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

Edited by R. Newton Mayall

PAPERS PRESENTED AT THE 50TH ANNIVERSARY MEETING, OCTOBER 12 - 15, 1961

The Golden Anniversary and Annual meeting of the AAVSO wqs held October 12-15, 1961 at the Harvard College Observatory, in Cambridge, Massachusetts at the kind invitation of Dr. Donald H. Menzel, director of the Observatory. It was a time of rejoicing, for it was at H.C.O. that AAVSO began its long service to astronomy. About a hundred Members came from all parts of the country, from Maine to California, Canada Florida, and Wisconsin. Although the weather was not kind, it could not dampen the enthusiasm of those who attended the meeting. What we lacked in weather was made up by the calendar. October 12, a holiday, occurred on Thursday, giving us the opportunity for a long and full weekend.

Mrs. Bibber kept the headquarters office open on Thursday to greet those who were arriving that day. Many took advantage of the opportunity to visit the office and see what happens to the observations that are sent in each month.

A special Chinese buffet dinner had been arranged for those arriving on Thursday. Fifty members sat down to dinner, following which Dr. Menzel gave his official welcome to the AAVSO.

Registration began in earnest on Friday morning. Each member, upom registering, received an envelope containing his name badge; a packet of anniversary matches; a leafiet showing the location and description of many old houses and other points of interest in the Harvard Square area, supplied by the City of Cambridge; a similar leaflet with map of historic places and the route of the Freedom Trail, supplied by the City of Boston; a 32-page booklet of memories of Old Boston profusely illustrated with old photographs and woodcuts, donated by the Boston Five Cents Saving Bank; a 50-page booklet of Historical trips in and about Boston, illustrated with delightful pen and ink sketches, donated by the American Oil Company; and a detail map of Harvard University and its vicinity, supplied by the University. The AAVSO is grateful to all those who supplied material for the registration packet.

All meetings for business and papers were held in the Library at Harvard College Observatory. Following the business meeting on Friday morning, the session for papers began. At noon the group photograph was taken, after which everyone went his own way to lunch, returning at 2 p.m. for the Symposium on Variable Stars, conducted by Dr. Dorrit Hoffleit, who so ably got together the program. Taking part in the Symposium were, Dr. V. Osvalds, Leander McCormick Observatory; Dr. Helen S. Hogg, David Dunlap Observatory, Dr. Harlan J. Smith, Yale University Observatory; and Dr. Cecilia Payne-Gaposchkin, Harvard College Observatory. (See Abstracts.)

Following the symposium we were broken up into small groups and taken on a tour of the Smithsonian Astrophysical Observatory, -- the laboratory, shops, communication center, and computing center. Upon leaving the building each person was given a typed list of all objects now floating around in space as a result of probing space by artificial satellites. The list contains 116 objects from small pieces of metal to the satellites themselves.

Returning to the library we partook of a sumptuous tea provided by the Observatory Council.

After dinner we returned to the library at H.C.O. to hear Dr. Shapley talk about the "Highlights" of the past 50 years.

Saturday morning our long list of papers was completed, with an historical session. Clinton Ford selected some interesting tidbits from the old Olcott files. Sig. G.B. Lacchini had sent a paper, which was read, telling how he became a member in 1911, and how he estimates magnitudes. Lacchini is the only member of the original group now living. At 77 he still observes.. It is with regret that the Grand Old Man of the AAVSO could not be with us on this our 50th Anniversary.

Harry Bondy outlined the history of the Solar Division and its contribution, which was followed by a short motion picture of Solar flares taken at Lockheed Solar Observatory, very kindly loaned to us by the Director, Mr. G.E. Moreton.

At noon everyone took off in automobiles for the trip to the Agassiz Station at Oak Ridge, Harvard, Massachusetts, about 35 miles northwest of Cambridge. Beset by cloudy skies, and chill winds, we ate our box lunches in the dome of the 61-inch reflector. The staff at the station were on hand to explain the various instruments and the radio telescopes. Also everyone had a chance to ride to the top of the 61-inch, a trip thoroughly enjoyed by the young members.

This was the largest meeting of members of AAVSO ever to be held in the 50 years of its existence. So, too, was the dinner Saturday evening which was held in the Ballroom of the Continental Hotel. Specially printed souvenir menus contributed by Clinton Ford, were set at each place; and on each chair Don Zahner placed a copy of the September-October issue of the Review of Popular Astronomy which contained the first article of two on the "Story of the AAVSO".

AAVSO dinners are always memorable occasions, full of joviality, good food,and the cementing of friendships. But this one will be long remembered. Six past presidents were with us -- Marjorie Williams, Clinton Ford, Cyrus Fernald, Richard Hamilton, Roy Seely, and Ralph Buckstaff. (Past presidents Harlow Shapley and Helen Hogg attended the Meetings, but were unable to join us at dinner.)

Also with us at dinner was Dr. Velghe, who spoke to us briefly about his work at Brussells and the Cape Observatory. Percy Witherell, our retiring treasurer, who has served the AAVSO for 30 years, acted as toastmaster. Clinton Ford read greetings from many distant members and from astronomers throughout the world.

Following the after dinner sense and nonsense, Margaret Mayall, as recipient of the last merit award, announced and displayed the 15th merit award given to Reginald P. de Kock, "whose constant vigilance of the morning and evening sky resulted in an invaluable contribution of over 100,000 observations of variable stars in the southern sky."

The 14th award was given jointly, therefore as the applause for de Kock died down, Newton Mayall rose to the lecturn and announced and displayed the 16th merit award, given to a very surprised and dumfounded Clinton B. Ford, "in grateful appreciation of his moral and material support during trying times, his long observing record, and his service as Secretary and President. Through his efforts the Endowment Fund has been established on a firm foundation."

Mr. de Kock's award was left unframed so that it could be mailed to him in a suitable container to avoid damage.

Following the presentation of the merit awards, we turned our attention toward the moving picture projector that had been set up inside the circle of tables. The highlight of the evening was then projected onto the screen, where for an hour we watched the antics of the AAVSO, in black and white and in color, astronomic and gastronomic, and through spring and annual meetings from 1928 to 1958 -- 30 years of AAVSO on motion picture film. The film was edited and put together on one 1600 foot reel by Lewis Boss, from his own movies and those of Clinton Ford and Claude Carpenter. The Association is deeply grateful to Lewis Boss for the expert job of editing, titling and everything else that went into making this a successful production. The professional character of the work indicated the enormous amount of time that had to be spent in producing a story that would hold the interest of one and all. We regret that Lewis could not be here to accept the applause in person and hear the constant laughter and vocal identification of many of the older members known to many of us, but who are known only by name to the younger members. The end came all too soon.

Before leaving the Ballroom, Mrs. Mayall invited all to stop at her home for a continental breakfast on Sunday morning. More than 30 members took advantage of the invitation. We hope that those who celebrate the 100th Anniversary will have as good a celebration as we enjoyed at our 50th.

Due to rivalry between certain states, such as California and Florida, we shall not say who travelled the farthest, but Claude Carpenter and Leif Robinson came from Los Angeles; the Sharpless's from Miami, Florida, the Buckstaffs from Oshkosh, Wisconsin; the Adamses from Missouri; Helen Hogg from Toronto; the Goods, Miss Williamson, de Kinder, O'Keefe and Papacosmos from Montreal.

HIGHLIGHTS OF 50 YEARS, by Harlow Shapley

In the past Dr. Shapley has given his 10 highlights of the year at the annual meeting of the AAVSO. This time, because of the 50th Anniversary he took on the difficult task of selecting the highlights of the past half century. In his usual entertaining way he set forth a few things which he thought contributed much to man's knowledge of the universe, or laid the groundwork for further research. The following are his suggestions for highlights of the past 50 years:

1. Founding and growth of the AAVSO.
2. Theory of relativity (1905) and the later general theory.
3. Discovery of the technique of the evolution of the chemical elements, leading to the era of the isotopes which changed the periodic table.
4. Cannon Draper Catalogue and Morgan's supplementary classification.
5. Jensky and Reber (1932) radio telescope.
6. The 21cm radiation from hydrogen atom in space made possible more information about spiral arms.
7. Lyot's coronagraph.
8. Schmidt telescope and the great reflectors.
9. Discovery of Pluto.
10. Siberian meteor.
11. I.G.Y. Solar parallax.
12. I.B.M. Computers
13. Rotation of stars. If star rotates, spectral lines shift.
14. Russell-Hertzsprung diagram. A powerful tool for the study of the evolution of stars.
15. Preliminary General Catalog of Positions and Proper Motions, by Boss. Material on cross motion contributed to determination of stellar distances.
16. Period-luminosity curve determined by Henrietta Leavitt. The relation of brightness to period became yardstick for distances in our galaxy and led to the pulsating theory.
17. Hans Bethe showed carbon can capture hydrogen, and transform it to nitrogen, to oxygen, to helium.
18. Cosmogony. Hypotheses on how the universe got started. The Mosaic theory, La Maitre theory, and Hoyle-Bondi-Gold theory.
19. Baade's stellar populations.

SYMPOSIUM ON VARIABLE STARS
Conducted by
DORRIT HOFFLEIT, Director
MARIA MITCHELL OBSERVATORY
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THE MOTIONS AND ABSOLUTE MAGNITUDES OF MIRA VARIABLES

by
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Long-period variables have been observed for over 350 years. However, the statistical studies of their physical and kinematical properties are of very recent date. Because of the possibility that Mira variables form a link between Populations I and II a considerable interest has been attached to this group.

A number of researchers have investigated their apparent distribution, spectra, light curves, apparent magnitudes, radial velocities, distances, absolute magnitudes, space velocities, and in many of the papers the lack of good proper motions has been emphasized.

Having realized the importance of good proper motions for any later statistical study, Dr. S.A. Mitchell, then the director of the McCormick Observatory, and his coworkers started a proper motion program and took the first epoch plates between 1928 and 1932. In order to make the program more complete, Dr. H.L. Alden, then in charge of the Yale Observatory Southern Station extended the observations to the southern hemisphere. With the help of several other observers plates of 345 Mira variables had been taken by the middle of 1956. As a rule two pairs of plates were taken at each epoch with an average epoch difference of 20 years. The average annual motions are of the order of 0".01 ±0".003.

For 22 variables both McCormick and Yale plates were available and the motions were derived in duplicate. They served for combining the results. No significant systematic difference has been found. The homogeneity of the proper motions is the significant feature of this work.

The reduction of the relative proper motions to the absolute motions on the FK_3 system was done by use of secular parallaxes derived by Vyssotsky and Williams (for brighter reference stars), and by [illegible]ndijk (for fainter reference stars).

Also, we needed spectra and magnitudes of the reference stars. Most of the magnitudes of the reference stars and of the variables have come from the observations by the members of AAVSO. For about 500 of the reference stars on the Yale plates either the magnitude or spectrum or both were not readily available. Through the generosity of the Harvard Observatory the series of MF plates were made available to us and Dr. Dorrit Hoffleit kindly determined the spectra of some 400 of them. For the reference stars on the McCormick plates the spectra were determined on our own spectral plates.

Our proper motions, and the radial velocities by Merrill were used to determine the mean distances and absolute magnitudes of the 345 variables, of which 324 are M type, 18 are SRa and 3 are SRb. In general the variables have been divided according to their period range into 8 groups of M stars and a group of 26 Carbon stars.

The mean annual parallaxes were derived from secular parallaxes which themselves were obtained in two ways: 1) from standard equations: $P_\alpha \times (\frac{h}{r}) = \mu''_\alpha$; $P_\delta \times (\frac{h}{r}) = \mu''_\delta$ and 2) from τ components. The mean parallaxes derived in these two ways agree satisfactorily; the range for the groups is from 0".0008 to 0".0025 with an internal accuracy of the order of ± 0".0002. The corresponding mean distances are from 1300 to 400 parsec.

For the derivation of absolute magnitudes the knowledge of the interstellar absorption is of very great importance. Only a few observed values were available therefore in most of the cases theoretical values were derived using Parenago's formula: $A(r,b) = \frac{a_0 \beta}{\sin b}(1 - e^{-\frac{r \sin b}{\beta}})$. The results were found to agree satisfactorily with available observations. The absolute magnitudes were computed using the expression: $M = m_{max} + 5 - 5 \log r - A_{(r,b)}$. A comparison of our absolute magnitudes with those from other sources reveals an acceptable agreement for variables with periods less than 300 days, but shows our magnitudes about one magnitude brighter than those from other sources for variables with periods greater than 300 days. The exception is the compilation by Miczaika which agrees well with ours for all except the longest periods.

Space velocities of 288 variables have been determined, the exclusion of 57 being necessary for lack of radial velocities. Their dispersions indicate that Mira variables with periods less than 300 days move farther away from the galactic plane and in orbits of greater inclination than those with periods more than 300 days.

The reality of the considerably greater brightness and large average space velocity of the group of Mira variables with periods less than 225 days probably could be determined definitely if radial velocities and proper motions were available for all known stars of this period group.

This work by H.L. Alden, V. Osvalds and A. Marguerite Risley will be published in detail in two papers in the Publications of the Leander McCormick Observatory Volume XI.

VARIABLE STARS FOR PHOTOELECTRIC PHOTOMETRY

by

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The study of variable stars is of course based on the science of photometry, the measurement of the brightness of light.

Astronomers use three radically different kinds of devices for detecting light: the eye, photographic emulsions, or photoelectric surfaces. Each type of detector involves characteristic problems, virtues and inherent precision. Visual photometry is by far the simplest and most convenient, but involves the largest errors (normally of the order of 0.2 mag.) plus the difficulty of establishing accurate magnitude scales. Photographic photometry can be made an order of magnitude more accurate than visual, but is tedious and cumbersome at best. Its principal advantage lies in the fact that many thousands of stars can be recorded and studied on a single exposure for great economy of telescope time. Photoelectric photometry is of extremely high inherent sensitivity and precision, being limited ultimately only by the statistics of arrival of photons from dim light sources; the method is capable of yielding accuracies of the order of several thousandths of a magnitude. Disadvantages of photoelectric photometry are the substantial amount of equipment required for the best work, and the fact that only one object can be observed at a time thus tying down a telescope to a very slow data-production rate.

These considerations are strongly relevant to work on variable stars. Thus, visual photometry remains ideally adapted to amateur work and modest telescopes, and to stars having relatively large amplitude of variation. The present monitoring programs on long-period variables and recurrent novae are examples of work where visual photometry is still highly useful.

Photographic photometry of sufficient precision has become primarily a professional technique requiring substantial telescopes and elaborate equipment for analysis of the plates. However, photography still excells in the discovery of variables having respectable amplitudes, and in the study of variables densely packed with other stars in clusters or in galactic and extra-galactic fields.

Photoelectric photometry is beginning to open up for amateurs, since modern photomultiplier cells can be used with relatively simple equipment to obtain results more than ten times as accurate as visual photometry. This increase in precision makes available a wide range of new activities to amateur astronomers and to professionals with limited telescopes. In particular, noting that photographic methods of detection seldom lead to discovery if the amplitude of variation is smaller than 0.5 mag, but that nevertheless more than 15,000 variables are now known, we see that the total number of detectable variables must be vastly larger. One can estimate that variations greater than several hundredths of a magnitude over periods ranging from minutes to months probably occur in more than 70,000 stars brighter than the 12th magnitude (a rough working limit for a 12-inch reflector). Many of these will require photoelectric detection, and most of them will require photoelectric study if the small variations are to be analyzed with sufficient precision. Such objects will include eclipsing binaries of small amplitude, extreme short-period variables, magnetic variables, flare stars, old novae, dwarf cepheids, red irregular variables, and undoubtedly other objects of types yet unknown. Discovery and classification of such objects could occupy a very large AAVSO group for several generations.

VARIABLE STARS IN CLUSTERS

by

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I would like to backtrack a little -- say about 35 years, to the time when I first began to work on variable stars in globular clusters here at the Harvard Observatory under Dr. Shapley. The subject of variable stars in star clusters was then concerned almost solely with the globular clusters of our galaxy. In these many RR Lyrae variables (cluster type) had been found, largely by Professor S.I. Bailey of Harvard with various collaborators like Miss I.E. Woods. And in globular clusters there were also a handful of long period cepheids which Dr. Shapley at Mount Wilson had been quick to grasp in support of the period-luminosity relation.

And what about variables in other clusters? Several people had pointed out that certain conspicuous variables were near some galactic clusters. For example, P. Doig noted the proximity of T Serpentis to NGC 6633, and U Sagittarii to Messier 25. But the great numbers of variables ripe for the picking in globular clusters rather drowned out interest in these isolated examples. As for associations -- that word had not yet been coined in astronomical language. And the clusters themselves in external galaxies, including the nearest, the Magellanic Clouds, were just beginning to be catalogued, so that investigations of the type of stars they contained had barely begun.

Let us consider then these four branches of the subject of variables in clusters. First, those in globular clusters, since that is essentially the first branch of the subject and the one in which I am most directly concerned. Since most globular clusters are seen projected against regions of the sky sparsely populated with field stars it has been easy to assume that the major portion of variables found in their midst actually belong to them. This is an important difference between the study of variables in the globular clusters of our galaxy and that in the other three categories I shall mention. Since these variables form such a clearly outlined group it has been possible to compile catalogues of them, as I have twice done.

In the 120 globular clusters of our galaxy, about 1650 variable stars have now been found in over 80 clusters searched. Ninety percent of these variables have been shown to be, or will prove to be, RR Lyrae variables. Contrary to some public impression, not all globulars are rich in variables. Four have about one hundred or more, Messier 3 the richest with 189; but several which have been searched have none. The ten percent of the variables which are non-RR Lyrae stars are a very interesting group composed of most of the common types of variables except flare stars and R CrB variables. Many of these variables, however, will prove to be field stars and not cluster members, but only tedious spectroscopic work on these faint stars can settle this question. Of particular importance are certain types which almost surely are cluster members, -- W Virginis stars, RV Tauri, and long period Cepheids. The long period variables in 47 Tucanae still remain as the best examples of this type of variable which seem to be actual globular cluster members. Novae still remain very rare objects as only the one found in Messier 80 in 1860, is a good candidate for membership -- that found by Mrs. Mayall near NGC 6553 is almost certainly not a cluster member. Some of the brightest variables in globular clusters are within the reach of some AAVSO telescopes and if you ever run out of other stars to observe it might be interesting to follow the vagaries of Chevremont's variable in Messier 2, an RV Tauri star which ranges from the 12th to the 14th magnitude with a 67-day period.

The variables in galactic clusters present a different type of problem. In the first place, the actual number of galactic clusters has increased enormously in recent years, to more than 800 now catalogued. The problem of identifying stars which are actual cluster members is harder for the galactic clusters. Since these are largely type I population, one would expect a difference in types of variables, and there is. As far as I know, no RR Lyrae star has yet been proved to be a member of a galactic cluster -- illustrating the great difference between galactic and globular clusters. About six years ago work by Irwin, Feast and Kraft showed that the cepheid U Sagittarii is actually a member of Messier 25, and S Normae of NGC 6087. About a dozen cepheids are under study as probable or possible galactic cluster members. NGC 7790 is the most outstanding cluster in this respect, having three cepheids as well as an eclipsing binary. The cepheids CEa Cas, CEb Cas and CF Cas have periods of 5.1, 4.4 and 4.87 days respectively. Eclipsing variables have been known for years in galactic clusters, and recently Sahade and Frieboes have published a list of 16 W UMa stars which are possible members of six clusters, including Praesepe and Coma Berenices. A survey by Kraft and Landolt found 26 eclipsing variables within the limits of galactic clusters where on the basis of probability one would expect only six.

By far the largest numbers of variables in galactic clusters are those of the RW Aurigae or T Tauri types, or Orion population. These occur by dozens or hundreds in certain regions of the sky associated with galactic clusters and nebulosity. The RW Aurigae stars are variables of almost any spectral class along the main sequence, irregular, with ranges up to several magnitudes. They are discovered photometrically. The T Tauri stars, showing emission lines, are found by spectrophotometric surveys and are considered by Kholopov to be a subdivision of the whole RW Aurigae class. Herbig presented at the IAU meetings a list of 32 different regions in which these variables occur. In these fields over 500 H alpha stars (excluding Be stars), 270 T Tauri and 50 RW Aurigae have been found. (The Hα stars will almost surely be variable in light) Because of the complexity of the fields these stars can be well identified only by marked prints, and the compilation of a catalogue of them, tidy as it might be, is a near impossibility, though the Gaposchkins gave one in 1938 when fewer were known.

Next we come to the associations. Ambartsumian first drew attention to these in 1949, and defined tham as stellar systems where the partial density of O and early B stars is larger than the average field density. The latest catalogue by Alter and his associates in Prague lists 82 associations. The stellar members of associations are spread loosely over rich Milky Way fields. Much observational work is necessary to identify any particular star as a member of an association. Accordingly at present we know little about the types of variables in them. However, in the same survey of eclipsing stars by Kraft and Landolt already mentioned, 577 eclipsing binaries were found in optical coincidence with the O-B associations catalogued by Schmidt. No one knows how many of these might be actual members.

The fourth realm of variables in clusters is that of the clusters of external galaxies. At present this study is limited to the clusters of the Magellanic Clouds since they are the nearest and brightest within our reach. Some dozens of variables have now been found in clusters of the Clouds. One cluster that has proved particularly rich is NGC 2257 on the outskirts of the Large Cloud. In it 28 variables have been found with the Radcliffe 74-inch, largely by J.B. Alexander who has derived periods ranging from .51 to .69 days for six with large amplitude. Some of the other RR Lyrae variables are probably c-type. On the outskirts of the Small Cloud NGC 121 has been investigated by A.D. Thackeray who has published periods and light curves for five variables, of which three are RR Lyrae stars. The other two, among the reddest and brightest of the cluster stars, have periods of 140 and 112 days. Work by Halton Arp has shown a number of cepheids with periods of a few days in several clusters. Recently Paul Hodge of Harvard has found in the globular cluster NGC 1978 what may be the first W Virginis type star to be found in the Clouds, either in their clusters, or the Cloud field. He and Frances Wright are now studying the variables in the Cloud clusters.

The Magellanic Clouds may not be a representative sample of the external galaxies. If the recent theory of G.M. Idlis is correct, then the Magellanic Clouds were knocked off our galaxy when it was hit by NGC 55. Therefore in composition one would expect them to be very similar to our own galaxy. So it will be especially interesting when we learn more about the variables in the clusters of external galaxies farther from us than the Magellanic Clouds.

VARIABLE STARS AND STELLAR EVOLUTION

by

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At the present time the problem of stellar evolution is clarified, if not completely solved, by the study of the color-magnitude arrays of star clusters. The stars in galactic clusters represent the earliest stages of stellar development, and a series of later stages also. The stars in globular clusters represent late stages of development. There is little doubt that differences of composition also distinguish the stars of galactic clusters from those of globular clusters, and that within each group there are also appreciable ranges in composition, globular clusters being notably poorer in metallic atoms.

The placement of variable stars in the color-magnitude arrays of clusters thus identifies them with the corresponding stages of development. In galactic clusters and associations are found T Tauri-like stars, Beta Canis Majoris stars, Cepheids, and semiregular red supergiants. Globular clusters contain large numbers of RR Lyrae stars, also long-period variables, RV Tauri and W Virginis stars, and occasional novae.

The life history of a star can be pictured in a number of stages, and the star passes from one stage to another in accordance with its developing structure and changing energy supply. Certain of these stages are marked by variability -- in many cases for reasons yet unknown.

A star first becomes visible as it contracts toward the main sequence, with gravitational energy as its main source of supply; during this phase it passes the T Tauri stage. When it reaches the main sequence it enters on a long interval of stability and quiescence (shorter for more massive stars), subsisting on its internal hydrogen. As the hydrogen is used up, the star leaves the main sequence, building an extended envelope as it proceeds toward the region of red giants. Luminous and massive stars soon reach a brief stage of periodic pulsation as Beta Canis Majoris stars, with periods a fraction of a day. Another stage of pulsation occurs as the star grows larger and redder, and it becomes a Cepheid; there is a lower limit to the luminosity of stars that can become Cepheids, probably because fainter stars, when on the main sequence, are below the critical temperature at which Cepheid pulsation occurs. The Cepheid stage appears to set in at the blue edge of the "Hertzsprung gap", and to last a relatively short time. The star then seems to develop rapidly in the direction of the red giants, becoming (perhaps successively) a semiregular red variable and a long-period variable.

At the top of the giant branch the star has undergone a fundamental internal change, and (as at the time, on the main sequence, when it switched from gravitational energy to hydrogen burning) it changes the direction of development. In the next stage (the "horizontal branch") there is again a critical range of color and temperature in which the star pulsates, this time as an RR Lyrae star, and also (if more massive?) as an RV Tauri or W Virginis star.

After development through the horizontal branch stage (whose direction is still not completely clarified) the star for the first time becomes fainter than it was when on the main sequence. In this phase of its existence it may undergo erratic explosions; small outbursts characterize U Geminorum stars, larger outbursts lead to novae. The former stars are almost certainly all close binaries, and the outbursts must be associated with the resulting instability. That novae also will prove to be binary phenomena is not at all unlikely.

This very brief outline points to extreme youth for T Tauri stars, youth for Beta Canis Majoris stars, and rather greater age for Cepheids. Next in age come the RR Lyrae stars, the red variables, and finally the U Geminorum stars and the novae. On the supernovae nothing can at the moment be concluded, and the R Coronae Borealis stars present an unsolved enigma for the evolutionary standpoint.

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PAPERS BY MEMBERS

Dr. Fred L. Whipple opened the meeting by extending greetings and welcome on behalf of the Observatory Council and read the following greeting from Dr. Menzel.

TO MEMBERS OF THE AAVSO

I greatly regret that an unexpected and urgent conference in Denver makes it impossible for me to welcome you personally to the Harvard College Observatory, at the meeting celebrating your fiftieth anniversary. I am glad, however, that I had the opportunity of being with some of you yesterday evening.

Of these fifty years I have myself been a member of the AAVSO for forty-three. And I have had the pleasure and privilege of meeting and knowing many of the early greats: William Tyler Olcott, Dave Pickering, Charles McAteer, Ernest Yalden, Charlie Elmer and-of-course-our beloved late recorder Leon Campbell. They were wonderful people who encouraged the efforts of a beginning amateur. My first scientific contributions were observations of variables, made at a small observatory of the University of Denver. By chance, I shall be visiting there this very morning. I delivered my first scientific paper at a meeting of the AAVSO at Harvard.

I rejoice at the growth and progress of your great organization. And hope that the next fifty years will be even more fruitful.

Welcome to Harvard! My best wishes for a most successful meeting!

(Signed) Donald H. Menzel

AUSTRALIAN OBSERVATORIES, by Claude Carpenter

Last year Claude Carpenter went to Australia where he visited with members of AAVSO -- Debono and others --, and went to Mt. Stromlo where he was received by Dr. and Mrs. Bart Bok. Everyone enjoyed seeing his colored slides of the trip, of the people he met, and of Mt. Stromlo. (Ed.)

STAR CHART CONSTRUCTION, by George Lovi

During the past year I've had the privilege of drawing some new star charts for the magazine "The Review of Popular Astronomy" which, as many of you know, is the new name of the "Monthly Evening Sky Map" which one of our members, Donald Zahner took over a couple of years ago. For a half-century, the MESM contained a set of star charts which were intended to enable anyone to go out under the night sky and locate the constellations. However, in spite of the fact that these charts managed to survive so long, they were very poor creations and left far too much to be desired in the way of decent sky maps. The picture they presented could only by a wild stretch of the imagination be made to coincide with what actually appears in our skies. Since undertaking the job of preparing a better set of star charts, I have given much thought to the problem of star chart construction, the principles involved, and what type of chart is best for what purpose. Star charts are a basic tool in astronomy and all of us who observe variable stars come in contact with them.

For purposes of mapping the heavens astronomers imagine that the celestial objects are projected outward from the Earth to an imaginary Celestial Sphere of infinite size. It is impossible to take a sphere and chart its surface on a plane without running into difficulty. To get around this problem, various systems of grids known as projections have been developed. However, all projections have one thing in common - each fails to chart all the relationships on a sphere as they intrinsically are on the sphere itself. All projections distort the sphere in one way or another. Each projection has its own faults and virtues and when we construct star charts we should first consider the purpose to which the chart will be put and then, in the light of these considerations, we should choose the projection which most nearly has the properties we are seeking.

In the old MESM charts, the Celestial Sphere was charted on a Polar Projection, which is the projection that the rotating star charts or planispheres use. This projection is not satisfactory for charts which are intended to enable a rank novice to locate the constellations. A beginner who uses sky charts will look in the sky for what he sees on his chart and he will not, for example, see the constellation Scorpius in the sky as it is shown on such a chart, since Scorpius is shown stretched out frightfully. A Planisphere can be very useful to the amateur or professional astronomer in that it can permit him to see the sky as it appears at any time and in this capacity it can be highly useful in planning observing programs.

A far better way to construct star-identification sky maps is to use a Stereographic Projection.

What the Stereographic Projection does is to counterstretch the constellations in a direction perpendicular to the horizon (in altitude) just enough to compensate for the azimuthal stretching they undergo on other projections, such as polar and azimuthal. Consequently, each constellation is restored to its correct shape. However, in doing this, the Stereographic Projection enlarges each constellation as it approaches the horizon. This can be observed by referring to the star charts in "The Review of Popular Astronomy" as well as the charts in "Sky and Telescope" which has used this projection for almost twenty years. For example, notice how Auriga shrinks in size from the time it rises on one of these charts to the time it passes overhead. However, notice also that although Auriga's size changes, its shape does not. Because of this special property of the Stereographic Projection, circles of altitude or almucantars become spaced farther apart from each other as the horizon is approached as can be noted by seeing how the meridian calibration of the "Sky and Telescope" charts move farther from each other as the horizon is approached. This is the method whereby this projection counterstretches the constellations as they move farther from the center of projection, which is usually the local zenith. As a matter of fact, the way this projection enlarges the constellations near the horizon greatly resembles the actual illusion we see in the sky which makes the constellations appear larger near the horizon, similar to the well-known moon illusion. Because this projection does not distort the constellations and because it permits the use of a natural circular horizon, and even because it puts its one major "shortcoming" -- the enlargement of constellations -- to good use in simulating an already existing illusion, it is without doubt the best system for plotting a map which is to show the sky as it appears overhead from horizon to horizon.

In making star atlases, such as the Skalnate Pleso, Bonner Durchmusterung, and Beyer-Graff, other types of projections are generally used, which are systems that imagine the sky to lie on the surface of a cone. These atlases use the conventional Polar or Azimuthal Equidistant Projection to map the sky immediately around the celestial poles and for the regions near the Equator they use simple rectangular grids. Star atlases break up the sky into small segments and each segment is drawn on a separate chart which is re-centered on whatever projection is used. No atlas covers as much as a hemisphere on one chart, so the distortion problem is not so great. Norton's Star Atlas uses for all but its polar charts a system known as the Globular Projection. This projection is a simple geometrical construction whereby a circle is drawn to represent the limits of a hemisphere as viewed equatorially with the poles at the top and bottom. Two diameters are drawn at right angles to each other, the vertical one represents a central hour circle and it is divided equally into 18 segments (10° apart), while the horizontal one represents the Celestial Equator and is divided equally into 12 segments to represent right ascension. The circumferential circle is divided into 36 equal segments representing declination. Then circular arcs are drawn connecting the meridian or vertical diameter calibrations with those on the outer circles and these arcs represent declination circles. Afterwards, circular arcs are drawn through the right ascension calibration on the horizontal line and these meet at the top and bottom of the central hour circle to form the poles. This projection, although lacking in any specific property such as conformality, nevertheless presents a rather pleasing picture of a hemisphere and does not contain excessive distortion. Such distortion as exists is concentrated around the circumference. Norton's Atlas does not show on any of its charts an entire Globular Projection, instead only the central portion going out only as far as 2 1/2 hours each side of a central hour circle and 60° above and below the Equator, hence most of the Globular Projection's distortion is avoided. The maps in Duncan's "Astronomy" also make use of this projection.

Finally we come to a group of projections known as Equal-Area Projections and as a rule, these are not used in making the common type star charts and atlases.

No doubt everyone who has done any reading in astronomy has encountered oval-shaped charts on which information such as distribution of galaxies or radio sources are plotted. The purpose of such charts is to show how different kinds of celestial objects are distributed over the Celestial Sphere. By studying such distribution charts astronomers can form an idea of where things are located and thusly he can spot special groupings or trends. For this purpose a projection is needed that preserves equality of area, which is the direct opposite of what the Stereographic Projection does. It is quite clear that if we were to plot the distribution of, say, galaxies on a Stereographic Projection, we would get a highly misleading picture. The galaxies would appear to be disproprtionately concentrated in that part of the sky that happens to occupy the center of projection. There are several types of projections that can be used to preserve equality of area such as Bonne's, Mollweide or Homolographic, the Sinusoidal, and the Aitoff, the latter being the most commonly used one for astronomical plottings. Constellations plotted near the central meridian of such a projection would appear quite free of distortion, but those plotted any distance from the center would encounter substantial distortion. However, for plotting distributions, distortion is of no importance as we are only interested in the density of the objects in question in various parts of the sky and not in the patterns they form.

So far I've covered some of the outstanding problems we encounter in star chart construction and how some of them are met. As previously stated, star charts are a highly essential and basic tool in astronomy, yet the unfortunate truth is that in this country during this century there has been a definite lack of good and accurate sky charts. It seems that the information pertaining to the drawing-up of good charts also has been slow in spreading. How else can one explain the wide-spread use of these abominable planispheric charts in books and magazines? It is necessary, of course, to use such a projection in spite of its glaring faults when making a planisphere since a planisphere must revolve and thereby have radial symmetry, but <u>why</u> should planispheres be photographed and printed on the pages of books and magazines, on pages which do not turn? Anyone who wishes to do astronomical work either on an amateur or professional level should have a good working knowledge of the constellations since such a knowledge gives him an instant idea of what lies where in the sky. And lest it be argued that acquiring a knowledge of the heavens is a momentous intellectual feat, let me state that there are taxi drivers in the City of New York (and we don't usually associate taxi drivers with the upper strata of intellectual achievement) who have a thorough knowledge of every last street in that city and how and where they run and some of the patterns that the streets form in that city make the constellation patterns look like simplicity itself. The difference here is, of course, that good maps of the city have been available for quite a while whereas good star maps aside from star atlases are still few and far between. This situation does not prevail in Great Britain, for example, and never has. Pick up virtually any British astronomy book and you will encounter excellent star charts, accurately and carefully drawn, easy to follow, and usually drawn on a sound projection. I might also point out that not one major star atlas has ever been produced in this country. Despite the fact that the Stereographic Projection has been available since ancient times, and despite the fact that it is virtually tailor-made for star chart construction, and despite the fact that it has been abundantly applied during past centuries to celestial cartography in different ways, we in this country have in our dogged way insisted on preparing sky charts in the most awkward and inaccurate manner. To many of our celestial map-makers the Big Dipper is just any old rectangle or square to which three additional stars are attached in a nondescript manner to form the handle (and all too often on the wrong side of the bowl as on celestial globes). When Charles A. Federer, Jr., one of our members, recognized the value of the Stereographic Projection in the early 40's and produced a set of Stereographic charts for his magazine "Sky and Telescope", the result was a set of sky maps which became a lighthouse in a sea of mediocrity and even today one must look far and wide to find something quite like his charts. I ascribe the success of his magazine in no small way to his charts and I remember that as a thirteen-year old I first became attracted to his magazine through his charts which I found to be an honest-to-goodness set of accurate charts, charts that show you the sky as it really appears.

Also, since we're discussing star charts, I would suggest that some enterprising manufacturer come forth with an honest-to-goodness celestial globe which is accurate, easy to read, and bereft of all these "men and monsters that are indiscriminantly scribbled on their surfaces" (to quote John Herschel), features that belong in a fortuneteller's cage and not in an astronomy classroom or observatory office. No such globe exists today and I've searched far and wide.

It is my hope that the lost art of Uranography or star chart construction will be revived, at least on this side of the Atlantic. We variable star observers could not appreciate it more. It certainly is quite difficult at times to locate a certain variable using one of our special charts, but it certainly is far worse if the observer wants to locate, say, U Cygni and first must locate a map to tell him where to look in the sky to find Cygnus.

NEW PECULIAR VARIABLE WITH S-TYPE SPECTRUM, by Dorrit Hoffleit

In Sagittarius we have found numerous irregular or peculiar variable stars. One of those recently examined appeared from the observations over the first 2500 days on Harvard plates, to belong to the R Coronae Borealis category. Observations on recent Nantucket plates, to the contrary, seemed to suggest a semi-regular periodicity of about 380 days. The magnitude varies from about 12.5 pg. to 15.0. The star is at maximum more frequently than at minimum.

A request to Dr. George Herbig of Lick Observatory for spectroscopic observations, brought the response that the spectrum, presumably at about maximum light, is class S without either titanium oxide or emission features.

Examining the General Catalogue of Variable Stars (1958) and its 1961 Supplement, I find 31 stars with spectral class S that are not Mira types. Three are classified SRa, 6 SRb, 7 SR without subdivision, and 14 Ib. Among the 31, only 9 have amplitudes comparable with the new variable, 2 mag. or greater. They are BG And, OS Cas, AA Cyg, V575 Cyg, RZ Sgr, ST Sco, EI Tau and CE Vul. All these are listed as semi-regular except OS Cas and CE Vul which are called Ib.

From the literature available at Maria Mitchell Observatory, I find that magnitudes suitable for intercomparing light curves, have been published for only four (1-SRa, 3-SRb). All four had been examined by S. Gaposchkin at Harvard in connection with the Milton Bureau project. Except for a graph of RZ Sgr, he published only lists of maximum and minimum mean magnitudes. These are plotted in a diagram together with the observations of the new variables, which may be considered an SRb type.

The position of the new variable is $18^h\ 27^m\ 10^s$, $-19^\circ\ 51'.0$ (1900).

V SAGITTAE, by Robert Adams

Since giving my report to you at the Chicago meeting in May 1959, I have expanded my graphic study of V Sagittae. Herein are presented the results of all observations from November 14, 1951 to July 19, 1961. I have added the results of Quarterly Report #24 and Mrs. Mayall kindly sent me photostatic copies of graphs she had worked up which filled the gap from quarterly report #24 to July 19, 1961. Two problems have presented themselves: is there any regular pattern to the light curve, and are there quick and sudden changes in light intensity?

Let us examine the graph over the 11 year period with a view of seeking out a regular pattern. We see, as we examine it, that there are large gaps when V Sge was not observable; but numerous peaks have been observed over this period.

Trying to select a regular pattern from the observations is difficult. Leaving out questionable peaks, what do we get? 180,585,485,980,400,420,390 and 320. Even allowing for the breaks in observations, I would say that we could not honestly arrive at a pattern. As in 1959 I made a 17-day time scale and ran it along my expanded graph and this time there was even less of a possibility of a 17-day period from 5400 to 7550 than from 3600 to 5400. In making this analysis we must be careful to have approximately the same number of observations for each unit of time. Finer calibrations are necessary to delineate short periods.

Now let us examine the graph for evidence that there are sudden changes. I think you will agree with me by even a cursory examination that there are many indications of rapid and sudden fluctuations in light intensity. There are too many indications of such sudden light changes to question the accuracy of visual observations as being valid. Many of the light changes have been observed by our most trusted observers over long periods of time. Most of these changes are of the order of one half to one magnitude. However, there are a few places on the graph where the changes are of the order of one to one and a half magnitudes. Mrs. Mayall writes that she has a letter from Dr. Romano of Italy who lists three separate occasions between 5655 and 6404 when he was able to obtain photographic evidence of rapid light fluctuations. These were:

1.)	5655.41	11.3	2.)	5717.32	10.6	3.)	6404.40	13.0
	5655.47	10.6		5717.43	11.4		6404.46	12.0
							6404.50	11.7

Mrs. Mayall writes that we had two visual observations, one from Adams 6404.6, 12.5 magnitude; and one from Curtis Anderson 6404.6576, 12.0 magnitude. Dr. Romano believes that the existence of these rapid variations suggests the possibility of flares and he further believes that these rapid fluctuations also may disturb the possibility of ascertaining any periodicity of the star.

V Sagittae has been described as a nova-like variable, one of a heterogeneous class of objects similar to novae according to the character of light variation or spectral properties. Its spectrum is continuous with the greatest strength in the ultra violet region and shows a few helium emission lines. It was first recognized as a variable by Lydia Petrovna Ceraski, in Moscow, in 1902.

Further studies of this star should prove of great value. Certainly the theory that there are many and rapid fluctuations has been completely vindicated.Now we badly need to go into the observational problem deeper. Are there periods of quiescence? What are the exact periods and intensities involved? It seems to me that concentrated visual observations are the way to find the answers. We still need coordinated observations of at least two observers working at the same time over half hour and hour periods. In order to achieve this perhaps groups of two seasoned observers working at the same time next to each other, each with his own 'scope would insure overlapping.

OBSERVATIONS OF EIGHT VARIABLE STARS, by Thomas Cragg

This is essentially a progress report on a study concerning 8 variable stars -- 5 previously known and 3 new ones, not as yet being regularly observed by the AAVSO. This is the result of a program to enlarge the coverage by the AAVSO of more stars by providing adequate visual sequences around good variables for which no easily obtainable sequence exists. The previously known variables are:

TU ANDROMEDAE. A reasonably good minimum was observed at JD2437280 with the following rise slower than one would predict from current data. A predicted maximum 149 days earlier occurred when the variable was too close to the Sun for observations. However, an M-m of 48 days would have us believe minimum to have occurred on 2437381, 100 days later than was observed indicating the accepted period may be a little too long. Further observations are necessary before one can really say the period is off as much as it seems.

X PISCIUM. Few observations were made, but it appears very clear the star may have been 40 days late for maximum. This 40 days error has accumulated in only 18 cycles, indicating the accepted period of 352.6 days is probably too short by about 2.2 days.

ST GEMINORUM. The observations clearly indicate maximum occurred some 40 days late. Since the epoch was some time ago, 67 cycles had passed accumulating an error of about 40 days. These observations indicate the period should be lengthened only about 0.6 day to bring it back in phase.

CX HERCULIS. This semi-regular variable did virtually nothing during the 130 days it was watched, varying a total of only 0.2 magnitude.

CS CYGNI. A plot of observations covering parts of three adjacent cycles indicates clearly the period is much shorter than the accepted 309? days. A period more like 250 days appears to satisfy this series much better. It is obvious this star is in dire need of following for a while since the accepted period is way off and a new epoch date needs to be determined. Evidence points to a very small value for M-m, probably less than 20% of the period.

The new variables are:

C-1 ANDROMEDAE. This star was selected as a comparison star for a sequence around TU And and was discovered to be a variable of large range as soon as "confirmation" of the map of the region was attempted. A weak spectrogram of the star when "normal" seems like an early R. Evidence is very strong that this is an R CrB type star of large range (more than 4 magnitudes).

C-2 ANDROMEDAE. This star was originally thought to be TU And but it was always so faint as to make the identification dubious. It was a red star as shown on the 48" Sky Survey Plates. It appears to be a long period or Mira type star with a period of about 285 days, a range of 13.4 - 15.0(v), and an M-m of about 80 days. The light-curve indicates the star is fainter than 14.2 about 65 per cent of the time.

C-1 PISCIUM. The same general confusion existed with this star and X Psc as with C-2 and TU And. The several existing observations indicate the star is a red long period variable with a period of about 300 days, a range of 13.4 - 15.2(v), and an M-m of about 140 days.

FINDER MAPS:

TU, C-1, C-2 ANDROMEDAE. A recent issue of the AAVSO "b" and "d" charts is now available for these three stars. They are close enough to be on the same "d" chart.

X, C-1 PISCIUM. "b" and "d" charts are now in the hands of the AAVSO for reproduction and should be available before very long. Both X and C-1 are close enough together to be on the same "d" chart.

ST GEMINORUM. A "d" chart has been prepared and submitted to the AAVSO for publication. Since the naked eye star 40 Gem appears on the "d" chart, this one chart seemed sufficient to find the variable.

CX HERCULIS. This star is marked on the existing AAVSO "d" chart for RT Her and is currently available through the AAVSO.

CS CYGNI. This star appears on an existing AAVSO "d" chart for TU Cyg. Although a little distant from the TU Cyg sequence, it can be used to make estimates of CS.

SUPERNOVAE AS EXTRAGALACTIC RADIO SOURCES, by Joel S. Levine

At the XIth General Assembly of the IAU at Berkeley, California in August 1961, Minkowski reported that there appears to be no preference for peculiar galaxies to be radio sources. Since colliding galaxies are peculiar galaxies, this rules out galactic collisions as major causes of radio sources.

Cygnus A and Centaurus A are both strong radio sources, believed to be colliding galaxies. The Russian astronomer, Shklovsky, believes that they are both single galaxies with the radio emission originating in supernovae outbursts within the galaxy.

It has also been suggested that ordinary novae may become radio sources a few decades after they explode.

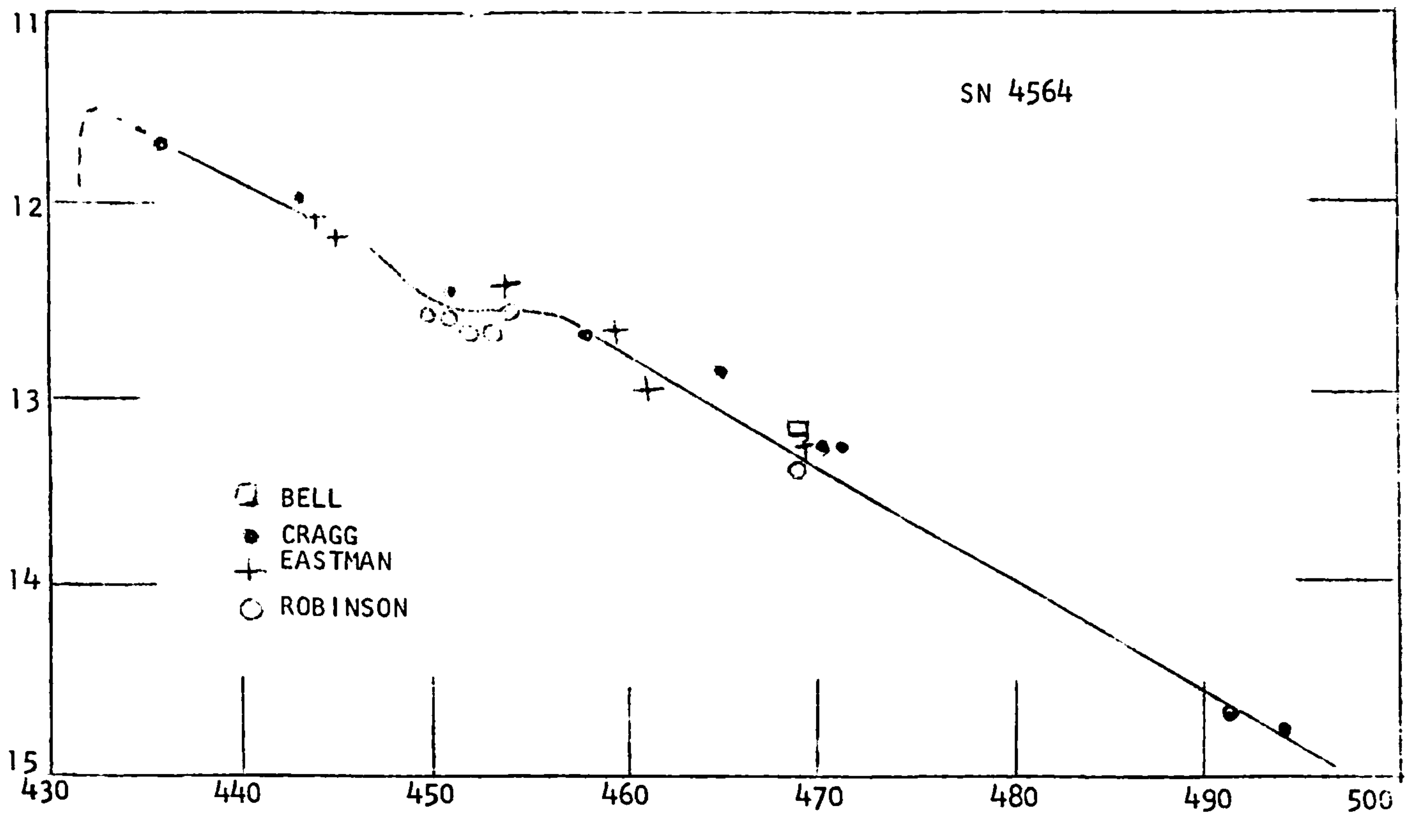
The number of supernovae outbursts throughout the years, in many different galaxies, may possibly account for the majority of radio sources now believed to be colliding galaxies.

OBSERVATIONS AND PRELIMINARY ANALYSIS OF SN 4564, by Robinson, Cragg, & Eastman

On May 13, 1961 a patrol plate taken at the Asiago Observatory, Italy, recorded a supernova within the Virgo Cluster galaxy NGC 4564. This object presented an ideal, if not somewhat difficult, test to ascertain the value of amateur observations of supernovae. The reason for this optimum opportunity came from the fact that this supernova was but 4" arc distant from the galactic ball; thereby making normal photographic observations most difficult. For some time many amateurs had expressed interest in observing supernovae, but the inherent difficulties in such observations had given little encouragement for such a program. The authors submit their observations for consideration and analysis.

The initial difficulty arises from the condition that brightness estimates of supernovae are not made against a dark sky. This condition is aggravated as the comparison stars used in making the estimates are located only in a dark sky. Hence, the observer must extrapolate the supernova from the galactic field background in making his estimate. It was the common practice of Cragg and Eastman to observe the supernova against the field, as if it were absent, and then make the comparison. Robinson, however, made his observations in twilight when the general sky intensity was higher than that of the galactic field in which the supernova was embedded. Of course, this proceedure became increasingly difficult as the star became fainter.

The next difficulty appears in that the supernova was situated very near the 12.5 mag ball of NGC 4564. As the star became fainter than 12.5 mag it was necessary for one to take pains that one was estimating the star and not the galactic ball



which appeared quite stellar, itself. We did not succumb to this hazard.

The final difficulty (a limiting condition in this observation) again arises from the brightness of the galactic field. As the supernova becomes very faint, the field brightness hampers observation; indeed, when the supernova reaches the same magnitude as the field (in this case 15.0) visual observations must cease.

With the above difficulties and conditions of observation in mind, let us now analyze the observations.

Using the expression for Standard Deviation(SD), the following becomes apparent. The SD for Eastman = 0.08 mag., 6 observations; Robinson = 0.08 mag., 6 observations; Cragg = 0.09 mag., 9 observations. We also find the SD for all observations (excluding Bell's) to be: 0.075 mag., 21 observations. The corresponding Probable Error(PE) of the observations would be: PE = 0.674 SD; or: PE = 0.051 mag.

This demonstrates the value of carefully made visual observations by experienced observers. It should be recalled that this was a very difficult test - better agreement should be procured on a brighter object. However, amateurs can make significant contributions in the field of supernovae observations.

PROJECT COELESCOPE, by Robert Davis

As a prelude to our visit to the Smithsonian Astrophysical Observatory, Mr. Davis described and showed slides of an instrument to be sent into orbit to photograph the sun. The complex mechanisms were described and illustrated, and a part of the casing was brought onto the stage. (Ed.)

LET THERE BE LIGHT, by Duncan Macdonald

A philosophical reminiscence and resumé of progress in science since his days at Harvard Observatory, in the early 30's. He drew particular attention to and commended the work of the AAVSO in stimulating young people to maintain an interest in scientific fields. (Ed.)

ORBITING ASTRONOMICAL OBSERVATORY SATELLITE, by Franklin Marsh

Mr. Marsh is associated with NASA. He showed us pictures of a proposed observatory satellite and described its operation, which in a few words is almost human. The automatic devices necessary to orient the satellite to take a picture of a given starfield are uncanny. (Ed.)

OLD ASTRONOMICAL PRINTS, by Albert Ullmann

Old astronomical prints are works of art, whether black and white, or colored. Mr. Ullmann has been collecting them for several years. He showed color slides of about a dozen of the more important and interesting prints of the constellations, in his collection. (Ed.)

ON THE TRAIL, by Cyrus Fernald

Those of you who remember the Pittsburgh spring meeting of the AAVSO, in 1955, recall that the present chief of the Research and Analysis Branch of the Army Map Service told us about some of the possibilities of observing occultations with a Cassegranian-Springfield telescope. This subject is discussed in considerable detail in a chapter in C.L. Stong's "The Amateur Scientist" published by the Scientific American in 1960. (Chapter 6 entitled "Using Shadowed Star-light as a Yardstick.")

Knowing how surplus material is disposed of by our government I thought it would do no harm to inquire, so I wrote my senator. I didn't get one of the telescopes, but I did get a very detailed instruction manual, and a letter stating that no surplus telescopes were available; and they didn't anticipate any would be. The telescope is made by the Army Engineer Research & Development Laboratory at Fort Belvoir, Virginia. The optics are by Perkin Elmer.

This is the manual. I am turning it over to Mrs. Mayall for inclusion in the McAteer Library, with the suggestion that it be loaned to any of our members who wish to pursue this subject further.

METEOR ASTRONOMY FOR THE AMATEUR, By Arthur Pearlmutter

Meteor Astronomy has largely been taken over by the mechanization of the twentieth century-improved photography, radio astronomy, photoelectrics. Of course, the amateur can use professional-type equipment as in the photoelectric work done in the AAVSO. However, for those who do not have either the location or the funds (or both) for such a program, a visual program must be used. The detailed reporting of the past must be reduced to basic rate, radiant and brightness data. Necessary supplementary data include a detailed report on the sky conditions and method of observing. Special projects, such as that proposed by Astopovich also may be attempted.

OBSERVATIONS OF A MOON ILLUSION, by Kenneth Weitzenhoffer

Almost all observers are familiar with the illusion of the horizon moon. The illusion occurs when the moon is seen just above the horizon and appears to be much larger than when seen higher in the sky. This report is of observations of the moon illusion made when the moon appeared to be <u>below</u> the horizon.

The observations were made about 11:00 pm, EST, on the night of September 29-30, 1961. I was in an airplane flying from Charleston, S.C., to Idlewild Airport. The last quarter moon was about 20 degrees above the horizon and about 20 degrees north of the east point. The night was brilliantly clear, ground visibility being over 15 miles.

At the time of observation, the airplane was flying north, with the last quarter moon on the right. The ocean was quite calm and the moon's reflection from the water was almost undistorted. The apparent size of the moon in the sky(altitude plus 20 degrees) and the apparent size of its reflection in the water (altitude minus 20 degrees) were the same. Soon the airplane was flying over Rockaway and no reflected image was seen. When the airplane flew on over Jamaica Bay, the reflected image could be seen in the waters of the bay for brief periods, because the bay is dotted with sand bars, small islets, and shoreline indentations which are non-reflective. The unusual observation was that the moon's reflected image then appeared larger than that of the true moon in the sky. Indeed, the reflected image seemed to be even larger than the moon appears to be when it is seen in the sky just above the horizon.

The observations can be summarized as follows: When observed at altitude plus 20 degrees in the sky, the moon appeared to be of normal size. When observed at altitude minus 20 degrees in the <u>clear</u> ocean, the moon's image was also of normal size. When observed in the waters of the bay and <u>framed</u> by land areas, the moon's image appeared to be much larger.

One explanation of the horizon moon illusion is that when the moon is seen just above the horizon, we compare it with terrestrial objects and unconsciously magnify the moon's size in our mind. When the moon is higher in the sky, there are no objects for comparison and we do not magnify the moon's size in our mind. The observations described above seem to tie in with this explanation. When the moon was simultaneously seen in the clear sky and in the open ocean, the image appeared to be of the same size. However, when the moon's image was seen in the waters of the bay (with terrestrial land areas for comparison)it appeared much larger than the true moon in the sky.

POEM, by Neil M. Travis*

S T A R S

I like to stand and look into the sky
To watch the stars and moon go by.
What infinite precision they all show,
As night by night around they go.

Though centuries come and centuries go,
The stars revolve around the globe.
Though nations rise and nations fall,
The stars remain despite it all.

Man looks up into the sky,
But he can only guess and sigh.
Compared to stars he is so small,
His knowledge cannot tell him all.

So each night the stars will rise,
And man will gaze up at the sky.
With all his charts and books galore
He can only knock at nature's door.

*One of our young members. He was suddenly confined to a wheelchair and could not attend the meeting.

POLAR AXIS ALIGNMENT WITH AAVSO "PATH OF THE POLE CHART", by Walter Scott Houston

The accurate alignment of the polar axis on the refracted pole seems today no better done than it was thirty years ago. At that time I watched an "expert" astronomer spend three nights adjusting an axis, and when he was done there was no visible proof of the accuracy of his work.

Recently there has been much interest in supplementary finders that contain offset markings to locate the pole from the north star. These have the disadvantage that mistakes can be made easily.

The AAVSO, for a couple of decades, has supplied the fast and accurate answer to polar alignment problems in their "path of the north pole" chart. It is distressing that most amateurs have apparently never heard of the chart.

The chart consists of a region around Polaris with stars down to about 10th magnitude. Superimposed on the chart is the actual path of the pole with locations marked every 10 years for several centuries. The exact spot can be located with an accuracy within a few seconds of arc for any given year. In my ten-inch the chart is used this way:

1. An extra hollow polar axis was built that fits the polar axis bearings.

2. This hollow axis has within it a small finder telescope fitted with excentric rings so the small telescope can be brought to exact parallelism with the axis defined by the polar axis bearings. In practice this is done by rotating the small telescope and adjusting the rings until the star fields do not wobble.

3. The mounting base is now moved with its adjusting studs until the exact pole is on the cross hairs of the small telescope. THE POLAR AXIS IS NOW ON THE POLE.

4. The hollow polar axis is removed, the telescope and its axis are put in place.

This has the advantage that no errors in the intersection of polar axis and declination axis, no errors in circle graduation or centering, no flexure, can spoil the alignment on the pole.

With my 10-inch reflector it takes about 5 minutes to get an alignment with much less than a minute of arc. I have done the setting in less than one minute.

For those who do not have a hollow polar axis, or whose mount makes it difficult to remove the telescope and its axis....a small casting should be made to hold the finder against the existing polar axis. Two sets of double "V" blocks will do. Parallelism of finder and main axis can be adjusted by rotating the "V" on the polar axis. Adjust until the star field in the finder does not wobble. Then the instrument can be set directly on the refracted pole.

This method is so simple, and immeasurably more accurate than the usual methods, that it is surprising so few amateurs know about it.

TWO VARIABLES IN SAGITTARIUS, by Gretchen Luft

A study of two stars in the region of Sagittarius ($18^h\ 24^m\ -23^{\circ}.3$), DH #8 and DH #300, was a part of my summer's (1961) work at the Maria Mitchell Observatory, Nantucket. Curves were drawn from magnitude estimates made visually from several hundred photographic plates taken from at least three different observatories.

The first star, DH #8, seems to be a long period variable with a period of about 700 days, whose amplitude was from apparent magnitude 11.8 to 12.6 at the beginning, but decreased to about 0.3 mag toward the end of the observations about 15,000 days later.

The second star, DH #300, is thought to be an eclipsing variable with a period of 20.253 days, with a variation from about 11 to 12 magnitude. The possibility of spurious periods was investigated with no results. It has been suggested that the star may have two minima, one major and one minor, with a period twice the one found, but this possibility has not been investigated.

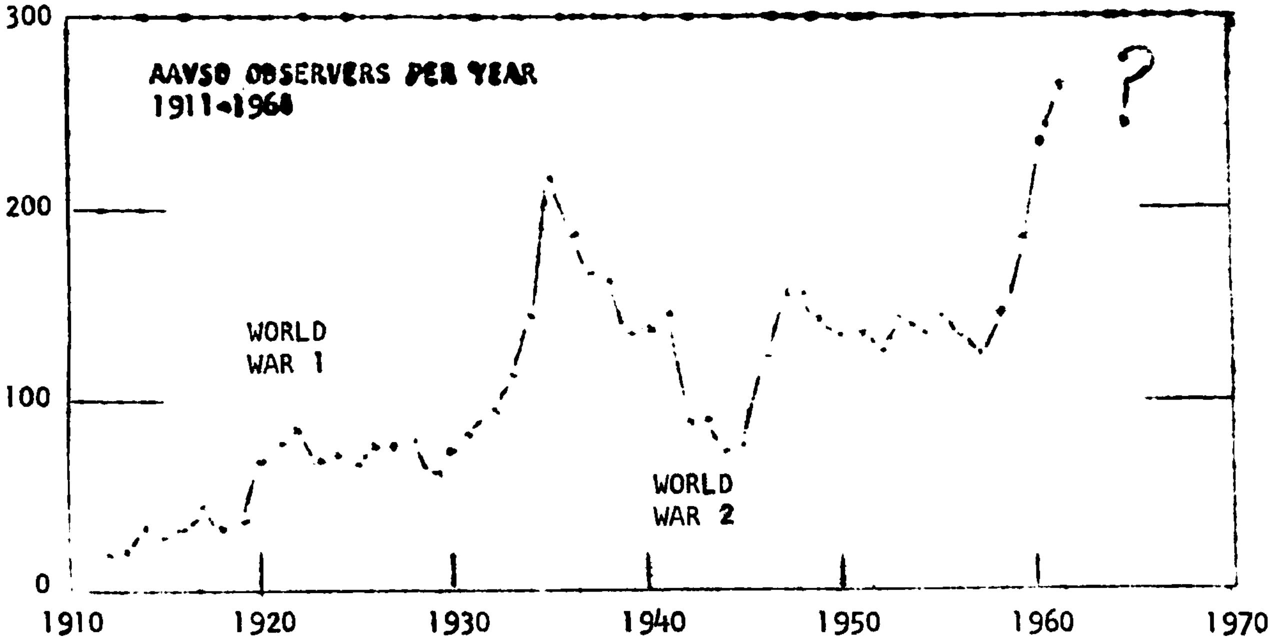
TWO NEW VARIABLES IN ORION, by Leif Robinson

Following my 1958 revision of the Orion-Nebula-area-chart for the AAVSO, 6 new variables have been discovered. Two of which -- Parenago 2080 = Var #7 and Parenago 1175 = Var #1 -- have shown periodic variation.

#7 ($\alpha = 05^h\ 30^m\ 33^s$; $\delta = -05^{\circ}\ 57'.3$ (1900)) appears to be an Algol type star with a period of $23^d.286875$; Max 10.0, Min 10.4, Min_2 10.3 (vis). The initial epoch for minimum was taken to be JD 2,436,990.6576; the secondary occurs at d = .37. Studies of this star have been made for sixteen cycles by several observers since Mr. Hector A. Rodriguez called its variability to the attention of this writer.

#1 ($\alpha = 05^h\ 28^m\ 30^s$; $\delta = -05^{\circ}\ 25'.4$ (1900)) is a very strange object with a period (?) of $12^d.3185$; Max 10.7, Min 11.6. The initial epoch was taken to be JD2436545.7. Observations by this writer during fifty-five cycles indicate that while minima occur at regular intervals the activity between minima is irregular and generally representative of RW Aurigae stars.

It should be explicitly noted that the above report is very tentative and the results should be held in great reserve. Further observations are required of these stars -- especially with a Wratten 57 filter. Such observations should be noted with the designation "G" to separate them from un-filtered observations. Observations of these stars are also being planned by the International Astronomical Association of Photoelectric Observers, under the direction of Mr. S. Archer.



HISTORICAL SESSION

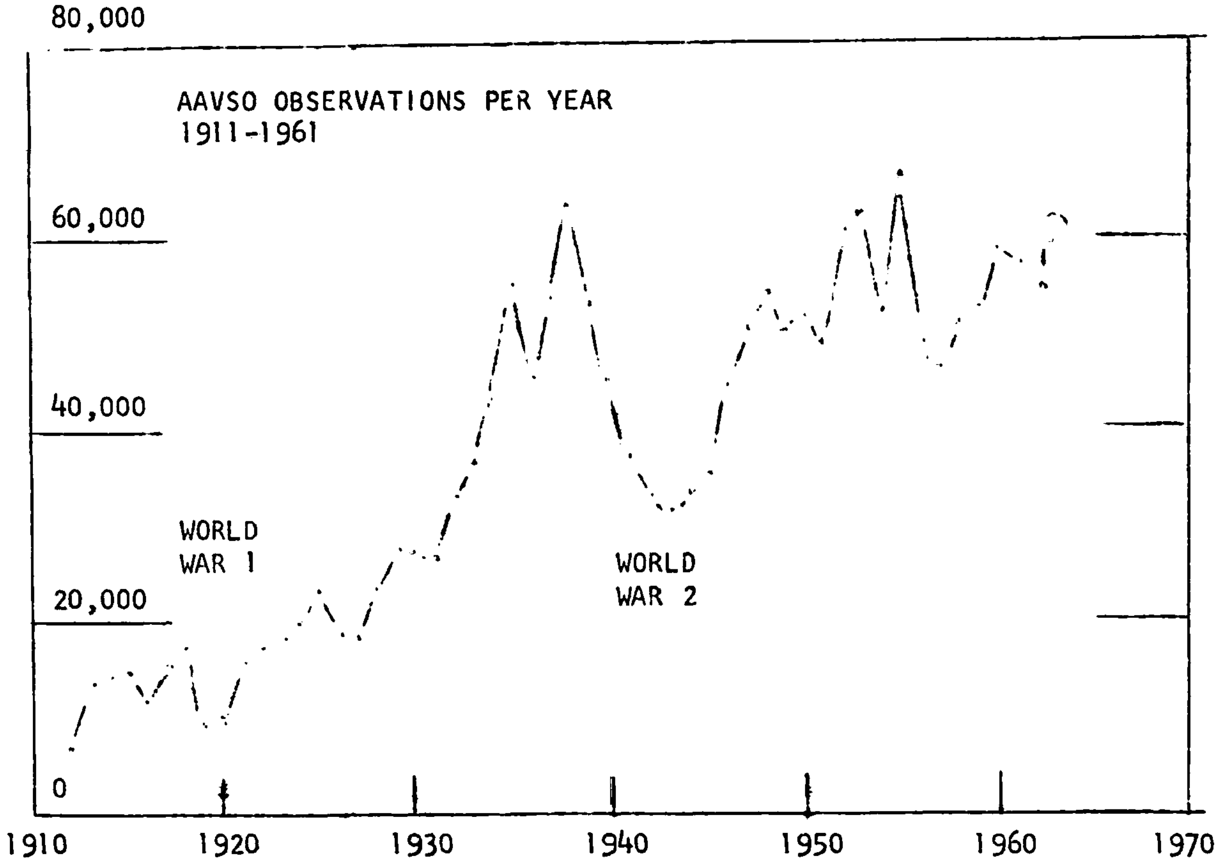
AAVSO OBSERVING TOTALS FOR 50 YEARS, by Curtis Anderson

This voluminous report was compiled by Mr. Anderson over a "considerable period of time". He has made an exhaustive study of AAVSO reports in Popular Astronomy, Variable Comments, Journal of RASC, AAVSO Bulletins and Annual Reports. His original report covers the period from the birth of AAVSO through the annual report of 1959-1960. Several gaps remained for which he could not obtain data, but these have since been filled, and the report has been brought up-to-date -- to October 1, 1961. Mr. Anderson's report is a valuable contribution to the historical records. He lists the top 25 observers from 1911 - 1961 (see below); all observers who have made 500 observa-

THE TOP 25 OBSERVERS FROM 1911 - 1961

	Name	Total		Name	Total
1	R.P. de Kock	117,157	14	H.E. Houghton	23,589
2	C.F. Fernald	104,444	15	Curtis Anderson	22,163
3	L.C. Peltier	96,650	16	Robert M. Adams	22,130
4	Ferd. Hartmann	55,590	17	Eppe Loreta	21,067
5	G.B. Lacchini	52,220	18	Joseph Meek	19,187
6	Edward Oravec	52,097	19	Carl J. Renner	19,047
7	Eugene Jones	44,763	20	Clinton B. Ford	18,397
8	Radha G. Chandra	37,215	21	D.P. Elias	18,349
9	Paul Ahnert	36,089	22	Domingo Taboada	18,172
10	J.M. Baldwin	30,710	23	W.L. Holt	17,563
11	David Rosebrugh	28,826	24	G.E. Ensor	14,952
12	Thomas Cragg	27,289	25	Morgan Cilley	14,906
13	T.C.H. Bouton	24,040			

tions or more, together with dates of their observing periods and total number of observations contributed. Another section lists the number of observations made each



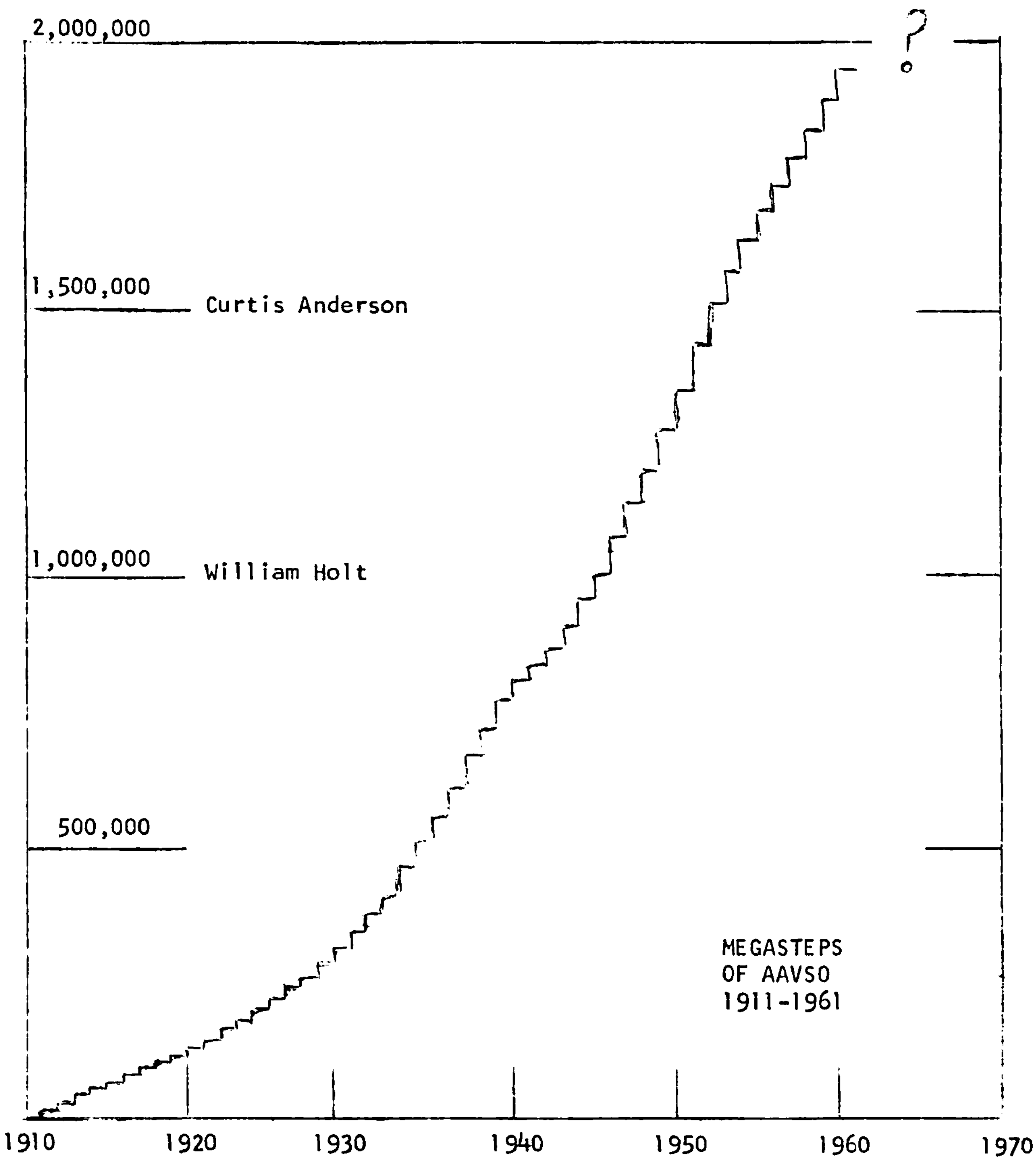
year by all observers, and the names and number of observations contributed by the 3 leaders each year, since 1911, and the total number of contributing observers.

He has found that about 300 observers have made 500 or more observations; that there have been approximately 1100 observers who have made less than 500 estimates;and that the total number of observers over the 50-year period is about 1420. The report has been submitted in such a form that it will be easy for the director to maintain it in the future.

As an illustrated supplement to the reading of a resumé of Anderson's report, Mrs. Mayall displayed three charts she prepared showing 1) Number of AAVSO observers per year; 2) Number of AAVSO observations per year; and 3) Cumulated totals of observations per year, titled Megasteps of the AAVSO (see next page). The latter chart showed how close we are getting to the 2 millionth observation. The three charts are reproduced here on a greatly reduced scale. The total number of observations as of October 1, 1961 is 1,948,707. (Ed.)

NOTES FROM OLCOTT'S FILES, by Clinton B. Ford

Our Secretary is fortunate to have in his possession an old file box full of Olcott's early records. From these he read excerpts which reflected the close cooperation between Olcott and Edward Pickering in providing data and producing charts for the use of early members. The menu of the first dinner meeting in New York was read. Many old bills were entertaining and informative. (Ed.)



GIOVANNI BATTISTA LACCHINI, "The Grand Old Man of the AAVSO"

An autobiographical sketch, translated from the Italian by Luigi Jacchia. (Edited by RNM.)

I was born 20 May 1884. I first expressed an interest in the phenomena of nature, particularly of the celestial sphere, at the age of 6, when a solar eclipse was visible in Faenza (17 June 1890). I heard my relatives talk about it, and it made a great impression on me, although I did not observe it. I found several books on natural science in my home library, but at that age I could only enjoy the figures.

However, my interest was kept alive and at the age of 10-12 I was reading with increased interest, and at the age of 12-13 I made my first attempt to construct a telescope with spectacle lenses. I felt as though I was emulating Galileo!

In September 1911, I subscribed to Popular Astronomy and stumbled on the article by W.T. Olcott, who invited those interested in observing variable stars to get in touch with him. All that I had read before treated the subject from a point of view different from that of practical observations. At that time I was employed in the Post Office of Imola. I had a 2 3/8' refractor which I used to observe from different windows of my home. Although my knowledge of English was limited, I wrote to Olcott, and on 25 October 1911 he sent me a chart for observing Mira Ceti which was waning.

My observations for October and November were sent to Olcott. They were acknowledged on 15 January 1912. He welcomed me as a member of the "new association" and complimented me on my work. I started correspondence with D.B. Pickering on 29 August 1915. At that time Olcott and Pickering were my two good friends of the AAVSO. They later visited my home -- Pickering on 20 April 1926 and Olcott on 23 June 1927.(See Pop. Ast. March 1927 and Sci. Amer. October 1930 for an interesting account of his visit).

Very important to me was the help provided by D.B. Pickering in the purchase by the AAVSO of the 8'-Wood equatorial reflecting telescope which was put at my disposal in 1927, and which today I am still using with unchanged enthusiasm if not with the same proficiency of the good old times. The work that united me with Pickering was the revision of the observation charts, my contribution being the checking of the drawings with the sky. It was here that Brocchi came into the picture. Brocchi, by strange coincidence, was born not more than 40 kilometers from Faenza.

My activity in the observing field impressed some astronomers and observatory directors, among whom were Bemporad, Cerulli, Abetti and others. Through their interest I was transferred to the personnel of the Government Observatories. On 15 May 1928 I became an assistant in Government Observatories and was sent to Catania Observatory.

The sky at Catania was almost always clear. During the first year I was able to observe on 330 nights. My observation program expanded rapidly. The number of variables increased from 59 in July with 207 observations, to 76 variables with 406 observations in December, 115 variables and 446 observations in January 1929. In 1929 I made 4811 observations and Campbell complimented me not only on the quantity but on the quality of the observations. It should be noted that I was busy during the day with other work -- solar observations, and measurement and computation of positions for the International Astrographic Catalogue of the Catania Zone.

In a letter dated 31 May 1952 Clinton Ford announced my nomination to honorary membership in the AAVSO, and promised to visit me -- a promise which he kept on 30 September. His was a memorable visit.

My method of observing may be of interest. I never make my estimate at first glance. And especially with red stars I wait for the moment when the apparent rise in brightness stops, to make the estimate. Generally, my observing timetable was for two hours after dusk and two hours before dawn. Altogether I have observed for the AAVSO 381 variables with 54,759 observations up to 1 October 1961. About all of these observations have been published in the communications of the AAVSO. I have published some of my results in the form of discussions, with several graphs of light-curves,such as for R Scuti, Mira Ceti, X Ophiuchi, and others.

I also published in 1929 a note on the limit of visibility with small refractors. I gave the following results:

Objective	Limiting Mag.	Objective	Limiting Mag.
6 cm(2 3/8 in.)	12.5	13.5 cm(5 1/4 in.)	14.8
7.2 cm(2 3/4 in.)	13.3	15.0 cm(5 7/8 in.)	15.00
10.00 cm(3 7/8 in.)	14.5		

With the reflecting telescope of 21 cm(8 3/16 in.) the limit is also 15.0 magnitude.

And now I conclude by thanking all my working companions, and especially I salute the memory of W.T. Olcott and Leon Campbell, and I make a wish to be able to greet you monthly with my observing report.

HISTORY OF THE AAVSO, by R. Newton Mayall

Mr. Don Zahner, editor of The Review of Popular Astronomy, originally wanted a short story about the 50th Anniversary Meeting of AAVSO. When he learned I had been appointed to write a history of AAVSO for the anniversary meeting, he offered to publish it in RPA. For this we are grateful, and a reprint is enclosed. This generous offer, made possible a more complete coverage and a much more attractive story than headquarters could have produced.

S O L A R S E S S I O N

SEVENTEEN YEARS OF THE SOLAR DIVISION, by Harry Bondy

Mr. Bondy traced the work of the solar division since its inception under the direction of Neal Heines. He pointed out the many problems involved, how observers were standardized, the development of American Sunspot Numbers, and the addition of SEA(sudden enhancement of atmospherics) observers. The Bureau of Standards helps support the work of this division, whose observations are sent to them regularly.

The following papers will be reported in Solar Division Bulletin: MEASURING SUNSPOT LOCATIONS, by Ernest Lorenz; RECORDING OF SUDDEN ENHANCEMENT OF RADIO SIGNALS - AND INDIRECT FLARE DETECTION, by C.H. Hossfield; SUNSPOTS IN DETAIL,Harvey Hepworth.

SOLAR FLARES, A Motion Picture

We are grateful to Mr. Gail E. Moreton, Director of Lockheed Solar Observatory, Burbank, California, for the opportunity of showing his beautiful film of solar flares made at the Lockheed Observatory. This 15-minute film showed the birth,growth,and death of many flares,and numerous fine photographs of other flares.

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THROUGH THE YEARS WITH THE AAVSO, by Lewis Boss

Fellow members of the AAVSO, guests, the motion picture you are about to see presents a cross-section of the Association from 1928 almost to the present time. It was my privilege, as producer of this film, to have had the opportunity to record pictorially many of the founders of the Association and prominent members now fast becoming legendary characters. It is hoped that these "candid camera" scenes will help recreate, at least briefly, the tremendous enthusiasm, fellowship and cameraderie that was generated at these early meetings and that have continued to be features of our meetings to the present day.

Many thanks are due to the contributing photographers, Clint Ford and Claude Carpenter, who have supplied films covering various meetings from 1941 on. It has not. of course, been possible to use all of the material contributed nor would your patience hold out to view such a lengthy record if it had been included. It has not been easy to discard many scenes which had interest and which in the original reels lent coherence to the record. However, it is hoped that the spirit of each occasion has been retained.

Your indulgence and charity is hoped for in viewing the first section of the film since the quality of the photographic material and the processing was rather poor in the early days of amateur cinematography.

And now may you all enjoy "Through the Years with the A.A.V.S.O." because "this is the way it was!" (This was an ideal way to end our 50th Anniversary Meeting, ED.)

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A.A.V.S.O. 1911 - 1961

We hope you are all making plans to come to our 50th Anniversary Celebration and Annual meeting at Harvard Observatory, from Oct. 12 - 15, 1961. Tentative plans call for a Council meeting on Thursday afternoon Oct. 12 followed by a dinner(perhaps a Chinese Mandarin buffet) and an informal evening of chit-chat. Friday morning we will have our business meeting and election of new Council members, followed by a session for papers. Friday afternoon more papers or possibly a symposium, then a conducted tour of the new research and computing laboratories of the Smithsonian Astrophysical Observatory, followed by tea in the HCO library. On Friday evening Dr. Shapley will again give his famous High Lights (and low lights), not of the year, but of the half century, Saturday, Oct. 14, will start with an historical session, then a trip out to the Agassiz Station of the Harvard Observatory, where we will have a picnic lunch and a chance to see the optical and radio telescope installations. The Association dinner Sat. evening will be followed by pictures to show what we looked like 25 or 50 years ago. Also movies from the 1920's on, taken by Lewis Boss, Claude Carpenter, Clinton Ford, and others. Our official historian is Newton Mayall, but we hope in addition to have reminiscences from many charter and other members, especially from Signor Lacchini, who continues his observing started in 1911.

We are always delighted with the fine papers from our members and hope this meeting will be even better than ever. As usual they will be limited to 10 min. each. We should follow the example set by the Amer. Astronomical Society and use a timer with a loud bell. We will have more sessions for papers at this meeting, and we plan to have a number of invited papers and/or symposia. We are still undecided about a Sunday morning session. Titles and abstracts of papers to be presented at this meeting, will have to be sent to Headquarters much earlier than usual, so we can set up definite programs for each session.

A.A.V.S.O. OFFICIAL INSIGNIA

The blue and gold AAVSO star is a real "conversation piece", and brings many admiring comments. Do you have yours? We still have a few $4 and $6 pins, a pair of $7 earrings, and two $7 tie bars. Some time we will get another lot of the insignia made up, but there may be a long delay. Order yours now, so you will have it to wear this summer, and at our Anniversary Meeting.

SOME SPECIAL OBSERVING PROGRAMS

SUPERNOVAE

The successful visual observations of the super nova in NGC 4564 make it look as though a visual search for supernovae could be fruitful. Any observer who can see 12th mag. objects and fainter can join in the search. He should select 5 or 6 galaxies from an atlas such as Becvar, study them carefully a few times to learn the general appearance, then take a quick look each time the telescope is used. Be sure to keep a careful record with time to the nearest 5 minutes and send a copy to Headquarters the first of each month.

VARIABLES IN ORION NEBULA REGION

Leif Robinson asks for more observations of the Orion variables, including the suspected variables Nos. 1 to 4, 6, and especially No. 7. He hopes to get enough observations this season to confirm their variation.

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