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

Edited by R. Newton Mayall

PAPERS PRESENTED AT 51ST ANNUAL MEETING, 12-13 OCTOBER 1962

Our annual business meeting once again was held in the Springfield (Mass.) Museum of Science, formerly the Museum of Natural History. Also the hotel used as Headquarters, formerly the Shelton, has changed its name to Sheraton Motor Inn, with ample off-street parking.

The weekend before our meeting New England was inundated by a storm that lasted several days and deposited as much as 12" of water in some areas. Fortunately it did not destroy the colorful countryside, so beautiful at this time of year, and our record is clean. Friday cleared warm and comfortable. Saturday and Sunday both were pleasant days.

Friday evening, Margaret W. Mayall, Director of AAVSO gave an account of her absence from Cambridge, for about 6 weeks during August and September. She received an invitation to participate in a special symposium on variable stars in Bamberg, Germany. Shortly after her acceptance she received another invitation to attend the meeting of the Astronomische Gesellschaft which was held in Freiburg the week following the Bamberg meeting.

Arriving at Bamberg she found only two other lady astronomers were there -- Helen S. Hogg, a past President of AAVSO; and Mrs. Detre from Budapest. These meetings are small compared with the IAU and AAS meetings. About 40 specialists in variable stars attended. Mrs. Mayall and Mrs. Hogg were the only astronomers from America. Father O'Connell, from Vatican Observatory, was there and as usual he had words of praise for AAVSO.

Mrs. Mayall reported that the meeting at Bamberg was extremely interesting and profitable. She was happy that a large group of young men from the Berlin observers came down to see her. The Berlin group began observing variable stars shortly after the war, and with AAVSO help has contributed observations ever since. Some of the original group are now professional astronomers. The Berlin group has been doing outstanding work on binaries, but in addition they continue their observing for AAVSO.

The interval between meetings gave her an opportunity to visit AAVSO member Father Oberstatter, who gave her a royal welcome, and guided her through Alsace-Loraine.

The Astronomische Gesellschaft meeting was large, similar to our AAS meetings. Here she made many new friends and met many old ones. Hans Rohr from Schaffhausen and Miss Seiter (formerly of Smith College) were there.

In addition to participating in an important symposium, the trip gave our Director the opportunity to visit and talk with some of our foreign members -- to talk over any problems and give them a personal account of our activities and programs for the future.

Following her talk, Mrs. Mayall showed her skill at color photography, by letting us see some of the beautiful country she visited, including the Duchy of Liechtenstein. She showed pictures of Father Oberstatter's 10-inch, the Innsbruck Observatory and the Schauinsland Observatory near Freiburg. Her commentary was both humorous and informative.

After a sumptuous breakfast Saturday, served gratis by the Inn, we gathered in the Museum Auditorium. Although our business meeting was the longest on record, allowing time for only one short paper, it was a particularly interesting meeting carried out with enthusiasm. New councillors elected were: Robert Adams, Lewis Boss, Thomas Cragg and Francis Morgan. The officers of the previous year were reelected, except for the Auditor. Percy Witherell succeeds Cyrus Fernald in that office.

Plans for the April and July meetings in 1963 have been completed, and were discussed (see separate announcement). At 12:15 p.m. everyone gathered on the front steps of the Museum for a group photograph. No official photograph was taken, but those with cameras made good use of them.

The afternoon session was given over to papers and general discussion. At 7 p.m. we sat down to a delicious roast beef dinner at the Sheraton Motor Inn. When the dishes had been cleared from the tables, President Hoffleit banged the gavel and opened the mysterious envelope that contained the number 2 million. She read a copy of the telegram that had been sent to Leslie Peltier, as follows: "Your observation of TX Ophiuchi made on 2437872 will be announced at the banquet tonight as observation 2,000,000. Congratulations. Sorry you can't be with us."

Following the announcement of 2 million Clinton Ford began unwrapping a large package containing a framed document. He read from it the following: "The AAVSO presents the 17th Merit Award to Richard W. Hamilton in recognition of his faithful devotion to the interests of the Association for over twenty five years, of his loyal services as President and especially of his untiring efforts as Curator and Distributor of Variable Star Charts."

With these two important matters taken care of, Miss Hoffleit called on Richard Davis, our treasurer, to account for his absence this summer. He justified his trip by taking us on a trip to Greece, via color slides. He showed us many delightful places not well known, and his commentary was bright and informative. The excellence of his photography and selection of subjects made a fitting climax to another very enjoyable weekend.

As usual, sociability lasted until the wee hours. We were particularly pleased to see our friends the Goods, De Kinders, and Miss Williamson from Montreal, who with the Buckstaffs from Wisconsin travelled farthest to the meeting.

There is much excitement over the forthcoming meeting in California, so read your notice carefully and arrange your vacation at the right time. It will be a meeting you can not afford to miss.

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ECLIPSE SITE HUNTING, by Cyrus F. Fernald

The 1963 Ephemeris locations of points on the central line of the July 20, 1963 eclipse trace a line through the villages of Brighton, Harmony, Newport, Orland, and Otter Creek, Maine. This last summer the Mayalls came up to see us and look over the territory with us on the July 20 weekend. We decided there was no need to explore east of Newport. This left us with three main highways to look over, and the second grade roads in the area from Newport west to Brighton.

On a subsequent trip in early September we checked other locations and found one that is so outstanding, in the vicinity of Athens, that we looked no further. It has several sites on the property and one site will give a 360° horizon from 30 to 60 miles away.

Now as to chances for a clear sky, I took my records for the last twelve years, covering the five day period July 18 to 22 each year. In 1953 we were away three days, which leaves 57 days for the check. On 15 days we had some rainfall. On 47 days I got a solar observation; excellent seeing on 24 days, with 0 for clouds on 16. Discounting for the moon, I observed variables on 18 out of 36 nights. (Tentative arrangements have been made for the exclusive use of this site by members of the AAVSO and their equipment. More details later. ED.)

A PECULIAR LONG PERIOD VARIABLE WITH N-TYPE SPECTRUM, by Nancy Houk

The variability of V1280 Sgr[1] was investigated on 1425 Harvard and Nantucket plates. 12 maxima were found. A period of 523 days fits the observed maxima fairly well. V1280 can not be seen at minimum in Barnard's atlas, in the Yerkes atlas, or on the Franklin-Adams charts, so its minimum magnitude is still unknown. Wide variations in width and brightness of the maxima occur. The magnitude at maximum ranges from 12.0 to fainter than 15.2. (Two predicted maxima are not seen at all.) A plot of estimated (i.e., sometimes extrapolated) maximum magnitude versus epoch indicates a possible secondary period with $P_2 \cong 10 \times P_1$. If there is a secondary period, the primary period, as well as the amplitude, should be affected. Therefore there should be a relation between estimated maximum magnitude and the deviation from the predicted time of maximum. Such a relation is found, and the graph of deviation versus epoch agrees closely with that of magnitude of maximum versus epoch, supporting the possible secondary period, where $P_2/P_1 = 10$. A study of secondary periods by C. Payne-Gaposchkin[2] has indicated that the ratio P_2/P_1 is related to spectral type. Her calculations are repeated by the author, using all N-type variables for which secondary periods are now known. An average ratio of 12.3 ± 2 is found.

Some other statistical information derived from the 1958 General Catalogue of Variable Stars and the 1960 Supplement, is shown in Tables I and II. Spectral types are known for only one third of the long period variables (Mira-type, semiregular, and irregular), so the percentages in Table I may well change as more variables are classified. Table II would tend to indicate that N-type variables may be less regular than other types of long period variables.

Table I

Sp. Type	No.	%
M	1946	85
N	195	8.5
S	73	3.2
R	39	1.3
C	34	1.1
	2287	

Table II

Class	N-type		All others	
	No.	%	No.	%
Mira	36	18	3755	56
SR	81	42	1674	24
I	78	40	1347	20
	195		6776	

1 The variability of this star was discovered in 1954 by A.V. Soloviev, who observed only two maxima. (Astronomical Circular, No. 154, 1954).
2 Harvard Annals, 113, 191, 1954.

THE ASTROLABE - THE ASTRONOMER'S SLIDERULE, by Richard H. Davis

The potentialities of the astrolabe for the simple and rapid solution of many problems with respect to the celestial sphere were discussed and the usefulness of such an instrument to the astronomer, amateur or professional, planning an observing program was pointed out. Reference was made to "Practical Astronomy" by Schroeder (London, 1956) for details as to the graphical construction of an astrolabe for the particular latitude of the observer; and corresponding trigonometrical formulae, derived by the author, and by means of which an astrolabe reading in standard time can be constructed for any particular latitude and longitude, were presented. Attention was drawn to the ease of determination by means of the astrolabe of the earliest and latest dates on which a particular variable star can be observed from a particular location, and construction and use of the instrument was urged to facilitate special efforts to make observations at and near these dates to reduce minimum "solar gaps" in the light curves of the AAVSO. (Copies of complete paper available from the author).

STELLAR SPECTACULAR, by Albert E. Ullmann

Mr. Ullmann showed the complete set of 12 color slides of nebulae, produced by Mt. Wilson and Palomar Observatories. A brief explanation of the meaning of the colors made them more interesting, although the slides are spectacular in themselves.(ED)

DARK ADAPTION, by Douglass Franklin Adams

(This paper was written at the request of Cyrus Fernald for presentation at this meeting. It is a boiled-down talk the Fernalds had with Dr. Adams about some of the experimental work the Army has done on night eye adaption. ED)

The retina of the eye is the extension of the brain which we as astronomers find essential for our particular endeavor. It lines the posterior portion of the inner globe.

The cellular layer of the retina possessing sensitivity to light in the 400 to 800 millimicron range is composed of two types of cells. These are called the "rods" and "cones" because of their microscopic appearance.

The cones are sensitive to color and to more intense light. They are more closely packed than are the rods and, therefore give better resolution. These cones are used for our common daylight vision.

Rods are sensitive only to varying degrees of light and not to color. The sparsity of these cells causes decrease in our visual acuity when we are operating in a dimly lighted situation. During such a time we are using our rods exclusively for vision.

It has been found that the retina is not similar to a photographic film in its reaction to light. Its sensitivity to light is by no means constant. It is common knowledge and experience that our ability to see dim light is proportional to the length of time that the rods remain unstimulated. The demonstration of this would be our improved vision after a period of time at our telescope when compared to first stepping from a brightly lighted house.

There are two methods available to limit the stimulation of the rods. The first is to place the eye in total darkness. The other is to limit the wave length of the light striking the retina to that portion of the spectrum not stimulating to the rods. The latter method allows activity during the period of adaptation and thus is preferred. It has been shown that the wave lengths greater than about 600 millimicrons provide adequate stimulation to the cones for useful vision, while the rods are practically unstimulated by this red end of the spectrum. It is from this knowledge that the use of red lights and goggles for dark adaptation has become a widespread practice among those working with critical amounts of light such as radiologists and night pilots.

Much of what has been said is knowledge with which most of us have been familiar for many years. Most of us, however do not fully appreciate the magnitude of the increase in light perception available through dark adaptation. This amounts to an increase in retinal sensitivity to light after 10 minutes of dark adaptation of approximately 10-fold. After 18 minutes the increase is 100-fold and after 50 minutes a 1000-fold increase in sensitivity is noted.

It should be pointed out that this dark adaptation is very quickly lost when the eye is again exposed to relatively high intensities of light. Each retina, however is independent in its adaptation as is each specific area in the retina. This provides the opportunity for exposure of one retina by opening one eye, or exposure of only a small portion of one retina by the use of pinpoints of light without losing complete dark adaptation.

The final concept which I wish to present is that of central versus peripheral vision. In the center of the retina there is an area called the "macula". This area is filled exclusively with closely placed cones and is used for very acute day and color vision. When an eye is functioning exclusively on rods the macula, which is devoid of rods, becomes a blind spot similar to the well known blind spot formed by the optic nerve. The macula covers about two degrees of the field of vision in the central portion. From this area the density of the rods increases to an area about 20 degrees from the center of the field of vision where the rods are denser than at any portion of the retina. It appears that best resolution, however, is noted at about 7 degrees from the center of the field of vision. The practice of scanning when the eyes are dark adapted is recommended. One should not look directly at the object. The object being viewed should be placed about 10 degrees off the center of the field of vision to keep it from falling into the blind spot of the macula. The advisability of this maneuver may be easily substantiated when in a very dimly lighted area one looks at a small, dim object with his peripheral vision at about 10 degrees off center and then looks directly at the object. He will immediately lose sight of the object.

SUMMARY: Rods provide up to a 100-fold increase in light sensitivity to the retina when properly adapted with dark adaptation. It is recommended that red goggles be worn from 20 to 50 minutes prior to observing and that red light be used at the console during observation. The use of scanning when viewing dim objects is necessary. Care should be used not to lose dark adaptation by viewing bright stellar phenomenon or other light sources prior to observing the stars of higher magnitude. A red filter might possibly be used while bringing the telescope into position for observation of stars of the higher magnitude.

THE 10" SPRINGFIELD, by Cyrus Fernald

At Stellafane, a year ago, Dick Davis heard of a Springfield mount that Stanley

Brower had for sale. Dick very graciously let me have first chance to buy it. After looking it over, and some dickering, I bought it. It was delivered last January. This mount was made by the telescope makers of Springfield, Vermont, and given to Albert Ingalls in 1927, according to the inscription on it. The mount for my 8' Springfield which I got in 1931 was obviously made from the same patterns, with a few improvements that experience evidently showed the makers. The major differences between the two are the 8' has a saddle that will take a 9' tube, and is made of cast iron. The 10''s saddle takes an 11'' tube, and is cast aluminum.

Most of the summer we have had workmen improving our living quarters so it was very convenient for me to have a job in my work shop. After considerable studying to determine just what I wanted for a mirror cell, and a spider holder for the primary prisms, I got down to the business of putting the telescope into operating condition. I didn't get in any observations in the 1961-62 AAVSO year with it; but by the middle of September I was making some observations, particularly of the fainter stars. The few weeks use since then has convinced me that a ten-inch Springfield is a very useable, serviceable telescope. It is not as fast as the 8', largely due to the increased weight which slows down movement of the tube considerably.The mirror and cell weigh 16 lb. 13 ozs., against 10 lbs. 3 ozs; and the counter-weights in proportion. Also the increased number of stars visible may slow the observer, particularly if care is used in checking the faintest ones visible.

While on the west coast in April I saw Dr. Custer's 12.5'' Springfield of 100'' FL. He had it set up for photographic use, so I had no chance to try it visually. I saw enough to definitely form an opinion that anything larger than the 10'' Spring-field has passed the optimum size for any except the very unusual case.

If my plans materialize I expect to take this 10'' Springfield to a winter home in the south or south west sometime in 1963-64 or after. Those of you who come to the Wilton meeting for the July eclipse will have the chance to see this instrument as now set up.

OBSERVING THE PERSEIDS WITH A TAPE RECORDER, by Arthur Pearlmutter

Mr. Pearlmutter believes that it is much easier to record meteors by speaking to a tape recorder which also records continuously the time signals from WWV. To demon-strate his method and prove his point, he gave a demonstration at the blackboard, by writing the information as played back by the tape recorder of an actual record made while observing the Perseids. (An extensive account of his work on the Perseids of 1962 appears in the November 1962 Eyepiece. ED)

BUILDING A SLIDING-ROOF OBSERVATORY, by Clinton B. Ford

Recently Mr. Ford has moved his 10-inch f/8 reflector to Wilton, Connecticut,where he has constructed a new observatory. Some undesirable features of the original sliding-roof building have been corrected, and these were pointed out and discussed. He described the construction in detail, by the use of color slides, from digging the foundation to the completed structure. The building has been made large enough to house a largertelescope, if he ever wants to use one. (ED.)

PHOTO-ELECTRONICS AND THE AAVSO PHOTOMETER, by Lewis J. Boss

Since you have been hearing for some years now about photoelectric photometry many of you may be wondering what it is all about. To go fully into the many details of the subject would certainly require more time than that allocated to this whole meeting! Therefore, we will take only a brief look at the fundamentals of the photoelectric "eye" itself and leave the circuitry of the amplifiers and recorders for another time.

When light, which is actually an electromagnetic radiation, falls on the surface of a metallic plate specially coated with an alloy such as antimony and caesium, the absorption of this energy will cause electrons to be emitted. If such a coated surface is enclosed in an evacuated glass tube together with an anode or "collector" carrying a positive charge of electricity the electrons released by the incidence of the light will be attracted to this point. The voltage applied to this anode must be sufficiently high to collect the majority of the electrons emitted as well as reasonably uniform over the cathode (photo-emissive) surface, so that the lowest possible saturation voltage can be obtained.

In the absence of light, a small current flows between anode and cathode which is termed "dark current" and which must be compensated for, before any observations can be made. Methods of doing this are described in the new AAVSO Manual of Photoelectric Photometry. "Dark current" is the limiting factor in astronomical work. Various sensitivities to light are obtained by combinations of photomissive alloys, such as silver oxide-caesium, which is capable of working at very low levels of illumination. The special applications of photoelectric devices as used in astronomical photometry involve electrical currents as low as 10^{-16} ampere.

As can be imagined the difficulties of accurately measuring such small quantities of energy are numerous and since the limit of accuracy of such measurement is governed by the statistical variation in the emission rate of the photoelectrons, the circuit noise generated in the electronic equipment and the measuring equipment, some method of increasing each electron emitted, by a constant (or near constant) factor, has been searched for diligently. By such a means the amplitude of the signal delivered by the photocell could be raised above the input noise level of the electronic amplifiers and the noise of the entire system reduced to that inherent in the process of photoemission.

Research along the lines outlined above has led to the development of the photomultiplier tube. Two (2) methods of amplification have been found: 1) which employs the phenomenon of gas multiplication, and 2) which utilizes the principle of a secondary-emission. This latter type is the one used in the AAVSO photoelectric photometer and recommended by your Committee.

The major design problem in a secondary-emission multiplier is to make certain that the electrons strike the secondary-emission elements (dynodes) at an area where the electric field is directed away from the emissive cathode and to the next dynode. This has very effectively been accomplished in the photomultiplier tube used in the Association's photometer design which employs such a design and provides a strong directional electric field resulting in greater output currents being available before space-charge effects become prohibitive and paralyze the tube. The over-all sensitivity of a photomultiplier tube varies with the applied voltage and the nine (9) dynodes of the tube used in the AAVSO photometer give an almost linear relation between voltage and the log of sensitivity.

As indicated earlier in this paper the measurement of extremely low levels of light such as emitted by low magnitude variable stars is attended by difficulty due to electronic "noise". Consequently by the use of the 9-stage photomultiplier tube, we have not only increased the sensitivity of our electronic "eye", but have introduced tremendous amplification of the signal to be measured, at a point ahead of the major source of "noise". As a result the signal-to-noise ratio is high and we are able to obtain observations of fainter stars and smaller variations in magnitude than would otherwise be possible.

One of the most frequent questions asked the Committee by beginners in the field of photometry is whether or not one of the modern low-cost photovoltaic photocells can be used in place of the photomultiplier tube. Since most of these units turn out to have either selenium or cadmium sulfide photo-sensitive elements which provide low light sensitivity, the answer is "no". The reason is, of course, electronic noise. These devices are able to handle such tasks as counting passing people or automobiles by the interruption of a light beam where the incident light level being measured is quite high. They are completely useless for astronomical work.

While only the high-lights of photoelectric fundamentals have been briefly reviewed here, it is hoped that a general idea of some of the basic points involved in the selection of a light sensitive device to be employed in this type of photometry have been made intelligible and interesting.

SOME RESULTS OF AAVSO OBSERVATIONS, by Margaret W. Mayall

Mrs. Mayall had some large blue prints of light curves on exhibit. One was a plot of the variations of R Coronæ Borealis from 1843 to the present time. A large scale plot was shown of the 1960 minimum and also one of the current minimum. Another large blueprint was of R Hydrae from 1906 to the present. R Hydrae is one of the few long period variables which has had a true change of period from over 500 days when its variability was discovered about 1700, to less than 400 days at the present time. The light curve and a discussion of the change of period appeared in Variable Star Notes in the Journal of the Royal Astronomical Society of Canada for July 1962 (Vol. 56, No. 4).

AAVSO AT GODDARD SPACE FLIGHT CENTER, by James H. Carlisle, III

Mr. Carlisle sent color slides which were shown in his absence. They gave an excellent impression of our visit to Goddard during our Spring Meeting, and what we saw there. (ED)

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