A A V S O   A B S T R A C T S

Edited by R. Newton Mayall

PAPERS PRESENTED AT THE CHICAGO MEETING, MAY 29-31, 1959

The 48th Spring Meeting of the AAVSO was held in Chicago, Illinois, May 29-31, 1959, at the kind invitation of the Chicago Astronomical Society and Dr. Albert V. Shatzel, Director of the Adler Planetarium.

Chicago lies at the bottom of and on the west side of Lake Michigan. It is a central location for our midwest, western and southern members, many of whom attended the meeting. Those who arrived on Thursday night had the opportunity of observing a typical tornado sky. In fact, tornado warnings were broadcast, but fortunately the tornado did not develop. However, a heavy storm with high winds did take its toll.

The Adler Planetarium, where our meetings were held, is situated at the end of a causeway that stretches almost a mile into the lake. On either side of the causeway are boat basins, full of activity, and nearby is an airfield with frequent helicopter service to Chicago's many airports.

The hot weather usually associated with Chicago did not materialize -- in fact it was quite cool during our stay. The planetarium, being in the lake, so to speak, was an ideal location. The view of the Chicago skyline from the planetarium at night is one of beauty. From this vantage point, the magnitude of Chicago's development can be seen. Perhaps the most outstanding characteristic of the city is the Lake Shore Drive which parallels the shore for many miles. Along the Drive and the shore, large parks and recreation areas have been developed.

Chicago is the home of the great Marshall Field department store, the world-famous Merchandise Mart, and many other prominent structures. On the cultural side is the Chicago (Field) Museum of Natural History, the Art Institute, Shedd Aquarium, Museum of Science and Industry, and many others.

Chicago has much to offer the traveller, and our members made the most of their time. Dr. Shatzel and his staff did everything possible to make us feel at home. Following his Friday evening planetarium talk, we had the opportunity of examining the Zeiss instrument and having its intricate operation explained. Dr. Shatzel also personally conducted us around the Museum and explained the exhibits. Here, the famous Mensing collection of astronomical instruments is on display.

Friday evening we gathered in the planetarium lecture hall to hear a talk by our friend, Dr. George Van Biesbroeck of Yerkes Observatory, on the subject of Mira (see page 2).

Saturday morning, Andrew A. Hay, President of the Chicago Astronomical Society, opened our meetings with a welcome to Chicago. After a short business session, the papers were presented. The official photograph was taken on the planetarium steps, after which some walked and others drove to the Field Museum for lunch. After lunch, the remaining papers were presented. At 3 p.m. we attended the planetarium lecture on the sun, given by Dr. Shatzel.

Our AAVSO Dinner was held in the Georgian Hotel in Evanston, Illinois, not far from Dearborn Observatory. In order to get everyone to the dinner on time, the Chicago Astronomical Society supplied bus transportation from the planetarium to Evanston and back. After an excellent dinner in a friendly and congenial atmosphere, we visited the Dearborn Observatory. Cloudy skies prevented us from using the 18' refractor, but we did have a chance to see the observatory and its equipment and to watch their giant computer in operation.

We had a wonderful time in Chicago, and we are grateful to Andrew Hay, and his associates in the Chicago Astronomical Society, who did so much to make for a smooth-running and enjoyable meeting; and to Dr. Shatzel, who gave so much of his time to making our visit a profitable one. Surely it will be a meeting long remembered.

Among those we had not seen for a long time are Robert Adams, from Neosho, Missouri, Edward Halbach, Milwaukee, Wisconsin, P.O. Parker and his wife from Griffin, Georgia, A. W. Mount, Fort Worth, Texas, and Curtis Anderson from Minneapolis, Minnesota. Honors for travelling the longest distance go to A. W. Mount, the Mayalls and Percy Witherell, who all travelled approximately 990 miles to Chicago, from Texas and Massachusetts!

* *

OMICRON CETI (MIRA), by George Van Biesbroeck

Mira is an exciting variable. It is the most frequently observed. It has been followed the longest time. Its minimum and maximum are never the same. Let's look at Mira from the standpoint of a double star.

Mira has been a favorite for the spectroscopist to study. It has a typical spectrum of a low temperature star. Bands of titanium oxide show up at maximum, and at minimum there are added aluminum oxide bands. Dr. Alfred Joy discovered a series of peculiar lines, and became convinced that Mira had a companion. This companion is about 10th magnitude. If the orbit can be determined, then the mass, weight, etc., can be determined. As a consequence of this discovery, Mira is observed not only by the AAVSO, but by double star observers as well. The companion also varies.

At certain minima of Mira, the companion stands out, whereas at others it does not. From the difference in brightness between Mira and its companion, we can determine the true brightness of Mira. When we observe Mira, we observe the total brightness, therefore the curve probably should be dropped 0.7 magnitude. The distance of the companion varies from about 0".5 to 0".9. The shape of its orbit is undetermined. It could be circular or eccentric. Circular orbits are a rarity. Measures made so far indicate a period of about 100 years. The stars are getting closer together, therefore the companion is becoming more difficult to observe.

F. G. Pease measured the diameter of Mira and found it to be about 300 times the diameter of the sun. Mira's density is equivalent to a very low vacuum.

Today the variable star observer, the spectroscopist, and the double star observer all are watching Mira. It is with this combination of effort that we establish information about a star. (Reported)

BODE'S LAW MODERNIZED, by George Diedrich

The modernization of Bode's Law really hinges on only one "trick" which makes the law work for all the planets -- even Neptune and Pluto, which up to now had resisted the utter simplicity of this famous law formulated by Bode as far back as before the American Revolution. As long as there were nothing but naked eye planets, and even with the addition of Uranus, the Law worked fine as a means of quickly getting an approximate distance of each of the planets from the sun.

As most readers of this article undoubtedly already know, the sequence of numbers put down by Bode furnished strong evidence that a planet, or piece of one, ought to exist at about 2.8 Astronomical Units away from the sun. And indeed when Ceres, the first asteroid, was found, its average distance was 2.77 Astronomical Units. Of course asteroids being what they are -- scattered all over the sky, so to speak -- many of them do not stick too closely to this 2.8 figure, but at least the initial impetus for looking for asteroids was generated by this law.

We get the distances to the planets by writing down a series of numbers, as shown in line 1 in the table below. This would normally mean ten numbers ending in 768. To each number is added 4 (line 2), the sum giving the series in line 3. It has been theorized that Pluto may at one time have been a moon of Neptune. Whatever catastrophe flung Pluto into its separate orbit around the sun, also may have generated enough energy to slide Neptune in closer to Uranus. However, for the purpose of Bode's Law it will suit us quite well to eliminate the 772 column entirely, slide Pluto over to the 388 column, and in order to provide a spot for Neptune, let us just arbitrarily take the halfway point between Uranus and Pluto [(196 + 388) ÷ 2 = 292] and see what this does to our approximations of distances to the sun.

If we take each of the numbers in line 3 and divide by 10, we have a new series, line 4. Under the column "Earth" we have 1.0 which we call the Astronomical Unit (A.U.). Let's simplify the law once more, so that it will be easy to remember the law without even calculating the numbers. This is done by the rounding of numbers in line 4, as shown in line 5. Line 6 shows the actual average distances from the sun in A.U. Compare line 6 with line 5. See how nicely they fit.

If we further manipulate these numbers, by multiplying line 5 by 100 we get the series in line 7. The actual distances of the planets in millions of miles is given in line 8 (compare with line 7). Certain discrepancies are noted. But instead of multiplying 7 by 100, multiply by 93 and the result is given in line 9, which gives numbers very close to the actual distances.

In summary then, three points are made in this article which are not part of the original Bode's Law:

1. Do not carry the 3, 6, 12 series to 768, but rather stop at 384.

2. Since Pluto now occupies the 384 spot, provide a place for Neptune halfway between Uranus and Pluto.

3. In the cases of planets out to the asteroids keep the decimal point but make the five most distant planets the even numbers of 5, 10, 20, 30, 40, and the A.U. will come very close to this rounded, modernized version of Bode's Law.

In these days when many of us are called on to explain the solar system, satellites, and astronomical phenomena to many individual or groups, it was my feeling that a simple way to remember planetary distances would be welcomed. I hope you will find this of some help.

								x one-half			
	Mercury	Venus	Earth	Mars	Asteroids	Jupiter	Saturn	Uranus	Neptune	Pluto	
1) Bode	0	3	6	12	24	48	96	192	288	384	768
2) +4	4	4	4	4	4	4	4	4	4	4	4
3) =	4	7	10	16	28	52	100	196	292	388	772
4) ÷ 10	.4	.7	1.0	1.6	2.8	5.2	10.0	19.6	29.2	38.8	
5) Rounded	.4	.7	1.0	1.6	2.8	5	10	20	30	40	
6) A.U.	.39	.72	1.0	1.52	2.77	5.20	9.53	19.19	30.07	39.5	
7) R x 100	40	70	100	160	280	500	1000	2000	3000	4000	
8) Millions of miles	36	67	93	141	256	483	886	1783	2791	3671	
9) R x 93	37	65	93	149	270	465	930	1860	2790	3720	

GRAPHIC STUDY OF V SAGITTAE, by Robert M. Adams

V Sagittae is an active irregular variable with some indications of possible periods of light fluctuation that may be more or less regular. It has a range of approximately 3 magnitudes. Previous studies of this star seemed to indicate a period of some 530 days and one of 17 days, but with erratic behaviour. (Graph displayed was based on AAVSO Quarterly Reports 18-21 inclusive, comprising observations over a period of 1,600 days. ED.)

Previous studies of V Sagittae were compared with the graph. There were indications of the existence of a 530 day period. A peak is noted at JD 2434557 and 5055. There is another peak at JD 3980 which is 577 days earlier than 4557. Thus it can be seen that this period varies from about 500 to 580 days with a median of 540 days. I made a 17 day scale and discovered there were a few rather ill-defined peaks of around 15 to 20 days. Examples are JD 3812 to 3831, 4607 to 4617, and 4930 to 4945. On the basis of our limited evidence, I would question the 17-day period.

The results of this graphic study seem to point up two or three significant possibilities. Except for the 540 day period, there do not seem to be any clearcut periods. Then there seem to be day to day light fluctuations and in spite of a lack of long-time hourly studies, there are growing indications that at times the light varies from 0.5 to 1.0 magnitude in very short time spans. There is little indication of light variation in the period 3950 to 3970. The period from 3990 to 4007 shows little or no light fluctuations. In other words, you seem to go along for 10 or 20 days with little light variation, to be followed by a period of many light changes. Generally speaking there seem to be more periods when there are light fluctuations than periods of steady light.

This brings me to the subject of accuracy in our reports. I know that visual readings are not as accurate as photoelectric measurements but there are far more observations per unit of time. Then I think our observations have a way of being ironed out in the long run. Perhaps each observer should have something like a K number attached to him. There should be long period studies of this star on an hourly basis much like the studies of the flare stars, and a beginning is being made in this direction as indicated in Quarterly Report 21. An interesting approach to the problem would be for two observers to observe as a team over, say, an hour or two several times a month.

Next to the indication of periods of rapid light fluctuations the occurrence of alternate periods of inactivity and activity mentioned above is most intriguing. It looks as if this star has plateaus of little light variation while it works its way up to maximum or down to minimum, and then periods of maximum and minimum are relatively long with almost constant minor light changes.

The more one gets into the study of this star the more one becomes intrigued by its gyrations. Its erratic variations may indicate several overlapping patterns which can be determined only after many years of combined visual and photoelectric observations. To me it is the most fascinating of the problem stars.

COSMIC RAY DATA AND VARIATIONS OF W ORIONIS, by Takashi Murayama

(Prof. Murayama's paper arrived in the form of a letter, which is being reproduced in full together with his accompanying diagram. ED.)

"Dear Mrs. Mayall: I am extremely grateful to you for sending the data for the variable W Orionis. It was very useful for my study. In our laboratory, search for the cosmic ray sources was continued for about 5 years with altazimuth cosmic ray telescopes, and found that the intensity of cosmic rays from the position ($\alpha \sim 5^h00^m$, $\delta \sim 0^\circ$) is higher than that from other positions on the celestial sphere. In view of the fact that the intensity of cosmic rays from this position shows remarkable time variation, and that this position accords with that of W Orionis, I have tried to compare the intensity of cosmic rays with the brightness of the star.

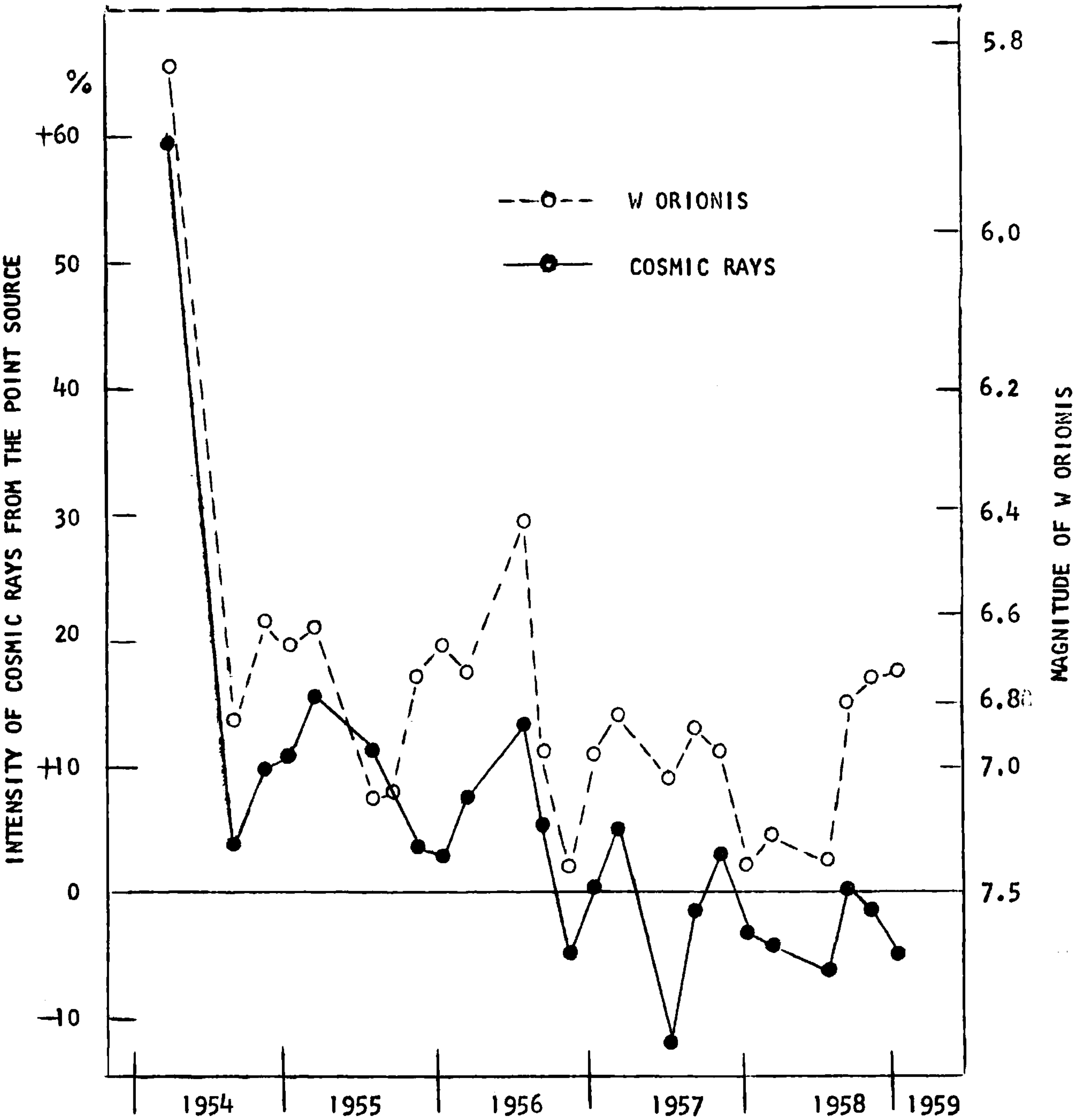
The result is shown in the figure enclosed. The magnitude of the star in this figure is a weighted mean value of those by the AAVSO and by the Japan Astronomical Study Association.

Agreement between the two curves in this figure is satisfactory, considering the experimental errors, which suggests that this star is one of the remarkable sources of cosmic rays. This result was reported at the conference on cosmic rays in Japan, and will be reported at the national conference on cosmic rays to be held in Moscow USSR in July of this year (1959).

To confirm this conclusion, further observations of the star and the cosmic rays are necessary. I should be very much obliged if you would kindly send me the data for W Orionis hereafter."

(Signed) Takashi Murayama, Physical Institute
Nagoya University, Chikusa, Nagoya, Japan

Diagram by Takashi Murayama



ASTRONOMICAL POSTAGE STAMPS, by Joseph A. Anderer

The beauty and variety in postage stamps that depict astronomical objects was presented by numerous kodachrome slides. Stamps from all over the world showed observatories, instruments, constellations, aurorae and sputniks. If you want to specialize in collecting stamps on one subject, no more colorful or interesting subject will be found than in astronomical postage stamps. The six Mexican stamps issued in 1942 for the dedication of the Tonanzintla Observatory, depicting wellknown objects such as the Ring Nebula, and so forth, will make an excellent nucleus. (ED)

EXPLANATION OF PHOTOGRAPHIC LIGHT CURVES OF VERY SHORT PERIOD VARIABLE STARS, by Chang Yuin *

For the very short period variable stars including all cluster, beta Canis Majoris, RR Lyrae types, etc., whose photographic light curves were estimated from the Harvard Patrol plates, with exposures of about one hour, it has long been known that the shorter the period (a) the smaller the amplitude of light variations; (b) the more symmetric the form; (c) the more round the maximum, or the width at the maximum more nearly approaches the width of the minimum.

Many prominent statistical investigations had been made to illustrate these peculiarities, by C. Payne-Gaposchkin, Hertzsprung, and many others. These superficial phenomena have been hitherto considered as the proper property or characteristic of the short period variables, including eclipsing variables.

We cannot say on scientific footing that these general appearances in the photographic light curves of both short period variables and eclipsing systems, are not real characteristics. But through theoretical research the writer finds that these appearances were exactly coincident with results depending upon the method of photographic observations, and they do not represent their proper property or characteristics. We know that the majority of light curves of short period variables were estimated from the photographic plates with exposure time averaging about one hour or more. If their period of light variations were as short as or less than half day or 12 hours, I found that the ratio of period to exposure time can determine the magnitude of the above appearances. In other words, if the ratio is much smaller than 1/12, the effect is more prominent. We face ,therefore, that all published light curves or elements evaluated from such photographic light curves of short period variable stars, including the eclipsing binaries, should be overhauled or corrected by new photographic or photoelectrical observations, or by means of a theoretical research as shown.

When a photographic observation of a star is taken, the following physical conditions should be satisfied: a) the intensity of light from a star may be expressed by the quantity of photons or quanta it radiates.

b) The flux of photons may be considered as a bundle of light which went out from the star and reaches our photographic plates.

c) If the quantity of radiating light is constant, this bundle would be expressed by a long run cyclinder, otherwise this cyclinder would change in thickness or in diameter in the course of variation.

d) The form of this bundle of fluctuating light may be represented by numberless consecutive cones, one after another.

e) If a photographic plate vertical to the direction of light is moved in constant speed from one side to another, the image on the plate has a form of long consecutive cones.

f) If the plate is constantly directed to the star, its image on the plate is a single point. The size of this point should be proportionate also to the quantity of light received. But this quantity of light depends upon the length of exposure

* Died, October 27, 1958, in Kowloon, Hongkong.

time and the intensity of radiating photons or geometrically upon the volume of the consecutive cones formed by the flux of photons that strike on the plate.

I have computed theoretical light curves for a series of periods less than one day, assuming an exposure time of one hour. It is evident that the shorter the period of light variation, the longer the plate covers the cones of light flux in each exposure. We can see that during the exposure time, the plate may cover altogether the ascending and descending branches of the light curves, especially in those last few shortest period stars.

When the exposure time "t" is equal to the period "P" of the light variation, there would be no more variation in image, i.e., we cannot in any way detect the light variation of the star, even if it is a real variable! That is why we have not as yet discovered any variable star whose period of light variation is shorter than one hour, although they really exist! In the field of variable star study, we recognize CY Aquarii as the shortest one, P = 0.061 day, or about 88 minutes. My conclusions are:

1. The deviations of all published light curves evaluated from conventional photographic observations of very short period variables are unavoidable depending upon the method of observations, and are not due to their proper property.

2. All elements evaluated from such light curves including the eclipsing systems with very short periods should be overhauled or have suitable corrections by graphics.

3. We should also check up all such published light curves with photoelectric observations, or a special new program of photographic observations.

4. The principle of a new program is, briefly, a regular or constant speed moving plate, in order that the images on the plates are not single points but pulsing light trails or in form of consecutive cones.

5. With such new program (the detail description is not included here) we only check up the published light curves evaluated from conventional photographic observations, but also have good hope to discover all very short period (i.e., smaller than 88 minutes) variable stars which we have thought did not exist in nature!

NEW VARIABLE STAR IN CAMELOPARDALIS, by Margaret W. Mayall

Early in 1949 an AAVSO member, Robert Greenley, called attention to a star not far from the variable 053068 S Camelopardalis, which he thought showed variability. He was asked to keep a close watch on it to confirm its variation. David Rosebrugh and several other observers volunteered to help out. Sufficient material has been accumulated during the last 10 years to permit a detailed study of the variable. The star is not in the Bonner Durchmusterung, and the position given is approximate.

The variable appears to be very red, and is probably of late spectral class, but it is too faint to classify on any available plates at Harvard Observatory. Individual observations show very large scatter, in all probability due in large part to the color of the variable, but rapid fluctuations are not ruled out. The extremely large scatter during the first two years is probably due to what we might call "psychological variation." It is usually found in the first observations of a newly discovered variable, when the observer subconsciously estimates the star either brighter around maximum, or fainter at minimum, than it actually is. A preliminary mean curve was formed and the observed dates of maxima and minima were determined. A revised mean curve has been computed from the elements: Maximum = JD 2,433,745 + 366^d x Epoch. Mean range of magnitude is 10.0 to 10.6. (Figure and light curve are given in JRASC Vol. 53, No. 4.)

PROGRAMMING MONTHLY ESTIMATES OF VARIABLE STARS, by Clinton B. Ford

The most valuable reports sent to AAVSO Headquarters generally are those containing estimates on the largest number of different variables. Assuming that each long period star observable with a 10-inch reflector should be estimated at least once a month, the list runs to about 250 different stars per month. In order to avoid confusion and to prevent wasting precious time at the telescope, I have found the form sheet below to be very useful. It allows an observer to see at a glance what parts of the sky have been covered and what is to be tackled next.

THE AMERICAN ASSOCIATION OF VARIABLE STAR OBSERVERS

VARIABLE STARS. . . . MONTHLY CHECK-OFF LIST

FOR THE MONTH OF________19____

R.A. HOUR	FIRST TIME	SECOND TIME	NOTES	ALL POSSIBLE
0				
1				
2				
3				
4				
21				
22				
23				

As the stars in each hour of R.A. are observed, the hours are checked off in the column shown. A check in the "1st Time" column indicates the hour has been run through once, some bright stars in that hour probably being omitted in favor of fainter ones on which estimates are more valuable. The "Notes" column can be used to show partial coverage, or any other incidental information. Clouds sometimes stop observing progress in one hour of RA, but do not affect it in others. By checking off on the form sheet just what has been done, duplication of estimates on a later night in the month can be avoided, even though considerable skipping around the sky may have been necessary on earlier nights.

When all available hours have been covered and checked off in the "1st Time" column, the list can be reworked and checked off in the "2nd Time" column. The "All Possible" column is useful to indicate that all stars which can be reached in the hour have been observed. A check in the "All Possible" column means that both faint and bright variables have been observed, and the hour is finished for the month. It is a great convenience to know at a glance where sky coverage stopped on previous nights, and where to begin observing again, so as to end up with a monthly report of maximum value.

****

formed and the observed dates of maxima and minima were determined. A revised mean curve was then computed from the elements: Maximum = JD 2,433,745 + 365^d x Epoch. Mean range of magnitude is 10.0 to 10.6. (Figure and light curve are given in JRASC Vol. 53, No. 4.)

PROGRAMMING MONTHLY ESTIMATES OF VARIABLE STARS, by Clinton B. Ford

The most valuable reports sent to AAVSO Headquarters generally are those containing estimates on the largest number of different variables. Assuming that each long-period star observable with a 10-inch reflector should be estimated at least once a month, the list runs to about 250 different stars per month. In order to avoid confusion and to prevent wasting precious time at the telescope, I have found the form shown below to be very useful. It allows an observer to see at a glance what parts of the sky have been covered and what is to be tackled next.

THE AMERICAN ASSOCIATION OF VARIABLE STAR OBSERVERS

VARIABLE STARS . . . MONTHLY CHECK-OFF LIST

FOR THE MONTH OF ________ 19____

R.A. HOUR	FIRST TIME	SECOND TIME	NOTES	ALL POSSIBLE
0				
1				
2				
3				
4				
21				
22				
23				

As the stars in each hour of R.A. are observed, the hours are checked off in the column shown. A check in the "1st Time" column indicates the hour has been run through once, some bright stars in that hour probably being omitted in favor of fainter ones on which estimates are more valuable. The "Notes" column can be used to show partial coverage, or any other incidental information. Clouds sometimes stop observing progress in one hour of RA, but do not affect it in others. By checking off on the form sheet just what has been done, duplication of estimates on a later night in the month can be avoided, even though considerable skipping around the sky may have been necessary on earlier nights.

When all available hours have been covered and checked off in the "1st Time" column, the list can be reworked and checked off in the "2nd Time" column. The "All Possible" column is useful to indicate that all stars which can be reached in the hour have been observed. A check in the "All Possible" column means that both faint and bright variables have been observed, and the hour is finished for the month. It is a great convenience to know at a glance where sky coverage stopped on previous nights, and where to begin observing again, so as to end up with a monthly report of maximum value.

****