NEW MEMBER

Joseph Booth, 2415 39th Street N.W. (7) Emerson 4350.

H.R. 6368 to provide for the issuance of a special postage stamp in commemoration of the dedication of the Palomar Mountain Observatory, is awaiting the President's signature as this goes to press.

OCCULTATION PREDICTIONS

Morgan Cilley and Edgar W. Woolard

Date	Star	Magnitude	Immersion	Hour Angle
July 11	1749	6.1	7:49 PM	3 W
16	2371	4.9	9:40 PM	3/4 W
18	2644	6.3	7:08 PM	3½ E
Aug. 12	2328	6.4	8:16 PM	1½ W
12	2336	6.6	10:10 PM	3¼ W
13	2468	6.9	10:05 PM	2¼ W
13	2476	6.9	11:20 PM	3½ W
14	2617	4.7	10:12 PM	1½ W
16	2784	3.4	0.21 AM	2 3/4 W
16	2914	5.0	11:08 PM	3/4 W

All occur on the dark edge.

THE SUPPLEMENT TO STAR DUST this month carries the three papers from NCA to be read at the Astronomical League convention. Two are written by junior astronomers John Lankford and Leo Carroll, ages 13 and 14. The other, by Charles A. Little, Jr., describes the radar he built for observing meteors, but it does not tell the difficulties he is having in obtaining a license from the Federal Communications Commission. This is in addition to his amateur and commercial operators' permits he now has. The case is still undecided.

To encourage amateur astronomers in pursuit of individual projects, we offer these pages as recognition of their efforts.

* *

Mabel Sterns, editor, 2517 K St. N.W. (7) DI-9422

STAR DUST

National Capital Astronomers
Washington, D. C.

July-August 1948 Vol. 5, No. 11

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DATES TO REMEMBER

July

- 3-5 Astronomical League convention at Milwaukee.
- 11 Public observation, Barnard Hill Park, 9-11 PM.
- 15 Telescope class, 505 Morse St. N.E. upstairs.
- 15 5-inch night, regular members, 9 p.m. DST. Moon and Jupiter. If cloudy, July 16.
- 17 Junior night at the 5-inch; Copernicus, main object of interest on the moon. Alternate, July 18. Rotbart Observatory. See text.

Aug.

- 3 5-inch night, regular members. Nebulae and double stars. Alternate, August 4.
- 8 Public observation, Barnard Hill Park, 8-10 PM.
- 12 International Latitude Observatory, Gaithersburg. Meet at Friendship terminal 7:45 p.m.
- 28 Junior night at the 5-inch; alternate, August 30.
- 29 Public observation, Barnard Hill Park, 8-10 p.m.

TELESCOPE CLASS TO BE RESUMED at new location. Trustees are willing that facilities be set up in space to be rented from R. M. McLellan at 505 Morse Street N.E., second floor. Streetcar #92 Calvert Bridge, or Navy Yard both via Florida Avenue pass within a block of it. Mr. Wright will direct operations, Miss Warthen will undertake the administrative work for the class in mirror grinding. The shop will be open two nights a week to be chosen at the first session July 15, 7:30 to 9:30. A schedule of rates according to size of glass will be established subject to change of manufacturer's prices. With a little work, open shelves can be converted to individual lockers. If the class is successful, it will be continued at those quarters throughout the year.

FINE SHOWING OF TELESCOPES by NCA makes public observation at Barnard Hill Park a success. The first in a series of four observations in collaboration with the National Capital Parks, Sunday, June 13th, coincided with the first evening of clear skies for a long period. NCAs Lyons, Slemaker, Lankford, Perkins, Wright, Little, D'Andelet, Warthen, and Rotbart focussed their telescopes for about 75 stargazers. Mr. Lyons described the various objects, using the special flashlight furnished by Mr. Rotbart and the amplifier supplied by Park Naturalist Chick. The official photographer took photos which may be obtained for 40¢ each, size 5x7, at room 1223, South Interior Building.

The next showing will be Sunday, July 11, 9-11 p.m. when we hope to repeat the success. In case of cloudy weather, some of the members will entertain with slides, chalk talks, and other aids. Also keep in mind August 8 and 29 for stargazing at Barnard Hill Park.

ROTBART OBSERVATORY, 4410 River Road N.W. You are invited to visit Mr. Rotbart's private observatory. Upon notifying the editor between July 8 and 12, the date will be assigned in order to avoid overcrowding. Anyone who has seen the observatory with its numerous ingenious devices will attest that it is well worth a visit. Members only (juniors too, of course). We are grateful to Mr. and Mrs. Rotbart for this opportunity.

TRIP TO INTERNATIONAL LATITUDE OBSERVATORY, and Perseid meteor count will be combined August 12th. Meet at the streetcar-bus terminal on Wisconsin Avenue at 7:45. There should be no trouble in providing auto transportation for those who need it. The route will be No. 240 to Gaithersburg, Md.; when you reach the brick schoolhouse at left of the road, make sharp turn left opposite the school; follow the road straight ahead, past white house where pavement turns right, continue straight ahead instead on dirt road until it ends at observatory less than half a mile from highway. No turns after leaving 240.

Mr. Earl Williams, director of the observatory, will tell us about his work, how it is affected by motions of the earth, and in small groups let us look at (not through) the telescope. The building is about the size of our 5-inch house. He has given us permission to use the grounds around his home while counting meteors. Bring blankets, ground cloth, or camp chairs. Only refreshments that leave no telltale signs are permissible. If cloudy, postpone to August 13; if doubtful, call the editor, District 9422.

BOOK REVIEW

"Atomics for the Millions," Maxwell L. Eidinoff and Hyman Ruchlis; Whittlesey House, N. Y. 1947; $3.50.

This is one of the best of the spate of popular books on atomic energy. It is the product of a happy collaboration between one of the Manhattan Project scientists and an educator with broad experience in high school science instruction. The treatment is non-technical, designed for the secondary school student and the general reader. Organization of the subject is conventional, starting with the background of atomic theory and experiment, describing the Manhattan Project, and discussing problems of peacetime use of atomic energy. A number of good drawings assist the exposition. Although the subject is expertly handled, the book does lack the spark of wit and humor which writers like Gamow are able to inject into their popular works.

---R. J. Hinckley

MR. SMITH AND HIS TELESCOPE AT HOBBY SHOW. On one day's notice, Edwin V. Smith exhibited his 6-inch reflector in wooden skeletal tube at the hobby show sponsored by the Department of Agriculture Welfare Association June 18th. The catalog listed some 200 exhibits, and in spite of the rain, the patio was crowded with visitors from 5 o'clock until closing time. Next year we hope to have a bigger display from NCA.

AUDITORS APPOINTED to examine the annual financial report, Mr. Joseph C. Boyle and Mr. Franklin H. May.

THE CONSTRUCTION AND OPERATION OF RADAR EQUIPMENT FOR OBSERVING METEORS

Charles A. Little, Jr.

Introduction

The meteor radar is an instrument for observing the occurrence and distance of meteors. The distance can be determined by measuring the elapsed time taken by a pulse of radio frequency energy of about 20 micro-seconds in width to travel to the ionized path caused by the meteor, be reflected, and return to the receiver. In the indicator the screen of a five-inch cathode ray tube is used to present both the original transmitted pulse and the reflected echo pulse. The elapsed time between the two is measured by the calibrated time base of the sweep generator also in the indicator. $D = T/2 \times 186{,}000$, where D is the distance to a meteor, T is time in micro-seconds required for radio waves to travel to a meteor and return, 186,000 miles is the distance radio waves travel per second. For simplicity, $D = 93{,}000 \times T$.

The occurrence of a meteor is of course observed by visually watching the indicator screen.

General Description

This home-built radar set is a relatively simple system, being of the self-synchronized type. The carrier frequency is set between 27.185 and 27.455 megacycles per second. This is the 11-meter band shared by amateurs, industrial, scientific, and medical apparatus. A special license is necessary to operate the equipment.

The radar set consists of six separate units: the transmitter, high voltage power supply, receiver, indicator, indicator power supply, and antenna system.

Cabinets for the receiver and indicator, and a large number of parts were salvaged from war surplus radar equipment. Some small sections of the surplus were used intact. Generally, it was found more satisfactory and less time-consuming to start from scratch and rewire, rather than to try to trace circuits which might be used.

The transmitter is 12 inches high and is built on a 10"x14"x3" metal chassis. The high voltage power supply is built on a plywood base and is 16"x15"x8". The receiver is built in a small metal cabinet 5½"x7"x13". The half-wave transmitting antenna reflector system and separate receiving antenna are supported by a 60-foot telephone pole.

General Theory

The transmitter is a two-tube, push-pull, Hartley oscillator. This is a self-pulsing oscillator which generates pulses of radio frequency energy by means of the blocking action of the grid circuit. As the transmitter operates on such a low carrier frequency for radar, conventional tubes are very satisfactory. Tuned circuits using conventional coil and condenser are used. In the grid circuit a condenser shunted by a resistance is connected from ground to the grids through radio frequency chokes. The duration of the radio frequency pulse is determined by the time required to charge this condenser by means of grid current. Eventually this charged condenser places enough bias on the tubes to stop oscillation. This condenser is then discharged by the resistance shunted across it. When the bias reaches a sufficiently low value, oscillation is started again.

The value of the condenser determines the width of the pulse. The value of the resistance determines the repetition frequency. The output of the oscillator is taken from the tank circuit by means of a balanced antenna coupling coil. Also from the transmitter a timing pulse must be taken to synchronize the indicator. A resistance is placed between filaments and ground through which plate and grid current must flow. Only during oscillation does a voltage appear across this resistance. This voltage is used to synchronize the indicator.

Receiver

Of the total power that is radiated by the antenna, only a small part reaches the meteor and a smaller part is returned to the receiver. It is probably of the order of a micro-volt or less. The receiver must be capable of amplifying this very weak echo signal so that it can be used to deflect the electron beam of a cathode ray tube. The receiver is a 10-tube superheterodyne. The principles of operation are similar to ordinary receivers except for a few very important characteristics. The capacitances in the grid circuits of all radio frequency and intermediate frequency amplifiers are kept to an absolute minimum to prevent overloading and reduce the recovery time of the receiver. The receiver must have a wide-band response in order to preserve the pulse shape. This is accomplished by using slug tuned coils in R.F. and I.F. circuits. The output section must be a video amplifier in order to pass the sharp pulses.

Indicator

The indicator incorporates eight tubes. It consists of a limiter, sweep generator, sweep clamper, limiter amplifier, sweep inverter, indicator gate, and cathode ray tube. The purpose of the indicator is to present by means of a cathode ray tube the distance of a meteor by measuring the time required for a transmitted pulse of radio frequency energy to travel to a meteor and back to the radar set. To perform this function a fluorescent spot is moved across the screen at a linear speed by a voltage of a sawtooth wave form in the sweep generator.

At the exact instant that the transmitter generates a pulse of radio frequency energy, the sweep is started by the sweep generator, that is, the spot is moved across the screen at a linear speed which requires 2150 micro-seconds. This is also the time required for radio energy to travel 200 miles and return, and is the maximum range of the instrument. Now, if the radio frequency energy struck an object 100 miles away and were reflected back, the spot would have time to advance only half way across the cathode ray screen. At this point the receiver would cause the spot to be displaced, forming a streak or echo pulse usually called a "pip," then continue across the screen. As this operation is repeated 100 to 150 times a second, visually it appears to be continuous. The echo pulse remains visible as long as the ionization caused by the meteor remains of sufficiently high density.

Power Supplies

The power supplies furnish the necessary voltages and current for the equipment; 2.5, 5.0, and 6.3 volts are required for various filament and heater circuits. Approximately 300 volts are required for the receiver and most of the indicator. Two thousand volts are necessary for the cathode ray tube. The high voltage power supply that feeds the transmitter operates at 5000 volts.

Antennas

The receiving antenna is a horizontal half-wave dipole connected to the receiver by means of a 52-ohm coaxial cable. It is mounted on a 60-foot telephone pole, about 20 feet from the ground, below the transmitting antenna. The transmitting antenna is mounted at the top of the pole. It is a horizontal, half-wave folded dipole with one reflector mounted a fourth wave-length below and two other reflectors mounted a fourth wave-length to either side. This tends to cut down horizontal radiation and lets most of the energy be radiated upward.

Operation

All filaments and low voltage power supplies of the various units are turned on and after waiting about two minutes, the high voltage power supply may be turned on. This puts the transmitter in operation which starts the whole set operating. A rough trace appears on the screen of the cathode ray tube in the indicator, the length of which represents 200 miles. The intensity control is adjusted to give satisfactory brightness to the trace. Then the focus control is adjusted so that the greatest detail may be seen in the trace. The trace now looks like a narrow green band with a large number of small peaks which appear as grass. This grass or noise is caused generally by thermal agitation in the tubes of the receiver.

The receiver tuning is now adjusted for the greatest intensity of the ground clutter caused by reflections from nearby objects and the transmitted ground pulse. This appears at the beginning of the trace.

It is now only necessary to watch the trace on the indicator screen to observe meteors which appear as pips or streaks originating in, and finally disappearing back in the grass. The length of pip or streak represents the intensity of the meteor, the length of time observed represents its duration, and position on the trace represents its distance away.

The average size of meteors is in the order of milligrams and varies from that of a grain of sand to a small grain of corn. The speed of meteors varies from 10 to 40 miles per second. When meteors strike the atmosphere, the air molecules in their paths receive a tremendous excitation causing ionization. These ionized particles are knocked in all directions, colliding with other molecules and causing more ionization. This ionized trail may be 100 miles long and several hundred yards in diameter. It is this ionized cloud that reflects the radiated energy from the radar set. Contrary to general belief, the light of meteors is not caused by the meteors' becoming incandescent due to friction with the atmosphere. Some air molecules in the atmosphere, when struck by a meteor, are excited to a sufficient degree to cause them to emit light. This is not unlike the passage of an electric current through a gas. A glow occurs as in a neon sign. This is the light we see from a meteor.

In two months, over 150 meteors have been observed. While this number does not really represent very many data, it does bring out several interesting conclusions; for instance:

Many more meteors are observed between midnight and noon than are observed between noon and midnight. (Fig. 1)

While the duration of observed meteors is from one-half to 18 seconds, no change in distance during occurrence has been observed.

In the morning from 9 to 10 o'clock, the distances of observed meteors average about 130 miles. In the evening from 9 to 10, the distances average about 75 miles. (Fig. 2)

Most meteors observed lasted from one-half to two seconds. (Fig. 3)

Most of the data taken so far have been on random meteors, or meteors that penetrate our atmosphere from any angle, from any point in space, and at any time.

Shower meteors are meteors that appear at certain times and appear to come from certain constellations for which they are named. These meteors travel in orbits which come close to the earth's orbit. The earth in effect travels through them, making them appear to come from a definite point in space.

It is expected that more data will be taken during the summer and autumn, especially during the various meteor showers.

EXTRACT FROM LOG, JUNE 5, 1948

Eastern Standard Time A.M.	Distance (arbitrary scale 28 = 200 miles)	Duration (in seconds)	Intensity (strength S1-S5)
8:17	24	1	S2
8:18	20	½	S2
8:21	22	½	S1
8:22	22	3	S3
8:25	21	½	S2
8:29	10	1	S3
8:29.30	19	½	S2
8:37	21	½	S2
8:37.30	22	½	S2
8:38	22	1	S3
8:38.15	23	2	S3
8:42	21	7	S2
8:42.15	22	2	S2
8:43	23	2	S2
8:50	16	8	S2
8:51	19	3	S3
8:55	18	3	S2

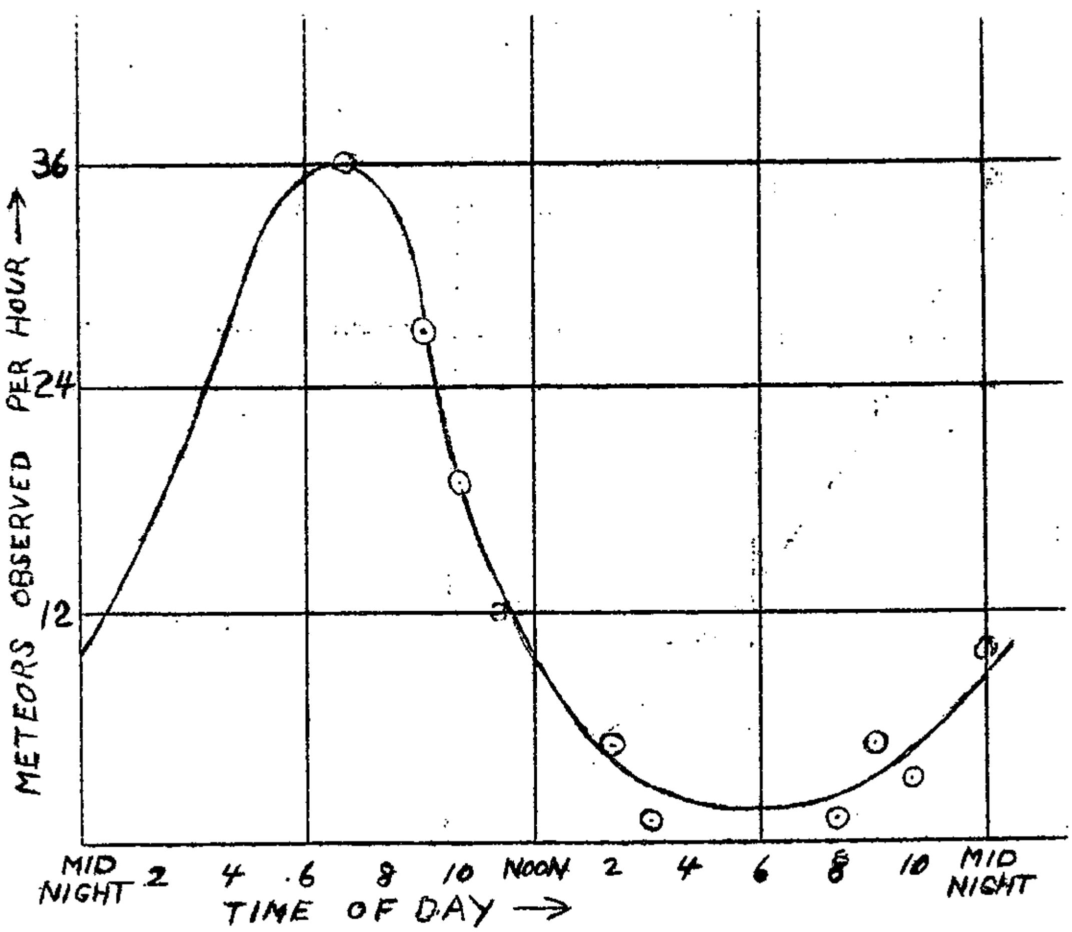

Fig. 1. The distribution of meteor occurence over a 24-hour period.

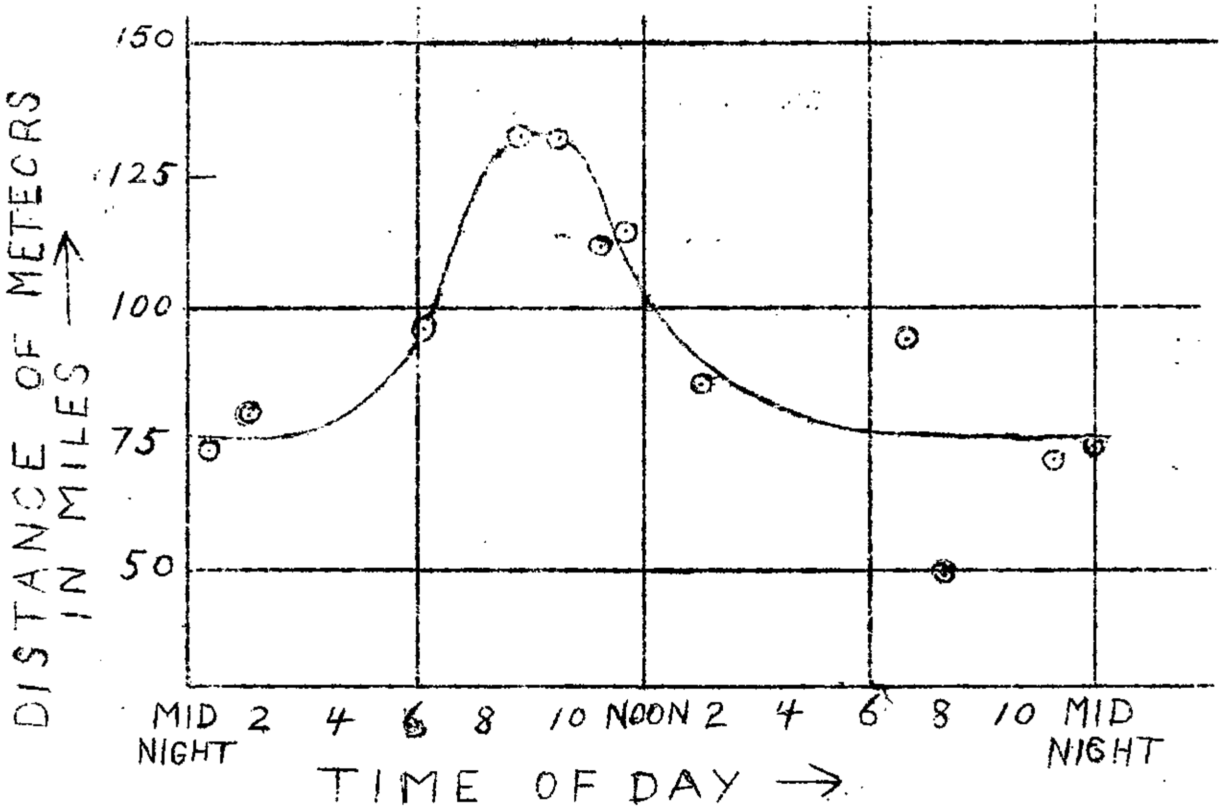

Fig. 2. The distribution of meteor distance over a 24-hour period.

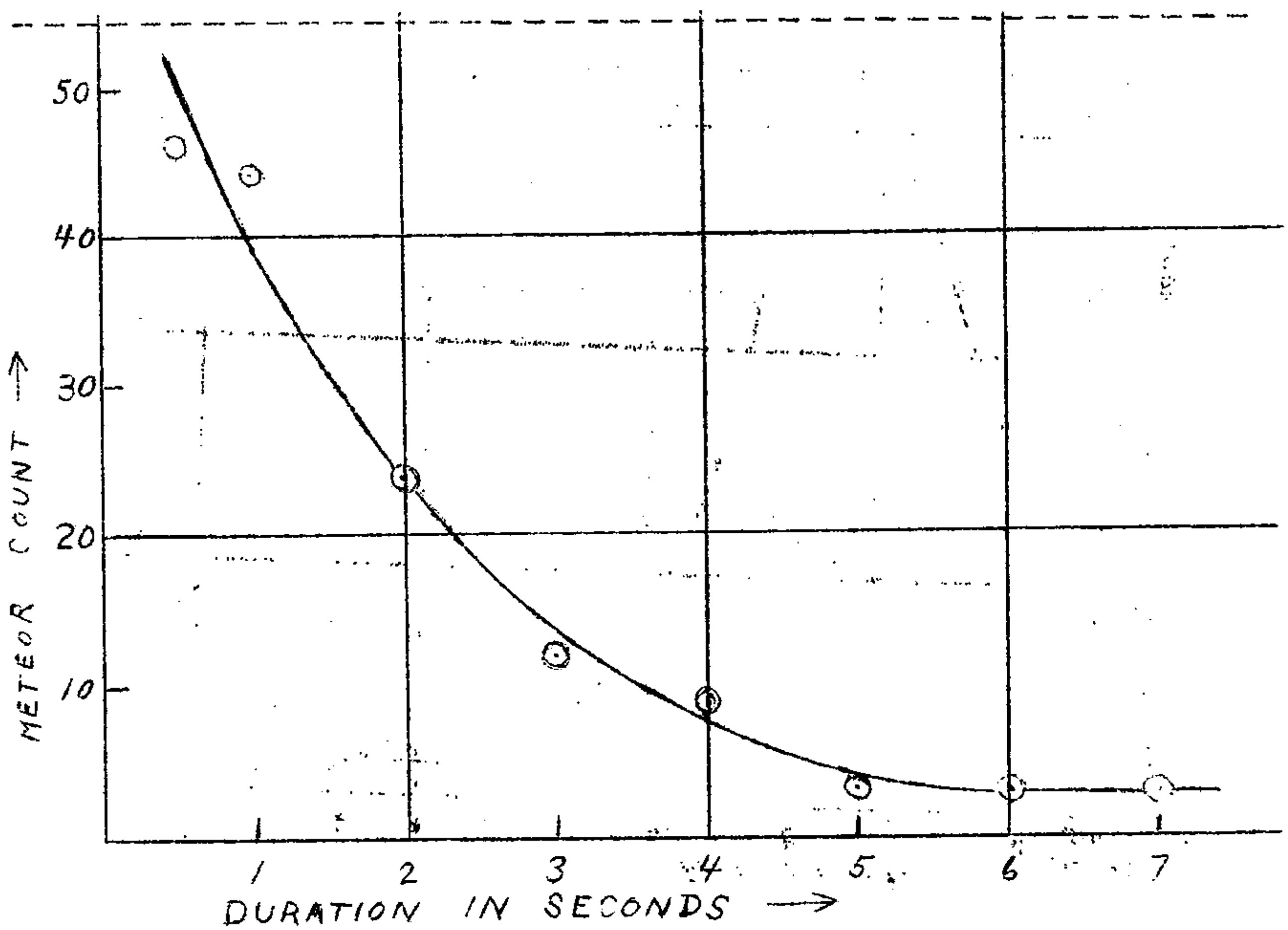

Fig. 3. Decrease of meteor count with increase of meteor duration.

Washington, D.C., June 1948

A HISTORY OF VARIABLE STARS AND THEIR IMPORTANCE IN ASTRONOMY

Leo M. Carroll

Although they are now such an important branch of astronomy, variable stars, with one exception, were not discovered until A.D. 1596 when Fabricus, the Dutch astronomer, noticed that there was a third magnitude star in the constellation Cetus which had not been recorded before that time. When it faded after a few weeks he decided that it was a nova and this was the general opinion until 1638 when it was observed by Holwarda who found that it disappeared after he had made a few recordings of it but again reappeared about eleven months later. It was also found that the star had been mapped in 1603 by Bayer who classified it as Omicron Ceti. When the phenomenon was announced, the star was immediately given the name Mira, meaning wonderful, by which it is still known.

The exception referred to is that of the star Beta Persei for it is now believed that the Arabs may have noticed its variability since the name of Algol (meaning demon) given to it is out of keeping with the complimentary names they gave to other stars.

If we include novas as a type of variable, it is possible to state that the study of variables began earlier than we thought, for "new stars" seen before 1596 are recorded history. In fact, up to the time of 1670, thirteen novae were recorded the most famous of which are Novae Cassiopeiae, known as the star of Tycho Brahe, in 1572, and Novae Ophiuchi in 1605, called Kepler's star. Tycho's star must have been something to see, for at the time he noticed it, it had already reached the brightness of Jupiter and later it rivaled Venus in its intensity.

Going even farther back into history, there are found in ancient chronicles references to a number of new stars such as the one which was observed for awhile between Beta and Psi in Scorpii in the year 134 B.C. and which is said to have been the phenomenon that prompted Hipparchus to make the first star catalogue to help future astronomers. However, it is not known whether or not these manuscripts tell of true stars or of some other celestial object such as a comet or meteor.

The study of variables at first proceeded very slowly. It was not until 1782, in fact, that a careful study was made of Algol, although mention of its fluctuations had been made in 1699 by Montanari.

The man responsible for these investigations was the English astronomer, Goodricke, who in 1782 advanced the hypothesis that is known to be correct--that Algol is actually a binary with a close, dark companion which in revolving about it periodically cuts off a part of the light, thereby making the star appear to vary in intensity. It was Goodricke also who later discovered the variability of Delta Cephei, the prototype of the Cepheid variables, and Beta Lyrae, another eclipsing star.

Although Halley is best known for his cometary work, nevertheless he deserves recognition for being one of the pioneers in this field of variables, for it was he who in 1677 noticed the most famous of irregularly variable stars, Eta Carinae. From that year until about 1825 it varied from the second to the fourth magnitude. In 1827 it rose to the first but fell again three years later. By 1843 it was the brightest star in the sky save Sirius, for it had reached a magnitude of -1. It then began to decline gradually and is now about constant at 7.5. With the introduction of photographic astronomy, many faint red stars in the Orion Nebula were found to be of this type and it has been suggested that they are friction variables, that is, that they have frequent encounters with the diffuse gas and are thereby heated and, of course, raised in brilliance.

The next group of variables is that of the long period variables of which we have already heard of the type star, Mira. These stars have periods from 250 to 400 days in length although a few have been found longer.

Of this type the only one found to be connected with a nebula is R Aquarii and thus the friction theory may be discounted.

This type of variable is sometimes called "semi-regular" as the period and maximum and minimum magnitudes are not always the same from cycle to cycle. Another interesting fact about this class is that it seems to be composed solely of the red giants, those "huge conglomerations of nothingness" with diameters larger than the orbit of the earth.

It would seem that the best explanation for this group is that they are waging a continuous war between the force of gravity and the pressure of the interior gases. When they are fully expanded, gravity acts upon the outermost layers of the star and begins to pull them inward. The star soon reaches the point at which it would become static if the pressures were equalized but continues to contract because of inertia. In the meantime, because of the compression at the center, it becomes hotter and therefore brighter. At last the forces of the gas overcome the gravity and the star begins to expand, to begin the cycle all over again.

There is a certain group of variables which I like to call the "anti-novae." These are stars which are accustomed to sudden drops in magnitude that have neither plan nor apparent reason. The prototype of this class is the star R Coronae Borealis, usually of the fifth magnitude but often dropping as low as the twelfth.

Then come the most important, or at least the most useful, variable stars, the Cepheids. These stars, named after Delta Cephei, the first to be discovered, are known as the pulsating stars. They are short-period variables, the longest cycle known being a little over 45 days. They are also the most widely scattered of all variables, being found in the Magellanic Clouds and other systems outside our galaxy.

The Cepheids themselves seem to be divided into two major groups, those with period over a day and those with periods less than that. The latter were formerly known as the cluster variables since they had first been discovered by Dr. S. I. Baily in photographs of certain globular clusters in the year 1895. It was not until after the turn of the century, in fact, that Mrs. Fleming of Harvard announced the discovery of the first short-period Cepheid outside of a cluster.

In the year 1915, a paper was published by Shapley outlining the work that he and Miss Leavitt had done in determining a period-luminosity relation for the Cepheids. This had been brought about by the fact that when in 1912 Miss Leavitt had arranged a series of reports on 25 Cepheids, she had found that to arrange them in order of increasing period was to arrange them in increasing brilliance. That of course meant that when a star's period was known, its absolute magnitude was also known. Then by comparing that with the apparent magnitude of the star, it was possible to determine its distance. Thus the distances of the various galaxies and clusters could be found as soon as a Cepheid was discovered in them.

The field of variable stars seems to be almost the only branch of astronomy in which the amateur is on equal terms with the professional. A nova doesn't seem to care who sees it first.

Washington, D.C.
June 1948

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AN AMATEUR OBSERVES THE PLANETS

John Lankford

Preface

Planetary observations are one of the most enjoyable branches of astronomy, not only because of the sheer enjoyment of looking at the rings of Saturn, the bands of Jupiter, the phases of Venus, and the canals of Mars, but because of the satisfaction of having trained the eye to the point where the minute markings of the planetary surfaces become visible.

This paper is only about the planets that its author has observed. The instruments used were a 6" reflector and a 5" Clark refractor.

Planet No. I: Mercury

Mercury is the fastest of the planets and therefore is difficult to observe. The several times I have been able to observe Mercury were in the early morning or late afternoon. In a small telescope its disk is nothing more than a half-lighted sphere; in fact, it takes a large telescope and fine conditions to see any marking or clouds on the surface. Percival Lowell at his observatory at Flagstaff, Arizona, is the American astronomer who has done the most work on Mercury. His maps appear in D. P. Todd's "Stars and Telescopes," "The Solar System," by Poor, and also in his own books.

Planet No. II: Venus

Venus is the fairest of the planets. Although in many books Venus is said to be a fine visual object but a poor object in a telescope, I have never found this so.

From March until the latter part of June 1948, I have seen Venus wane--first to a disk like the last-quarter moon, and then to a thin crescent a few seconds of arc in diameter.

Through the 5", Venus has exhibited many interesting things: first, her phases; second, her diamond blue color; and third, spots and streaks from time to time, the most noticeable of which I observed on the 30th and 31st of March 1948.

On March 30 at 7 P.M. eastern standard time, using a power of 250 and with atmospheric conditions very fine, the first spot was picked up near the terminator. It was small and dark.

On the night of March 31, with the same power and not quite as good atmospheric conditions, the same spot was noted only it was larger and ran down the terminator. This spot could not be followed because of bad weather. Not until the 23rd of May did the results of my observation prove positive. That night I sighted a small spot but not in the position of the March spot. By now Venus is in the morning sky but will return to the evening sky in early 1949.

Planet No. III: Mars

This fourth planet in the solar system is one of the most controversial subjects in astronomy today. From an amateur's point of view which is usually a 6" or 8" reflector, Mars offers a real test to the eye if not to the imagination. My first observation of this planet was in 1946. It was my first and last until January 1948.

At 1 A.M. on a cold January morning, I first laid a trained eye on the ruddy planet. It was light red with a white blob on the bottom. My first observations through a 5" were in early February of this year. Since that time I have made about twenty-five observations of Mars of which many have been fair, some poor, and three excellent. Its main topographical features are the W. Herschel continent, Laplace Land, Cassini Land, Lockyer Land, Tycho Sea, and smaller unknown bits of land. The map I first used was in "Other Worlds Than Ours" by Proctor. It was drawn by Dawes in about 1880 and is a good map for the beginner.

After you have trained the eye and have a telescope of 400 X or 500 X, it should be possible to see canals of Mars. Lowell's maps found in his books, "Mars," "Mars and Its Canals," and "Mars as the Abode of Life," are extremely helpful.

Planet No. IV: Jupiter

Fifth planet and largest of the sun's children. The night of May 22, 1947, the author, for the first time with his new 4-inch telescope, set eyes on Jupiter. This was my real beginning in planetary observation.

On the night of June 15, 1948, the great planet again will swing near the earth. This happens every thirteen months. This year Jupiter is at its lowest southern declination and will reach its highest point twelve years hence when it will be in the winter and spring skies.

Jupiter offers a host of observable material. Its four moons make it look like a miniature solar system. With three or four hundred power, Jupiter's moons are shown to have a slight variation in light.

Next come the spots and bands of the planet, which with a high power are very clear. The most noticeable of the spots was the great red spot of the later 18th and early 19th centuries. One other interesting thing in a small telescope--its shape is that of an oblique spheroid.

Planet No. V: Saturn

Saturn is the sixth planet and the most picturesque of the planets in the sun's family. With its many attendant moons, rings, and bands, Saturn is a gold mine to the amatour.

First, the rings. The Cassini division and second ring are visible in a small telescope. It is worth while to watch the rotation of the planet's rings over the 29½-year period.

The spots on Saturn are fewer than on Jupiter, but there are some. The shadow of the rings is visible on the planet also. Saturn has a shape like Jupiter.

Saturn and its moons with the aid of 200 X or so are really wonderful. At the 5" I have seen five of the moons.

Planet No. VI: Uranus

Seventh planet in the sun's family, it was discovered 300 years ago by an amateur astronomer, William Herschel, with his homemade 6" reflector. Uranus is a telescopic object and requires a little plotting to find. It shines like a sixth magnitude star at present in the constellation Taurus. It has five moons, several bands, and is greenish in color.

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The Earth and Stars - C. G. Abbott
Mars - Percival Lowell
Mars and Its Canals - Percival Lowell
Mars as the Abode of Life - Percival Lowell
The Solar System - Poor
Earth, Moon and Planets - Whipple
Astronomy, Vol. I - Russell, Dugan and Stewart
New Handbook of the Heavens - Benhard, Bennet and Rice

(Washington, D. C., June 15, 1948)