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

Edited by R. Newton Mayall

PAPERS PRESENTED AT THE SPRING MEETING, MAY 7-8, 1954

The 43rd Spring Meeting was held in New York City, May 7 and 8, 1954, at the kind invitation of Columbia University and its Department of Astronomy, through its head, Dr. Jan Schilt. Our meetings were held in the Pupin Building and the Harkness Theater. This was a doubly important meeting for the AAVSO, for we participated in the celebration of Columbia's Bicentennial. We were pleased that many members from the Amateur Astronomers Association of New York met with us.

Dr. Schilt, in his greeting, pointed out the important role Columbia has played in astronomy.

As usual, a highlight of the meeting was a good dinner and a long social hour, held at the Mens! Faculty Club. After the dinner, a long time friend of the AAVSO, Armand Spitz, had a representative, Mr. Merwin Smith, bring one of his latest devices, the Spitz Junior Planetarium, for demonstration. This was a preview before its public offering. The instrument was set up in one of the small rooms, where both professional and amateur astronomers enjoyed fully the demonstration. Armand sent along the old tin can which he punctured several years ago to show his daughter the stars. Also the first commercial model was displayed, so that we could see how such things are developed for the market. Again Armand has contributed greatly to the furtherance of astronomy.

Friday evening, Dr. Wallace Eckert, who has had a long association with various members of the AAVSO, gave a most interesting and appropriate talk, copiously illustrated, on the development of calculating machines from early times to the present electronic computers.

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CONTRIBUTIONS OF THE ELECTRONIC CALCULATOR TO ASTRONOMY
by Wallace Eckert

Dr. Eckert introduced his subject by referring to his close association with the AAVSO and in particular with two of its members, J. Ernest G. Yalden and Prof. Ernest W. Brown. He traced the history of computing chronologically and by comparison, from Paschal's adding machine, built in 1642, to the desk calculator in general use in the 1920's, and overlapping it the punch card automatic calculator which came into use in 1925, although begun in 1893, down to the present day electronic calculator that emerged after 1945. The early machines used wheels and so did the punch card machines up to 1935.

In 1925 it was discovered that you could count with an electronic circuit, and Dr. Eckert's comparisons are quite interesting, the first group being that of development; namely that it took 300 years to get the desk calculator, about 50 years to get the punch card calculator, and about 25 years to get the electronic calculator.

Another interesting comparison was the relative amount of work done by each. For example, a calculation that would require a week to do by hand (log tables) can be

accomplished with a desk calculator in one day; with a wheel punch card in one hour; with the electronic calculator in one minute; and with the latest electronic calculators in one second.

So fast has been the development of the electronic calculator, it is hard to realize that only about 20 years ago International Business Machines set up a computing laboratory at Columbia University for computing complicated equations used in astronomy. Previous to that, in 1928, a statistical computing bureau had been set up at Columbia which was used in conjunction with the census. Columbia University and Dr. Eckert have had a great deal to do with the development of the electronic calculator.

Up to 1934, 1000 multiplications per hour were possible with the punch card automatic calculator, and in 1939 Columbia had a punch card machine that could handle 150 cards per minute and print 150 lines per minute.

In 1934 the machines at the astronomical computing laboratory at Columbia were used to trace planetary motions by differential equations. In 1940 an installation was made at the U. S. Naval Observatory where the machines are used to compute the American Ephemeris, Nautical Almanac, and Air Almanac. Tracing the planets' positions is a laborious mathematical computation, and the electronic calculator makes possible many computations that heretofore were nearly impossible and that might take a lifetime of effort. For example, one of the most recently completed works is the position of the outer planets from 1780 to 2060 at 40 day intervals (Astronomical Papers, Vol. XII, 300 pp., Nautical Almanac Office). This book contains over a million figures. The computation was carried out to 16 decimal places and the published figures to 11 decimal places.

Another interesting example of the work of the electronic calculator is the 1952-1972 Ephemeris of the Moon, which is now ready for publication. Prof. Brown's lunar tables were the result of a lifetime of work to which members of the occultation division of the AAVSO contributed observations. To obtain one position for the moon by means of Brown's tables would take one man half a day, but with the electronic calculator the entire computation can be done in seven minutes, which includes 165,000 digits in the machine, 10,710 additions and subtractions, and 8,680 multiplications.

New machines can read, multiply, and type in 1/1000 second. They can read at the rate of about 30,000 digits per minute, record 16,000 digits per minute on cards; print 24,000 digits per minute and store 400,000 digits.

PERIODS 100 TO 150 DAYS, by Dorrit Hoffleit

Variable stars with published periods between 100 and 150 days are of special interest because they fall between the recognized classical Cepheids and the ordinary long period variables. To which group do they belong? Among the Cepheids the intrinsic brightness increases with period-length; among the long-period variables the reverse is true. Many of the stars of intermediate period are not permanently regular in their light fluctuations. Are they an unstable link between the other two groups?

In the 1948 Kukarkin Catalogue of Variable Stars I have counted 372 intrinsic (non-eclipsing) variables with periods between 100 and 150 days. Of these, 97 had been classified as "Mira," 115 as "Long Period" (of which 29 were not seen at minimum and may therefore eventually be classified as Mira if their total amplitudes are found to be greater than $2^{m}.5$), and 160 as "Semi-Regular."

The apparent positions of the stars in these three categories show that the Mira stars have the most pronounced concentration toward the galactic center. The semi-regular variables, on the other hand, while somewhat loosely concentrated toward the galactic plane, have a more nearly uniform distribution in galactic longitude. For example, between 0^h and 8^h Right Ascension we find only 14 stars, or 14 percent, of the Mira class; but 34, or 21 percent, of the semi-regular variables. This suggests that the Mira and the semi-regular variables may well be two independent population groups.

Margaret Mayall has kindly put at my disposal the observations made by the AAVSO on stars in this critical period-interval. She has data on 27 stars observed over a time interval of at least 700 days.

My purpose in presenting this note is earnestly to encourage the AAVSO to continue its concentration on the so-called Long Period and Semi-Regular variables whose periods lie between 100 and 150 days and whose amplitudes are under three magnitudes. It is particularly important, I believe, to concentrate on those whose periods now appear to be the most regular, for perhaps like SX Her they will suddenly surprise you by their apparently characteristic instability.

Let us keep watch on all of these stars in as many ways as possible so that eventually the mysteries of their physical behavior and constitution may be solved.

VARIABLE STARS IN THE SCUTUM CLOUD, by Margaret Harwood

An investigation of variable stars in the shield-shaped mass known as the Scutum Cloud is needed in the study of the structure of our galaxy. It has been one of the research problems of the Maria Mitchell Observatory for the past thirty years.

The region studied is the area of about two hundred square degrees covered by photographs made with the $7\frac{1}{2}$-inch triplet refractor and centered on the galactic cluster M11. It includes all of the constellation Scutum Sobieski and portions of Aquila, Sagittarius and Serpentis. It takes in the less dense areas which surround the apparent boundaries of the Cloud.

Data concerning 327 variables have been published. Of these, 152 variables are within the heart of the Cloud. In order to find and study variables in the densest part, it was found necessary to use plates of larger scale than those made with the $7\frac{1}{2}$-inch Cooke on which the scale is 248" = 1 mm. We are fortunate in being allowed to use photographs made with the Bruce 24-inch doublet refractor of Harvard Observatory; the scale is 60" = 1 mm. Plates made at two centers cover the region of the Cloud and a little beyond. On these there are 182 published variables. An examination of the large scale plates revealed over 600 new variables. We have elements and light curves for 105 of these. There are at least 250 more for which we hope to get sufficient data to establish distances in the Cloud.

Periods have been derived for 75 stars. The variations of 17 are definitely irregular. The reductions are being completed for 12 stars of short period. The following table gives the number of each type of new variable in the Cloud as well as a similar list which shows the distribution of the published variables.

580 of the new variables have been identified on infra-red spectrum photographs made at the Warner and Swasey Observatory with the 24-36 inch Schmidt telescope.

The spectra of 356 range between M3 and M8; the type of the majority is M5 or later.

Type	No.of New Variables	No.in IAU Gen. Cat.	Type	No.of New Variables	No.in IAU Gen. Cat.
RR Lyrae	21	20	Eclipsing	16	57
Cepheid	2	16	Irregular	17	11
RV Tauri	2	3	Short	12	3
Mira Stars	19	33	Novae	..	6
Long	10	8	Doubtful	..	17
Semi-Regular	6	4	Total:	105	178

The large percentage of late M-type stars in this region leaves little doubt but that the Scutum Cloud is a "window" through which we see giant stars of Population 11 in the central lens of our galaxy.

WHAT WILL THE SUN LOOK LIKE ON JUNE 30, 1954? by Harry L. Bondy

In spite of the progress made with coronagraphs, only the innermost corona may be observed outside of an eclipse. However, our knowledge of the fundamental solar cycle as reflected in the activity of spots, plages, prominences and the corcna, permits us to predict the most likely appearance of the sun on the day of the eclipse. The current minimum of solar activity makes it likely that the sun will appear spotless. Should there be some spots and should these be close to the limb, a minor prominence may appear nearby. Other faint prominences may be seen in latitudes from 40° to 50°. The most impressive white corona will show long equatorial strea ners extending a few solar diameters into space. In contrast, short brushlike streamers will surround the poles. All in all, the sun should not appear much different than it did on February 25, 1952.

SUNSPOT NUMBER AUTOCORRELATIONS, by Leith Holloway

A time series is a series of values of a continuously varying variable at equally spaced times. Monthly mean sunspot numbers or ten-day means of variable stars are examples of time series. The autocorrelation coefficient is the ordinary correlation coefficient (computed by standard statistical techniques) between a given time series and the same series displaced an integral number of time intervals with respect to itself -- this number being called the number of "lags." As the ordinary correlation coefficient is a measure of how well one can predict one variable from another, the autocorrelation coefficient is a measure of how well one can predict future values of a time series from previous values of the same series.

Autocorrelation coefficients were computed for monthly mean Zurich sunspot numbers between 1749 and 1950 inclusive for lags up to 300 months, by the Univac electronic computers. I am indebted to Dr. John W. Mauchly of the Eckert-Mauchly Division of the Remington Rand Corp. for supplying me with these computations. The job required 20 minutes on the Univac. This statistical technique should be quite useful in the study of variable stars. It may be able to detect hidden periodicities in apparently irregular stars.

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Mr. Giuseppe DiDomenico told about an "apparatus" for better understanding the true motion of the planets around the sun. Clint Ford spoke briefly of his plans for studying polarization with his photoelectric photometer during the eclipse. Papers by Robert Greenley, Ralph Wright, and M. L. Felts were read by title. R. S. Luce outlined his study of the amplification ratio of a Barlow lens with various types of oculars;and Herbert Luft announced the publication of a new edition of the B.D.charts and a microprint copy of the catalogues in which 9 pages of the original fill 1 page of the reprint.

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