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

Edited by R. Newton Mayall

PAPERS PRESENTED AT THE 45TH ANNUAL MEETING, OCTOBER 19-21, 1956

Once again our Annual Meeting was held in the Springfield Museum of Natural History, at the kind invitation of Director Leo Otis. Springfield is an ideal location for this important meeting for it is convenient to all, regardless of the form of transportation. Three major railroads serve the city, and two major highways cross. The fall color, famous in New England, had just passed its prime but the russet-colored leaves, intermingled with evergreen foliage still presented an ever changing colorful sight as the sun traversed the sky.

Dr. Harlow Shapley had a large and attentive audience for his Friday evening talk. Many youngsters were invited to attend, and were photographed with Dr. Shapley. Mr. Frank Korkosz demonstrated the planetarium, which he designed and built.

The business of the Association was transacted Saturday morning, and in the afternoon the papers were given. The annual dinner was held in the Shelton Hotel. Following the dinner, Clint Ford and Leith Holloway showed slides of observatories in the West, and Bob Dunn showed candid movies of the past two meetings. Dr. Shapley presented his Highlights of American Astronomy for 1956 (see abstracts).

After the dinner, everyone went to the home of Jack Welch in West Springfield. Telescopes were set up in his yard for anyone to use, and his personable wife Sarah kept the inner man warm and full with a most pleasant and eye appealing arrangement of a variety of appetizing food and plenty of coffee.

This year the Williston Observatory at Mount Holyoke College in South Hadley, Mass., is celebrating its 75th Anniversary. Dr. Alice Farnsworth, head of the department of astronomy and Director of the Observatory, invited the Association to visit the Observatory Sunday morning. The sun was projected, and all had a chance to observe the great activity on the disc. The weather was sunny and mild, which always adds to one's pleasure. We are very grateful to Dr. Farnsworth and her assistant, Miss Jocelyn Gill, for a pleasant visit.

GALAXIES AND WHAT THEY DO TO US, by Harlow Shapley

What the galaxies do to us is indirect. It is by constant study of them that our thinking is changed. Dr. Shapley pointed out that it was Emmanuel Kant who first suggested that there may be other systems than our own. Some nebulae may be tied up with supernovae of long ago. Also it is interesting to note that nothing unusual has been found about other galaxies. The chemistry of these outside systems is the same as our own system. Numerous slides vividly illustrated Dr. Shapley's running commentary. He brought out that the limits of the Magellanic clouds have been moved out further by a continuous study of variable stars in them, and the limits are being still further enlarged by radio astronomy. His talk was followed by a question period, and when he was asked about life on other planets he suggested that there are in the universe at least 100 million planets with biochemical evolution similar to the earth's. (Ed.)

SOME HIGHLIGHTS OF AMERICAN ASTRONOMY IN 1956, by Harlow Shapley

The artificial satellite and the breathless growth of radio astronomy have monopolized the astronomical interest of the scientific public this year. Some less spectacular contributions of high merit have been made in the older astronomical fields, and in the following list of American Highlights they compete with radio,satellites,and some new and striking hypotheses.

1. At the top of the list of Highlights should be the completion of the prolonged study by Milton Humason of Mount Wilson and Palomar Observatories of the radial velocities of several hundred galaxies, a work upon which we shall for long base our knowledge of the rate of expansion of the universe. The report on the work is published jointly with his colleagues A.R.Sandage,and N.U.Mayall of the Lick Observatory.

3. Discovery of the anti-proton by the nuclear physicists of Berkeley, California, which gives to cosmogony a basis for strange speculations,as,for example, the suggestion by Dr. M.Goldhaber of the Atomic Energy Commission's Brookhaven Laboratory,of an anti-matter universe quite distinct and different from our proton cosmos --a sort of mirror image of it.

3. The beginning of the world-wide organization of amateur astronomers for the visual tracking of the artificial satellite,the launching and study of which is one of the semi-astronomical projects of the International Geophysical Year.

4. The firm assurance,after three years of exploration and planning, that a large inter-institutional observatory will be located in the arid southwest,possibly in Arizona,outfitted with an 80-inch reflector and equipment for precise photometry,and with the possibility of still larger instruments in the future for the study of sun, planets,and stars. The goal is to provide instruments chiefly for the use of astronomers located at institutions with unfavorable climates or with small research facilities. This project,underwritten by the National Science Foundation,is a companion enterprise to its establishment of the 140-foot-aperture radio telescope in West Va.

5. A convincing astrophysical theory by W.A. Fowler and Jesse L. Greenstein of the California Institute of Technology to account for the formation of the heavy elements in stellar interiors -- a contribution of high importance in our rapidly increasing knowledge concerning the evolution of stars and of the stellar universe.

6. The completion, through publication, of the University of Michigan's great program of discovery and measurement of southern visual double stars, an enterprise of some thirty years' duration, with R.A. Rossiter as the principal observer; he discovered more than 5500 new double stars (mostly faint), which is more than any other astronomer in all past time, and a record which will probably never be excelled.

7. Detection for the first time of red shifts in the radio spectrum of distant galaxies,by A.E.Lilley and E.F.McLain of the Naval Research Laboratory,Washington,D.C., who found the speed of recession of a pair of galaxies (Cygnus A source) the same in the radio wave length as in the optical measures by W.Baade and R.Minkowski -- namely about 17,000 km/sec.

8. Two special conferences of high importance at the McCormack (Virginia) and Cook (Pennsylvania) observatories,the first to pool the continued worries of astronomers about the stellar distance scale and its revision,and the second to explore,with international participation, the future of precision instruments for measuring faint star light.

9. The dedication and putting into successful operation, under the general supervision of Dr. Bart J. Bok, of the 60-foot radio telescope at the George R. Agassiz Station of the Harvard Observatory, an instrument designed especially for research on the neutral hydrogen radiation of 21 centimeter wave length, with the structure of the Milky Way spiral arms as one of the principal objectives.

10. The dominance in the summer and autumn sky of the planet Mars, which was in early September 1956 a mere 35 million miles distant, permitting much intense study by spectrograph, photometer, and radio,of the planet's surface at this most favorable approach in many years.

11. The announcement from the Canadian Radio Physics Laboratory at Shirley Bay, of Project Janet, a development by P. A. Forsyth and colleagues for using the ionized trains of meteors for the transmission of radio messages over long distances, at least up to 1000 miles.

PREDICTIONS OF NEXT SUNSPOT MAXIMUM, by J. Leith Holloway

My prediction of 196 at 1957.25 (around April 1, 1957) for the next maximum of the smoothed relative American sunspot numbers given in a paper read at the May 1956 meeting of the AAVSO and printed in numbers 115-118 (March-June 1956) of the Solar Division Bulletin, is reconsidered in the light of the recent sunspot data. According to prediction, the smoothed numbers are rising very closely along the line having a slope of 8 spots per month and crossing the time axis on March 1955 (11 months after minimum on April 1954); thus it is concluded that the above prediction needs no revision at this time. A comparison between predicted and available observed smoothed relative American sunspot numbers appears in the table below:

Month	Predicted $\bar{R}'_A$	Actual Observed $\bar{R}'_A$	Month	Predicted $\bar{R}'_A$	Actual Observed $\bar{R}'_A$
November 1955	64	65	January 1956	80	80
December 1955	72	73	February "	88	89
			March "	96	99

SUNSPOT REGIONS ON SUN, THIS CYCLE, by Ralph N. Buckstaff

The spots are more or less equally distributed in both hemispheres. Sometimes the counterpart of a spot in the northern hemisphere will be found in the southern hemisphere on or near the same meridian. Spots have been observed from 50°N (the highest) to 10°N. There have been a large number of J-groups and a few E-groups. The largest group of all occurred in February 1956, and another very large group was observed in September 1956, measuring 17° E-W and 5° N-S.

OBSERVATION OF A STAR OF LARGE PROPER MOTION, by George Lovi

One evening in August 1956 while locating T Cephei 210868 with my AAVSO b-type chart, I came across a little group of stars approximately 1 1/3 degrees southwest of Beta Cephei. I noticed that one of the stars in this group does not occupy the same position in the sky as it does on the chart. I suspected it as being a star of large proper motion. The chart was traced from the Bonner Durchmusterung,epoch 1885. In the period of time elapsed since then, it is possible that some stars have shifted their apparent position on the celestial sphere considerably. I checked with the list of a few stars of large proper motion in the latest edition of Olcott's Field Book

of the Skies, but was unable to find it listed. The approximate magnitude of the star is between 8.1 and 8.8. I hope I did not merely observe an error in either the chart or the BD. This observation of mine was indeed fascinating, and I hope it is an actual case of large proper motion. (This paper serves as a reminder that anyone, after careful checking, who finds such discrepancies in the AAVSO charts, should report them to headquarters, so that if real they can be corrected, and all observers will benefit. Ed.)

A NOVA IS COMING, by George Diedrich

A nova is on its way,but if we are going to find it we need more observers. There are plenty of fields waiting to be assigned. Why not pick a field and look at it after you get through making your variable star observations. It takes only a few minutes. Why not make it a routine practice? If you are interested, write to George Diedrich, Chairman,AAVSO Nova Search Division, 653 Weller Road, Elyria, Ohio.

OBSERVATION OF A MYSTERIOUS OBJECT, by Herbert A. Luft

One evening as the sun went down and the stars began to appear, I noticed a bright star where no star should be. This bright "star" remained stationary, but as the sun went down it got fainter. As darkness approached, it vanished. What was it? (A lively discussion labelled this mysterious object a high altitude weather balloon. They may be observed after the sun has set. Ed.)

WHITE DWARF STARS, by John E. Gaustad

There are certain special groups of stars that deviate from the pattern of the Hertzsprung-Russell diagram: namely the giant stars in the upper righthand corner, and the white dwarfs, falling below and to the left of the main sequence. It is with this latter group that I am concerned.

Why is the study of this class important? The white dwarfs rate special attention for three reasons. First of all they are an example of a very special state of matter, the degenerate gas, which is not obtainable in any earthly laboratory. Secondly, they furnish one additional test and confirmation of the theory of relativity. And thirdly, they play an important role in discussions of stellar evolution.

First, let's discuss how white dwarfs are found today, and their relative abundance in the universe. Much of the credit for the observational work done on this group may be given to W. J. Luyten of the University of Minnesota. He procures two photographic plates of the same region taken 25 years apart and looks at them in a blink instrument to find those faint stars with large proper motions. These must all be close to the sun (about 10 parsecs) to show any motion at all in so short a time,and since they all appear faint (10-15 magnitude) must be intrinsically faint and hence dwarf stars. To separate the red dwarfs of the main sequence, which are in the majority by far, he compares photographs taken in red and blue light. In this manner, he has found over 100 dwarfs and has been able to compute that about 3% of all stars belong in this group. Of course we will never see more than the nearby ones, since they are all so faint. What kind of state must matter be in to allow such high densities as are found in the white dwarfs? At the high pressures that exist in the white dwarfs, the atoms are stripped of all their electrons, literally crushed to death, and there exists no longer a collection of individual atoms, but a mixture of nuclei and free electrons in a gaseous state. This is known as a degenerate gas or Fermi gas,after the man who formulated some of the basic theories underlying its behaviour.

In these stars it is the balance of this electronic pressure against the gravitational forces that keeps the star in equilibrium. The size of a white dwarf depends inversely upon its mass; the heavier stars are smaller than the light stars.

What is the composition of the white dwarfs? It is fairly certain that there could not be appreciable hydrogen in the interiors, for if there were, much more energy would be produced than is actually observed. This is in contradiction to spectral evidence, for there are strong hydrogen lines in the spectra.

The white dwarfs have played an important role in all theories of stellar evolution. It is thought that since they contain little hydrogen, they are an example of a dying star -- one that has burned up all of its hydrogen. One theory is that the white dwarfs were very massive O or B stars that burned up their hydrogen rapidly and then started contracting, blowing off any material over the maximum allowable mass in nova or supernova outbursts. Once they are in the degenerate stage, however, it is hard to see how they will ever get out of it. They cannot cool to a solid body like the earth, for they would have to expand to reach densities allowable for solid matter. That is, they would have to do work, and expend energy to grow cool! The star on its deathbed finds itself in a terrible predicament, continually losing heat by radiation into outer space, but with insufficient energy to grow cold. I know of no one who as yet has found a way out of this situation.

We see then that the white dwarf stars, although comprising only 3% of the stellar population, form a very broad and interesting subject of study. There is much more that remains to be discovered about them, but if past experiences are any indication, the effort expended in their direction will reap many values in an extended knowledge of the nature of our universe.

MARTIAN SEEING SEEN WITH CALIFORNIA SEEING, by Clinton B. Ford

Our vacation this year was spent in California and at such a time as to bring us in close proximity to large telescopes -- Mount Wilson and Claude Carpenter's 18". We spent several days with Claude Carpenter and observed Mars at his observatory; and we observed Mars on September 7, 1956 through the 60" at Mount Wilson, with our host Tommy Cragg. The polar cap had receded, but we could not see the canals. Neither did Slipher nor anybody else. (Colored slides taken at Mount Wilson and at Carpenter's made us all a little envious. Ed.)

TIMING LUNAR OCCULTATIONS, by William G. Cleaver

There could hardly be a more fascinating and rewarding pastime for the amateur astronomer than timing occultations of stars by the moon. Moreover, it provides the amateur with a means of contributing valuable data which can be used by the professional astronomer in contemporary astronomical research. The prime requisites are a telescope of 6" diameter or more (if a reflector), a reliable stop-watch, and a means for determining exact time, such as a short-wave radio capable of picking up the time signals broadcast by the National Bureau of Standards, Beltsville, Maryland, over Station WWV on 2.5 and 5 megacycles. The precise latitude, longitude, and altitude of the point from which observations are made should be known. The great majority of the stars occulted by the moon in its passage across the skies are too faint for successful timings. The American Ephemeris and Nautical Almanac gives information only as to the brighter stars; that is, those down to about the 7th magnitude, with predicted times for Washington D.C., and five other standard stations in North America. Adjustment of the predicted time for the nearest standard station

must be made, depending upon the distance from the standard station to the point of observation. Patience and perseverance are desirable attributes in the observer, for observations must be made at all hours of the night, and in all sorts of weather. Many conditions conspire to thwart one, such as haze, mist, dew, atmospheric turbulence; and in the summertime, bugs and mosquitoes.

By way of illustration, during the year 1955 the number of bright star predictions given by the American Ephemeris for longitude +70° 30', latitude +42° 30', totalled 75. Out of 68 timings attempted, only 36 were successful. Twenty-nine of the failures were attributable to clouds, rain, mist, etc., 3 to other visual difficulties, or failure of equipment. The disparity between the predicted time, and the actual time of the 36 successful observations varied from 0.5 seconds to 1.5 minutes.

Although the results are often disappointing, the rewards are many and varied. Nothing short of absolute accuracy is good enough in timing occultations, for an error of as little as one second renders the observations useless. With practice and reliable equipment, however, accuracy is not difficult to acquire. The modern method of timing occultations is, of course, with photoelectric equipment. Few amateurs, however, have access to such equipment. Dr. Dirk Brouwer of Yale asserts that the visual method is by no means obsolete. He and other astronomers urge amateurs to continue to make, and to report, their visual observations.

OPERATION PERSEID, by Edward P. Majden

This year the Regina Astronomical Society organized a Province-wide coverage of the 1956 Perseid Meteor Shower. Eight observing groups scattered across the Province of Saskatchewan joined together in this operation.

Amateur radio hams provided us with station to station communications throughout the three-night observing period. The radio contact proved useful in transferring important information between groups. Each station reported at a designated time during the observing period. This provided us with up to the minute information from all points. A time signal was transmitted every half hour so clocks could be kept in synchronization.

Regina operated a base-line station 20 miles south of the city, on a farm. The observing group was stationed at approximately 200 yards from the house where the transmitter was situated, but full contact was maintained between the house and the observers by V.H.F. walkie-talkies. Other stations used portable or mobile installations right at the observing sites. The radio contact proved useful in obtaining information on certain meteors observed by both stations, and it was particularly useful to the photographic division. This meant that exposures could start at the same time at each station, thus saving film and wasted effort.

The whole operation proved very successful. Over 2000 meteors were recorded. The photographic division reported 96 exposures totalling 25 hours of exposure time. This resulted in two direct meteor photographs and one spectrum of good quality. The following groups participated in this project: Regina Astronomical Society, R.A.S. Regina Beach, R.A.S. Base-Line, Saskatoon Astronomical Society, Kindersley Astronomical Society, Indian Head Astronomical Society, Eastend Astronomical Society, Moose Jaw Astronomical Society, and the Regina Amateur Radio Association.
(Ken Weitzenhoffer reported that the AAA of New York also observed this shower and said that it was one of the finest they had ever seen. He suggested that each year the Perseid shower is worth taking time to watch. Ed.)

BOSTON MUSEUM OF SCIENCE PLANETARIUM, by John Patterson

The planetarium is complete, except for the projector, which will be completed early in 1957. There will be five points of projection, and in order to make the projected images fall on the ceiling in their proper positions, a coordinating engine was built to obtain the coordinates from an actual scale model. Needles, accurate to 0.0001 inch, are used to punch holes in 0.003 inch aluminum sheets. These sheets are then sent to Rochester to be reduced and the stars etched on the back of the projector lenses. Every effort has been made to have the stars appear as they do in the sky; that is,the diameters of the projected images will not be distorted or enlarged. Another interesting feature of the projector will be the introduction of a mechanism to allow immediate change of the configurations from the present to any time in the future or past, which will result in a great saving in time and wear and tear on the machine.

(An aluminum sheet and the special needles used were on display, and the method of punching the holes was demonstrated. All of this work for the Boston Museum of Science Planetarium is being done at the Museum of Natural History in Springfield, Massachusetts. Ed.)

SOME INTERESTING LIGHT CURVES, by Margaret W. Mayall

I have brought a miscellaneous collection of light curves along to show you some of the most interesting features that have come out of recent AAVSO observations.

This curve of 184205 R Scuti has been brought up to date, and you can see the history of the star since 1844. The faint minima of February and June 1956, first reported by David Rosebrugh and later by others, are the deepest since about 1870. In June the range of brightness was nearly four magnitudes.

Other curves with current observations plotted are those for 001755 T Cas, 081473 Z Cam, and 070122 R Gem. I also have the curve for 192745 AF Cyg from 1914 to the present time.

In the past I have shown you the predicted curves for 9 long period variables. Recently I have made a revised set of predictions up to 1960, and have them here, with the observed mean curves superposed for 1955 and part of 1956. These curves are most useful for showing up current deviations, such as those especially evident in 001838 R And.

(Blueprints of these various light curves were on display. Ed.)

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