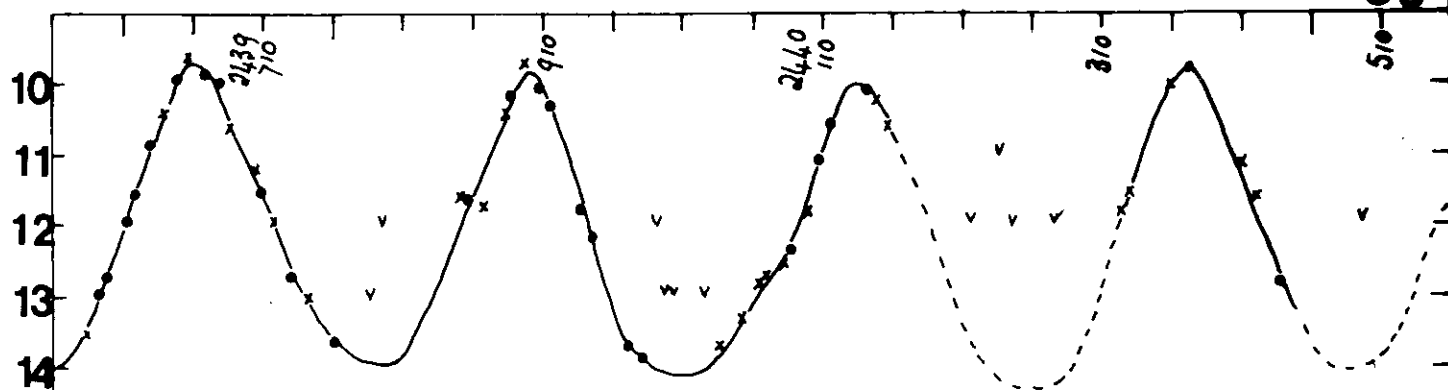


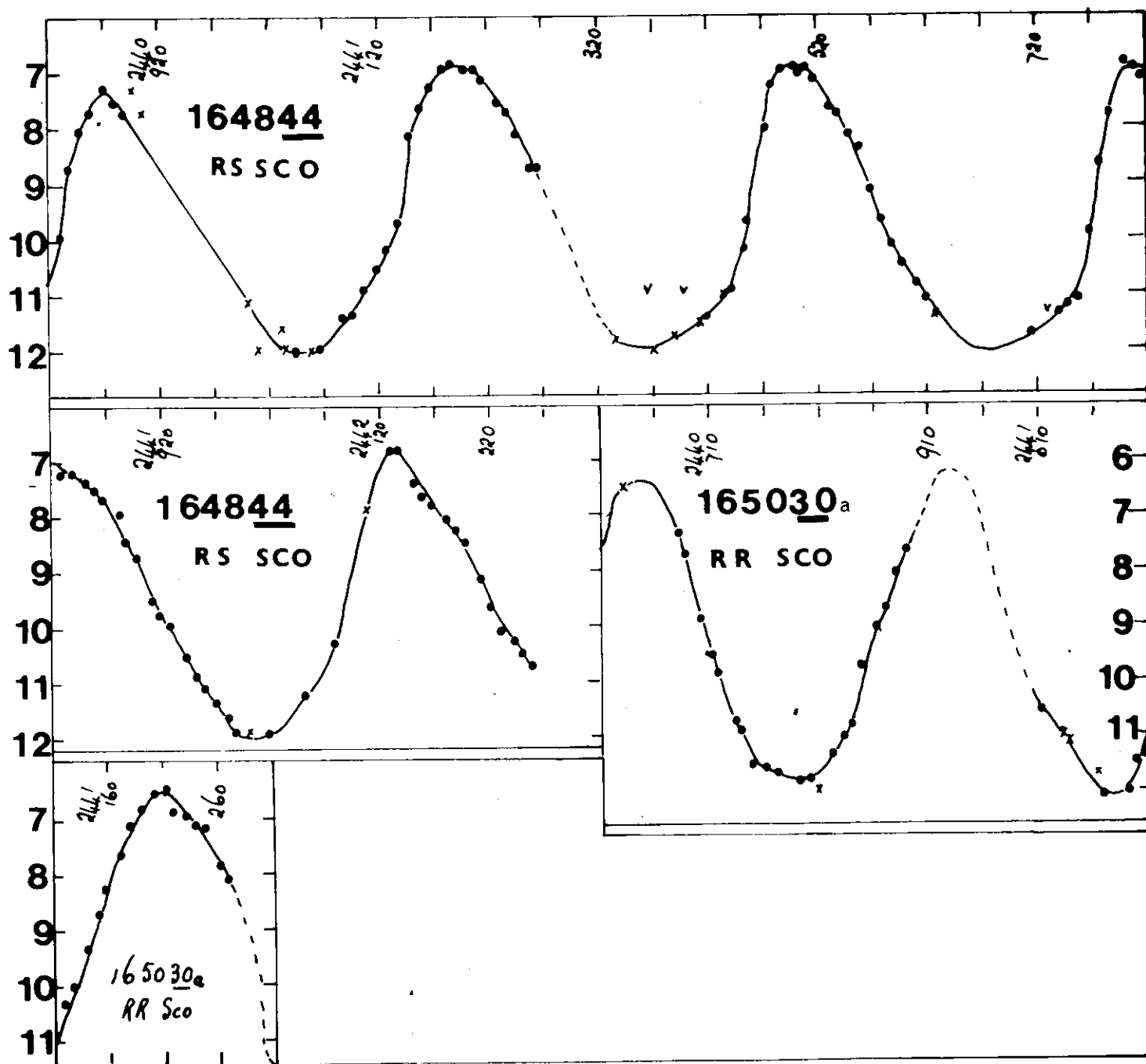


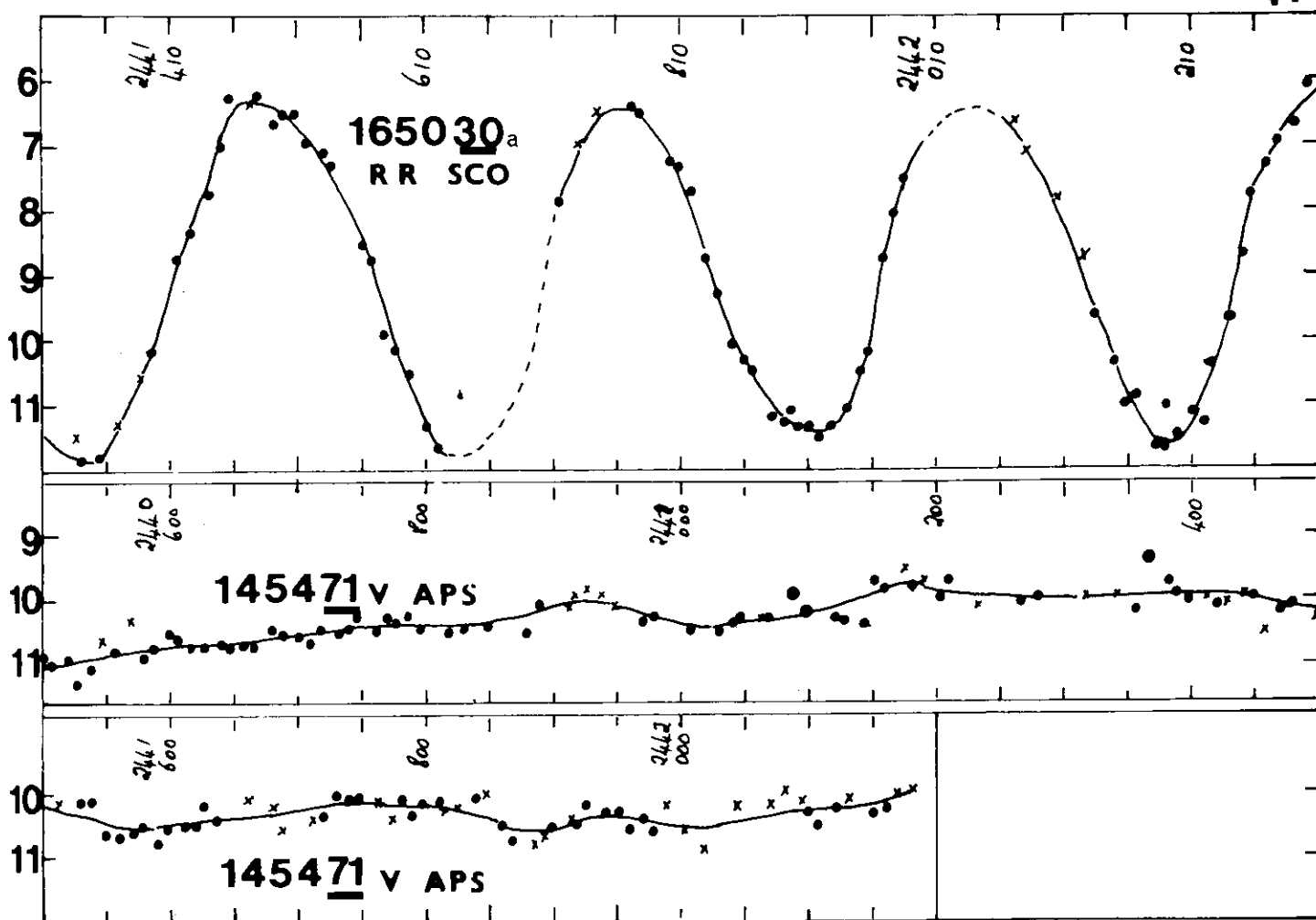




153654 T NOR







SOME PREDICTIONS FOR 1975.

Frank M. Bateson.

Predictions of maxima and minima for a number of Mira variables are given below. Observers are reminded that such predictions are subject to some uncertainty because this class of variable stars have mean periods, from which a particular star deviates from one cycle to the next.

An inspection of the light curves reproduced in this, and the previous, publication will also show that the amplitudes of many of these stars also vary. Hence the magnitudes shown are merely an indication to the observer as to whether he is likely to be able to make useful observations, which will be dependent on the threshold of his instrument.

The dates given are expressed in G.M.A.T.

<u>MAXIMA</u>				<u>MINIMA</u>	
000339	V Scl	Feb. 14	9.8	July 18	14.6
		Dec. 7	9.5		
001032	S Scl	Nov. 6	6.5	May 15	13.0
001862	S Tuc	Aug. 22	8.8	May 8	14.6
002438a	T Scl	July 5	9.0	March 30	13.0
				Oct. 20	13.0
002546	T Phe	Feb. 19	9.4	Aug. 13	14.2
		Nov. 28	9.4		
004435	X Scl	March 3	10.6	July 12	14.6
		Nov. 20	10.6		
011556	W Phe	Jan. 31	8.9	Aug. 11	14.0
		Dec. 30	8.9		
025050	R Hor	Oct. 17	5.4	May 8	13.2
121155	BH Cru	Sept. 5	7.4 (1)	May 9	9.5 (1)
				Nov. 2	8.2 (11)
133155	RV Cen	Nov. 24	7.6	March 20	10.7
133633	T Cen	Jan. 10	6.0	Feb. 27	8.0
		Apl. 11	6.0	May 29	8.0
		July 11	6.0	Aug. 28	8.0
		Oct. 9	6.0	Nov. 26	8.0
134236	RT Cen	July 18	9.4	Apl. 6	13.0
				Dec. 18	13.0
134327	W Hya	Nov. 30	6.0	May 15	9.8
134536	RX Cen	Jan. 15	9.2	Aug. 10	<14.0
		Dec. 9	9.2		
134677	T Aps	Sept. 15	9.4	May 26	<14.0
140959	R Cen	July 23	6.4 (1)	March 22	11.0 (1)
				Nov. 19	8.0 (11)
145254	Y Lup	Oct. 16	10.0	May 23	<14.0
152849	R Nor	Jan. 1	7.6 (11)	Aug. 15	13.5 (1)
		Dec. 16	9.0 (1)		
153654	T Nor	Jan. 17	7.5	June 13	13.2
		Sept. 16	7.5		

<u>MAXIMA</u>					<u>MINIMA.</u>		
154736	R Lup	March	17	10.0	July	13	14.0
		Nov.	8	10.0			
164844	RS Sco	Jan.	30	7.0	Aug.	2	12.0
		Dec.	10	7.0			
165030a	RR Sco	July	2	6.2	Feb.	28	11.8
					Dec.	5	11.8
212030	S Mic	July	5	8.5	Apl.	6	14.0
					Nov.	3	14.0
214247	R Gru	June	19	8.2	Jan.	30	<14.0
					Dec.	22	<14.0
221230	R PsA	June	20	9.0	Feb.	6	14.4
					Nov.	29	14.4
221938	T Gru	March	20	8.4	Jan.	13	11.8
		Aug.	4	8.4	May	30	11.8
		Dec.	20	8.4	Oct.	15	11.8
221948	S Gru	July	21	7.0	Jan.	29	<14.0

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INDEX TO VARIABLE STAR SECTION CIRCULARS Nos. 1-199

C.W. Venimore

The following pages contain a complete index to the Circulars of the Section from No. 1 to No. 199, after which the Circulars were superseded by the new style Publications.

The Index has been framed to provide the easiest way of locating any particular subject. Thus sequences for the individual stars can be found both under a particular star's designation, arranged in constellation order, and again under the heading of Sequences.

Observations, as published in those Circulars containing the records of the Section, are indexed only under the general heading of observations and have not been cross indexed under each individual star since this would make the index too long. However, when a Circular has dealt with one star exclusively it can be found indexed under the star's designation.

It is hoped that the Index will prove useful to those using the Circulars. I have found it quite useful myself. It does show the vast amount of useful published data that has been issued since the formation of the Section.

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NOTE FROM DIRECTOR.

I would like to express my sincere thanks to Rev. C.W. Venimore for the vast amount of time he has devoted to compiling the foregoing Index. I am sure that it will prove to be most useful to members.

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