AMERICAN ASSOCIATION OF VARIABLE STAR OBSERVERS

ABSTRACTS

OF

PAPERS

PRESENTED AT WOODS HOLE MEETING

17 OCTOBER 1970

CONTENTS

187 Concord Avenue, Cambridge, Massachusetts 02138

AAVSO ABSTRACTS

Edited by R. Newton Mayall

The 59th Annual meeting of the AAVSO was held in Woods Hole, Massachusetts, at the Nautilus Motor Inn. This is the second meeting we have held at the Nautilus, which has everything required -- a good meeting room, good living quarters and an interesting restaurant.

Friday was a bleak day, but when we reached our headquarters and looked out over the lovely garden and the harbor it didn't seem such bad weather. In the evening Dr. Shirley Patterson Jones gave us a talk on "Is the Sun a Variable Star?" She proved it is by means of slides and motion pictures. Among the movies was one made by the Lockheed Solar Observatory, which Dr. Jones said was probably the best grouping of motion pictures of the sun she had seen. These pictures showed details of sunspots, flares and prominences. Truly an excellent film. She ended her talk with a motion picture of the eclipse at Nantucket taken by two of her students who had not taken movies before. Not only were the pictures of the eclipse good, but they also provided a little comedy before the eclipse and afterward, to use up the film.

Saturday morning arrived bright and clear and we had our business meeting in the morning and papers in the afternoon. We had a 12-minute snow flurry in mid-afternoon. After dinner we were entertained by Barbara Welther and five other musicians playing short pieces with ancient instruments such as the Krumhorn, Rauschpfeife, Racket, Pipe and Tabor, and the Shawm. Everyone was interested in the music and instruments which were demonstrated individually.

Following the music session we repaired to the meeting room where Dorrit Hoffleit entertained with a report on the IAU meeting held at Sussex University at Falmer, Sussex, England. She illustrated her talk with slides taken at Stonehenge, London and other places of interest.

The IAU is the international gathering of professional astronomers, which meets every three years. We are fortunate in having two of our members -- Dorrit Hoffleit and Margaret Mayall -- who are members of several commissions of the IAU and they spread the good word of the AAVSO at the meetings.

After a hearty breakfast and informal discussions with members on Sunday morning we wended our various ways home, under warm clear skies.

This year those who travelled the greatest distance were Franklyn Shinn from Winnipeg, Canada; Richard Sweetsir and Karl Simmons from Florida; and the Adamses from Missouri.

Remember next October, our 60th Anniversary.

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THE AAVSO IS POOR, NOT RICH, by Richard H. Davis

It seems that many people think that the AAVSO is rich. Actually, the AAVSO is poor.

The AAVSO has an Endowment Fund now worth about $335,000. Doesn't this make the AAVSO rich? No - because the AAVSO Constitution specifically prohibits the expenditure of the principal of the Endowment Fund for any purpose whatsoever. And that is a wise Constitutional provision. The AAVSO relies upon the principal of its Endowment Fund to generate most of the annual income required to carry out its responsibilities to its members and to the astronomical community. Use of the principal of the Endowment Fund to cover operating deficits or for any other purpose would permanently reduce the amount of income thereafter available, leading to larger operating deficits in all succeeding years; and continued use of the principal of the Endowment Fund would eventually lead to bankruptcy of the Association.

In its last Fiscal Year, the AAVSO had income from all sources totaling almost $29,000. Doesn't this make the AAVSO rich? No - since that income was insufficient to meet current obligations, let alone to permit the Association to properly discharge its responsibilities. The fact that we can operate at all on our limited annual income and deal with the tremendous job of processing and preparing for publication the more than 100,000 observations received each year is a tribute to the efficiency of our director and her assistant -- and to the willingness of our director to accept sub-standard compensation for her beyond-the-call-of-duty services. Actually, we should have at least one more full-time employee -- which would mean at least $4,500.00 more income each year -- which would mean an Endowment Fund at least $90,000 larger than we have now.

Benjamin Franklin once said that happiness consisted in having one's annual income meet one's annual expenditures. Similarly, the true test of "rich" or "poor" is to compare annual income with annual expenditures -- or, more precisely, -- with the annual expenditure required to meet one's responsibilities. By that test, it is clear that the AAVSO is not rich; but poor -- its annual income is less than the amount required to fulfill its responsibilities.

FILTERS FOR SOLAR OBSERVING, by Cyrus F. Fernald

For counting sun spots, I have used my regular Springfield telescopes, modified by substituting an uncoated mirror for the aluminized one. Sometimes I have used a reversed prism for the third reflection in the optical chain. This is essentially a Herschel wedge of 90° instead of the more usual 30°. Over the 33 years that I have been observing the sun, I have tried many filters to bring the light down to a comfortable intensity. Sometime soon after the AAVSO solar program started I got three welder's glass filters #10, 12 and 14. These were darker than necessary and so have not been used much. I did have some taken from a pair of dark glasses that served me well for many years.

Last spring, our present Solar Division Chairman decided to try out a series of these welder's glass filters and he selected me as the guinea pig. So last May I received from him a set of filters, #5 through #12. He cut them to size to fit into the standard 1.25" eyepiece holders. To hold the filters in place I inserted a retainer ring in the eyepiece holders. This assures that the filters are level.

I tried these out in Longwood, Florida, and brought them up to Wilton, Maine, for further trial. Filters #5 and 6 are too light for use on the sun, but do nicely toning down the bright moon with the regular telescope. Filter #7 proved to be out of series, being nearer #9. Using the reversed prism, and solar mirror, #8 gives a little too dark an image. Dick Davis sent me a Willson-Weld shade #7, and this proves to be in series with the original set Cap sent me, and is just right with the reversed prism, and solar mirror for solar observing. With the regular prism in the optical chain, #10 filter gives the correct brightness, indicating that the reversed prism is equivalent to three numbers in the filter series.

After trying most of the combinations possible with the solar mirror I got up my courage to try my regular aluminized mirror. Using the reversed prism and #11 filter, results were very satisfactory. The parabolization of the regular mirror is better than that of the solar mirror. Enough so to make the small fainter spots stand out better. The regular mirror is 8" in diameter, while the solar one is stopped down to 6".

Occasionally with a hazy sky it is safe to use the next lower number filter for the observations. Quite frequently under such conditions the seeing is considerably better than normal. Haze seems to steady the atmosphere a good deal. Over the past summer the very few times that I have recorded "excellent" seeing have nearly all been hazy days.

FOCAL LENGTHS OF EYEPIECES FROM MEASURED RAMSDEN DISKS, by Cyrus F. Fernald

There are two simple equations that we will need. 1. Eyepiece magnification equals the diameter of the mirror, divided by the diameter of the Ramsden disk. 2. Eyepiece magnification also equals the mirror's focal length divided by the eyepiece's focal length. Of course, the same units should be used in each part of the equation, inches or millimeters. One inch equals 25.4 millimeters. If you are measuring the Ramsden disk of a stopped down mirror, it is the diameter of the stop that should be used, not that of the mirror. The Ramsden Disk is the circle of light that you will quickly notice if you hold your eye some six inches or so away from the eyelens of the eyepiece, when it is in the telescope. In my case the cross arms of the spider holding the prism are clearly seen. Incidently, this is a good test of the alignment of the telescope. If the circle of the Ramsden disk is quartered by the spider things are good. I measured the Ramsden disks with a barrel micrometer reading to .001". The telescope was focused on Venus.

For this report I used my stellar mirror of 8" diameter and 74.0" focal length. Substituting these in the equations first given, gives Ramsden disk equals eight times the focal length of the eyepiece divided by seventy-four. This reduces to .108 focal length of eyepiece. So we can make the following table.

E.F.L. in ".	Ramsden Disk.	E.F.L. in mm	Ramsden Disk.
1/8	.0135"	4	.017"
1/4	.027	8	.034
1/2	.054	12	.051
3/4	.081	16	.068
1	.108	20	.085
1 1/4	.135	24	.102
1 1/2	.162	28	.119
2	.216	32	.136

I measured some of my eyepieces and got the following results:

Eyepiece		Mea. R.D.	Actual F.L.	Eyepiece	Mea. R.D.	Actual F.L.
Brandon	32 mm	.160	37.6 mm	Ross M 1	.095	7/8"
"	16	.070	16.5	Tinsley 1/4"	.027	1/4
"	8	.034	8.0	" 1/8"	.0135	1/8
"	4	.017	4.0	Clausing 1/6"	.018	1/6
Cave	28	.130	30.6	Erfle large	.150	1 3/8
Galoc	16.3	.070	16.5	Erfle small	.162	1 1/2
Edmund	28	.133	31.2	Zoom high 8.4	.035	8.3 mm
"	12.5	.053	12.5	Zoom low 21	.089	20.9 mm

Most of these eyepieces were bought over the last 25 years. Some bought back in the 1930's showed considerable more variation. It would seem that the low power, big field eyepieces, are not true to their labels. The higher powers are usually correct, or nearly so.

Recently, I found a short article in Sky & Telescope, October 1944 issue, by J. Hugh Pruett. He reported on some 35 eyepieces. About a quarter of these were very good and the rest varied considerably. His best agreements were with eyepiece near 1" in FL. Longer and shorter FL's were off.

AR ANDROMEDAE: AN UNUSUAL U GEMINORUM STAR, by Wayne M. Lowder

AR Andromedae [$01^h39^m09^s$ $+37^\circ$ $26'.6$ (1900)] is listed in the 1958 edition of the General Catalog of Variable Stars as a 264.5-day Mira star with a photographic magnitude range of 11.5 - (15. However, Markaryan's study of this star[1] established that it had the photometric and spectrometric properties of a U Geminorum star. His observations included three maxima, two of which were separated by an interval of 68 days, as well as minimum, and indicated a visual range of 12.2 - 17.0.

Since July 1968, I have made nearly 100 observations of this star. During the 1968-69 observing season, three maxima were observed, at intervals of 93 and 43 days. During the 1969-70 season, seven more maxima were observed, at intervals of 35, 19, 19, 51, 27, and 42 days. Allowing for unobserved maxima and uncertainties of perhaps as much as five days in the intervals, frequently estimated from single positive observations during a particular maximum, an estimated mean period of about 20 days seems to adequately fit the observations. On two occasions, the star was seen to be as bright as visual magnitude 11.7, which together with Markaryan's observations establishes the visual range as slightly in excess of five magnitudes.

Other U Geminorum stars of comparable ranges, such as SW Ursae Majoris and U Geminorum itself, tend to have considerably longer periods. Payne-Gaposchkin's discussion[2] of the relationship between the range and mean period of these stars indicates that a star with a period of 20 days would be expected to have a total range of 4 to 4.5 magnitudes, after the observed range is corrected to account for the effect of the presence of a companion. The fact that no such correction can yet be made for AR Andromedae, although its duplicity is highly likely, only emphasizes the anomalous characteristics of this star.

Further observations of this star and the many other nova-like variables that are rarely looked at might contribute significantly to the solution of one of the most fascinating puzzles in modern astronomy, namely, the apparently close relationship between the U Geminorum stars and the recurrent novae in terms of duplicity and period-amplitude correlation in spite of great differences in physical characteristics and perhaps in evolutionary status. (Note added in proof: Additional evidence for the indicated period is provided by observations of rises to maximum on October 5 and 28, 1970)

1 B.E. Markaryan, On the Nature of AR Andromedae, Astrofizika 3, 511-8, 1967.
2 C. Payne-Gaposchkin, The Galactic Novae, North-Holland, 1957 (Dover reprint).
(The 1969 edition of the General Catalogue of Variable Stars lists AR And as UG (30 days) B range 12.8 - 17.3)

CORRECTION OF MAGNITUDE SEQUENCE FOR X LEONIS, by Charles E. Scovil

X Leonis has long been a problem field for observers because of the two stars labelled 13.5 which were obviously not of equal brightness. Preliminary measurements of a Mt. Wilson plate of the field indicates further scatter among the other sequence stars. A new sequence using as many as possible of the original magnitudes is to be derived.

SHADOW OF MOON IN THE SKY AT SOLAR ECLIPSES, by William H. Glenn

At the time of a total solar eclipse the shape of the moon's shadow on the ground is that of an ellipse with its semi-major axis directed towards the sun's azimuth. For an observer witnessing the total phase the moon's shadow in the sky overhead appears deep blue, and the light from outside the shadow appears as a bright border around the horizon. Since air transmits the long wavelengths of light more readily than the short ones, the light from outside the shadow tends to be yellowish or reddened, the exact color depending on the distance of the shadow's edge from the observer.

Observers near the beginning of the path of totality, where the moon's shadow strikes the earth almost tangentially, first see the shadow in the sky above them as it falls through the atmosphere. During totality, the shadow stands like a truncated V in the eastern sky, with the eclipsed sun placed within it. After totality, the shadow seems to "drop to earth", quickly disappearing as it falls below the horizon and races eastward. Visual observations and photographs made by Japanese observers at Mt. Rausu, Hokkaido during the eclipse of July 20, 1963, have provided extensive documentation for the appearance of the shadow at the sunrise eclipse. A series of visual sketches by Katsuhiro Sasaki clearly shows the shadow first appearing in the eastern sky above the sun, forming a truncated V based on the horizon at mid-totality, and falling to the horizon and disappearing after totality. The visual observations are confirmed by photographs by Hiromichi Fukuda and K. Yamamoto.

Observers along the path of totality at places where the sun is high in the sky first notice a swath of darkness in the quadrant of the sky below the sun just prior to second contact. At totality the sky overhead appears a deep blue color such as is seen at the end of civil twilight and the horizon in all directions appears pale yellow-orange. As the end of totality nears, a bright area is seen rising in the sky as the oncoming sunlit sky outside the umbra approaches, and at third contact the shadow quickly moves off and disappears. Observations in Canada and Maine at the 1963 eclipse were generally marred by cloud cover and a detailed description of the appearance of the moon's shadow in the sky has been difficult to complete. Observations made by members of the Amateur Astronomers Association of New York City under perfectly clear skies at Virginia Beach during the March 7, 1970 eclipse, however, have enabled the writer to compile a good description of the appearance and motion of the moon's shadow. A series of color slides taken by the writer at Virginia Beach with a "fish-eye" 180° field-of-view lens clearly shows the shift of the position of the bright areas near the horizon during the eclipse.

The degree of darkness during totality can be estimated by reference to the magnitude of stars that become visible. At the 1963 eclipse members of the Tokyo College of Science party, observing totality shortly after sunrise from Hokkaido, reported that "every star of the pentagon of Auriga was visible, so at mid-totality stars down to third magnitude were visible." In 1970, from Virginia Beach, where totality occurred 1 1/2 hours after noon, George Lovi observed Alpha, Beta and Gamma Cassiopeiae, indicating that stars in the magnitude range 2 1/2 - 3 were visible.

CH CYGNI, by Michael Mattei

For the past two and a half years at Harvard, Dr. Liller, Jerome Shao, Jay Goguen, and myself have been observing CH Cygni with photometers and a spectrum scanner.

Observations made in 1967 show an excess of ultraviolet in the spectrum of CH. It is possible this is a double star system, and we can not see the small hot blue star.

In 1968 I talked of the possibility of this hot blue star, and the rapid variations in the ultraviolet of CH that may be caused by it. Observations made in May, June and July of this year show that the variations in the UV were decreasing in intensity and some time in mid-July they stopped. Now the UV readings are constant and do not vary at all, and the UV magnitude is 9.6, and the V is 7.0. The increase in V is due to the variability of the red star which is known to vary and the decrease in blue could be due to an eclipse of the blue star by the red star.

Did the star go into eclipse? We are not sure at this time, observations will continue, to see if this is true and we hope to catch it coming out of eclipse.

PROBLEMS OF LARGE TELESCOPES IN SPACE, by Leonard Solomon

The Large Space Telescope is a NASA program now in the formative study phase. The entire problem of the LST is complex, since a much higher quality instrument not limited by atmospheric considerations can be used in space with an extended range of observations. The situation is complicated by the fact that local conditions are more severe and maintenance is less available than at an observatory.

Under contract to NASA, a study was performed by Itek Corporation to examine the system, from the point of view of the optical technology, for a telescope to be built by the 1980's.

There are many problems involved, particularly those relating to selection of materials, optical manufacture, alignment and thermal control, and environmental limitations. From these the telescope design is chosen which can be developed within the state of the art of current optical technology. A telescope of about 80 inches aperture has been suggested as the next logical step in the development of large telescopes for space use.

Some of the characteristics of such an orbiting telescope would be:

- Wavelength capability - approx 1000Å - > 20 micron with present mirror coatings
- Sensors - probably all electronic (no film required)
- Operation - unmanned with occasional (1 per year?) astronaut maintenance
- Lifetime - minimum 5 years with maintenance

Orbit - Between 400 and 600 miles (limited by air drag and radiation)
Field of View - about 5 arcmin in far ultraviolet. Possibly as large as 30 min in visible
Form of telescope - Ritchey-Chretien Cassegrain - f/3.3 primary, f/15 overall
Optical quality - depends on central obstruction of Cassegrain. Present estimates are for 1/10 wave at 3000Å (RMS) for the system in orbit
Primary Mirror quality - Better than 1/50 wave at 3000Å
Secondary Mirror adjustments - (for 1/100 wave degradation)
Focus - approx 2.6 microns
Tilt - approx 4 arcsec
Decenter - approx 26 microns
Suitable materials - for mirrors ULE fused silica or Cervit, for metering structure invar and good thermal control
Performance Image diameter - 0.195 arcsec (80% encircled energy)
Resolution - 0.098 arcsec
Guiding Accuracy - approx 0.″008 at 12.5 mag (pv) stars
Limiting magnitude - approx 26 (pv) in 3 hours

PHOTOGRAPHIC STUDY OF VARIABLES, by Kamal Arsalan

This paper sets forth the value of making a photographic study of variable stars. Not only is photographing variables an interesting job, but a useful one, in that a detailed study of the variables can be made. Various methods of determining the magnitude are explained. References given are "American Astronomers Report" (Wesselink, Sky & Telescope, Nov. 1969); "Limiting Magnitude", by Roger S. Kolman (AAVSO Abstracts June 1968); and "Wonders of the Night Sky", by F. Zigel, Moscow. (ED)

PHOTOGRAPHIC RECORD OF LIGHT CHANGES AT PERRY, FLORIDA DURING THE SOLAR ECLIPSE OF MARCH 7, 1970, by Joyce and Eliot Sterling

The purpose of this experiment was to record the changes in light at regular intervals during the progress of the eclipse. Originally we planned to make two series of photographs simultaneously. The first series (A) was to be taken of the sun's image projected on a screen attached to our 3" refractor and would record the amount of the sun's disc which was eclipsed. The second series (K) was to be taken of some convenient object or scene to be determined at the time. For the (A) series we were going to use an Argus C-3 camera which could be adjusted as the light diminished, and for the (K) series a Kodak Instamatic camera with fixed settings (f-11 at 1/50 sec.). Kodachrome X film was to be used in both cameras.

Because of the cloudy sky we had to abandon the (A) series completely, but since the weather remained uniform throughout the duration of the eclipse, the (K) series, which was not dependent on the weather, turned out very successfully. During the first half of ingress, we recorded the light at 10-minute intervals correct to the nearest second, beginning at $16^h 55^m 57^s$ UT. From $17^h 35^m 57^s$ to $18^h 10^m 57^s$ pictures were taken at 5-minute intervals, and from $18^h 10^m 57^s$ to $18^h 15^m 57^s$ (2nd contact) at 1-minute intervals. The same progression was repeated from 3rd contact at $18^h 19^m 11^s$ for the first five minutes of egress. (A piece of board with swatches of green, red, blue, and yellow was photographed. As it grew darker the green swatch disappeared. ED)

TWO BRIGHT VARIABLES (?), by Wayne M. Lowder

During the past several years, two bright stars in the Autumn skies have seemed to my eyes to differ significantly from their cataloged magnitudes. Alpha Andromedae has always seemed brighter than gamma Andromedae (2.10) and alpha Arietis (2.00), and usually the equal of alpha Persei (1.80). The five visual magnitude estimates listed for this star in the U.S. Naval Observatory Photoelectric Catalog range between 2.00 and 2.17, possibly indicating some variability. A similar case is epsilon Pegasi, with six estimates in the same catalog ranging from 2.37 to 2.45. However, this star has always seemed fainter than alpha Pegasi (2.49), though brighter than alpha Aquarii (2.93) and eta Pegasi (2.95.). I would rate it approximately constant at magnitude 2.7. It is listed as a suspected variable in the Yale Catalog of Bright Stars. Visual and (especially) photoelectric observations of these stars by other observers would be useful in testing the validity of my observations. Because of the wide angular separations of these various bright stars, visual observers should take care not to compare their relative brightnesses on moonlit nights or when their altitudes are significantly different.

COMPARISON STARS FOR R SCUTI, by Arthur Stokes and George Diedrich

The variable star R Scuti has long been a favorite of AAVSO observers. George Diedrich had brought to my attention his observation that the 6.1, 6.7 and 7.1 comparison stars did not appear to quite fit the magnitude designations on the 184205 chart.

To check this out, a set of photoelectric observations were made on 17 August 1970 using a 1P21 phototube and V filter on a 16" reflector at Hudson, Ohio.

The following magnitudes were observed using magnitude 4.5 for beta Scuti as a comparison standard:

Chart-Value		Obs. Value	
6.1		6.22	
6.7		6.72	
7.1		7.33	
iota Aql		4.35	check star

Although there is a difference of 0.1 and 0.2 mag on two of these stars, it appears that this is not a serious error for visual estimates of R Scuti. The 6.1 star is of spectral type K and may appear somewhat out of sequence with the 6.7 and 7.1 stars of spectral type A.

We would like to encourage AAVSO observers to not only make estimates of the variable on the charts but also to carefully check the comparison stars for any possible variations which might occur or errors which may exist on the charts.

WAS THE SUN ONCE A VARIABLE STAR?, by Marcia Keyes

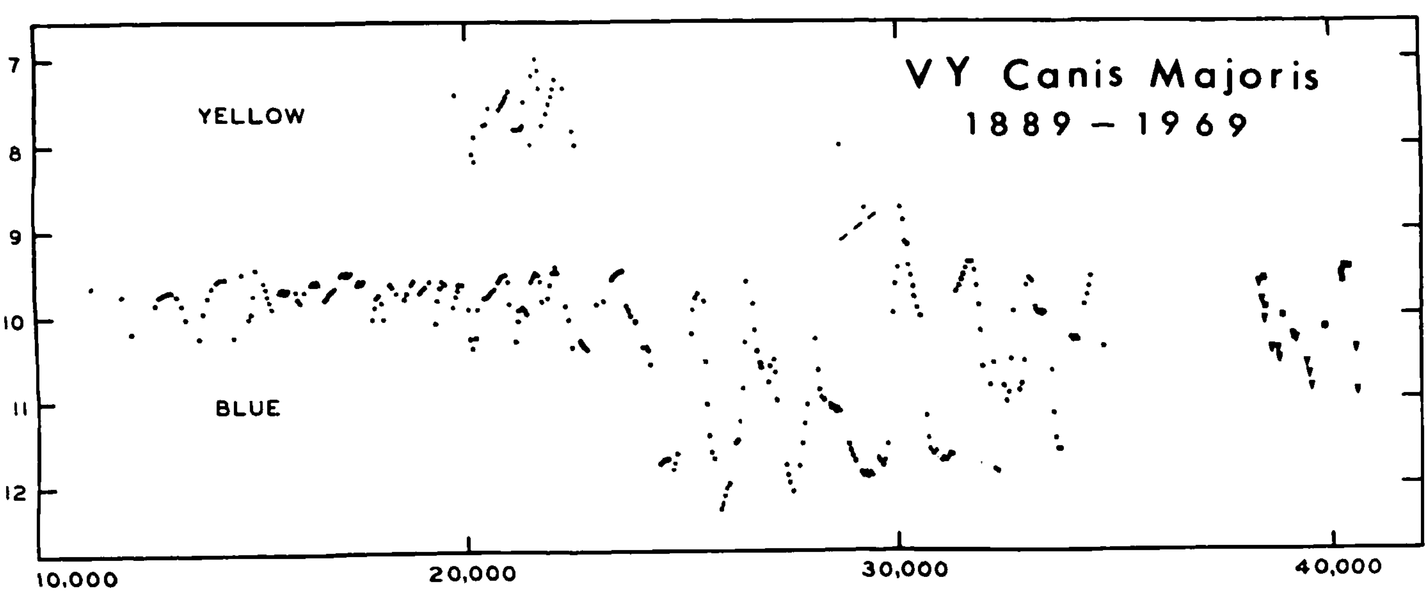
Fortunately for us the sun is not a variable star and has not been one for several millions of years. Men have speculated on the formation of the sun for many years -- the general consensus now is that the sun condensed from a gas and dust cloud until the interior temperature reached a point where thermonuclear reactions became self-sustaining and the sun reached equilibrium. This is fine, but does not tell if the sun was ever variable. A clue can be found in a very interesting class of erratic variable stars, the T Tauri stars.

T Tauri stars are variables whose light shows almost no trace of periodicity -- a few have shown traces of periods that may be related to rotation but even these frequently exhibit bizarre fluctuations in brightness. Sometimes a T Tauri star will remain practically constant in brightness for weeks and then vary as much as three magnitudes, sometimes varying a magnitude in just a few hours. Some spend more time at maximum, others more time at minimum. Their light variation is quite puzzling. These variables are related to the sun in this way. T Tauri stars are roughly the same spectral type and are of the same absolute magnitude and mass as the sun. They give an indication that the sun once was variable because they themselves are very young -- so young that they radiate by heat generated by contraction rather than by nuclear reactions. We have been able to deduce the youth of T Tauri stars on three counts -- 1) they are found exclusively in clouds of dust and gas, the birthplace of stars, 2) spectral evidence indicates that they are still in the process of contracting and have not yet reached the main sequence, and 3) their chemical composition is much like that of the early solar system. Perhaps several billion years ago the sun was a T Tauri star, a very erratic variable.

VY CANIS MAJORIS -- A UNIQUE VARIABLE, by Lief Robinson

By accident, the unique variability of VY Canis Majoris went unrecognized. The object was too faint to be included in Harvard's Milton Bureau, and the observations by Florja, Van Hoof and Deurinck did not span a sufficient time interval.

Recently, at the suggestion of G. Herbig, I observed VY Canis Majoris on about 2,000 plates in the Harvard collection. My sequence was based on photoelectric magnitudes of nearby comparison stars, kindly pro-



vided by G. Wallerstein, and extended to fainter stars through Selected Area 147. The average error of one estimate was about 0.1 magnitude. Good coverage on blue plates was available from 1893 to 1954, but adequate yellow plates were available only from 1913 to 1920.

The synoptic light curve was prepared by plotting all observations, drawing a smooth curve through them, and reading the magnitude at 50-day intervals. The details after 1954 are from 87 observations kindly made by Dieter Friedrich on plates at Remeis Observatory (triangles), as well as a few individual photoelectric measurements (boxes).

From about JD 2,411,300 to 22,000 (1889-1919), VY Canis Majoris exhibited variations of less than a magnitude. The cycles ranged from 200 to 1,000 days, with the average length of about 600 days. Then the character of the light curve changed dramatically. At least until the end of the Harvard patrol, longer cycles persisted, 400 to 1,900 days, with an average of 1,100 days. Though the range became as large as three magnitudes, a tendency for diminishing amplitude seems to have prevailed since JD 30,000. Note also the brightening trend of the major minima, about 0.1 magnitude per 1,000 days.

Probably the best evidence that the relatively minor features of the photographic light curve are real is the agreement between it and the yellow curve between 1913 and 1920. The "yellow" light curve has less range than the "blue" because VY Canis Majoris becomes much redder as it fades.

Continued surveillance should be maintained, and the AAVSO is adding VY Canis Majoris to its regular program. However, great care is needed in making magnitude estimates due to the extreme redness of the object. Estimates every few nights would not be unreasonable, at least until the short-term activity of VY Canis Majoris is better known. One pair of observations by Cragg is worth recalling, a change of 2.3 magnitudes in only 31 days; nothing like this has been observed on photographic plates. Long series of estimates by individual observers are particularly desirable. (See article and chart in Sky & Telescope 40, p. 330, 1970)

OBSERVATIONS USING PEP, by Howard Landis

My early interests in astronomy included astrophotography, telescope making and the construction of a 12 ft. domed observatory. My observing log was used to illustrate how a set of readings is converted to a magnitude reading.

The first object to be observed systematically was Nv Del 1967, which I observed for about three months. It was very interesting for me to watch its changes in brightness from night to night. I became a member of the AAVSO early in 1968 and obtained a group of the brighter eclipser charts. That Fall I did my first eclipsers, the first one of Algol, which was not a good one due to too short observing time on it. Later on I reported on 4 eclipses of RZ Cas. Observing eclipsers is very rewarding to me, but I miss a lot of them due to my restricted horizon both East and West. In the Spring of 1969, Carolyn Hurless handed me a chart sequence problem to work on. It was a questionable 10.0 star on the preliminary UY Cancri chart and though that is about the limiting magnitude of my system, I decided to try it. The star was then 10.4, but this year it was any where from 9.2 to 9.4 over a period of 34 days. I hope to observe that one in the future and attempt to determine its period. The August 1969 Sky & Telescope had a note on V568 Cygni being an irregular worth observing with PEP. That I did, for a period of 90 days, and was able to make observations of it on 37 nights. During the first 20 days there was one increase of nearly 0.5 mag., then it settled down to less than 0.05 mag. variation for the rest of the period. At the Spring 1970 meeting Clint Ford suggested that I work on the sequence stars for Nv Ser 1970. I found this to be very interesting work, and a lot more demanding in accuracy, both in equipment and technique. The "home brewed" photometer now in use needs replacing with one of conventional design in order for me to make readings of over 2.0 mag in one step. Then there were charts for Nv Aql and Nv Scuti also. In all, we have worked on 12 stars on Nv Ser, 16 stars on Nv Aql and 3 stars on Nv Scuti. I should like to express here and now, my thanks and gratitude to Clint Ford for answering my letters and for the encouragement he has given me in this work. When there is no one close at hand with whom to discuss your work, it means a great deal to be able to carry on correspondence with another interested person. At Mrs. Mayall's suggestion I am making observations of stars in the spectral classifications of R, N, and S. These are very red and give some visual observers trouble.

SUMMARY OF SUMMER 1970 WORK ON VARIABLE STARS, by Dorrit Hoffleit

This summer more diverse categories of objects were studied at the Maria Mitchell Observatory than in the past. As usual, several of my hitherto unpublished variable stars in Sagittarius were examined on upwards of 500 plates. Two new long periods and a changing period for an RR Lyrae type, $18^h33^m07^s$ $-21^\circ14'.2$ (1900), were determined. For the latter, Loretta Locicero derived one period from the Harvard MF plates for 1924-34, and a slightly different period from the Nantucket plates for 1957-70. At the end of the season I succeeded in combining into a single expression these results and scattered intervening observations by Miss Locicero for 1942-51, which she herself had not utilized:

$$\text{Phase in fractional part of period} = JD \cdot P_o^{-1} - n - k\,(JD - JD_o)^2$$
$$= 2.467825 \cdot JD - n - 0.130 \cdot 10^{-8}\,(JD - 2438500)$$

In the more usual terminology this is equivalent to phase of maximum in days:

$$\text{Max} = 2438563.748 + 0^d.405215n + 0.865\cdot 10^{-10}n^2$$

These expressions adequately represent all of the available observations from 1924 through 1970.

As symbiotic stars hold special interest for me, Dr. G. Herbig at Lick Observatory graciously sent me finding charts for six stars with symbiotic spectra in VSF 193, which had not previously been examined for variability. Two proved non-variable on our plates; three are suspected of variability but are too badly affected by blended images of optical companion stars for reliable estimates. For the sixth, AS 293, at $18^h08^m10^s.6$ $-29°51'03''$, Martha Clarke found significant variation and we derived a period of 243 days. The light curve, however, stays at minimum only a third of the time, and the curve bears some resemblance to the much longer period symbiotic stars, CI Cyg and AS 313.

At Yale one of the graduate students, Wayne Osborn, provided me with a list of stars whose spectra show the molecule CH. Only 18 such stars had been discovered, of which 4 are known variable stars. I hoped we might find some of the others to be variable. Unfortunately, the MMO collection has only 2 to 29 plates on all but one of these, and no variation was detected on so few plates. For HD 187216, at $19^h44^m84°.6$, some 150 plates were available and Linda Lucignani strongly suspects it of variability. (See her paper.)

Within the boundaries of our variable star fields, VSF 193, DF Cyg, and Coma Berenices, Dr. W.J. Luyten has found a number of high proper motion stars with M-type spectra. In the hope that some of them might be flare stars, we examined six such stars, all with negative results.

Margaret Vogt examined the plates on DF Cygni that had accumulated since Miss Harwood's classical paper of 1938 on this star. Miss Vogt presents her interesting results in another paper.

During the summer the IAU Circulars announced two novae in fields for which we have earlier plates. Miss Lucignani searched for Nova Cyg 1970 (in the field of HBV 475 which I had recently examined upon request). Her results are given on IAU Circular 2257. Later, Nova Scuti 1970 was searched by Marcia Keyes, as reported on IAU Circular 2272. In neither case was the nova found to be recurrent.

The highlight of the season was the acquisition of the Rodman Blink Microscope, designed and built for us by Dr. James P. Rodman of Mount Union College in Alliance, Ohio. Everyone at the observatory tried it out, limiting, in general, the search to the central approximately 9 square degree area of the plates where the definition of the images is best. 21 pairs of plates were scanned and 83 variable suspects marked. Although all have not yet been definitely checked against earlier published lists, it appears that a considerable percentage are rediscoveries. In a few instances the same pairs of plates were also examined by the positive-negative method, with closely the same number of discoveries. (See paper by Marcia Keyes)

Miss Vogt rediscovered KP Cygni, and combining her observations with those of Whitney in the Publications of the Astronomical Society of the Pacific, confirmed that the star has an unusually long RR Lyrae type period, and improved slightly upon the older period. Marcia Keyes found a star in Coma Berenices which had been listed only in the Catalogue of Suspected Variable Stars. She determined and published its period (IAU Information Bulletin on Variable Stars, No. 454). She also tried the positive-negative method for finding variable stars and, among others, discovered a new eclipsing variable with a period of 30 days.

One reason why so much appears to have been accomplished this summer is that night-time observing conditions were worse than usual. Nevertheless, the girls succeeded in adding 87 more plates to our collection.

My staff and I are very grateful to the National Science Foundation, without whose support all of this work could not have been accomplished.

THE RODMAN BLINK MICROSCOPE, by Marcia Keyes

This last summer the Maria Mitchell Observatory was able to expand its program through the use of its new Rodman blink microscope. Uniquely designed and built by Jim Rodman, it works on the principle common to all blinks -- rapid alternation between two plates of the same region which causes the observer to see variable stars blink because of their differing image size while other stars appear constant. Mr. Rodman has modified the standard design in coming up with a more serviceable and easier to operate blink. Most blinks accomplish the alternation of plates by a rotating prism which directs the light from first one plate and then the other to the observer. This method has the disadvantage that the prism tends to fall out of alignment during rotation. The Rodman blink has a completely stationary optical path with a stroboscopic wheel which interrupts the light path and allows the observer to see only one plate at a time. The other major improvement makes it easy to move from one star field to the next. When changing regions, realignment of the plates is usually necessary because of differing amounts of distortion on the plates. Most blinks can compensate for this only by physically moving one plate which is clumsy and time consuming. On the Rodman blink one of the mirrors which directs the light to the observer from the plates is adjustable, allowing the light paths to be brought together.

One of the first variables found with the blink is a star which has been a suspected variable (CSV1904) for some time. The star is in Coma Berenices which is a region the Maria Mitchell Observatory is just starting to work on. We were afraid that we would not have enough plates to derive a period, but the fifty plates proved to be adequately distributed for period determination. The variable has a period of .472469 days and an amplitude of 1.2 magnitudes which makes it a fairly typical RR Lyrae variable.

MISCELLANEOUS PROJECTS, by Linda L. Lucignani

My summer work at the Maria Mitchell Observatory involved a number of miscellaneous projects, rather than mainly concerning myself with finding the periods of variable stars.

First, I checked the 28 available plates (JD 2424070 to JD 2440736) containing Nova Cygni 1970 $20^h50^m.8$ $+35^\circ 48'$ (1950) to see if it is a recurrent one. I could not detect the star on any of the earlier plates except those two near maximum, and deduced that its magnitude was less than 15 and that it was not recurrent during the time of those plates.

Using three of Luyten's high proper motion stars, I measured their magnitudes for the possibility of flare stars in the Coma Berenices region. They are LTT 13444 (BD $+29^\circ$2279); LTT 13647 (BD $+32^\circ$2274); and LTT 13470 (BD $+28^\circ$2110). On 73 Nantucket plates from JD 2427780 to JD 2440767 they did not "flare" or vary appreciably in magnitude.

Using the newly installed Rodman Blink Microscope, I searched for variables in the Coma Berenices, Sagittarius, Cygnus, and Trifid and Lagoon Nebulae regions. On all the plates I found variables, both rediscoveries and new ones, the latter needing more observational data for period determination. In the Cygnus region, I used two methods of search -- the Blink and the Positive-Negative method -- to test the effectiveness of the instrument. In my opinion I thought that the microscope was better since it could detect small amplitude variables that are lost in the process of making a positive plate from a negative. Two drawbacks to the microscope are that the plates have to be matched well in plate limits and location of centers, and that the strain on the eyes after a prolonged time limits the machine usage by one person.

The project I am presently working on is a CH star (HD 187216) at coordinates 19^h44^m $+85^\circ09'$. There is little known about the characteristics of this type of star except that it has very strong hydrogen lines and CH band when measured against the spectra of carbon stars. HD 187216 has a magnitude variation of .5, spectral class of R2, and seems to have an irregular period despite my measurements of 178 Nantucket plates (JD 2420091 to JD 2440808), and about 300 Patrol plates from the Harvard Observatory (JD 2420051 to JD 2425511).

DF AND KP CYGNI, by Margaret Vogt

If there is any one star that can really be said to belong to the Maria Mitchell Observatory, that star would be DF Cygni. Miss Margaret Harwood earned her place in the realm of variable star observers by discovering it on Nantucket plates in 1926 and subsequently analyzing its complicated light curve (Annals of the Observatory of Harvard College, Vol. 105, pp 521-535, 1936). This past summer, I attempted to bring her work up to date by using approximately 730 NA plates of the Cygnus region taken between 1937 and 1970.

DF Cygni is an RV Tauri-type variable, varying between 10.8 and 15.2 in magnitude; it exhibits the characteristic alternating deep and shallow minima with an occasional reversal of the primary and secondary minima. The maxima within any one short double period are approximately equal in magnitude.

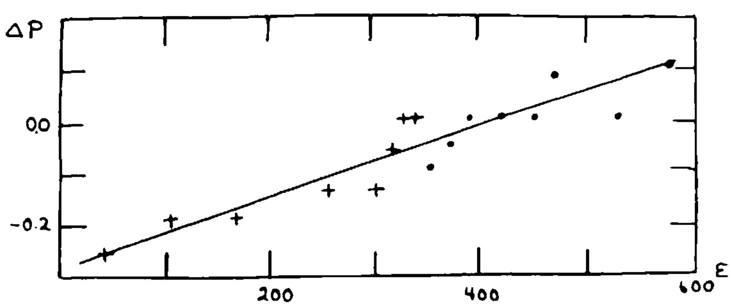


FIGURE 1. Deviations of the short periods of DF Cygni from the standard period of $49^d.808$, as a function of epoch.

Superimposed upon this short double period is a 782-day long-period which represents a slow variation of the mean brightness of the star. The range of the short period variation is greater at the maximum than at the minimum of the long period variation. My work confirmed the regularity of the long period; it works remarkably well for my observations.

The short double period seems more irregular, as might be expected in an RV Tauri-type variable. The period was originally calculated as $49.^d808$ with a systematic, cyclic variation of the O - C's of the maxima and minima over an amplitude of about 20 days and a period of 30 years. However, a pattern of progressive secular change in the short period can now be detected and may be given by the formula

$$P = 49^{d}.608 + 0.00065(E-80)$$

where the epochs E are counted from JD 2311279. The amplitude of period-variation amounts to 0.3 days over a span of 500 epochs.

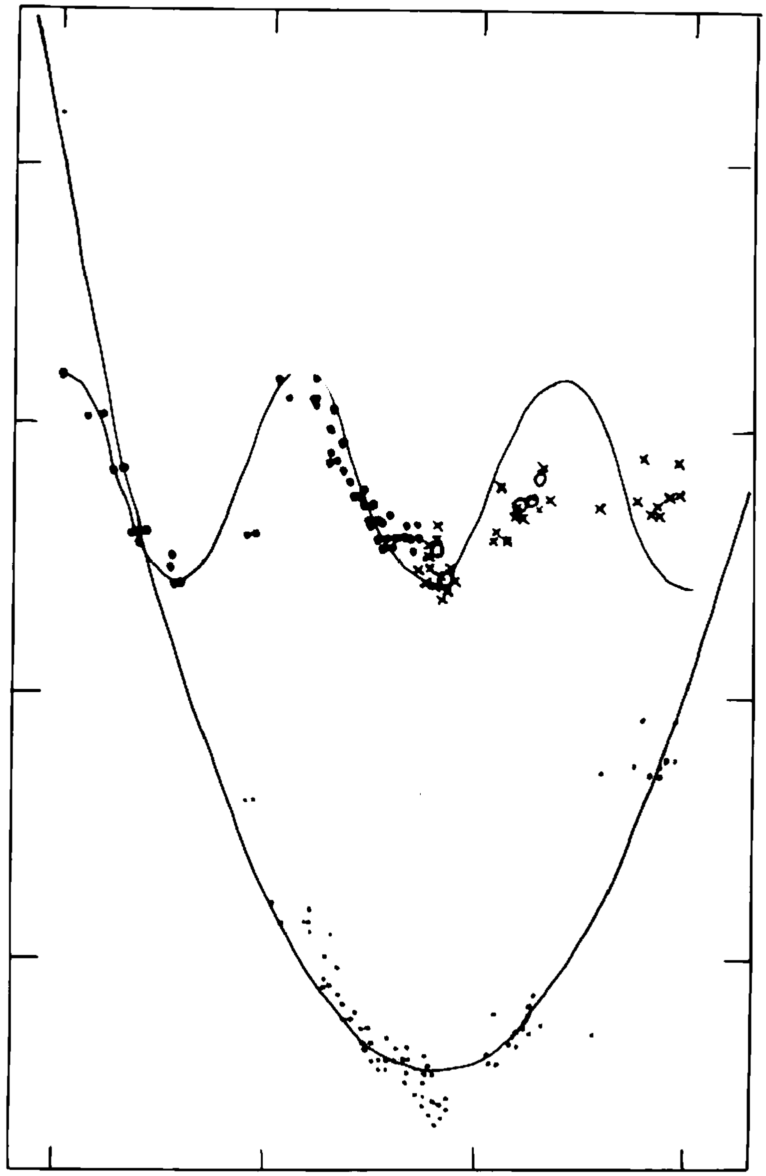


FIGURE 2. O - C for $49^{d}.808$ as a function of epoch. Large dots, Miss Harwood's observations from Harvard Annals 105; open circles, Zessevich's observations; crosses, new observations by Margaret Vogt. Sine curve according to Zessevich analysis. Small dots, O - C displaced by one or two half periods, with parabolic fit. Ordinate markers, intervals of 25 days; abscissae, intervals of 100 epochs.

These results were obtained by using both Miss Harwood's published observations from JD 2411313 to 2428521 (or from 1889 to 1936) and the observations this summer to cover a range of 81 years. The short period maxima and minima for the early data were read off Miss Harwood's graph; the later points were determined by deriving a mean long period light curve and reading off the short period maxima and minima from it. The phases of maxima and minima were then plotted against their magnitudes for intervals of several epochs, using several different periods, and the best period was chosen for each interval. The progressive change became apparent as different periods best satisfied different intervals (Figure 1). Using this method I arrived at a period for my later observations, $49^{d}.838$, that checked with the preliminary determination I had made independently, earlier in the summer. The phases computed on the basis of Miss Harwood's period show an unmistakable shift, indicating the change of period for epochs 348 - 586.

Finally, using Miss Harwood's methods, I continued her 0 - C curve (Figure 2) with my observations. These points were reduced by formulae to represent half the true double period, thus erasing the effect of primary and secondary minima. My points (crosses in Figure 2) for epochs 348 - 586 again show a definite trend toward a longer period. (See footnote by D. Hoffleit)

Another variable in the Cygnus field occupied my summer -- the RR Lyrae-type star KP Cygni. I rediscovered this star on the new Rodman blink comparator and noticed that its period had been determined as $0^{d}.855933$ for the interval from JD 2433617 to JD 2435299 (Whitney, Balfour S., Publications of the Astronomical Society of the Pacific, Vol. 68, p. 269, 1956). Since a period of this length is extremely rare for an RR Lyrae-type variable, I made further observations on approximately 950 plates taken at the Maria Mitchell Observatory. The plates covered the years 1926 to 1969, ranging in Julian Days from 2424684 to 2440508. The magnitude of the star varied between 12.48 and 14.05.

Between the years 1939 and 1969, for example, a noticeable shift in the ascending branch of the light curve was apparent; a correction of 0.000004 in the reciprocal period produced a satisfactory curve. The new elements thus determined are:

$$\text{Max.} = \text{JD } 2426178.579 + 0^{d}.855936\ E.$$

Phases were computed using a reciprocal period of 1.168312.

Footnote to Margaret Vogt's paper, by D. Hoffleit

Miss Vogt's interesting results on DF Cygni stimulated me to further investigation after she had returned to Swarthmore College.

By 1953 Zessevich (Odessa Pub. Vol. 3, p. 293 and 313, 1953) had added new observations (open circles in Figure 2) to those by Miss Harwood, and derived a cyclical correction term ($5.08 \sin 1^{\circ}.51808\, E + 93^{\circ}$) to represent the deviations of the phases computed from her period. Zessevich's observations agree well with Miss Vogt's for the time interval they have in common. Through 1953 the sine term based on Zessevich's formula, shown by the sine curve through the observations in Figure 2, represents the phase-maxima and minima well. But the shape of the observed curve is obviously not a true sine curve; the time of rise is appreciably shorter than the time of decline. The most recent observations, moreover, are poorly represented, although this might indicate an additional damping term.

Miss Vogt's redeterminations of the period over shorter time intervals, on the other hand, indicate a parabolic rather than a sinuous correction term. One might therefore re-interpret the distribution of 0 - C values by assuming that the true value is not necessarily the one originally plotted, which is the shortest possible deviation. Rather, the true value might be any multiple of half a period greater or less than the plotted value (half period in view of the fact that the period of an RV Tauri star is a double period, with deep and shallow minima alternating with an occasional reversal of primary and secondary). On this assumption it is possible to represent the 0 - C values by a parabola, indicating a progressively increasing period. The best fit obtained by trial and error, confirms Miss Vogt's determination of the change in period and is shown in Figure 2. Phases of "primary" minimum are then predicted by

$$\text{"Primary" minimum} = JD_{0} + 49.808E + 6.5 \cdot 10^{-4} n^{2}$$

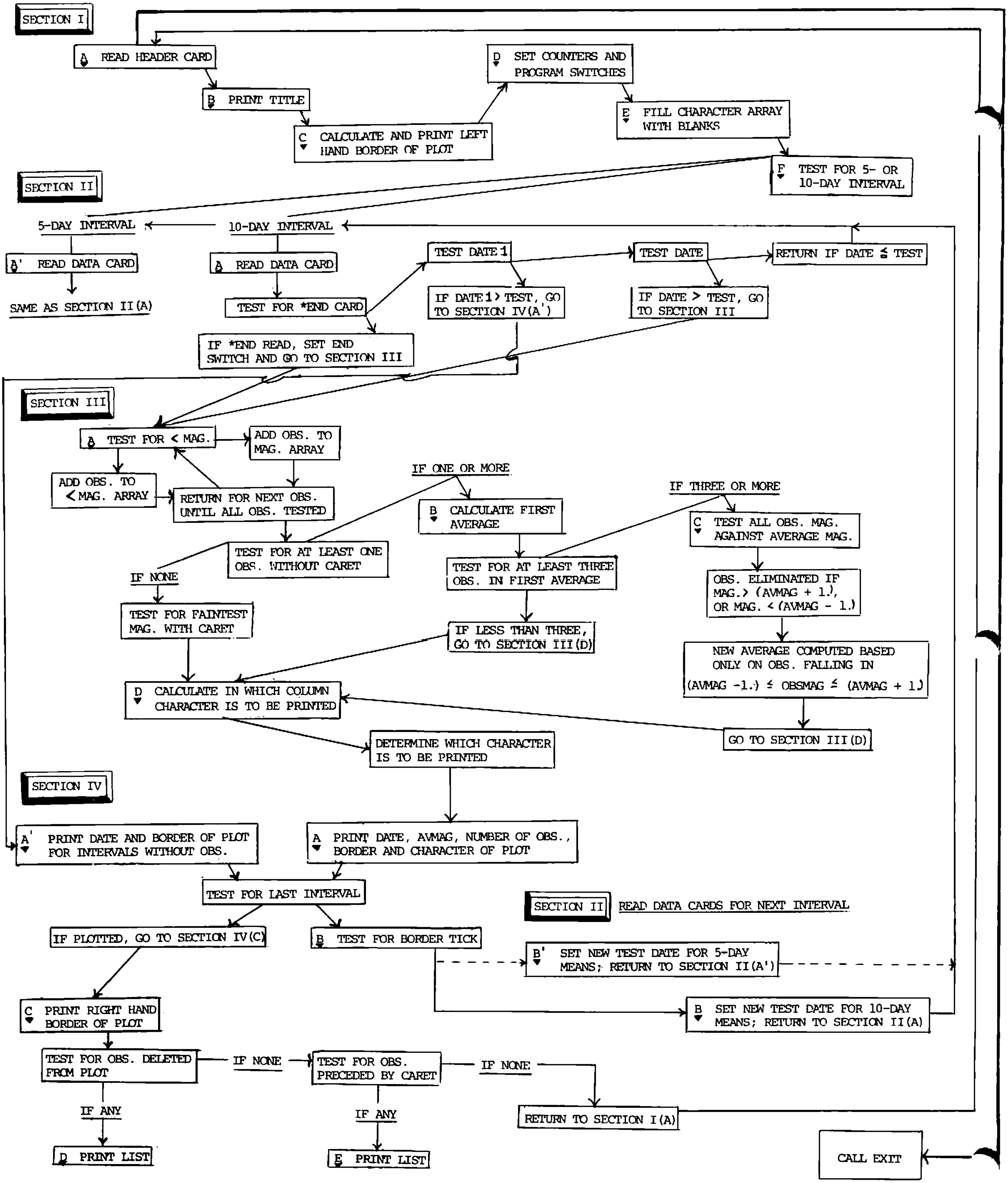
where the JD_0 corresponds to a minimum at the vertex of the parabola, and the epochs n are counted from that JD_0 (at approximately E=360).

Further observations and analyses are clearly desired to test if this parabolic representation is really better in the long run than the sine term. What is remarkable about this star is not so much that there are deviations from predictability in an RV Tauri star, but that so much of the behavior of DF Cygni can be represented by a smoothly varying period.

COMPUTER PLOTS OF AAVSO OBSERVATIONS, by Barbara L. Welther

Before the end of this year, the AAVSO plans to publish plots of magnitude changes during the period JD 2437600 - 2438290 for approximately 500 long period variable stars. This fact is remarkable only in that these plots, unlike previously published ones, will all have been calculated and printed by the computer.

At the Nantucket meeting in the fall of 1966 Mrs. Mayall consulted Professor Owen Gingerich about the feasibility of this project. With his help the AAVSO acquired an IBM key punch and by the summer of 1967 had begun punching observations onto data cards. As soon as a substantial number of observations was punched onto cards, Professor Gingerich asked me to help transform the raw data into finished plots. The initial program plotted 5-day means for the star, R Scuti. The second program refined certain aspects of the initial one and plotted 10-day means for VX Sagittarii. The computer plot for this latter star was recently published in the Journal of the Royal Astronomical Society of Canada, 64, 264, August, 1970.



APPENDIX 2: A SCHEMATIC FLOW CHART OF THE PROGRAM, AVPLOT.

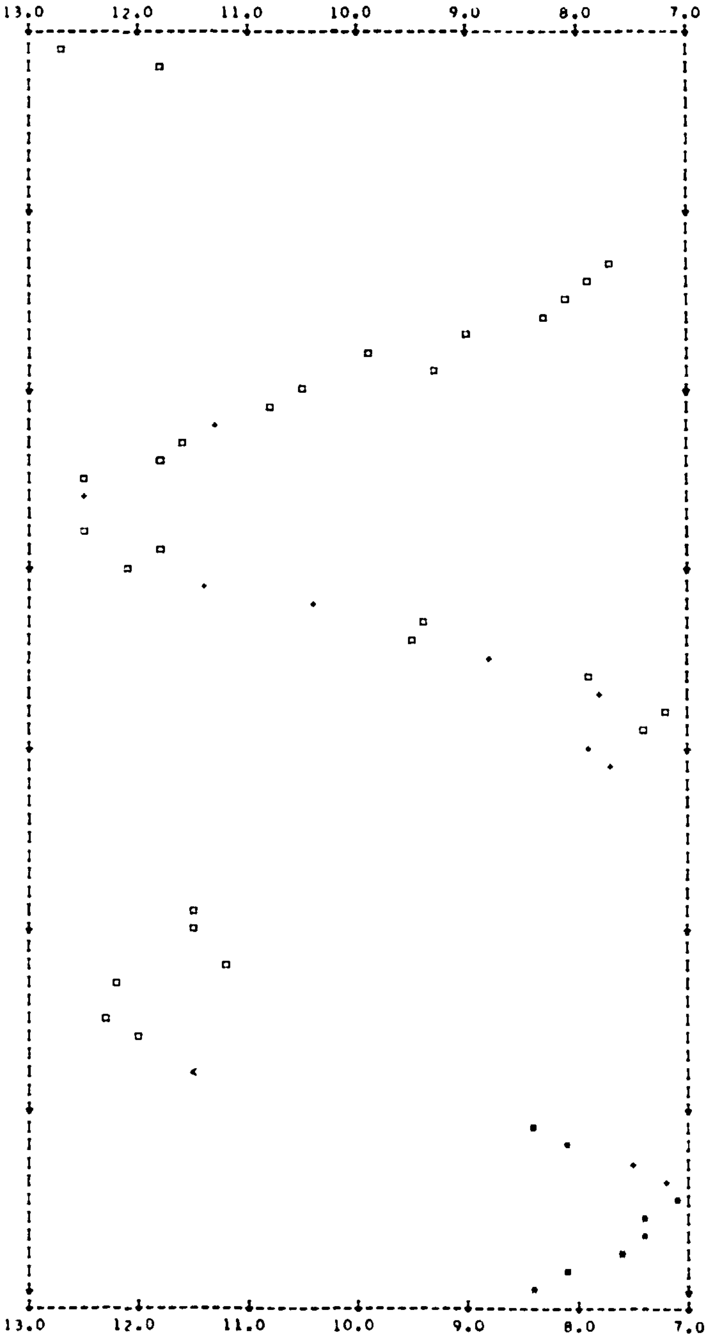
STAR=R SGR INTERVAL=10 INITIAL DATE=2437600.00 FINAL DATE=2438290.00 NUMBER OF MEANS= 70
COORDS=1910-19

MAXIMUM MAGNITUDE= 7.00 MINIMUM MAGNITUDE=13.00 MAGNITUDE RANGE= 6.00

(□) REPRESENTS 1-3 OBSERVATIONS (•) REPRESENTS 4-6 OBSERVATIONS (*)REPRESENTS 7-9 OBSERVATIONS

(■) REPRESENTS 10 OR MORE OBSERVATIONS

JD	AVMAG	OBS
2437600	12.70	1
2437610	11.80	1
2437620		
2437630		
2437640		
2437650		
2437660		
2437670		
2437680		
2437690		
2437700		
2437710		
2437720	7.70	2
2437730	7.85	2
2437740	8.13	3
2437750	8.35	2
2437760	9.05	2
2437770	9.90	1
2437780	9.35	2
2437790	10.47	3
2437800	10.85	2
2437810	11.35	4
2437820	11.60	1
2437830	11.80	1
2437840	12.47	3
2437850	12.50	6
2437860		
2437870	12.50	1
2437880	11.85	2
2437890	12.10	1
2437900	11.40	4
2437910	10.43	4
2437920	9.40	1
2437930	9.53	3
2437940	8.84	5
2437950	7.90	2
2437960	7.77	6
2437970	7.20	2
2437980	7.40	2
2437990	7.85	4
2438000	7.70	4
2438010		
2438020		
2438030		
2438040		
2438050		
2438060		
2438070		
2438080	11.50	1
2438090	11.50	1
2438100		
2438110	11.20	1
2438120	12.25	2
2438130		
2438140	12.35	2
2438150	12.00	1
2438160		
2438170	<11.50	2
2438180		
2438190		
2438200	8.40	11
2438210	8.10	9
2438220	7.47	6
2438230	7.20	6
2438240	7.06	9
2438250	7.44	8
2438260	7.43	7
2438270	7.59	7
2438280	8.05	11
2438290	8.41	9
JD	AVMAG	OBS



---------- OBSERVATIONS END ON JD=2438290.00----------

THE FOLLOWING OBSERVATIONS WERE MORE THAN ONE MAGNITUDE FAINTER OR BRIGHTER THAN THE FIRST AVERAGE FOR THE INTERVAL

THE FOLLOWING OBSERVATIONS WERE PRECEDED BY THE SYMBOL "<".

INTERVAL	JD(CARD)	MAG	OBSERVER
2437850	2437851.60	)12.8	KY
2438170	2438165.70	)11.5	ST
2438170	2438165.70	)11.5	STR

Although the first two programs laid good groundwork for the present project, many aspects still had to be refined before we could undertake plotting a succession of stars with different magnitude ranges and other individual problems. Even the first fifty plots in this project did not catch all the problems we were to encounter. Because the computer cannot make intuitive corrections to light curves, and cannot correct simple errors unless they are logically anticipated, Mrs. Mayall and I both edited the list of data cards before computing the plots. My aim was to find errors in punching and sequencing, and Mrs. Mayall's was to find bad observations. After each plot was run, Mrs. Mayall checked it against her master one containing all the recorded observations for the star.

Essentially, this paper is a manual which defines the variables used and explains how the program works. There are three main sections: (1) to read data cards, (2) to perform operations on the data read, (3) to print the results of the operations in a meaningful plot. Each of these main sections has several subsections which concretely deal with the specific problems of the format of the data cards to be read, the kinds of operations needed for the desired results, and the formats in which the various results are to be printed. To illustrate the write-up there are five appendices: (1) a listing of the fortran program with the sections blocked out and marked, (2) a schematic flow chart of the program, (3) a reproduction of the first and last ten cards of a typical data pack, (4) a listing of all the data cards for R Sagittarii for JD 2437595.50 through JD 2438295.49, and (5) the computer plot of observations of R Sagittarii for that same interval.

Note: Appendices 2 and 5 are included here. The complete program will be printed with the light curves in AAVSO Report 28. (Ed)

SOLAR OBSERVATIONS UNDER EXCELLENT VISIBILITY CONDITIONS, by Herbert A. Luft

This past summer, when we quite often have extremely hot and humid weather on the east coast of the USA, the sun appears through the quite heavy haze. On such days the air turbulence is very low, the solar images are very steady. One of the consequences is that an experienced sunspot observer is able to detect numerous small groups and tiny spots, which under the usual circumstances are not visible. It is no wonder that an observer with a high W_1 factor in the American Sunspot Numbers derives the monthly means of these American Relative Numbers as high as the well known Zurich Numbers. This also is apparent since July 1970, when I noted an unusual number of such "clear" days for sun-spot observations.

UP-DATED REPORT ON NEW CHARTS, by Clinton B. Ford

Since my last report in these Abstracts (October 1969), the production of new pencil-traced standard-format AAVSO charts at the Secretary's office has continued and accelerated. In response to requests from an increasing number of observers, a complete list is given below of all new tracings made since the inception of the Olivier chart program (1966). This table thus consolidates information which is currently available only by consulting several earlier AAVSO Abstracts issues (May 1966; May and October 1967; June 1968; October 1969), and includes all new charts completed as of October 1, 1970.

A glance at the key to abbreviations will indicate the wide variety of information sources consulted, most of which have been accredited in detail in previous reports. Among recent developments, most important have been the continuing cooperation of Wayne M. Lowder in sketching previously uncharted fields from his researches in the variable star literature; Charles E. Scovil's excellent work in photographing field details with the Stamford (Conn.) Observatory's 22-inch reflector; and Scovil's measurements of his Stamford (and other) plates for comparison star magnitudes, using the Cuffey iris plate photometer at Yale Observatory.

Dr. A.U. Landolt of Louisiana State University has kindly measured PEP V-magnitudes in the fields of 005427 W Psc and 143922 UZ Boo with a Kitt Peak 36-inch reflector, and it is possible that his observing programs there will allow him to furnish us with additional much-needed sequence information in the future. Valuable PEP V-magnitudes have also been furnished in the past year by Howard Landis of East Point, Georgia. The cooperation of all these individuals and observatories is gratefully acknowledged.

Black-on-white electrostatic (Gafax) copies of the listed new charts are available on a limited basis from my office, free of charge. Address: C.B. Ford, AAVSO Secretary, 10 Canterbury Lane, Wilton, Conn. 06897. However, the size of an observer's telescope and some indication of his observing experience must be stated. As noted in previous reports, most of the newly charted variables cannot be observed adequately with telescopes smaller than 10 inches aperture. For those desiring a complete set of the new charts, the size of the package has now made it necessary to make a charge of $5.00 (U.S. funds) to cover postage etc., payable directly to C.B. Ford. For complete-set orders to be sent outside the USA and Canada, the charge is $7.00 (U.S. funds).

The following table lists 318 variable stars and 380 field tracings none of which existed in any standard reproducible form prior to 1966. Most of these stars are Mira-type long-period or U-Geminorum type variables which AAVSO members should have been observing long ago. The 1970 edition of the Russian General Catalog of Variable Stars contains information on well over 20,000 stars, probably 4,000 of which are objects we could meaningfully observe by visual means with modest-sized telescopes. Of that 4,000, we now have usable standard-format quantity-reproducible charts -- many of them regrettably with incomplete comparison star sequences -- for only about 700 listed in the 1968 AAVSO Chart Catalog, plus roughly 250 on the attached list. In other words, a total of only about 1,000 stars, or 25% of the estimated possibilities, have been suitably charted, even when one includes the approximately 150 new charts which have recently been produced in various forms for the Association's eclipsing binary and RR-Lyrae observing programs. Much progress has been made, but there is clearly plenty of room for further work in the chart department!

LIST OF PENCIL-TRACED AAVSO-FORMAT CHARTS NOT INCLUDED IN THE 1968 AAVSO CHART CATALOG --- COMPLETIONS AS OF SEPT. 25, 1970

HCO Design. (1900)	Name	New Chart Types	* Basic Info Sources	# Notes re Sequence, etc.
000612	WW Cet	b¯, d	S;P	Ltrs. only
000862	UX Cas	d	L;S	L (incomplete)
002561	VX Cas	e	L;S	ditto
003162	TY Cas	e	L	L;SA
005427	W Psc	d, e	C;Y	PEP(V), Landolt, Kitt Peak (8/70)
010359	HT Cas	c, f	B;C	Lo
010621a	X Psc	e	C;P	C
010621b	UX Psc	e	C;P	C
011055a	VZ Cas	d	L	L
011055b	GG Cas	d	L	L
011355	AA Cas	d	L	L
011638	TX And	d	L;C	L
011724	TZ Psc	d	C;P	Ltrs. only
012031	TY Psc	d, e	C	Ditto. Ident'n ?
012020	RX Psc	cd	L	L;SA
012216	ST Psc	d	01	Incomplete
012350	RZ Per	e	A;S	Exp'n of d chart
012746	SX And	d	C	Ltrs. only + est's by Saladzius
013050	KT Per	e+	L	L
013300	SW Cet	d	01;S	01
013937	AR And	b, d, e	01; S; P	01
015505	TT Psc	d	01	01
020356	UV Per	f	A;S	Exp'n of e chart
020556	UW Per	e	L;S	Lo (based on UV Per)
022132a	S Tri	d	HCO;01	01
022132b	-- Tri	d	HCO;01	01
022232	-- Tri	d	HCO;01	01
023238	UY And	b, d, e	C;01	01 Ident'n ?
024356b	EO Per	d	L;A	From W Per field
024456	ZZ Per	d	L;A	Ditto
031919	SV Ari	d	L;S	Ltrs. only
034307	BR Eri	b	S;V	V
034809	SW Eri	b, d	01;S	01
040150	FO Per	c, f	C	Ltrs. only
040106	XY Tau	d	01;S	01
040351	FR Per	c	C	Ltrs. only
041813	AH Eri	d, e	C	C
041916	VX Tau	d	L;A	L. From W Tau field
042625	UZ Tau	d, f	P;Li	H. Ident'n ?
042725	DL Tau	d	S;L	L. Also Landolt(1967)
043322	VY Tau	d	01	01
044907	FG Ori	e	01	01
045048	TV Aur	e+	L	L
045007	SX Eri	b, d	S;01	01
045148	TY Aur	e+	L	L
045256	TX Cam	e+	L	L
045715	GP Ori	d	01;S	01
045935	AQ Aur	d	L	Lo;SA. Ltrs. only

HCO Design. (1900)	Name	New Chart Types	* Basic Info Sources	# Notes re Sequence, etc.
050130	RW Aur	d, e	Li	H
051011	V431 Ori	d	01	01
051316	X Lep	b, e	01	b chart, D. Lucas
052036	W Aur	f	A	Exp'n of e chart
052034	S Aur	e	A	Exp'n of d chart
052607	BK Ori	d	S;L	Lo
052702	RY Ori	d	L	L
052825	AD Tau	b, d	01;S	01
052924	CQ Tau	b, d	L;S	L
053106	BN Ori	e+	L;S	L
053328	AW Aur	d	L;S	L
053538	SZ Aur	d	L	Lo;SA;F
053604	Y Ori	d	L;S	L
053800	GT Ori	b, d	01;S	01
053920	Y Tau	c	S;A;St	St. Rev'n, Oravec
053900	V351 Ori	b, d	01;S;L	01; L
053915	CP Tau	b, d	01;S	01
055439	AZ Aur	d	L	Lo
055610	DP Ori	d	01	01. Photo incompl.
055716	RR Ori	d	St;01	St;01
060222	SS Gem	d	St	St
060443	RR Aur	d	A;St	St. Rev'n, c chart
060547	SS Aur	e	A	Exp'n of d chart
061117	CZ Ori	e	A	Exp'n of d chart
061317	UY CMa	a, bc, d	Z;Vg;S	Z
061417	UZ CMa	a, bc, d	Z;Vg;S	Z
061947	GQ Aur	d	L;A	Incompl.; from V Aur field
061725	ZZ Gem	d, e	L;S;Y	Lo;Y
061824	CD Gem	d, e	L;S;Y	Y
061925	VV Gem	d, e	01;S;L	01
062047	AG Aur	d	L;A	Ditto GQ Aur
063026	BR Gem	d, e	01	01
062926	KN Gem	d, e	01	01
063100	CW Mon	b	AE	Chart by J. Thomas
063201	SY Mon	b	AE	Ditto; no sequ.
063444	AA Aur	d	L;Vg	Lo
063909	FX Mon	b, c, e	C;01	01. b only by C.
064128	IR Gem	d, e	L;S;Ds	Lo;Ds. Ident'n ?
064108	ST Mon	e	C;S	Ltrs. only
065107	BG Mon	d, e	01;L	01;Lo
065209	EQ Mon	bd, e	C;BP;P;Y	Ident'n ?
065510	BI Mon	e	01	01
065911	Z CMa	d	S;BA	BA
070205	RS Mon	d, e	C	C;F
070714	VX Gem	e+	L	L
071026	WZ Gem	d	St	St, exp'n & rev'n
071628	AW Gem	f	C;Ds	Ident'n ?
070717	UZ Gem	e+	L	Lo
072141	VX Aur	d	L;S	Lo
072240	HM Aur	d	L;S	Lo
072404	RX Mon	d	C	C
072811	T CMi	e	A	Exp'n of d chart
072820b	Z Pup	e	A	Exp'n of d chart
073234	ST Gem	e	A	Exp'n of d chart
073400	GK Mon	d, e	01	01
073914	BE Gem	b, e	01;S	01
075320	BP Gem	e	01;S	01
080428	YZ Cnc	d+	Ds;L;S	Ds;Lo
081617	V Cnc	f	A	Exp'n of e chart
081710	GG Hya	d	01	01
081935	X Lyn	d	A	Exp'n and Rev'n of c chart
082953	SW UMa	e	A	Ditto, d chart
083013	UY Cnc	b, d	01	01; b, D. Lucas
083126	AA Cnc	e	C	C

HCO Design. (1900)	Name	New Chart Types	* Basic Info Sources	# Notes re Sequence, ect.
085202	WW Hya	d	01	01
085300	TU Hya	b, d, e	C;01	01; b, Cragg
085518	SY Cnc	d, e	C	C
091104	UZ Hya	b, d	01;S	01
092421	TU Leo	d	C;S	C
093320	ST Hya	b, d	01;S	01
093720	RS Leo	d	A;S	Exp'n and Rev'n of c chart
094501	W Sex	d	01;S	01
101806	X Sex	b, d	01;S	01
103926	W LMi	d+	L	L
105802	SX Leo	b, d	01;S	01
111000	TT Leo	d	01;S	01;F
111817	TZ Leo	d	01	01. Ltrs. only
113303	T Leo	e	C;S;Y	Y
113639	RU UMa	d+	L	Lo;SA
114003	TW Vir	d, e	C;P	C
114749	BC UMa	d	L	Lo; chart incompl.
115903	TZ Vir	b, d	01;S	01
122402	3C-273 Vir	b, d	C	C
122917	U Crv	d	01;S	01
123366	RV Dra	cd	L	L
123517	V Crv	d	01;S	01
123937	TX CVn	cd	L	L
124238	U CVn	d	HCO;L	L
124728	EX Hya	d, f	C;BP	St(?); incompl.
130105	YY Vir	cd	01;S	01
132262	RR UMa	d	L;S	Lo;SA
134000	WZ Vir	cd	01;S	01
134434	RT CVn	d	St	St
135304	SY Vir	d	01	01
135829	RZ Boo	b	St	St
142204	AE Vir	d	01	01
143719	SX Lib	d	C	C
143922	UZ Boo	d, f	BP;C;S;Y	Y; also Landolt, PEP(V), Kitt Peak
144339	RR Boo	c	C;St;S	St (revised)
145441	TT Boo	d	L;S	Lo; SA
151336	RT Boo	d+	L;S	L
151714	S Ser	e	A	Exp'n of d chart
152319	WX Ser	d	L;S	Lo;SA
152703	WW Ser	b, d	01;C	01; b, Cragg
153801	BG Ser	d	L;S	Lo;SA. Ltrs. only
155420a	AH Ser	[d, e	01;P	01. Indent'n ?
155420b	-- Ser	d, e]	01;P	01. -- Ser = AH ?
155502	BC Ser	d	01	01.
160710	DN Her	d, e	01;P	01; Lo
160825	VV Her	d	L;A	Lo. From RU Her.
161326	NP Her	d	L;Vg	Lo; SA
162623	DO Her	d	01	01
163414	AS Her	d	L	Lo; SA
164025	AH Her	b, e	C	C. b, J. Thomas
164012	UV Her	d	L	Lo; SA
165007	V970 Oph	d	01	01
165504	V855 Oph	d	01	01. Ident'n ?
165722	SY Her	c	L;St	Lowder chart
165912	UX Oph	d	L;St	St; SA
170217	VY Her	d	L;HCO	L
171157	TT Dra	d	L;S	Ltrs. only
171507	V746 Oph	d	St	St. Ident'n ?
171707	UZ Oph	d	St	St
171904	V759 Oph	b, d, e	01;SA	01. b, D. Lucas
172809	RU Oph	e	A	Exp'n of d chart
174021	CF Her	d	L;S	Lo;SA;F
174422	SU Her	d	L;S	Lo; SA

HCO Design. (1900)	Name	New Chart Types	* Basic Info Sources	# Notes re Sequence, etc.
175423	FU Her	d, e	01;S;P	01. Zero pt. needs revision
175523	WY Her	d	01	Ditto
175619	BL Her	d	L;St	St; SA
175718	WZ Her	d	L;St	St; SA
180436a	V653 Sgr	f	C	C
180436b	V655 Sgr	f	C	C. Ident'n ?
180518	XZ Her	d, e	L;S	Lo; SA
180514	UZ Ser	cd, d, e	BP;L;S	H;HCO. Brt. stars, W Ser b chart
180536	V725 Sgr	f	C	C
181131	TV Her	e	A	Exp'n of d chart
181141	V533 Her (Nv 1963)	d, ef	A;P	Ft. stars, ltrs. only + L. Hazel est's.
181103	RY Oph	e	A	Exp'n of d chart
181306	BC Oph	d, e	L;S;Y	L;SA;Y
181406	AY Oph	d, e	L;S;Y	L;SA;Y
181512	V450 Oph	d, e	01;P	01
182039	TW Lyr	e	C;S	C
182416	SS Sgr	d	S;St	St
182604	TY Oph	d	01;St	01
182916	DS Her	d, e	01	01
183138	LL Lyr	d, e	C;M;Ds	C;Y
183225	RZ Her	e, f	A	Exp'n, rev'n of d and e charts
183423	V348 Sgr	f, g	A;C	C
184008	NvSct 70	c, d	S;Y	Y; also new AAVSO blueprints
184137	AY Lyr	e	A	Exp'n of d chart
184243	RW Lyr	e	A	Exp'n of d chart
184826	CY Lyr	b, e+	AE;Li;M	b, J. Thomas
185036	SU Lyr	d, e, f	C;Ds;S;Y	Y (f chart only)
185032	RX Lyr	f	A	Exp'n of e chart
185200	V493 Aql	b	C	C
185316	EU Aql	b, e	AE;01	01. b, D. Lucas
185634	Z Lyr	f	A	Exp'n of e chart
185600	V336 Aql	b	C	C
185901	SZ Aql	b	C	C
190017a	V338 Aql	b, d, e	01;L;SA	01;L;SA(D. Lucas)
190017b	V807 Aql	b, d, e	01;L;S	Ditto
190157	BH Dra	b, d	AB;S	b, Sky & Tel mag. April 1969
190301	TT Aql	b	C	C
190527	TY Lyr	d	St;L	St
190627a	UV Lyr	d	St;L	St. Ident'n ?
190627b	FK Lyr	d	St;L	St
190627c	GZ Lyr	d	St;L	St. Ident'n ?
190728	UW Lyr	d	St;L	St
190904	XY Aql	d, e	L;S	L;SA. Ltrs. only
191046	SS Lyr	d	L;S	L; SA
191416	V889 Aql	c, d	L;St	St + Oravec(part'l)
191517	W Sge	c, d	L;St	Ditto
191717	T Sge	c, d	L;St	Ditto
191805a	EM Aql	d	L;St	St
191806	V531 Aql	d	L;St	St. Ident'n ?
191904	NvAql 70	b, d, e	S;Y;P	Y. Also new AAVSO blueprints
192121	WW Vul	d	C;Ds;S	C
192201	TU Aql	b, d, e	S;SA;HCO;01	01
192928	TY Cyg	f	A	Exp'n of e chart
192914	KX Aql	cd, de	BP;L	L
193014	EY Aql	cd	BP;L	L
193312b	LS Aql	d	01	01
193312c	V343 Aql	d	01	01

HCO Design. (1900)	Name	New Chart Types	* Basic Info Sources	# Notes re Sequence, etc.
193411	SV Aql	e	A	C (from RT Aql d)
193408	EZ Aql	d, e	01	01
194027	YZ Vul	e	L;S	Lo;SA;F
193911	DX Aql	d	St	St
194127	AH Vul	e	L;S	Lo;SA;F
194111	DY Aql	d	St	St
194219	RZ Vul	e	L;S	L;SA
194327	CK Vul	b, d, e	AE;S;Y	C;Y;Sk. Ident'n ?
194326	NvVul 68	a, b, d, e	AE;S;Y	C;Y;Sk
194436a	V811 Cyg	b, g	Vg;P;L	L;Ds
194436b	V1152 Cyg	b, g	Vg;P;L	L;Ds. Ident'n ?
194427	S Vul	a, b, d, e	AE;S;Y	C;Y;Sk
194542	DF Cyg	d, e	L;S	L; SA
194727	SV Vul	a, b	AE;S;Y	C;Y;Sk
195032	EY Cyg	d, f, g	BP;S;Y	Y. Ident'n ?
195109	UU Aql	e	A	Exp'n, rev'n of d chart
195377	AB Dra	b	BD;A;S	New finding chart
195553	V476 Cyg	b, f	A;SA;S	Exp'n of e chart + new b, D. Lucas
195551	CM Cyg	b, d, e	A;SA;S	Y; Lo(partial); Hz
195636	V698 Cyg	d	L	L
195635	KM Cyg	d	L	L
195819	TX Sge	b, d, e	AE;01	01; b, D. Lucas
195816	RZ Sge	e, f	C;BP;L	Lo. Ltrs. only
195916	TY Sge	e, f	C;BP;L	Ditto. Const.?
200209	HI Aql	b, e	AE;01	01; b, D. Lucas
200473	AQ Dra	d	C;S;Ds	Ds(?)
200525	W Vul	c	S	N
200647	SV Cyg	c	S	St(?)
200706	TV Aql	d, e	HCO;01	01
201209	RU Del	d, e	01	01
201207	QZ Aql	d, e	01	01
201434	AU Cyg	d	L	L
201633	MY Cyg	d	L	L
202512	RX Del	b, d, e	01;SA	01; b, D. Lucas
202509	RY Del	b, d, e	01;SA	Ditto
202611	RZ Del	b, d, e	01;SA	Ditto
202918	AG Del	d, e	L;S	Lo; SA
203513	SS Del	b, d, e	AE;01	01. b, D. Lucas
203611	Y Del	b	AE	b, D. Lucas
203618	SZ Del	d	S	C. Ident'n ?
203718	HR Del	b, d, e	A;S;Y	Y;Sk
203942	DG Cyg	d	L;S	L
203918	ES Del	d	S	C. Ident'n ?
204104	BR Del	d, e	01	01
204846	RZ Cyg	e	A	Exp'n of d chart
204843	V751 Cyg	e	L;S	L
204835	NvCyg 70	d, e	S;Y	Y. Also new AAVSO blueprints
210408	Z Equ	d	01;L	01;Lo
210405	RR Equ	d	L;S	L;SA
210558	UY Cep	d	L	L
210612	AN Peg	d	L;S;A	From R Equ d
212503	VZ Aqr	cd, e	BP;L	Ltrs. only Ident'n ?
213742	Q Cyg	b, f	A;CB	b from SS Cyg
214306	EV Peg	d	01	01. Const.?
215147	LV Cyg	b, e	01;S;HCO	01
215247a	LX Cyg	b, e	01;S;HCO	01
215247b	LY Cyg	b, e	01;S;HCO	01
215445	MP Cyg	b, e	01;S;HCO	01
215548	FG Cyg	d	L	Lo. Ident'n ?
215545	MS Cyg	b, e	01;S;HCO	01
215648	CSV5499 Cyg	d	L	Lo. Ident'n ?
215848	GY Cyg	d	L	L

HCO Design. (1900)	Name	New Chart Types	* Basic Info Sources	# Notes re Sequence, etc.
215813	DG Peg	d	Ol	Ol
220133b	RZ Peg	d, e	A	Exp'n of c chart
220555	EE Cep	d	C;L;S	L
220912	RU Peg	e	A	Exp'n of d chart
221255	CP Lac	e	A	Ditto
221456	YZ Cep	d	L	L
222924	SS Peg	d	C;St	St
223809	CSV5598 Peg	d	Ol	Ol
224258	CR Cep	d	L	L
224517	SX Peg	[d, e]	C	C;SA. Ltrs. only
224617	AF Peg	[d, e]	C	Ditto
225258	OI Cep	e^+	L	L
225859	UV Cas	cd	C	C
231539	RY And	e	A	Exp'n of d chart
231839	BU And	d	A;L;S	L (from RY And)
232543	DX And	[d^-	L	L
232642	BG And	d^-]	L	L
233109	FF Peg	d	Ol	Ol
233860	PY Cas	[d	L;S	L
233961	PZ Cas	d]	L;S	L
234315	DL Peg	d	Ol	Ol
235053	RR Cas	e	A	Exp'n of d chart
235255	WY Cas	e	C	BS (incomplete for WY Cas)

KEY TO ABBREVIATIONS USED IN THE FINAL TWO COLUMNS OF TABLE

* Basic Information Sources:

A	Earlier AAVSO blueprinted or temporary chart issued from Headquarters
AB	Becvar Atlas Borealis (for b or a chart only)
AE	Becvar Atlas Eclipticalis (for b or a chart only)
BA	British Astronomical Association (BAA) chart
BD	Bonner Durchmusterung (Argelander)
BP	Brun & Petit Atlas of U Geminorum stars (1959)
BS	Burbidge & Sandage, ApJ. 128, 175 (1958)
C	Mt. Wilson (60-inch) photo, T.A. Cragg
CB	Earl of Crawford chart, Copernicus, II (1878)
Ds	G. Darsenius chart or sketch
HCO	Harvard College Observatory photo
L	Sketch by Wayne M. Lowder, from literature research (Fordham University Library and other sources)
Li	Lick Observatory photo (G.H. Herbig)
Ol	Dr. C.P. Olivier, Publications of Flower Observatory, University of Pennsylvania, as previously reported in these Abstracts. Photos by J.L. Woods (Baltimore, Maryland)
P	Palomar Survey photo prints, expanded to scale by W.S. Houston and others
S	C.E. Scovil photograph, Stamford (Conn.) Observatory 22-inch reflector
SA	SAO Star Catalog (sketch only, for b or a chart)
St	I. Stein, A.S.V. IX Catalog and charts (1941), or earlier A.S.V. Volumes (Hagen)
V	M. Vattuone, sketch
Vg	H. Vehrenberg Photographic Star Atlases
Y	Sequence measured by C.E. Scovil with Yale University Observatory's Cuffey iris plate photometer
Z	R.A.S. of New Zealand chart

Notes regarding Sequence, etc.

BA	BAA Sequence
C	Sequence by T.A. Cragg, Mt. Wilson Observatory plate photometer
Ds	Darsenius sequence
F	C.B. Ford, eye estimates for partial sequence
H	G.H. Herbig sequence (1938?)
HCO	Harvard Observatory sequence
Hz	Photograph by L.H. Hazel
L	Sequence researched by W.M. Lowder from various literature sources (Fordham University Library and others)
Lo	Sequence eye estimated only by Lowder
N	U.S. Naval Observatory Catalog of PEP (V) Magnitudes (bright stars only), 1969
Ol	C.P. Olivier sequence, University of Pennsylvania Publications, as noted in previous Abstracts
SA	SAO Star Catalog & Atlas (bright stars only)
Sk	PEP (V) sequence (partial), A.J. Stokes
St	Sequence from I. Stein, A.S.V. IX (1941), or earlier A.S.V. volumes (Hagen)
V	M. Vattuone, estimated sequence
Y	C.E. Scovil, sequence measured with Yale University Observatory's Cuffey iris plate photometer
Z	R.A.S. of New Zealand sequence

THE AMERICAN ASSOCIATION OF VARIABLE STAR OBSERVERS

IN MEMORIAM

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Frank J. De Kinder May 24, 1891 - April 27, 1970

Almost a year ago to the day at Nantucket, just a few miles from here (Woods Hole), we listened to a farewell address by our immediate Past President, Frank De Kinder, in which he so eloquently expressed his love for astronomy and especially the A.A.V.S.O. Frank passed away April 27, 1970.

His dedication to the A.A.V.S.O. was well known as well as his long association with the Montreal Centre of the R.A.S.C., holding offices in both associations. He was also a hard and willing worker on all committees of which he was a member.

Frank was an extraordinary and talented man in many ways. In addition to his native Dutch, he spoke and wrote fluently in at least three languages, English, French, and one very dear to him, Esperanto, an international language, by means of which he corresponded with fellow Esperantoists all over the world.

In addition, Frank was the father of six children, twenty-four grandchildren and ten great grandchildren. To those who knew him well, Frank will always be remembered for his unconventional driving habits, a sort of damn the torpedoes and full speed ahead philosophy. There is no doubt he lived his life to the full and enjoyed every moment of it.

Charles M. Good
1st Vice-President of AAVSO

Percy W. Witherell January 8, 1877 - May 22, 1970

Percy W. Witherell, former Treasurer of the AAVSO died on May 22, 1970. He was in his 94th year. Percy was, in effect, the second Treasurer of the AAVSO. M.J. Jordan, his predecessor, died in office on December 22, 1929. After a brief interlude Percy was elected Treasurer on October 18, 1930. He served in this arduous capacity until October 1960.

During this 30 year period, which covered the depression of the 30's, World War II, and the establishment of the AAVSO as a separate entity in 1953, acute financial problems faced the AAVSO such as the non-payment of dues by members, the rising costs of publishing, the steadily increasing numbers of our observations of variable stars, and the fiscal problems of the newly independent AAVSO.

Throughout all these crises Percy was a solid rock of strength. The AAVSO owes him a great debt of gratitude for his 30 years of service.

However, it is in a much more personal sense that we grieve his loss today. The writer first met him in May 1935 at Mt. Holyoke. Thereafter Percy was among the first that I sought out to greet at the Spring and Fall Meetings. His warm personality and unshakeable enthusiasm for the work of the AAVSO were always heart-warming indeed. I always returned home from these meetings with a glow in my heart, to which Percy had greatly contributed. It is in this way that I, and my fellow AAVSO members will miss Percy most.

He was a gallant gentleman of the Old School and we can count ourselves fortunate that we knew him. He served as Treasurer for more than half of the lifetime of the AAVSO up to now.

It is altogether fitting that we bow our heads in silence for a moment of tribute to an old and most valued friend.

David W. Rosebrugh
Past Secretary and
Past President AAVSO