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

Edited by R. Newton Mayall

PAPERS PRESENTED AT THE ST. LOUIS MEETING, 17-19 APRIL 1964

The 52nd Spring Meeting was held in St. Louis, Missouri on 17-19 April 1964 at the invitation of the St. Louis Astronomical Society.

St. Louis is a city of 3/4 of a million people, founded in 1764 and named in honor of Louis IX of France. This year St. Louis celebrates its bi-centennial. It sprawls along the west bank of the Mississippi River and constitutes one of the oldest settlements in the Mississippi Valley. The old section, adjacent to the river has been cleared and is being developed as the Jefferson National Memorial.

St. Louis is a great industrial area, but it has a goodly number of schools of higher learning, museums, planetarium and many other cultural points of interest.

Our meeting was held at the Planetarium in Forest Park. Here Mr. Charles A. Schweighauser gave a special demonstration. There were several invited papers from members of the staff of the Aeronautical Chart and Information Center. Dr. Allen Hynek, Director of Dearborn Observatory was the Saturday night dinner speaker.

A star party was held across the street from the offices of the Review of Popular Astronomy. Delicious refreshments were served at their open house.

Two of our Canadian friends from the Montreal Centre - Isabel Williamson and Jim Low - and Margaret Mayall and the Bibbers from Massachusetts and the Fords from Connecticut travelled the farthest distances. Also several from New York attended.

This was a great opportunity for the midwesterners to come to a meeting, the second across the Mississippi.

There is no doubt that those who travelled long distances found the meeting worthwhile and a good time was had by all.

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NEW DATA ON V SAGITTAE *** THE VARIABLE GREMLIN, by Robert M. Adams

V Sagittae is listed in the General Catalogue of Variable Stars as one of a heterogeneous class of objects which are similar to the novae according to the character of the light variations and the spectral properties. The representative stars number about 35. Leon Campbell and Luigi Jacchia in the Story of Variable Stars also indicate the star to be probably related to the novae. The variability is about 13.9 to 9.5 or a range of approximately 4.5 magnitudes. Its spectrum is continuous with the greatest strength in the ultra violet region showing a few helium emission lines.

My concern of course is with observational data obtained by the AAVSO from 1950 to the present utilizing the Quarterly Reports supplemented by my observations and those of my colleagues: Carolyn Hurless and Tom Cragg.

I have given two papers on this subject, in 1959 and in 1961. In the second paper was an examination of a graph prepared from the Quarterly Reports published and additional data given me by Margaret Mayall. My conclusions were that there were no clear cut periods but there were times when the star would remain from the 12th to the 13th magnitude followed by periods when it would range between 10 and 11. There seems to be a tendency for variations to fall in periods of 500 to 600 days and from 15 to 30 days. I also reported that there seemed to be rather sudden light changes. An examination of the graph certainly verified my observations. Most of the order of the light changes were less than 1 magnitude -- with the greater number .5 magnitude or less. Mrs. Mayall also gave me information that Dr. Romano had made photographic observations giving unmistakable evidence of sudden light changes. Dr. Romano believes that this suggests that there are flares and these rapid light changes disturb the possibility of determining the periodicity of V Sagittae.

Since 1961 my observations only go to reinforce what already has been stated. I have not noticed any markedly large fluctuations over short periods of time nor have I been able to deduct any definite periodicity even though I have poured over the graph many a time. I cannot escape the fact that there may have been such a periodicity in the past and that something akin to a gaseous envelope intervenes at unpredictable times. There are a few places on the graph where there could be quick light changes of over 1 magnitude.

Early in 1963 I set up a schedule of observations in August, September, October and November. I scheduled myself to observe on the 5th, 10th, 15th and 20th of each of these months. I planned to observe at one minute intervals from 9:00 to 9:04 inclusive, from 9:15 through 9:19 and from 9:25 through 9:29. I passed the information on to several members for concurrent observations. Cloudy conditions and other committments forced me to use only a part of these dates. Some interesting data were obtained. I followed my schedule in August intact. V Sagittae appeared to me to be of rather steady brightness on all occasions. Since there were only .1 magnitude differences in some instances I did not consider this to be of significance since I am open to errors. On the 5th the star hovered around 12.3 and on the 10th it was around 12.5. It was around 12.6 on the 15th and 12.5 on the 20th. Carolyn Hurless saw it at 12.2 to 12.4 on the 25th. I only observed one night in September, the 20th. It jumped from 12.2 in the interval I was not observing from 9:18 to 9:25. On the 16th Tom Cragg saw it from 11.8 to 11.3. He observed several minor fluctuations over periods of one minute. Mrs. Hurless reported only 1/10 magnitude changes on the 26th of September. In October Tom Cragg observed quite intensively on the 6th, the 11th, the 26th and the 31st. He noticed several short magnitude changes and two .4 magnitude changes. Both of the latter lasted less than 10 seconds. My observations on the 15th revealed only minor changes and could have been the result of errors on my part. My observations on the 20th were remarkable for the steadiness of the light with absolutely no light changes during the fifteen times the star was observed. It is well to indicate that on this date the air was very quiet and there was a slight haze. All stellar images observed during my evening rounds of variable stars were outstandingly steady. I saw only slight changes on November 10th and 20th.

On examining the above information we are again faced with the necessity to accept flarelike changes in V Sagittae. It is a little difficult for me to accept the 1/10 magnitude changes but certainly the .4 and .5 magnitude changes are real.

At the present time it does not appear that the flarelike variations form a pattern of regularity. A study over longer periods of time might give us the answer. What seems rather significant is that V Sagittae goes through periods of time when there are no flares and when there are many flares. Is there a relationship between the relative increase in flares and the light change from maximum to minimum or vice versa? Cragg's observations of flarelike activity, or perhaps more correctly flickering, a term utilized by George Mumford in his recent studies of U Geminorum stars, possibly herald a general rise in light intensity. Thus V Sagittae changed from the 12 to 13 magnitude range in November to the 10 to 11 magnitude range. Then I noticed that V Sagittae was apparently continuing its flickering activity during December.

In conclusion it is now quite apparent that the study of V Sagittae raises many questions and certainly it deserves further study in the future. Perhaps this star should be compared more intensively with the other so-called novalike variables such as Z Andromedae, BF Cygni and η Carinae, and other eruptive stars in general.

WW AURIGAE MINIMA, by M.E. Baldwin

Early in 1961 while making a series of magnitude estimates with 7x50 binoculars on the Cepheid variable RT Aurigae, I was fortunate enough to accidently catch the eclipsing variable WW Aurigae, near minimum. Subsequent observations enabled me to determine WW's approximate period and to make an uncertain distinction between primary and secondary minima. On my inquiry, Joseph Ashbrook confirmed the correctness of my deductions and outlined the star's history.

My interest being firmly established, I have, each year, projected my data forward and made observations of the star's primary minima. Until recently I had no access to WW's ephemeris and had only reported my observational data to AAVSO without further action. However, Mrs. Mayall recently loaned me a copy of the "Finding List for Observers of Eclipsing Variables" which contain WW's ephemeris. I, therefore, undertook a formal determination of my observed mid-minima, including heliocentric correction, and made comparison with the ephemeris.

Optimistically carrying the result to the fourth decimal I arrive at the following:

E	J. D. Min	O - C
1884	7702.6766	+0.0011
1903	7750.6562	+0.0053
2023	8053.6566	+0.0034
2044	8106.6806	+0.0020
2162	8404.6297	-0.0012
2164	8409.6774	-0.0035
2166	8414.7257	-0.0052

I find the small scatter for each year's observations highly encouraging. Making the improbable assumption that I have made no systematic errors and, further, that the variation in WW's period during any observing season is negligible, I proceed to determine the mean O - C for each season and the probable error of the mean.

Year	Mean O - C	Probable Error	No. of Minima
1962	+0.0032	±0.0014	2
1963	+0.0027	±0.0005	2
1964	-0.0033	±0.0007	3

With only two minima recorded for each 1962 and 1963 we note that the resulting individual probable errors are highly academic, but collectively they gain meaning and are indicative of the reliability of the observations.

We may draw two inferences from the foregoing. First, we find that it is possible to determine visually the minima of WW Aurigae within a few minutes with an instrument no better than 7x50 binoculars. Secondly, we find it highly probable that the minima of WW were a few minutes later than predicted during the year 1962 and 1963 seasons and a few minutes earlier during the 1964 season.

PRACTICAL MAGNITUDE LIMITATIONS OF AMATEUR TELESCOPES, by Roger S. Kolman

As a variable star observer, I am of course interested in the limitations of the instrument I work with insofar as light gathering power is concerned.

Many new observers think that the aperture of the instrument is the only factor that determines this limit. This idea is far from the truth. Many other factors are present that are very important -- sky conditions, quality of optics, experience of observer, sensitivity of eyes, altitude of objects, steadiness of image and such psychological factors as richness of field. For instance, I find it much easier to find a faint object in a rich field than in a sparse one. The eye has comparisons and reference points in the stars nearby.

The standard limiting formula of a telescope is usually given as $M = 9 + 5 \log A$, where M equals magnitude and A equals aperture. Normal eyes and good conditions are assumed. However, under good to excellent conditions, an observer can surpass this limit by as much as one full magnitude and in some cases, even more.

When one observer sees a certain phenomenon, this may be termed unique, but when a good many observers see the same phenomena, then it may be considered normal.

I had found that under good conditions, I had been able to easily surpass this theoretical limitation as had most of the other observers I had talked to.

When making generalizations about a subject as unique as one's eyes and instruments, observations by one observer cannot be used. Ten observers is an essential minimum and these observers must not be influenced by one another.

LIMITING MAGNITUDES AS SEEN BY OBSERVERS USING AAVSO CHARTS

Observer	2.4"	3"	3.5"	4"	6"	8"	10"	12"	12.5"	16"	18"
C.E. Anderson					14.4		15.0				
L. Bornhurst *							15.6				
C. Carpenter											17.2
T. Cragg *					15.7						
C.F. Fernald						14.0	14.7				
C.B. Ford *							14.3	14.5			
"			12.4		13.6		14.7	14.7	15.2		
"							(14.5)	(14.6)			
C. Hurless				12.5		14.1		16.5			
R.S. Kolman			13.5		14.8	13.5		15.0			
E. Oravec				12.2							
L.C. Peltier				12.5	14.8			16.5			
R.E. Wend					13.5						
Average	-	-	12.9	12.4	14.5	13.9	15.0	15.6	15.2	-	17.2

*Made available by C.B. Ford

In order to verify my observations, I asked Curtis Anderson, who is in correspondence with many Inner Sanctum observers, to ask some of them to send me their limits under good conditions. The reaction was gratifying, and above is a listing of the results of this survey. Each observer's observations carried equal weight. The observations for each scope were averaged, and then compared with the theoretical limits. The differences of these two were averaged, and the average was 1.05 magnitudes rounded off to 1 magnitude. This magnitude was added to the theoretical limit to give a practical limit for each telescope.

The practical limit was subtracted from the average and the average of the remainder came out to be zero. Using the practical limit formula derived from these observations, that is, M = 10+5 log A, a theoretical practical limit, we could say, was obtained. The remainder in all cases of the practical limit was zero.

	2.4"	3"	3.5"	4-4.5"	6"	8"	10"	12"	12.5"	16"	18"
Average	-	-	12.9	12.4	14.5	13.9	15.0	15.6	15.2	-	17.2
Theoretical (M=9+5logA)	10.9	11.4	11.9	12.0	12.9	13.5	14.0	14.4	14.5	15.0	15.3
Avg.-Theo.	-	-	1.2	0.4	1.6	0.4	1.0	1.2	0.7		1.9

Average Difference 1.0 Magnitude

	2.4"	3"	3.5"	4-4.5"	6"	8"	10"	12"	12.5"	16"	18"
Pr. Limit (Exc.cond.)	11.9	12.4	12.7	13.0	13.9	14.5	15.0	15.4	15.5	16.0	16.3
Avg-Pr.limit	-	-	+0.2	-1.0	+0.6	-0.6	0.0	+0.2	-0.3	-	+0.9

Average Difference 0.00 Magnitude

Workable Practical Limit Formula (M = 10+5 log A)

	2.4"	3"	3.5"	4-4.5"	6"	8"	10"	12"	12.5"	16"	18"
M=10+5 logA	11.9	12.4	12.7	13.0	13.9	14.5	15.0	15.4	15.5	16.0	16.3
Pr. Limit (Exc.cond.)	11.9	12.4	12.7	13.0	13.9	14.5	15.0	15.4	15.5	16.0	16.3
Difference	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

PROJECT "ANNA", by H. Leroy Kuykendall

"ANNA" is a geodetic artificial satellite developed by the Aeronautical Chart and Information Center of the U.S. Air Force at St. Louis, designed for receiving high-frequency command signals and for flashing a high-intensity visible light beam to accurately positioned ground stations, for the purpose of extending precise mapping of the earth's surface.

The satellite is 40 inches in diameter, and weighs about 350 pounds. Satellite apogee is about 600 miles above the earth's surface, and the orbit is inclined 50 degrees to the equator. Each flashing light signal has an output of 8,800 cps, making it visible from the earth with 40-power field glasses. The equivalent stellar magnitude is about 6.5. Signals are photographed with special cameras which are located on the east coast of the United States. Camera focal length is one meter.

Flashes are superposed against the star background of the night sky, and exposure intervals and times are established by means of crystal-controlled clocks and automatic camera-capping shutters. Individual flash traces are 3/4-inch long on the plates used, which cover 10x10 degree sky areas. Information from the Air Force Cambridge Research Center predicts where to set cameras for each run, and timing records are kept on magnetic tape. Read-out cards from the tape show duplicate [illegible] timing records plus the satellite flash record, and accuracy of measurement on the plates is to within plus or minus 3 to 4 microns, or 2 milliseconds of time.

Special star background charts have been prepared by enlarging the Becvar Skalnate Pleso Atlas charts to the scale of the plates used, and by designating stars by number from the Boss Catalog. Computers have been programmed to afford automatic star identification down to about magn. 9.0. Each plate contains about 100 star images and at least one set of 5 flash tracks from the satellite.

By April 1963, the flash intensities were only about 90% of peak, so the program was temporarily discontinued while solar cell pads were turned toward the sun and satellite batteries re-charged. Intensity of flashes is now restored to 100%.

Photographs are made simultaneously from three accurately positioned ground stations, and data are used to compute precise coordinates for a fourth "unknown" station. A total of 39 selected "unknown" points in the United States will be accurately triangulated, and eventually the program will be extended to other areas of the earth's surface. (Reported by C.B. Ford).

OBSERVING METHODS, by Fr. A. Oberstatter, Sturzelbronn, France

Observers who have earned their chevrons have explained their methods to you at former meetings. The beginner, especially an isolated observer and even though fortified by the excellent advice of Mrs. Mayall's Manual, is surprised at the ease with which the difficulties that discourage one are disposed of by others. Being myself a self-made man in this sphere, I believe it would be useful to supplement the instructions of the experts by some information which could help the more routine-bound new colleagues.

My private observatory is situated under a thankless sky where the nights of good visibility are rare (59 in 1963). In order to profit by all clear intervals, often unforeseen, I must be ready at any instant, hence the necessity of organizing my work well in advance. This is how I proceed.

A. MY CHARTS

I place my charts for each variable in a heavy folder. These files are arranged, in order of Right Ascension, in a large box.

On the first page I write in very legible characters:

in the upper right - the designation of the variable
in the middle - the name
- underneath, the type of chart, (b) etc., contained in the file.
- underneath that, the actual position of the star in R.A. and Decl.

On the left hand side of the sheet, I list, one below the other, the characteristics of the variable; on the right, the predictions for the year.

		max.	min.
Color	1964	.....	.....
Per	1965	.....	.....
mv			
SP			
Type			

In the centre I copy a portion of the light curve to let me know at what moment it is necessary to increase or decrease observations. I add a few practical remarks:- need observing, green filter, faint max., below.....

The inside of the folder is reserved for reference to articles in magazines or books which deal with this variable. A few conventional color signals help me to see at a glance, even in dim light, the work to be done. To avoid confusion, it is good to set down in writing the code that one has chosen.

	Code		
Variable should be observed once in 10 days	at max.	.(red dot)	at min.
twice in 10 days		..(2 red dots)	
each night	blue square	▢	
many times each night	yellow square	▢	
need observation . (green dot)	at max		at min
urgent need : (2 green dots)			

observations during the whole period ... (3 red dots)

B. MY CATALOGUE OF VARIABLE STAR CHARTS

I have set up a double list - (a) a classification by R.A. - designation, name max., min., SP, type
(b) a classification in alphabetical order by constellations - name, designation, type of chart, remarks.

If, instead of a loose-leaf, one uses a bound notebook, leave sufficient space to insert new acquisitions.

C. MY DATE BOOK

My date book is divided into two columns - on the left the maxima
- on the right the minima.

By referring to the predictions, I enter under each date, in one column or the other - for the variables for which I have charts - the designation, name, probable maximum or minimum, special remarks, e.g. faint maximum. For any day of the year it is then easy to prepare quickly an observation program for that night.

D. PREPARATION

With the help of the notes in my date book, I arrange the files in different portfolios. I choose the stars well placed in the sky for the contemplated hours of observation. I have five different portfolios.

1. Variables needing observation
2. Variables near maximum
3. Variables near minimum
4. Miscellaneous
5. An empty portfolio in which, in the course of the night, I place the files <u>after</u> making estimates, keeping them in the order in which observations are made.

E. OBSERVING SESSION

I observe by preference the variables for which observations are urgent. If visibility is good, the faint variables close to minimum. If visibility is mediocre, the brighter variables or those close to maximum. If there is any time left, I take Portfolio 4 - Miscellaneous.

F. THE NEXT DAY

The estimates entered in my observation notebook are numbered consecutively according to the time of observation. Chart in hand, I check again my estimates. I insert the magnitude, convert local time to Universal Time, and add the Julian Day, with decimals. I copy this data onto the card for each variable, entering the Observation No. from my notebook. After this transcription, the files of charts are immediately replaced in their respective portfolios.

G. MONTHLY REPORT

By reviewing my observation notebook, I make a list of variables observed in order of R.A. After each star I insert the Observation No. I prefer to work from the notebook instead of the cards in order to avoid possible errors in copying. I first make a preliminary list of variables which I can correct for any omissions. Then I simply fill in on the report form in the desired order the variables and their magnitudes. In my observation notebook I draw a line across the page and insert:- Report No. ...., comprising .... sheets, stars observed ...., estimates ...., which signifies that the report has been sent to Cambridge.

A FEW DODGES

You have an equatorial mounting. You have just calculated sidereal time. Before commencing your work, check to see that the watch is correct by referring to a naked eye star for which the exact position is known.

For immediate use, I fasten my charts, (b) and (d) for example, to two sides of a cardboard with clips. This permits me to hold them without crumpling and to consult them without misplacing them on the desk. A red bulb in a pocket flashlight gives the most practical light. Never look at the chart with your observing eye.

If you are bothered by a very bright star, it is sometimes possible to eliminate it with a higher magnification or by a Wratten 57 green filter. This filter is famous for comparing stars of different colors! To identify a variable with certainty, even in cases where for the comparison stars chart (b) will suffice, it can be helpful to use the next chart which also shows stars in the field fainter than you can see in your instrument. If the variable is placed in such a way that you are forced to take an uncomfortable position, wait until a later hour or commence a little earlier the next day. Cramped muscles favor neither good humor nor good work. Don't get upset if after a reasonable time you cannot identify the field or the variable. Keep smiling and pass on to an easier star. Tomorrow things will go better!

I find it helpful to insert in the observation notebook the type of chart used for the estimate, thus facilitating checking at time of copying.

For extreme cold, take along a thermos bottle of good tea, the only authorized heat. If you have a sensitive skin, use a non-greasy silicon cream. This gives a good film of protection and does not stain. To protect the eye from the night light, I encircle my eyepiece with a sleeve of rubber cut from the inner tube of a bicycle. This is effective and works well.

Work as an amateur for your own pleasure. No one demands of you either speed or quantity, only precision. If you have doubts about your estimate, say so. If you doubt a comparison star, try to calibrate it by comparing it with others and if possible avoid using it. But never forget that the angle of position can play tricks on you.

And now, good hunting!

(Translated from the French by Isabel K. Williamson, Montreal Centre R.A.S.C.)

ACTIVITIES OF R CRB AND OTHER VARIABLES, by Margaret W. Mayall

The irregular variable R Coronae Borealis continues to live up to its reputation of being the perfect irregular. A study of its light curve from 1843 to the present gives not the slightest indication of periodicity. The current minimum started in 1962, when the star took a sharp drop from its normal 6th magnitude to 11 1/2 and then more slowly to below 13. Several times since then it has appeared to be getting back to maximum, but each time it went back down again before it was as bright as 7. For about 200 days before the meeting it has been between 13 and 14. At the meeting, Ford and Adams both reported it has risen to about 12th magnitude.

Large blueprints of light curves of several other variables were also on exhibit.

(Note added in press: During the last few days of June and the first of July, R CrB dropped again to below 14th magnitude, the faintest it has been for many years.)

ON LUNAR CARTOGRAPHY, by Don Meyer

Mr. Meyer is a member of the Aeronautical Chart and Information Center in St. Louis. He showed slides and explained some of the work currently being done on the map of the moon being sponsored by the Air Force.

Mr. Meyer stated that the members of the project first enter the gross surface features on the map using the best photographs from such large 'scopes as Lick, McDonald, Pic Du Midi, Mt. Wilson and Yerkes. This is done on a prepared grid system and features are entered with north at the top and south at the bottom with east to the right. Contour lines are developed using an arbitrary datum plane and shading corresponds to illumination by the afternoon sun whose altitude is about equal to the slope angle of the surface.

Attempts are made to transfer all features from the rounded surface to the flat surface of the map using so-called rectifying cameras. The greatest difficulty is experienced, according to Mr. Meyer, near the limb where such items as Mare Crisium and Schikard are highly distorted because of their position close to the edge of the lunar surface. This requires the greatest skill at foreshortening. Heights are measured by measuring the shadows.

Mr. Meyer stated that after the main features are spotted and drawn in on the grid system, an artist then goes to the high power eyepiece of a telescope where fine details are added. These include such items as faint rills, domes and craters. Resolution down to .3" of arc has been found to be possible.

Nomenclature follows acceptable patterns according to Mr. Meyer. Thus all items officially adopted by the International Astronomical Union are utilized with a few corrections. Letters are assigned to hitherto unnamed small features.

The whole project is progressing according to a schedule. Maps are being published section by section. Mr. Meyer included a slide showing that much of the equatorial area is now available at the U.S. Government Printing Office for a nominal fee. Incidently it was brought out that anyone who observes an error is invited to contact the A.C.I.C.

A fascinating part of the project is the construction of views of the lunar surface from heights of several hundred miles showing mountains, crater rims, rills, etc. as an astronaut would see them coming in for a landing on the lunar surface. These are devised so that the astronaut can familiarize himself concerning all parts of the visible surface. (Reported by R.A. Adams)

A SUCCESSFUL VARIABLE STAR TRAINING PROGRAM, by David Williams

After reading an article on the δ Cephei observing program at Swarthmore College (Sky-Tel, June 1953), the TWIN CITY AMATEUR ASTRONOMERS decided to try the method of van de Camp, which is to use two comparison stars: one labelled "A" (var. at max); and one labelled "E" (var. at min). The observer compares the variable in the usual way, but calls the variable A, B, C, etc. instead of a real magnitude. Estimates can be plotted and analysed in the usual way; and the A-E system avoids the confusion of magnitudes, for a beginner.

Because of the success of the δ Cephei project, it was decided to add other bright variables to the program, such as η Aquilae, β Lyrae, and zeta Geminorum. These variables are ideal objects for beginners because they can be observed any time, any night, and need no planning ahead for minima; they change rapidly, periodicity is apparent in one or two weeks, and a long sustained effort, as with long periods is not necessary; and a 5-minute observation can be made with no 'scope, no finding field, and no confusing comparison sequence.

The TCAA program has been successful in training 6 observers. It teaches about cepheids and eclipsing systems and most important, gets members out under the stars.

EYEPIECE PROBLEMS OF THE AMATEUR OBSERVER, by Robert E. Cox

Too much attention and stress have been placed by the amateur on the wide-field oculars having an apparent field of about 70°. Although they are fine for acquisition purposes or just for "beautiful viewing" for the serious observer they have a number of drawbacks. Paramount is the loss of light due to the extra elements of design; also, the higher cost hurts the amateur in his pocketbook, always a tender spot. A well designed Ramsden eyepiece with an apparent field of 40° is a fine ocular for the observer and the lower cost and gain in light should be attractive selling points. Some observers use a single lens, generally in the form of a high quality triplet to cut light loss.

Coma of the reflector seriously limits the usable field of any eyepiece and again the 70° design is sadly wasted when one analyses the effects of this aberration. With even the 40° apparent field ocular and using an f/8 reflector, by theory, only the central 24° are coma free. For the 40° eyepiece one has to have an f/10.5 telescope to have the entire field coma free to the expert eye.

Too few amateurs focus their telescopes properly and are not familiar with the focusing range of such an instrument. This is the distance on either side of the plane of best definition over which it is not possible to detect any change in the sharpness of an image. For a reflector of f/4 it is about 0.002", an f/8 0.006" and for a compound reflector of f/26 about 0.060"! How to use this for proper focusing? Instead of focusing by moving the ocular from an out-of-focus position until the image is sharp and leaving it, one should focus on the extreme limits of the focusing range, by noting when the images become "soft" while moving the eyepiece in and out of the holder, and then try and leave the eyepiece at the mid point of the shift. This is the correct way to obtain the optimum focal point.

THE FIGHT FOR PHOTONS, by Dr. J. Allen Hynek

Radiation is the raw material with which the astronomer works. This is true whether the radiation is in the form of light, or of radio waves, or even of x-rays. This radiation can be considered in each case as a stream of photons -- single packets of energy. The problem of today's astronomy is to make the maximum use of every photon that we receive.

In the past astronomy has been quite wasteful of photons in the sense that our instruments required a heavy flux of photons before the instrument would record that any were coming al all. For example, the naked eye requires over a thousand photons per second before the eye will admit that there is a star up there. This is the same as saying that the eye must be told over a thousand times before it is convinced. Yet, ideally, a good instrument would detect and report a star even if the flux were as little as a photon every sixty seconds.

The historical way out of this difficulty, as you all know, was to build bigger telescopes -- that is bigger collectors. A 21st magnitude star provides about one photon every three seconds over the area of the human pupil. By using a collector 200 inches in diameter at this rate, and funneling the photons through the eye, a man can see a 21st magnitude star. But it is still an incredibly wasteful process. A thousand photons are used where one ought to do.

The photographic plate, and this will come as a shock to some of you, is just as wasteful of energy as the human eye. A plate requires about 1000 photons before it will sensitize a silver grain in the emulsion. And for a measureable image on the plate we need hundreds of grains. This explains why a photographic plate cannot reach as faint a magnitude as the eye for very short exposures.

The photographic plate will do one thing the eye cannot do -- the plate will integrate. It will add up the photons coming in for hours and in this way it can reach fainter stars than the eye can see with the same equipment. This helps when we merely want a photograph of a static distant nebula. But a ten hour spectrum exposure is of little use if the spectrum is changing over that ten hour period. A ten hour exposure is of no significance when the eclipsing binary has a period of two hours.

The photoelectric work of Stebbins, Huffer and Whitford in the twenties and thirties suggested a partial solution of how to make our photon counting as effective as possible. In the photoelectric process 10 photons will produce one electron. And our electronic technology is good enough so we can count individual electrons today. Also the photoelectric cell can integrate. You can see too that this integration is a 100 times faster than the photographic plate. The ten hour exposure drops to an hour. When we get to the stage where we can reliably count individual photons the ten hour exposure will drop to less than 10 minutes. Such are the necessary goals.

The photoelectric effect, the basis of the new techniques, consists of the absorption of a photon by a metal or semiconductor, and the subsequent release of an electron. This electron may then be registered by its impact on a photographic plate. It may be made to hit a phosphor plate with the release of an amplified swarm of secondary photons. The electron may have energy added to it from electrical and magnetic fields so that it is easy to detect. In other words a TV picture tube affair. Technically we call this an image orthicon tube.

This image orthicon tube has a big advantage over the early photoelectric systems that registered one star at a time. We can project an area onto the phosphor plate and sweep the area with an amplifying beam. Instead of stars individually as points, we can now obtain a picture of a planet.

This spring members of the Northwestern University Observatory with only a 12-inch reflector made photographs of Jupiter that surpass anything the 200-inch telescope has made. Remember the contrast control on your TV set? It comes in handy in photoelectric work. Most planetary images, as amateur astronomers know, have low contrast especially at high magnifications. Little can be done to correct this in photographic techniques. But the photoelectric system makes contrast control simple.Hence better pictures.

These facts so far are basic. The possibilities now being considered are fabulous. The Air Force is considering a photoelectric scanner that will sweep the whole visible sky and will be sensitive enough to detect faint earth satellites. The records will, of course, contain much of interest to the pure astronomer. Here would be a really complete nova search program, records of flare stars, and a listing of perhaps new types of variable stars that have hitherto escaped notice.

Photoelectric equipment can be compact, and the emerging data in electronic form can be sent long distances to the eventual recorder. Here is an ideal tool for balloon astronomy. By getting the pick-up above the atmosphere many of the problems of data reduction that now plague the planet-bound astronomer will be eliminated.

In fact the long cherished observatory on the moon can be a reality today if photoelectric collectors are used. Northwestern Observatory has a program to place a compact observatory on our satellite. It will carry an 8-inch telescope mounted in a disc shaped box. No matter which side comes up when the package comes to rest on the lunar surface the telescope will operate. Ground controls will be via laser beams because they provide more channels than does a radio signal. A SNAP atomic power pack will provide power for the little observatory.

This may not sound too impressive. But an 8-inch telescope operating on the moon today would more than rival the output of the biggest telescopes on our mountain peaks. Present satellite hardware could place such a package easily on the moon tomorrow. (Reported by Walter Scott Houston)

HONORS FOR GIOVANNI BATTISTA LACCHINI
(From IL PICCOLO, Faenza, Italy, 25 January 1964)

On Saturday 18 January 1964 the President of "La Riunione Cittadina", Dr. Antonfrancesco Vicini, accompanied by Mayor Elio Assirelli visited the Convalescent Home of the Civic Hospital, where the Astronomer Giovanni Battista Lacchini had been a patient for several days. They presented him with a Gold Medal for distinguished works in the field of astronomy.

In the room where the patient is lovingly cared for by the personnel of the hospital, were his daughter and son who live in other cities, the chief Doctor of the hospital Professor G. Bazzocchi, with a few of his co-workers and friends of the astronomer.

The Mayor and Dr. Vicini, in presenting the medal, spoke words of praise and good wishes for a speedy recovery. Professor Lacchini thanked them, with emotion.

The astronomer, a student of variable stars, was one of the seven founding members of the AAVSO -- observers who study the stars and their variable luminosity -- a society which was founded more than 50 years ago in Massachusetts (U.S.A.). Beside studying the variations of 450 stars out of the 20,000 whose variable brightness are known, Professor Lacchini has also busied himself with the reform of the calendar and his studies are known all over the world.

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To the valiant fellow citizen we wish a quick recovery and we are rejoicing for the favor bestowed upon him by the Executive Council of the Cultural Society, which every year singles out for this honor the citizen of Faenza who has kept high the name of his native city in the fields of culture, sports and literature. (Translated from the Italian by R.N. Mayall and L. Jacchia)

We too wish Professor Lacchini a quick recovery. (ED)

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