AAVSO ABSTRACTS

Edited by R. Newton Mayall

PAPERS PRESENTED AT THE CHICAGO MEETING, 27-29 MAY 1966

Once again we held our Spring (55th) Meeting in Chicago, Illinois, on 28 May 1966, at the kind invitation of the Chicago Astronomical Society and the Adler Planetarium.

Our Friday evening lecture was given by Dr. Donald McLeod, of the Physics Department, University of Illinois, who talked on the subject of K - Mesons. After the lecture we went to the roof of the planetarium where we had a wonderful view of the Chicago skyline. The planetarium, built about a quarter of a mile into the lake, affords a magnificient view of the city and the boating on the lake.

Saturday was our business meeting and papers. In the evening we had a sumptuous dinner at the Pick Congress Hotel. After dinner Clint Ford entertained with colored slides of his trip to the Caribbean last winter. Following him, Tommy Cragg kept us in good humor talking about the things that happen to an astronomer that are not taught in the physics books.

A special session was held on Saturday afternoon on Eclipsing Binaries. David B. Williams, Chairman of our new Eclipsing Binary Stars Committee presided and presented a very fine program. Another special session was held on Sunday morning on the U Geminorum stars. Thomas A. Cragg presided and invited remarks were given by Carolyn Hurless and Clinton B. Ford.

Gerald Schultz, Mr. Robert Johnson and Mr. Slemp, of the planetarium, and many others from the planetarium and Chicago Astronomical Society did everything possible to make our visit a memorable one.

The honors for farthest distance travelled go to Tommy Cragg of Mt. Wilson, California. Then, too, our friends Robert Johnston (Toronto) and Frank De Kinder (Montreal) came in from across the northern border. Among the missing were Cy and Emily Fernald, Ralph and Annie Laurie Buckstaff, Curtis Anderson, and our President, Ed Oravec.

There is little doubt that a good time was had by all in Chicago, the Windy City -- and it was that.

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THE AAVSO ECLIPSING BINARY PROGRAM, by David B. Williams

An eclipsing variable star is a binary system whose orbital plane is coincident with our line of sight, so that once in each revolution the primary star is eclipsed by its companion. One half period later there is a secondary eclipse when the lesser member is eclipsed by the brighter, but this is frequently too small a difference to be easily noted visually. Almost every eclipsing variable that has been adequately studied for a length of time has shown changes in its period, revealed to us by a progressive acceleration or retardation of the times of eclipse. Unfortunately, very few of the almost 3,000 known eclipsing systems have received more study than the initial investigation necessary to classify it as an eclipsing star and to determine its average period. There is therefore an immense field open to the amateur observer with a small telescope in the timing of eclipses of these stars for the purpose of following their period changes, which are an indication of internal disturbances in the binary pair of interest to professional astronomers.

For several years a number of AAVSO observers have timed minima in cooperation with Sky and Telescope, which frequently publishes finder charts and predictions for eclipsing variables. This participation indicated that with AAVSO sponsorship the program might be greatly expanded and become a major source of timings for professional studies. At the 1965 Fall Meeting in Cambridge the Council decided to form an Eclipsing Binary Stars Committee. David Williams, the Chairman, is general coordinator of the program, and has also produced a set of charts of selected eclipsing variables which he now distributes, in addition to producing monthly prediction sheets and the Eclipsing Variable Star Circular containing news and information for the observers. Leif Robinson, of Sky and Telescope, has taken on the task of reducing the many runs of estimates and preparing them for publication. Due to the greatly increased number of timings, Sky and Telescope is no longer able to print them, and all the results since the summer of 1965 have appeared in various numbers of the I.A.U. Information Bulletin on Variable Stars published by the Konkoly Observatory in Budapest.

To date, four of these lists have been published (IBVS #'s 111, 114, 119 and 129). All together 335 individual timings of minima of 47 different eclipsing stars have been included. This was the work of 28 observers. Observing instructions and information about the program were distributed to all AAVSO members early this year.

At present, however, there is a great need for more regular observers. Currently two observers are making over half of the timings, leaving the other half for two dozen observers. Robert Monske, of Mercer, Pennsylvania, has timed just over one third of all the published minima; Marvin Baldwin, Whiteman AFB, Missouri, has contributed one fifth of the results. What the program needs is about a dozen observers who will time just one or two minima per month, but do this every month. This would create a greater stability and more even coverage for the program in general. This small monthly contribution would not have to interfere with regular AAVSO work. Several of the top observers have found that they can monitor an eclipsing star with a pair of binoculars or a smaller second instrument while continuing their long period work with a main instrument, thus losing no time in repeated returns of their regular instrument to the eclipsing star's field.

Due to the large part allowed to individual initiative and interests, the program's future course will depend to a large extent on the observers themselves. The continuation and enlargement of the regular list of eclipsing stars on the program seems assured, and it is also apparent that the observers will continue to do a lot of "hunting", picking little-known eclipsing stars and, producing their own comparison sequence and predictions, studying them in the hope of finding an undiscovered period change from their own observations. It is hoped that as more observers gain the needed experience, much more work can be done on the more difficult stars, those of small range or longer duration of eclipse. A general extension of the program into the area of the RR Lyrae and Cepheid variables is also possible. But whatever the future additions and improvements may be, the AAVSO has certainly now established itself as one of the very few major sources of timings of eclipsing star minima.

NEW FINDINGS ON ECLIPSING VARIABLE V342 AQUILAE, by Marvin E. Baldwin

Last year I wrote a short paper for the Spring Meeting outlining events leading to discovery of a major period change in the V342 eclipse cycle requesting new observations by interested observers. Prior to that writing Leif Robinson had researched published minima of V342 finding a total of seven from 1935 to 1957. He further found that the minima of 1956 and 1957 (the most recent available) and mine from 1964 would all fit, perfectly, a new set of elements. These new elements are JD $\mathrm{min}_{\odot}$= 2435632.603 + $3^{\mathrm{d}}.3909574$E as compared to the 1958 "General Catalogue of Variable Stars" elements, 2428023.550 + $3^{\mathrm{d}}.390842$E. We published these findings in the I.A.U. Information Bulletin on Variable Stars, Number 92.

More recently, I have received correspondence from two sources on the subject of V342. Robert Monske visually observed two minima during the 1965 season and found them even farther from the old elements that Robinson's new elements predicted. Helmut Busch of the Bruno H. Burgel -- Sternwarte in Germany writes that he has observed V342 on photographic plates obtaining six minima from 1959 through 1964. Herr Busch has pointed out that his photographic method is not generally as accurate as the visual method, but I believe it is significant that all of his observations support the position that the change in period is greater than we first thought.

The following tabulation lists all the minima presently available to the writer with O - C given relative to GCVS elements for all minima and also relative to Robinson's newer elements for the more recent minima.

		(GCVS)		(ROBINSON)	
OBSERVER	J.D. MIN	E	O - C	E	O - C
Piegza	2428023.550	0	$0^{\mathrm{d}}.000$		
Zessevich	31343.180	979	-0.004		
Szafraniec	34520.399	1916	-0.004		
Szafraniec	34920.527	2034	+0.004		
Szafraniec	34988.343	2054	+0.004		
Szafraniec	35632.603	2244	+0.004	0	$0^{\mathrm{d}}.000$
Szafraniec	36073.427	2374	+0.018	130	0.000
Busch	36819.385	2594	-0.009	350	-0.053
Busch	36897.307	2617	-0.077	373	-0.123
Busch	37192.408	2704	+0.021	460	-0.035
Busch	37582.352	2819	+0.018	575	-0.052
Busch	38233.441	3011	+0.066	767	-0.026
Baldwin	38599.691	3119	+0.105	875	0.000
Busch	38640.401	3131	+0.125	887	+0.019
Monske	38955.750	3224	+0.126	980	+0.009
Monske	38972.707	3229	+0.128	985	+0.01[illegible]

It now appears that the period change may have taken place nearer 1959 or 1960 than 1956, as we first thought, and that the new period is nearer to $3^{\mathrm{d}}.39105$. It is important that this variable be observed closely in the future and that any existing data not yet published be found and applied for a better definition of its behavior during recent years.

LIGHT CURVE OF IK PERSEI, by Marvin E. Baldwin

Last summer I checked the 1958 GCVS for a number of eclipsing variables with poorly established periods which promised to be within my observing capabilities. My objective was to make observations which could lead to major improvements in the known periods of some of these stars. Although I have, up to this time, failed to meet my original objective, a by-product of my effort nicely demonstrates a means by which an amateur can construct a definitive light curve for a variable of small magnitude range with visual observational methods.

One of the variables I had chosen, IK Persei, soon revealed a period of about 2/3 day and a W UMa type light curve. I later learned that an extensive study of this star had been made at Sonneberg and a paper published on the subject in 1959 including very accurate elements, J.D. $\mathrm{Min}_0 = 2427397.514 + 0^{d}.6760369E$. Having no more hope of making an original piece of work, I continued observations hoping to establish a time of minimum for the season relative to the Sonneberg elements.

From October through March I obtained 320 visual observations of IK Per. These data have been reduced to the 32 points listed here. Phase position is given in days after minimum predicted by the Sonneberg elements with heliocentric correction included. The brightness step based on an arbitrary scale is given and the number of observations incorporated into each point also listed.

PHASE	STEP	OBS	PHASE	STEP	OBS	PHASE	STEP	OBS
$0^{d}.018$	10.89	9	$0^{d}.253$	6.72	11	$0^{d}.492$	5.13	8
.044	9.46	13	.273	7.75	8	.511	4.43	7
.069	7.60	10	.291	9.00	11	.535	4.67	6
.092	7.90	10	.312	9.62	12	.549	3.25	8
.105	6.45	9	.334	9.09	12	.572	4.67	9
.122	6.09	11	.361	9.35	17	.588	6.40	10
.146	4.32	15	.384	9.50	8	.612	7.67	9
.171	4.00	10	.400	8.70	13	.638	9.89	9
.194	5.23	13	.421	6.80	10	.658	10.20	5
.216	5.20	10	.445	6.25	8	.675	10.14	7
.235	6.70	10	.470	5.08	12			

A plot of these data reveals a light curve of good definition, considering that Sonneberg lists a range of only 0.31 magnitude. Using the tracing paper method on the plot I have established a primary minimum O - C of $+0^{d}.009$ and a secondary minimum O - C of $+0^{d}.004$ based on the assumption that secondary minima should come midway between predicted primary minima. Considering probable accuracy, this represents little or no deviation from the established elements.

OBSERVATIONAL STUDIES OF RR LYRAE STARS, by Robert Monske

As a relatively new amateur astronomer, one of the areas I have attacked is that of RR Lyrae stars. I became interested in these stars by way of Marvin E. Baldwin, who was planning an extensive RR Lyrae observing program. RR Lyrae stars are characterized by a rapid rise from minimum to maximum and a gradual decline of brightness back to minimum, the average period for such a cycle is about 0.56 days. Since charts were non-existent for most RR Lyraes, we had to identify each star and make our own comparison values. Mr. Baldwin has done the bulk of this work.

Then a method for observing these stars had to be found. After some experimentation we decided to use the method of making at least 200 observations for each star made in a semi-random way (usually every 10-40 minutes, depending on phase.) These were then plotted on a single graph. This was done by finding the difference between the times of each observation and the nearest predicted time of maximum, adding heliocentric correction to this time difference and then plotting the time differences and their magnitude values. But this general plot of all observations was too rough to give accurate results. Therefore, a mean curve was formed from the general plot. This was done by taking the mean magnitude value at certain time intervals, usually 10 minutes near maximum and 25 minutes at other phases. Only estimates within one or two minutes of a selected time were used. But at certain places on the general plot there were not a sufficient number of observations or they obviously were spurious. At these places, I used my own judgment. Another way to find a mean curve is to find the average time for a particular magnitude. This can be averaged with the first method for added accuracy. The mean curve thus formed can then be applied to individual timings of maxima now and in the future, but the mean curve formed by one person should not be used for some other observer's observations.

The results for the star RR Ceti show what can be expected. From about 200 observations I determined an O - C of +0.006 days. The mean curve formed showed excellent detail. Also, I obtained three individual timings which by themselves had O - C's of +0.005 days, +0.011 days, and -0.002 days. When the mean curve was applied to each timing the O - C's were +0.007, +0.012, 0.00, the mean O - C being +0.0063 days which agrees closely to the mean curves O - C. Recently I was informed of five German amateurs who each made a timing of an individual maximum during the period I was beginning to observe this star. Their O - C's were +.012 days, +.004, +.004, +.004, and +.008 the mean being +.0064 which agrees very well with my results.

Complete reduction has not been completed for any other stars yet but results for about a dozen other RR Lyraes will probably be discussed in a paper for the Fall meeting.

But even before we have complete results we have encountered many problems and have come to some conclusions which disagree with the facts for these stars in catalogs. Probably the most interesting problem is that of VX Hya. Mr. Baldwin and I have both seen what appears to be a missing maximum. I've observed this three times so far and I've also observed two maxima that were positively brighter than normal. My theory is that this star's maxima are variable ranging from 10.30 to 9.85 with its minima being 10.50. VX appears to have a large O - C so this could have a hand in this effect.

Another problem is that of TZ Aurigae. Its maxima appear to be almost midway between predictions, therefore what's its O - C, plus or minus?

Many discrepancies of the ranges for the stars so far studied have shown up. RR Ceti was listed in the Cracow supplement as 9.2 to 10.3. I found its range to be 8.90 to 10.35. The two largest discrepancies are with TT Cnc and AT And. TT Cnc was listed as 10.8 to 11.9. I find it to be 10.6 to 11.45. AT And listed as 10.9 to 11.7 has a range of only 10.65 to 11.0.

The weight of more observers and observations are needed to confirm what has been observed and to add more stars to the observing list. Anyone interested may contact either Mr. Baldwin or myself.

A VIEW OF SS CYGNI, by Roger S. Kolman

One of the favorite stars observed by members of the AAVSO is the dwarf nova, SS Cygni. Mrs. Margaret W. Mayall, Director of AAVSO has said that it is safe to say that not one maximum of this star has been missed since AAVSO began observing it more than 50 years ago.

If one were to compare it with other stars in the heavens using size as a yardstick, he would be disappointed. Based on studies of the star by Kukarkin and Parenago in the Soviet Union, the proper motion is 0.038" per year. This indicates a relatively near star. But SS Cygni is twelfth magnitude at minimum. Kukarkin and Parenago conclude the star is a white dwarf of absolute magnitude of 10.0. K.A. Strand obtained results in fair agreement with those of the two Russian astronomers. Based on a trigonometric parallax of 0.032", he concludes the star is of absolute magnitude 9.6 at minimum. Most other observations are in agreement with those cited here.

SS Cygni is typically an 11th to 12th magnitude star not far from α Cygni (Deneb). However, at irregular intervals it attains a brightness of 8.1-8.5 magnitude. The average period between maxima being 51 days. However, sometimes it takes 100 days and at other times the star never reaches minimum before brightening again.

In the mid-1950's, A.H. Joy discovered that SS Cygni is a spectroscopic binary with a period of 0.276 days. When the components of the system were studied, they were found to be a dG5 star and an SdBe star. When plotting them on the Hertzsprung - Russell diagram it can be seen that the Be star lies half way between the main sequence and white dwarf sections of the diagram. In this respect it resembles a typical nova. This component is most likely the source of variation.

A spectroscopic study of SS Cygni as it goes through its variation reveals the fact that the Be star is the source of change. It is again like a nova in that at maximum there are absorption lines and at minimum emission lines take their place. It differs because forbidden lines are not displayed.

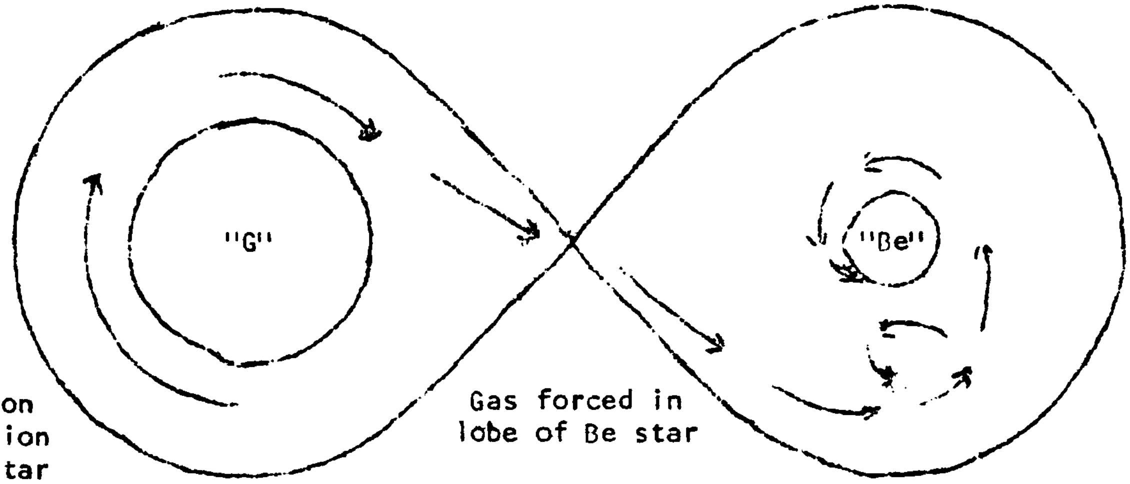
At maximum, SS Cygni resembles an early "B" or "A" star, while at minimum the system resembles a "G" star. Using large instruments, the color change is obvious.The spectrum is slightly different for various maxima being on the average A0-A1 during a flat-topped maximum.

Since the "G" spectrum is prominent at minimum and A or B at maximum, added to the fact that the G spectrum is more clearly discernible at some minima than others again leads us to the conclusion that the fluctuations are intrinsic to the Be star. Furthermore, we have Hinderer's study of temperature ranges on SS Cygni. His results give a maximum temperature of 12,000° C and a minimum of 4900° C. This, too, agrees with the evidence pointing to B star fluctuation.

Besides its large variations of four magnitudes, SS Cygni goes through other small, rapid changes in brightness. G. Grant, using the 40" refractor at Yerkes Observatory and a photoelectric photometry setup from August 21 to September 17, 1955, noted a 0.2 magnitude change in about 10 minutes and at other times flare activity of 0.3 to 0.4 magnitudes all in a period of 10 to 15 minutes. These variations closely resemble those of another star of the SS Cygni type -- AE Aquarii. These changes might very well be worth watching by some enterprising amateur.

A model of U Geminorum was devised by Robert Kraft of Mt. Wilson Observatory and presented by Tom Cragg in a paper at the N.A.A. convention August 1964 in Denver. This model proposes a zero gravity surface for each of the two stars. These surfaces are called "Lagrangian Surfaces". As can be seen in the figure shown, the rotation of the larger star forces gas into the lobe of the Be star. When the Be star becomes gorged with gas, it becomes unstable; throwing off an envelope of gas -- hence becoming brighter.

This is a recent model, yet it explains, in part, a systematic study of light curves of SS Cygni made by the late Leon Campbell, former recorder of the AAVSO. In essence, his study revealed that when there was a long interval between successive outbursts of the star, the second maximum would be a bright one -- if they occur in rapid succession, they are fainter. This seems reasonable from the Kraft model. In a long period outburst, there is more gas forced into the lobe causing a violent explosion, whereas less gas induced in a shorter time will result in a not-so-violent explosion.



Rotation direction of G star

Gas forced in lobe of Be star

Lagrangian Surfaces Of SS Cygni Components

As we mentioned before, the average period of SS Cygni is 51 days and it has an amplitude of about 3.5 magnitudes. Kukarkin and Parenago worked out a formula for all novae and nova-like stars relating period and amplitude. It is as follows:

$$A = 0.63 + 1.667 \log P$$

where A is amplitude of outburst and
P is period in days.

In plugging in the values observed for the amplitude of SS Cygni, we obtain a theoretical period of 53.5 days -- very close to the average observed period.

One reason for the popularity of SS Cygni is its unpredictability. At times, great changes are recorded from one night to the next. For this reason, it is a good star for the new observer to use for practice, since it should be observed every night.

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A VIEW OF V SAGITTAE, by Roger S. Kolman

Robert Adams, one of the top AAVSO observers, who has done extensive study into the problem of V Sagittae, has labeled that star "The Variable Gremlin." Indeed,201520 V Sge, is one of the most peculiar stars in the AAVSO program.

The General Catalog of Variable Stars lists it as a unique variable. It has a peculiar spectrum which resembles the emission spectrum of a nova. The range is 9.5 to 13.9 visual magnitude.

Because of this nova-like spectrum, it has been uncomfortably placed in a class called Ne (Nova-like). This is a nebulous term not unlike the term which was first used to describe Quasars.

The main problem encountered with V Sge is its three periods:

1.) A long range period of 530 days
2.) An irregular 17 day period
and 3.) A 0.51 day eclipse period

Although the author cannot, unfortunately, read Russian, the General Catalog mentions something about a 130 day period.

The first two periods are mentioned in several older sources, but the eclipses were investigated just recently by Dr. George Herbig and his associates at Lick Observatory. These eclipses led to a new policy on observations in the AAVSO. They are now to be made at 10 minute intervals with as high an accuracy as is possible. Random observations are now of little or no worth. However, there is reason to believe that even a 10 minute interval between observations may be too great, and they should be made as frequently as feasible.

The reason for this skepticism is apparent flare activity associated with the star.

There is much evidence to support the idea of flares on V Sge. Inspection of any of the AAVSO Quarterly Reports will show many abrupt changes of 0.5 magnitudes or more. This is a significant change - 50% of the total brightness. It must be borne in mind that variations of this magnitude are most certainly real.

Robert Adams reports three quite dramatic examples of this flare activity from Dr. Romano of Italy.

1.)	35655.41	11.3
	35655.47	10.6
2.)	35717.32	10.6
	35717.43	11.4
3.)	36404.40	13.0
	36404.46	12.0
	36404.50	11.7

Clearly, the third observation must be the most convincing -- a change of 1.0 magnitude in only 0.06 day. Such changes as this, could be missed in observing the star once every 10 minutes.

Simultaneous observations by Tom Cragg, Robert Adams and Mrs. Carolyn Hurless have strongly pointed to irregular flare activity. This activity is not continuous,

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since there are periods of time when the magnitude of V Sge is perfectly constant. There appears to be a possibility that this flare activity fortells the coming of a great rise in intensity. There seems to be a slight connection between reported flickers and a general increase in intensity.

Interested in these observations of flares, the author began doing monthly "runs" on the star during the summer of 1965. These ran from .030 - .040 day, with observations made, at first once every 0.003 day and later, with Tom Cragg's advice, once every 0.001 day. The "flares" observed were quite a sight. During one run, V Sge was varying so rapidly, it was difficult to even make an estimate! The more exciting changes are listed below.

1.)	38997.852	11.8
	.858	11.0
2.)	38997.892	11.7
	.896	10.9
3.)	39061.674	12.0
	.676	11.1

Note the third couple shows a 0.9 magnitude change in only 0.002 day!!! This definitely would have been missed had not the observations been spaced more closely.

If and when the task of finding and devising a suitable model for V Sge has been accomplished, it will likely be a rather complex one -- not as pretty as that of U Gem. It will have to account for three -- possibly four, periodic variations and possibly two sporadic changes. Possibly one or two of these "periodic" changes (excluding the eclipses) is due to a "beating" of one mode of variation with another.

(REFERENCES page 8a)

A DETERMINATION OF THE COLOR CALIBRATION CONSTANTS FOR THE U, B, V SYSTEM, by Arthur J. Stokes

The accurate determination of stellar magnitudes and color indices by photoelectric photometry requires the calibration of a particular telescope system in reference to a standard system. The standard U, B, V system as set up by Johnson and Morgan is extensively used and this work is based on corrections to the standard U, B, V system, however the actual standards used were taken from the Arizona-Tonantzintla Catalog as published in Sky and Telescope, July 1965, pp. 25-31.

The general procedure used in this workwas to make readings on several of the bright stars in a number of major constellations. Yellow, blue and ultra violet readings were taken on each star and simultaneously a zenith angle reading was taken.

Since atmospheric extinction varies considerably in the Cleveland area and can cause serious error, the extinction was determined each night by repeated readings on several stars as the Zenith angle changed. The observational data was reduced in the following sequence:

First: the extinction coefficients were determined by plotting the magnitude differences of several stars versus the change in the air mass as a function of zenith angle. The computations are quite readily accomplished with the help of magnitude ratio and air mass tables. The extinction coefficient is taken as the change in magnitude per unit air mass and is determined for yellow, blue and ultra violet. In the subsequent treatment of data, the telescope readings are corrected to zero air mass, that is, the readings are taken out of the atmosphere.

Second: The instrument transformation coefficients are determined by plotting the natural color index of several stars versus their standard color index as taken from the Arizona-Tonantzintla catalog. The telescope readings are reduced by means of the following equations:

$$C_{yo} = 2.5 \log y/b + S_b - S_y$$

$$C_y = C_{yo} - (K_b - K_y) \text{ air mass}$$

$$C_{uo} = 2.5 \log b/u + S_u - S_b$$

$$C_u = C_{uo} - (K_u - K_b) \text{ air mass}$$

Similar equations are used for the blue and ultra violet readings and plots are made of $B - V$ vs. C_y and $U - B$ vs. C_u. Four of the instrument transformation coefficients are obtained from the slopes of the lines and the Y intercept at $X = 0$ of each graph. These are indicated as A_1, A_2, A_3, and A_4.

Third: One last graph is needed to fix the sensitivity of the system which obviously could vary, if, for example, the photomultiplier tube voltage changed. On this graph is plotted:

$$V + 2.5 \log y + K_y \text{ air mass} - S_y \text{ vs. } C_y$$

The slope of this line gives A_6 and the Y intercept gives A_5.

We now have all six coefficients required to take any set of unknown star readings and determine the color indices and the photometric magnitude. The following set of equations are used for these calculations.

$$B - V = A_1 + A_2 C_y$$

$$U - B = A_3 + A_4 C_u$$

$$V = -2.5 \log y - K_y \text{ air mass} + A_5 + A_6 C_y + S_y$$

In closing, I would like to point out that perhaps it isn't quite as easy to observe the magnitude of a star as some of you visual observers may have thought.

NOW YOU SEE IT, NOW YOU DON'T
GRAZING OCCULTATION OF 139 TAURI, MARCH 29, 1966, By John J. Ruiz

Last March one of my friends (or enemies), gave my name and address to David E. Laird, who is co-ordinator in this part of the country, of the Grazing Occultation Program sponsored by David Dunham of Yale University. He wrote to me asking for our cooperation in organizing observing parties in the path of the graze near Harbor Creek, which is a few miles east of Erie, Pa. I wrote back that I did not know anything about grazing occultations, but would conduct a survey of possible observing parties. Mr. Stewart Cadwallader, President of our local Astronomical Club, made an automobile trip and selected several sites. David, his wife and a young student arrived at my house at supper time. He came completely equipped, but I had to scrounge around for some gadgets. I have a 4' refractor and I borrowed a short wave receiver and a tape recorder for the time signals. Later another party from the Cleveland Museum and the Case Institute arrived. We selected three sites along the graze path. The Cleveland party was stationed at the Klein School near the Lake. The Erie party lead by Stew Cadwallader and myself was stationed at the Harbor Creek High School and the David Laird party at the Clark School farther south. David explained that they like to select sites near the schools as these are clearly located on the USGS maps.

It was bitterly cold. We set the telescope and tried to get the short wave receiver to work. We could not get any signals from any of the channels from WWV or even from the Canadian station CHU. The set had worked satisfactorily at my house early in the evening. Failure No. 1. Failure No. 2. We had brought only one wide angle low power eyepiece of the Erfle type. This was a mistake as it encompassed too much of the crescent Moon and even the Earth shine kind of blinded us. Failure No. 3. The slow motion in right ascension refused to work. In the excitement of the moment, comparable to that of a total solar eclipse we had forgotten to tighten the clamp.

Lacking reliable time signals we tried to time the occultation with a stop watch that had been compared at my house early in the evening with WWV. The occultation occurred very near midnight. Stew Cadwallader kept his eye glued to the eyepiece and I tried to keep time, but Stew was not able to give definite indications. He kept saying, "Now I see it, Now I don't." Whatever time we got must have been in error by two or 3 seconds. Not good enough. It was a thrilling spectacle watching the star approach the limb of the Moon and disappear behind a mountain. Two of our lady members had a good time watching the occultation with a $2^1/2$" Unitron. Binoculars proved to be worthless as the glare of the Moon blinds you. A long focus telescope with a high power eyepiece is best.

The Cleveland party also missed the time signals, probably for the same reason as us; that is, that at that hour of the night the ionosphere had receded so high that we were caught in the shadow of the skip distance. They got relative times of immersion and emersion, however. The David Laird party had better luck and got some time signals on their tape recorder.

Well, we learned something from this experience, and are prepared for the next graze at our place which according to David Laird will occur 50 years from now.

SOME VARIABLE LIGHT CURVES, by Margaret W. Mayall

About a dozen large blue print light curves plotted from AAVSO observations, were exhibited. They all offered proof of the necessity of continued observations of the variables on our program, from R CoronaeBorealis, the most unpredictable of variable stars, through some semi-regular red variables to the fairly "normal" long periods R Leonis and R and X Cygni.

PREPARATION OF NEW AAVSO CHARTS FOR FAINT VARIABLES FROM FLOWER OBSERVATORY SEQUENCE DATA, by Clinton B. Ford

In 1928, Dr. C.P. Olivier, director of Flower Observatory of the University of Pennsylvania, instituted a program of photometric observations of faint long-period variable stars, using a visual photometer attached to the 18-inch refractor at that observatory. The stars chosen were in general too faint to be on AAVSO observing lists at that time. Insofar as possible, field photographs and basic sequence material for brighter comparison stars were obtained from Harvard College Observatory; however, a large number of new photos were taken especially for the Flower Observatory program, and completely new faint comparison star sequences were determined photometrically for each field.

This program continued, with the help of various graduate students, until about 1941, and eventually 44 "new" faint long-period variables were investigated. The results, including detailed comparison star positions and sequences, were published in *Publications of the University of Pennsylvania, Astronomical Series, 5,Part III (1940)*, and in two later papers by Olivier in *A.N.*, *284*, 4 (1958), and *285*, 3 (1959). Shortly thereafter, Dr. Olivier kindly turned over to the AAVSO the original photos and field sketches covering 18 of these variables, and the present paper concerns work completed to date in the preparation of standard reproducible AAVSO "d" and "e" chart tracings from this material.

None of the original field sketches or photographs was in reproducible form, but these have been very useful in checking out the plots made from the published sequence data. In most cases, a grid was constructed on tracing paper to either the "d" or "e" chart scale, and all comparison stars plotted thereon with dividers. This grid tracing was then traced onto a second and final tracing, and field stars filled in on that tracing with the aid of the photos and field sketches. The adopted star-disc scale is slightly expanded from that used by Brocchi in most AAVSO standard charts. Tracing paper is K & E Albanene, and tracings have been made in dark pencil, to provide for additions and corrections which direct comparisons with the sky soon proved to be necessary.

As of May 1966, the following "new" star chart tracings have been completed and sky-checked, and temporary verifax copies of these are already in use by a list of 10 AAVSO observers with larger instruments:

055716	RR Ori	"d"	(Completely new chart)
065510	BI Mon	"e"	
075320	BP Gem	"e"	
085300	TU Hya	"e"	(Also "b" by T.A. Cragg)
135304	SY Vir	"d"	
152703	WW Ser	"d"	
185316	EU Aql	"e"	
200209	HI Aql	"e"	
202611	RZ Del	"e"	

The project is continuing, and adequate reproducible chart tracings for most of the 44 stars on Olivier's original program will eventually be ready for regular blueprinting duplication and inclusion in the AAVSO Chart Catalog.

A NEW TELESCOPE FOR BRANDEIS UNIVERSITY, by John T. Goodwin

Brandeis is a coeducational college in Waltham, Massachusetts. Construction began in 1948 and is continuing today. It is a liberal arts college with an enrollment of 400 graduate, 1600 undergraduate, and over 100 special students. The college takes its name from Louis Dembitz Brandeis, associate justice of the U.S. Supreme Court from 1916-1939.

Among the new buildings recently completed is the Gryzmisch Science Quadrangle. This new complex contains laboratories for mathematics, chemistry, biology and physics. A sixteen foot dome on the west wing of the physics building contains the 24" Cassegrain system. The scope, built by Tinsley Labs., has a focal length of f/4 and custom made is valued at $55,000. According to Dr. Jack Goldstein, the Director of the Physics Department, it should be in operation by mid-summer.

The telescope will be used mainly for astro-physics, studying stellar atmospheres.

Infra-red studies of better than 4 microns are expected. Students taking the astro-physics course as well as graduates doing research work will use the instrument. Photometry and spectroscopy experiments are scheduled to begin within two years. Work with the telescope will be kept to a teaching level because of the size of the instrument and the design of the course.

In the future, the possibility of expanding to radio instruments is not out of the question.

TO RAPIDLY FIND THE HOUR ANGLE OF A VARIABLE STAR, by Alphonse Oberstatter

(Translated from the French by Frank J. De Kinder)

If you work in a region where astronomical observations are difficult, it is necessary to rationalize your methods in order to profit to the utmost of the rare hours of good visibility.

While the calculation of the hour angle, which is important to know how to point your equatorial instrument to the desired variable, is an easy problem to solve, you nevertheless can save precious time by the following procedure, based on a simple addition.

At the beginning of each three months period, you select your variables which for the next few weeks will be in a favorable position. Beforehand you calculate quietly in your office the hour angle of all these stars for a complete sidereal hour, for instance 7^{hr}, 8^{hr} or 9^{hr} corresponding to the hour you generally begin your observations at that period of the year.

You write your results very legibly on a handy card board.

Spring at Sidereal Time 8 hrs.

ST Tauri	+19°04'	H.A.	2^h	14^m
SS Aur	47 45		1	50
U Gem	22 08		0	08
Z Cam	73 17		23	40
R UMa	69 02		21	18
RU Vir	40 25		19	15

When a good night is apparent, you take up your post near the telescope with your cards carefully classified and with your trimestrial list. You set your instrument in declination. A single look at your watch, set to sidereal time, will indicate the difference between the sidereal time of the moment and the sidereal time of your list.

for instance:	watch	10^h 8^m	
	list	8	H.A. 2^h 14^m

You simply add the 2^h08 to the previously calculated Hour Angle

$$\begin{array}{l} 2^h\ 14^m \\ \underline{2^h\ 08^m} \\ 4h\ 22\ \text{min} = \text{H.A. at 10:08 Sidereal Time} \end{array}$$

This is an ultra rapid method. It is especially useful for often observed variables or stars observed several times in the same night.

Sample: You want to find the hour angle of RU Vir at 12:03 sidereal time.

Classical calculation:

$$12^h\,03^m = 36^h\,03^m = \begin{array}{r} 35^h\;63^m \\ -\;\underline{12\;\;\;45} \\ 23^h\;18^m \end{array}$$

(or)

$$\begin{array}{r} 12{:}45 \\ \underline{-12{:}03} \\ 0^h42^m \end{array} \qquad 24^h = \begin{array}{r} 23^h\;60 \\ -\;\underline{0\;\;\;42} \\ 23^h\;18^m \end{array}$$

New Method: Your watch indicates $12{:}03^h$

The list $\underline{8.00^h}$

Thus a difference of 4.03^h

$$\text{H.A. of RU Vir @ } 8^{hr} = \begin{array}{r} 19.15 \\ +\;\underline{4.03} \\ 23^h18^m \end{array}$$

Two cr three trials will convince you. Greetings to all.

FAMOUS ASTRONOMY ENTHUSIASTS IN AMERICAN HISTORY, by George Lovi

Those of us who pursue astronomy as a hobby and sometimes feel self-conscious that perhaps this is an activity that may make us seem "odd" to others can take comfort in the fact that many a notable person has shared our love for the stars -- long before astronomy became somewhat "fashionable". I wish to cite some of these individuals, confining myself to just Americans.

The author of the Declaration of Independence and our third President, Thomas Jefferson, counted astronomy as one of his many interests and it has been recorded that he knew enough of the science to calculate an eclipse -- which not many amateurs can do today.

A contemporary of Jefferson and another illustrious Revolutionary-Era figure and the first Chief Justice of the Supreme Court, John Jay, was an avid sky watcher and in the restored Jay Homestead in Katonah, New York, one can today find among Mr. Jay's artifacts a beautiful celestial globe he brought back from England in 1795.

In a message to Congress, our sixth President, John Quincy Adams, expressed his displeasure over the fact that the United States did not during his era contain even one observatory worthy of the name, or "lighthouses of the skies", as he put it. When the Cincinnati Observatory was dedicated in the 1840's, he made an arduous trip from Massachusetts in his old age to dedicate it -- so important did he deem that event.

Although Abraham Lincoln's interest in astronomy wasn't that avid, he was more curious about the mysteries of the science than most people, as evidenced by his unexpected visit to the Naval Observatory one night during the Civil War at which time he asked Asaph Hall (who we remember as the discoverer, in 1877, of the two Martian satellites) to explain why the moon appears inverted in a telescope.

Until the time of his death in 1926, Lincoln's oldest son and the only one that survived into adulthood, Robert Todd Lincoln, maintained a private observatory at his New England home.

Two well-known poets of the 19th Century could also be cited: Ralph Waldo Emerson and Walt Whitman. In his essay "Self Reliance", Emerson complained that since the average man has a watch, he knows not a star in the sky; he also enjoyed visiting Williams College Observatory and exploring the heavens with its telescope. Whitman is noted for his poem, "When I Heard the Learn'd Astronomer" and indicates in some of his other works a more than average familiarity with the heavens.

President Franklin Roosevelt's first Secretary of Agriculture, Henry A. Wallace, during his college days would spend many an entire night on a campus hilltop studying the stars, which was then a very strong interest of his.

The well-known entertainer Dave Garroway is an enthusiastic amateur today and many of us recall the congratulatory telegram he sent the AAVSO during its 50th anniversary meeting in Cambridge in October, 1961. (He became a Life Member of the AAVSO 2 years ago. Ed)

So, in studying the stars we seem to be in good company.

THE CURRENT SUNSPOT CYCLE, by Richard H. Davis

A plot of smoothed monthly means of American Relative Sunspot Numbers R_A, for the period from January, 1951 through October, 1965 was exhibited. A separate plot of such numbers for the period from January, 1951 through October, 1965 was also exhibited. This latter plot had points added showing predicted dates and heights of the maximum of cycle 20, as follows:

Avery	1968.8	157.0	(1)
Smith	1968.9	142.0	(1)
Smiley	1969.3	135.0	(1)
Dalrymple	1969.3	127.5	(1)
Waldmeier	1968.7	100	(2)
King-Hele	1968.1	140	(3)

Those several estimates were compared and briefly discussed.

(1) Smiley, AAVSO Abstracts (see following paper)
(2) Waldmeier, Sky and Telescope, page 375, June, 1966
(3) King-Hele, Nature, page 285, January 15, 1966

PREDICTION OF THE SUNSPOT MAXIMUM IN CYCLE 20, by Charles H. Smiley

Using the definitive Zurich sunspot numbers for 1963, 1964 and 1965, the last minimum occurred at 1964.8 and the corresponding sunspot number was 8.7. This information was obtained by using a parabola through the three points corresponding to the means for 1963, 1964 and 1965 on a graph of sunspot numbers versus time. The values thus obtained may be compared with those predicted by members of one of my classes and me in May 1962:

	Time	Number
James Dodge	1963.8	9.0
Robert Brown	1963.8	10.1
Charles Smiley	1964.6	6.9
Walter White	1964.0	9.7
Wesley Green	1964.9	10.7

At the time these predictions were presented to the AAVSO, it was suggested that we would be able to predict the next sunspot maximum better after the minimum of

1964 was passed.

The following predictions for the next maximum have been made by members of a current class and me:

Cycle 20	Rexford Avery	1968.8	157.0
	Charles Smith	1968.9	142.0
	Charles Smiley	1969.3	135.0
	Alice Dalrymple	1969.3	127.5

My own prediction varies only slightly from the one I made for the maximum in May 1962: 1969.3, 133.

The method I used was to assume that after sixteen cycles, maxima (and minima) would repeat, but that corrections to both times and numbers would have to be applied which would depend on the maxima (or minima) of the two previous cycles and the corresponding values 16 cycles before. This is not equivalent to the use of a 168-year period; it is "variable step" method, similar to one which works well in the prediction of planetary phenomena such as the times of consecutive conjunctions with the sun, etc.

Cycles 20 and 21 promise to be very interesting ones. Already some experts are predicting a maximum in Cycle 20 even higher than that in Cycle 19, the highest in recorded history, and others are expecting quite a drop.

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