AMATEUR ASTRONOMY

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A Page from the History of Amateur Astronomy

ALICE H. FARNSWORTH

Try to imagine your excitement if you were getting ready on a certain day to observe an astronomical phenomenon never before seen by mortal eye. Add to this the fact that you are doing so deliberately on the basis of your own prediction, contrary to the accepted best thought of the time. Only your best friend and your brother in Liverpool have been told. Of course the thing has to happen on Sunday, when, as a busy young curate, your services at church are required at intervals during the day. Moreover there is the ever-present anxiety lest clouds interfere at the crucial moments.

Some of you have already guessed that the state of mind described belonged to young Jeremiah Horrocks of Hoole, Lancashire, as he prepared to watch Venus transit the sun on November 24, O.S., 1639. Ten years before, the great Kepler had predicted for the year 1631 a transit of Mercury in November followed by one of Venus in December. Gassendi in Paris observed Mercury to his great gratification, but not Venus. It looked like a long postponment, as Kepler stated that the next transit of Venus would not occur until 1761. At the conjunction in 1639 his table showed the planet, passing 8′ below the sun.

Horrocks, a farmer's son already astronomically curious when he entered Cambridge at 15, worked his way in Emmanuel College for three years. At that time no branch of either mathematical or physical science was taught at the University. He left without securing a degree and returned to his home near Liverpool where he soon opened correspondence with William Crabtree, a spirit kindred to his own in astronomical enthusiasm. In May 1639 Horrocks observed a partial solar eclipse with a little telescope obtained the year before, and was a few weeks later ordained to the curacy of Hoole.

Noting the discrepancy between Kepler's prediction about Venus' behavior in 1639 and computations based on Lansberg's tables (which indicated that the planet would cross the upper part of the sun's disk in that year), Horrocks figured out to his own satisfaction that Venus would actually pass over the lower half of the sun a little before sunset on the date already mentioned. He prepared to observe the projected image of the sun on a 6-inch white disk whose diameter was divided off into segments of 15″ each, these to help him estimate the angular diameter of the planet.

On Saturday, the 23rd of November 1639, he examined the sun frequently and of course on Sunday watched carefully until it was time to go to church. Nothing did he see except a small sun spot which had been present for several days before. At 3:15 when he was free to look again, what was his triumphant delight to find "a new spot of unusual magnitude" near the limb at the expected place! Only half an hour or so remained before sunset, but in that time he watched the motion which proved beyond a doubt that this was indeed no sun spot, measured its place on the disk three times, and estimated its angular diameter at not more than 72″.

Crabtree at his home near Manchester had had a despairing day because of thick clouds. Fortunately, however, the sun burst through about 3:35. He was so entranced actually to see the black dot which was Venus that he made no precise observations of its position, but did estimate its diameter at about 63″.

Horricks' account of his achievement was re-written several times, but by December 1640 he was ready to consult Crabtree about a publisher. Moreover Crabtree had been in touch with Gascoigne, another young astronomer who had just invented the micrometer; and Horrocks wanted to get his value for the lunar diameter made with the new instrument. So a visit to Broughton, long planned and much anticipated, is in a letter dated December 19 set for January 4. According to a note made by Crabtree on the back of this letter, Horrocks died suddenly on January 3, 1641.

Twenty years later "Venus in Sole Visa" was published by Hevelius (in connection with his own "Mercurius in Sole Visus") from a copy of Horrocks' manuscript made by Huyghens. Such other

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Plotting the Disk of Jupiter

LATIMER J. WILSON

Movement of markings on the disk of Jupiter can be studied when plotted graphically. A graph will show at a glance the changing motion of the red spot and south tropical disturbance and the apparent effect of these markings upon each other. Also, the variation in motion in longitude of other markings can be effectively disclosed graphically.

When a drawing is made, a record of the time is important. The American Ephemeris and Nautical Almanac, in data for Physical Observations of Jupiter, furnishes the longitude of the central meridian of the illuminated disk for each day at 0^h G.C.T. (Greenwich Civil Time). Standard time is changed to G.C.T. by adding five hours to E.S.T., six hours to C.S.T., etc. Thus, an observation made at 8:00 P.M. C.S.T. is changed to G.C.T. as follows: 8:00 P.M. C.S.T. eqauls 20^h0^m C.S.T., add 6^h0^m which gives 26^h0^m G.C.T. Subtract 24 hours, giving the time as 2^h0^m G.C.T. or 2:00 A.M. of the coming day.

The 1936 American Ephemeris, pages 658-9, furnishes the longitude of the central meridian for System I and System II. Assuming that our drawing of the planet's disk was made at 20^h0^m (8:00 P.M. C.S.T.) on the night of July 1, 1936, which corresponds to 2^h0^m July 2, G.C.T., the longitude of the central meridian at 0^h0^m July 2, 1936, is given as 351.°7 for System I and 174.°6 for System II.

In one hour, 36.°580 in the zone of System I, the equatorial regions, cross the central meridian, and also 36.°262 of System II, the rest of the disk, cross the meridian in an hour. Our time difference is two hours, so we multiply 36.°580 by 2; we also multiply 36.°262 by 2. We find that in the interval 73.°160 of System I have followed the predicted longitude of 351.°7, so we add these numbers. This furnishes 424.°86 or 64.°86 (424.°86 minus 360°) as the longitude of the central meridian for System I, of our drawing. The same computation gives 247.°1 as the longitude for System II.

When a series of drawings representing succeeding days are plotted, with the dates in the vertical margin and the longitude in the horizontal margin, the motion of any marking can be readily seen. The difference in longitude can be changed to a time different to furnish the rotation period of any particular marking. From the plotted motion, or from subtracting the longitudes, the

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Sketching at the Telescope

(Translated from the German article by Walter Loebling) "Die Himmelswelt" Jan., 1929.

HANS D. GAEBLER

The graphic representation of objects seen through the eyepiece doubtless merits its careful study along purely technical lines.

In many cases of such scientific undertakings this will involve a schematic portrayal, for example in the case of the moon, where ultimately one had best use conventional signs to show the topography, since to depict lunar scenes in their ever shifting appearance in all their effects of light and shade, is only of value when exact shades and changes of lunar surface are to be determined after the topography is already indicated.

Now this is a somewhat difficult assignment. It requires command of drawing media and the ability to sketch. One must remember that complete portrait likeness and absolute accuracy, combined with the many gradations of light and shade is demanded. Photography cannot accomplish this; at least it can only do so in the case of showing the large expanses, but is useless for details.

Fauth (in 1927, Himmelswelt) introduces an interesting subject, one in which he describes sun spots. The changes in the areas of eruption on our solar luminary come exceedingly fast, so that in sketching a large area of this kind many changes occur during the time of sketching. I refer here to "Sirius", November 1926 where I already emphasized this in connection with the sketching of the large September group of 1926.

We ask, therefore, by what technical means we may most speedily depict with absolute truth what has occurred. When one considers that particularly with the sun spots and also in the case of the moon, many fixed features such as hardness, soft transitions and delicate shading must be recorded, the medium must possess the necessary range, fluidity and modeling quality.

For this, charcoal alone is suitable. With charcoal one can draw anything, moreover, in the shortest period of time. One may select, therefore, the best and thinnest charcoal on the market, made of prickwood or basswood 5-6mm thick of suitable degrees of hardness.

The choice of paper is very important. I use for this purpose the French Ingres paper which may be had everywhere. The charcoal adheres to this firmly and will not easily rub off. One begins with shading large flats, then, by erasing with artgum, produce the minutest detail in

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Meteor Section

FRANKLIN W. SMITH

PART I

The organization of the Meteor Section has been completed only recently and for this reason the only section report which has been received is that of the Wisconsin-Northern Illinois group. This report forms Part II of these notes.

The only other observations which are at hand are the following:

Observer	Location	Minutes	Meteors
F. W. Smith	Glenolden, Pa.	540	18

Before these notes appear the second and third major meteor showers of the year—the Lyrids and the Eta Aquarids—will be over and the next need not be expected until the latter part of July. (The maximum of the Delta Aquarid shower usually falls on July 28.) In the meanwhile we may expect to see sporadic meteors. Although these are not as spectacular as a major shower they provide the opportunity for observational work which is of interest and importance. Many of these so-called sporadic meteors are actually members of very sparse showers from which a single observer may usually expect to see only a meteor or two per hour. Although the study of these minor showers is still largely an open field, the showers have been watched by many observers over a long period of years and there are many questions in regard to them which remain unanswered. Moreover, recent statistical investigations of the subject have shown that many of the radiant points published for such minor showers are entirely fictitious. The need for new and reliable data is therefore evident. It cannot be denied that this work presents many difficulties, yet they are by no means insurmountable and should only serve to encourage the observer to put forth his best efforts.

When attempting to determine the radiants of minor showers the observer should watch continuously for at least two hours at a time and even longer watches are more satisfactory. Minor showers, in general, do not appear regularly every year and for this reason any predictions in regard to them are not only worthless but are likely to bias the observer's work. It should be his aim to plot the meteors on his star map just as he sees them without any regard to what he may have been led to expect. It should be added that observations made for the purpose of determining the radiants of minor showers may also be used for determining rates, if the time required for plotting each meteor is deducted from the elapsed time, so that the time actually spent in watching the sky is known.

The study of minor meteor showers has been considered very briefly, and some practical suggestions for making observations for this purpose have been given. In conclusion it should be pointed out that an organization such as the meteor section of the AAAA is in a position to do much effective work in this field because such work should be a cooperative rather than an individual project. The most satisfactory way of determining whether or not the meteor paths plotted by one observer indicate a real radiant is to see whether that position is confirmed by someone else who was observing independently at about the same time. Our organization should make such cooperation possible.

PART II

Report of the Wisconsin-Northern Illinois Region

L. E. ARMFIELD

Messrs. Callum and Halbach submitted spendid lists of telescopic meteors, not in numbers perhaps, but in the neatness and thoroughness of compilation of the subordinating data. The following summary lists the telescopic meteors observed by members of the AAAA during 1935 while observing variable stars. The observations have been submitted to the American Meteor Society.

Observers	Location	Aperture of Telescope (Inches)	Min. at Eyepiece	Telescopic Meteor
Armfield	Milwaukee	13	7836	58
Callum	Chicago	8	2959	5
Halbach	Milwaukee	10	1392	10
Diedrich	Milwaukee	10	1983	1
Knott	Milwaukee	4	120	1
Observers, 5			14290	75

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Nova Program Notes

L. E. ARMFIELD

With abominable weather still persisting throughout the country the nova report for March is exceptionally meager. Consequently, the following contributions are doubly appreciated.

Observers	Group	Region Number	Magnitude of faintest star visible: 7	6	5	4	)4	Total Nights
Hamilton	Norwalk		—	1	2	1	1	5
Rosebrough	New York	57	3	6	1	—	—	10
Seely	New York	**	—	3	2	1	—	6
		**	—	3	2	1	—	6

**Regions for which numbers have not been assigned to date.

We are happy to announce the receipt of new numbers and revised regions for the nova search from Professor Campbell of the AAVSO. Monthly report blanks are now available for distribution. Tracings of nova region charts are rapidly nearing completion under the skillful hands of D. F. Brocchi of Seattle. With the advent of spring, better observing weather, and tools to work with, we are confidently looking forward to a thorough search of the sky being made by our observers during the coming season.

2046 So. 59th Street,
Milwaukee, Wis.

Occultations

R. D. COOKE

Occultations for Milwaukee and vicinity during June.

Date	Star	Magnitude	Immersion	Pos. angle
June 2	47G Librae	6.1	9:52 PM	92°
June 3	32B Scorp	5.4	6:46 PM	130°
June 24	55 Leonis	6.0	7:31 PM	90°
June 29	17G Librae	6.4	8:22 PM	130°
June 29	18G Librae	6.1	9:17 PM	144°

Franklin W. Smith, leader of the AAAA meteor section, has made the timely suggestion that it would be of interest to keep a record of the number of occultations reduced by members of the AAAA. We think this is an excellent idea. Will members please report to the occultation section the total number of reductions separately by years since 1933. If sufficient number are reported the list will be published in a future issue of Amateur Astronomy.

6811 Cedar Street,
Wauwatosa, Wis.

Meteor Section

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The following contributions to the Olivier-Hoffmeister program for February and March are hereby gratefully acknowledged.

Observers	Location	Minutes	Meteors
Abrahams	Milwaukee	160	5
Diedrich	Milwaukee	60	1
Loepfe	Milwaukee	60	5
Moore	Milwaukee	60	8
Schmid	Milwaukee	370	16
Observers, 5		710	35

Grateful appreciation is hereby tendered to Misses Houston, Mueller, and Nickels of Milwaukee for their excellent contributions to the AMS in the form of typing the voluminous Olivier-Hoffmeister program observations obtained by members of this region during the year 1935.

407 Scott Avenue,
Glenolden, Pa.

AAAA Notes

The association takes great pleasure in announcing the birth of the Metropolitan Astronomical Society which is composed of organizations of amateur astronomers in New York City, suburban New York and New Jersey, as well as New York state proper. Additional information of much interest to AAAA members concerning the new society will be found under Metropolitan Notes. The formation of this splendid addition to the AAAA is due entirely to the tireless efforts of James S. Andrews, regional organizer of the New York and New Jersey district. Mr. Andrews cannot be complimented too highly for the host of contributions he has made, is making and will make in the future, to the cause of amateur astronomy. He has devoted practically every leisure moment since last October to the development and growth of the AAAA in his region. Truly, the amateur spirit, "for the love of the science" is again exemplified by Mr. Andrews.

Ed Martz, Jr., leader of the planetary section is now residing in Mandeville, Jamaica, B. W. I., where he is studying under that dean of planetary astronomers, William H. Pickering. A splendid opportunity, to be sure, and knowing Mr. Martz, we are assured that he will

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Amateur Astronomers Association of Pittsburgh, Pennsylvania.
Amateur Astronomers Association of Rutherford, New Jersey.
Amateur Telescope Makers of New York, N. Y.
Astronomers Guild of Jamestown, New York.
Chicago Amateur Astronomical Association, Chicago, Ill.
Long Island Telescope Makers, Wantagh, N. Y.
Louisville Astronomical Society, Louisville, Ky.
Madison Astronomical Society, Madison, Wis.
Metropolitan Astronomical Society, New York, New York.
Milwaukee Astronomical Society, Milwaukee, Wis.
Norwalk Astronomical Society, Norwalk, Conn.

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Send all communications to the above address.

The AAAA cordially welcomes the following new memberships received during the month of March. Memberships received from the Chicago region will be published en masse in the June issue of this magazine.

Richard Abrahams	5046 N. 39th Street	Milwaukee, Wisconsin
C. H. Anderson	2434 Fox Avenue	Madison, Wisconsin
Sophie Armfield		Fennimore, Wisconsin
M. P. K. Baird	2210 Fox Avenue	Madison, Wisconsin
W. R. Binney	315 N. Franklin Street	Madison, Wisconsin
William Breeden	6 Patchen Place	New York, New York
L. E. Buszynski	20 No. Third Street	Madison, Wisconsin
John Crerar Libray	86 East Randolph St.	Chicago, Illinois
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Raymond C. Gagnon	125 Prospect Street	Willimansette
A. D. Geigel		Monroe, Wisconsin
A. Gottschalk, M. D.	291 Geary Street	San Francisco, Cilaf.
H. H. Hackler	2825 Center Drive	Madison, Wisconsin
N. J. Heins	570 Broadway	Paterson, New Jersey
E. C. Johnson	2184 Carter Avenue	St. Paul, Minnesota
L. W. Ketchum	714 Oneida Place	Madison, Wisconsin
E. B. McCartney	76 Roslyn Road	Mineola, New York
Noah W. McLeod		Christine, North Dakota
Gordon W. Ridley	517 Capp Street	San Francisco, Calif.
Jack Schmid	1947 N. 36th Street	Milwaukee, Wisconsin
Dr. J. S. Supernaw	818 Prospect Place	Madison, Wisconsin
Helen L. Thomas	44 Langdon Street	Cambridge, Massachusetts
Mrs. Dorothy Tobias	613 State Street	Madison, Wisconsin

Milwaukee News Notes

MILWAUKEE ASTRONOMICAL SOCIETY
HERBERT L. GRUNWALD, Correspondent

On April 16th, Dr. Arthur H. Compton of the University of Chicago was a guest of the MAS at their luncheon held at the City Club. Dr. Compton's research deals with the study of cosmic rays, and he presented a phase of this work most closely allied with astronomical study.

A professor of English at Oxford University one time suggested to Dr. Compton that the earth's motion might be determined by a study of the cosmic ray. The motion of the earth on its axis or even around the sun would be too small to use as a measure to determine the effect of this motion on the rays falling in the path of the oncoming earth. It was some time later that the study was continued, using as a measure the rotation of the galaxy as indicated by the motion of the sun through space.

Dr. J. H. Oort of the University of Leyden, an authority on the rotation of the galaxy, was asked to determine at what time the earth was facing in the direction of the galactic rotation. If there was no magnetic influence on the earth, it was calculated that a difference of 1% in the intensity between the side of the earth facing in the direction of motion and that side away from it would be apparent. Most of the rays, however, are bent by the earth's magnetic influence and pass around it, making a correction necessary before the intensity on the different sides of the earth could be measured.

The chief components of the ray seem to be positive and negative electrons which are bent east and west as they enter the earth's magnetic field with a maximum bending in the direction of the earth's motion. Because of the earth's inclination to its orbit, the impact would naturally be more intense in either the northern or southern hemisphere, depending on which was in the leading position at the time of observation. This fact made necessary a study in different latitudes both north and south of the equator.

In 1932 an instrument, "maxima cum laude" meter, was designed by Dr. Compton and made with Carnegie Foundation funds to measure cosmic ray intensity. Its weight is one and one-half tons and it is composed of an ionization chamber surrounded by a sheath of lead shot to protect the chamber from impulses originating in radio-active materials on the earth. A steamship traveling between Vancouver, B. C., and Sidney, Australia, was selected for the transportation of this instrument as it made the longest north-south water route. Several problems were encountered in attempting to mount on board ship an instrument intended for rigid location on land. Adjustments were finally made to compensate for the ship's motion and the instrument was ready for use during the voyage into the southern hemisphere.

After the data obtained are gathered, definite results will be known in regard to the intensity of cosmic ray impact on the leading side of the earth. The results of this investigation will show either that cosmic rays do not come from outside of the galaxy but from within it, or that the source is not moving along with our galaxy but is outside of it. This has long been a problem of those interested in cosmic ray origin, and it may be that a solution is at hand through these investigations of Dr. Compton.

The origin of the cosmic rays is unknown, and there is no reason to suspect that they originate in any specific galaxy. How long they are in flight and the distance they have traveled is also not known, but we are acquainted with the fact that they are coming to the earth uniformly from all directions and hence must come from outside of our galaxy. Eddington deducts the age of cosmic rays as ten billion years and Lemaitre says that the lessening of their energy in that time would be only about the same as if they had passed through 1/10 millimeter of water. Hence this absorption is negligible. The rays now under measurement have been in flight from one to ten billion years and have probably come from a point more remote than the farthest observable stars.

2431 N. 46th Street
Milwaukee, Wis.

Planetary Notes

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SUNSPOT OBSERVATIONS

By John D. Luczka, West Allis, Wis.
Feb. 11-27, 1936

Number of days of observation: 7.

Average number of groups per day: 3.7.

Average number of new groups per day: 1.0.

Average number of spots per day: 8.1.

Neither hemisphere predominantly active.

Aboard S.S. Vestvangen
New Orleans to Jamaica.

Metropolitan Notes

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Astronomers Guild of Jamestown, New York

ANTON HANSON, Persident
MARSHALL HEDSTROM, Secretary,
529 Stowe Ave., Jamestown, N. J.

The continued unfavorable weather has greatly hindered our work in finishing the observatory. Heavy snow storms were the order all winter. As late as March 17th, 30 inches fell and on the 21st of March 14 inches more clogged traffic. However, we are machining a Springfield mount for a 6 or 8-inch telescope, besides grinding mirrors. We sent a 10-inch Pyrex mirror with a pitch polishing lap, a 6-inch Pyrex with grinding tool and H. C. F. lap, two eyepieces in stages of grinding, and a testing rig to the exhibition held in New York during ten days in April.

Amateur Astronomers Association of Rutherford, N. J.

JAMES S. ANDREWS, President

On March 23, Mr. Fisher read a paper, "The Earth as an Astronomical Body". Mr. Harry G. Phair discussed the meteor which appeared over New Jersey, in the early morning of March 14.

The meeting of April 13, was addressed by Mr. John Loebbick, who read a very excellent paper "The Mythology of the Stars."

The following report on a brilliant meteor is submitted by Irving Meyer, one of our most active observers. "On the morning of March 14, 1936, the writer had just gone to bed after an evening of observation, when suddenly a rapidly brightening bluish glare lit up the window and room. One jump brought me to the window to see a huge meteor flash by. The time was 2:47 A.M., E.S.T. It was brilliantly blue, about magnitude -15. There were two short yellow flares of about the 1st magnitude after the main part had died. The duration was estimated at 5 seconds, but this is not strictly accurate because my position was poor. About a minute or two after passage, a loud rumbling noise was heard, which persisted for close to one minute. This was certainly not the noise of a train or any other common disturbance and might very well have been made by the meteor. Being partly cloudy and the moon out, (looking dull by comparison with the meteor), it was not easy to plot the meteor's path. It seemed to travel southeast, between the following positions: R.A. $12^h\ 40^m$ Dec. -2°, to R.A. $14^h\ 36^m$, Dec. -15° (1920).

"My position is approximately 40° 49′ 47″ north and 74° 6′ 3″ west."

Our Robert Cox ground and polished a 6-inch Pyrex and polished a 10-inch Pyrex at the recent astronomical exhibition at the New York Museum of Science and Industry. More will be said about the results of his labors in the next issue.

Long Island Telescope Makers

A. R. LUECHINGER, President
Box 214, Wantagh, N. Y.

Our last regular meeting was held at the home of A. Scholl at which time Mr. Scholl had arranged for a motion picture on relativity. As part of our regular program we conducted a discussion on light which we are working on at the present time. We are using "Astronomy" by Russell, Dugan and Stewart, as a text book and have regular talks by our members on subjects relating to astronomy. We find this method of conducting a meeting very satisfactory.

AAAA Notes

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take full advantage of the privilege. While we regretted his departure to such a great distance we are happy in the knowledge that he will continue to guide the activities of the planetary section from Jamaica.

The association heartily welcomes the Long Island Telescope Makers.

The Long Island Telescope Makers have recently voted to become affiliated with the AAAA. The association extends them a hearty welcome and every wish for success in their various endeavors. Their group is a unit of the Metropolitan Astronomical Society and A. R. Luechinger. Box 214, Wantagh, N. Y., is their president.

The AAAA was introduced to the radio audience from coast to coast over the RED Network of the National Broadcasting Company by James S. Andrews, chairman of the Metropolitan Ast. Soc. on Friday, April 17, 1936, at 10:45 P.M., E.S.T. Mr. Andrews briefly outlined the aims and purposes of the association and then introduced Dr. O. A. Gage, of the Corning Glass Company, who described the construction of the 200-inch mirror. The AAAA is very grateful to Mr. Andrews for the favorable publicity it received through his efforts.

A Page from the History of Amateur Astronomy

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fragments of work as had been preserved, mainly by Crabtree, appeared in 1672 under the editorship of Dr. Wallis, as "Jeremiae Horrocii Opera Posthuma." These fragments, including material in letters, indicate that Horrocks showed brilliant promise in theoretical astronomy. With reference to his explanation of the moon's evection, for example, Grant states that "he took the last great step in the development of the laws of planetary motion before Newton's theory of gravitation and doubtless helped the latter." We find him recognizing irregularities in the motions of the outer planets, making systematic observations of tides, and watching occultations of the Pleiades. Dr. Wallis said "had he but lived, what would he not have done?"

On your next trip to Europe look for the memorial to Horrocks, erected by the Royal Astronomical Society at the time of another transit of Venus in 1874. It is part of a monument to Conduitt (Newton's relative) on the north side of the west door to Westminster Abbey. Crabtree's observations of the transit in 1639 forms the subject of one of a series of frescoes, painted by Ford Madox Brown, in a large room in the town hall at Manchester.

In this brief article we pay our respects to these early members of the fraternity of youth of all times who find inspiration and delight in studying the sky.

John Payson Williston Observatory,
Mount Holyoke College,
South Hadley, Mass.

Plotting the Disk of Jupiter

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Change of Longitude in 30 Days

Rotational Period	Seconds System I	Seconds System II
0.1	0.1345	0.1369
0.2	0.2690	0.2738
0.3	0.4036	0.4107
0.4	0.5381	0.5476
0.5	0.6726	0.6845
0.6	0.8071	0.8214
0.7	0.9417	0.9583
0.8	1.0762	1.0952
0.9	1.2107	1.2321
1.0	1.3452	1.3689
2.0	2.6905	2.7379
3.0	4.0357	4.1068
4.0	5.3810	5.4758
5.0	6.7262	6.8447
6.0	8.0714	8.2137
7.0	9.4167	9.5827
8.0	10.7620	10.9516
9.0	12.1072	12.3206
10.0	13.4525	13.6895
20.0	26.9050	27.3790

The rotation period of zero meridian of System I is $9^h\ 50^m\ 30^s.004$ that of System II, is $9^h\ 55^m\ 40.^s632$.

If the longitudes are found to have been diminishing, the difference during the interval of 30 days must be subtracted; if the longitudes have been increasing, the difference should be added. Drawings of Jupiter thus plotted will furnish interesting information otherwise not disclosed.

1606 Woodland Street,
Nashville, Tenn.

Sketching at the Telescope

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the highlights. Small stomps serve a useful purpose. For intense sharpness a black crayon should be held in readiness. The expert will already gather this from my brief description.

I use a soft lead pencil for planetary detail of Mars and Jupiter because of their small size. One will soon discover that it is possible to work down without effort to the finest detail.

Time for completion of these sketches amounts to from 30-40 minutes. If seeing is good the observer may record further details.

In sketching, the observer will be surprised at the speed with which changes take place upon the sun. But even on the moon, changes of illumination are noticed after a short time. Only with charcoal is it possible to simulate speedily and true to nature, the granular surface and prominences.

404 - 8th Street,
Watertown, Wis.

AMATEUR ASTRONOMY

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Know Thy Telescope

D. F. BROCCHI

The study of literature pertaining to the theory of the telescope cannot be said to lead readily to a clear understanding, even assuming a high degree of intelligence on the part of the student. That such is mostly the case, may be due to the usual failure of pointing out two essential features:

First, any number of light wave trains can and do act through the same space at the same time without mutual interference.

Second, when used for visual purposes, the telescope supplies only part of the optical system, the balance being supplied by the eye of the observer.

At the optical plane of the objective the image of a point in the object is a surface of uniform illumination, equal in form and extent to said optical plane, being the result of an immense number of independent wave trains of different frequencies or wave lengths.

Assuming for the sake of simplicity that the objective is free from chromatic aberration (true for reflectors, but not for refractors), it will serve the present purpose to state that at the optical plane of the objective the image of the object consists of as many of the illuminated surfaces mentioned above, as there are points in it, each such surface the result of a wave train acting independently of the others and advancing in different direction, according to the positions of the points from which they originate.

In what follows, the refracting objective only will be considered. The reflecting objective requires some modification in treatment, which, however, would lead to the same conclusions.

Unobstructed light radiation from a point in the object may be visualized as an expanded sphere with center at the point, and the portion utilized by the telescope as a cone with base at the objective and vertex at the point; a cone that becomes a cylinder for all practical purposes, if the object is at a great distance. In passing through the objective the cylinder is refracted into a converging cone with vertex in the focal surface of the objective, this vertex being the *focal image* or simply the *image* of the point in the object.

The field of a telescope is so restricted that atmospheric refraction can be expected to have the same effect over its entire extent, and can therefore be disregarded in what follows. Then the axes of entrance cylinder and converging cone can be said to lie in a straight line joining the point in the object with its image, and constitute the *principal ray* of that particular light beam. As a matter of fact the principal ray undergoes a slight offset at the objective, but owing to the very small ratio of extent of field to focal length, this also can be disregarded.

All principal rays intersect at the same point in the axis of the objective, the *optical center,* so that linear dimensions of the image are to homologous dimensions of the object, as the focal length of the objective is to the distance from optical center to object.

Light flux is the rate of light energy radiating on or through a surface of given area per unit of time. *Illumination* is the rate of light flux per unit of area. From these definitions and the foregoing explanations it becomes at once apparent that the light flux of any part of the image is directly proportional to the area of the objective or to the square of the aperture, is inversely proportional to the square of the focal length; consequently it is the same for all objectives of the same ratio of aperture to focal length, which enables us to understand why in reflectors the moon and planets appear brighter, the ratio of aperture to focal length being invariably larger in this type of objectives than in refractors.

We are also prepared to understand that the form of the objective and obstructions in the path of the light beam have no effect on the form of the image. The light beam from a point in the object converges to a point in the focal surface irrespectively of the form of its cross section in any portion of its path.

If the telescope is to be used for photographic purposes, little more need to be said. The optical system consists of the objective with or without auxiliary equipment such as correcting lenses to offset the chromatic aberration of the more actinic rays in refractors, hyperboloidal mirrors to increase the focal length and reduce aberrations in reflectors, plane mirrors to deflect the light beam before or after it reaches the objective, or reflecting prisms, makeshift substitutes for plane mirrors.

If, however, the intention is to look through the telescope, we must revert to the light beam as it converges to a point, but continues as a diverging cone of the same angle as the converging one, its axis also coinciding with the principal ray, and after passing through the ocular into the eye, forms a point image on the retina, as will presently be explained.

The ocular has this in common with the objective, that it may be considered as a single converging lens, with optical center, focal surface. Inversely light from a point in the focal surface emerges as a cylindrical beam.

Let the ocular be placed in the telescope so that its focal surface coincides with that of the objective, as near as may be, the two surfaces being of slightly different curvature in most if not all cases. If the common cone vertex in the light beam from the objective were radiating light in all directions, this light would reach the ocular as a full cone, and emerge as a full cylinder with a common axis passing through the common cone vertex and the optical center of the ocular. The diverging cone of the light beam from the objective being a fractional part of this hypothetical full cone, the emerging cylinder must be a fractional part of the hypothetical full cylinder, its direction parallel to the line joining the common cone vertex with the optical center of the ocular, its axis or principal ray intersecting the axis of the telescope at some point beyond the ocular. A diagram will readily show that the angle V that this principal ray makes with the axis of the telescope, and the angle v that the original principal ray makes with the same axis, are connected by the equation

$$\tan V / \tan v = F/f$$

or, the angles being quite small in all cases,

$$V/v=F/f$$

where F and f are the focal lengths of the objective and ocular respectively; a relation which holds good for any two points in the object and their images, if v is the angle subtended by the points or their images from the optical center of the objective, and V the angle between the principal rays originating from the same points and emerging from the ocular.

If several principal rays are drawn at random in the diagram, it will be seen that on emerging from the ocular, they intersect at a common point in the axis of the telescope, the *eye point* of the ocular, the underlying geometrical principle being quite evident from inspection of the diagram.

The optical principle of the eye is the same as that of the telescope when used for photographic purposes, with the advantage that the eye is better equipped for correction of aberrations, although normally affected with a slight amount of astigmatism, very likely present for some useful purpose.

When viewing two points with the unaided eye, the distance between their images on the retina is to the actual distance between the points, as the focal length of the eye is to the distance from optical center of eye to object, as in the case of the telescope objective, as it should be; in other words, the retinal images subtend the angle v from the optical center of the eye.

If the optical center of the eye is placed at the eye point of the ocular, each cylinder is changed into a cone with vertex at the retina, its axis on the same line as the entering cylinder. Consequently the retinal images of the two points subtend the angle V from the optical center of the eye. It follows that linear dimensions of the retinal image obtained through the telescope are to homologous dimensions of the unaided eye retinal image, as the focal length of the objective is to the focal length of the ocular.

Unfortunately technical treatment of the subject of telescopic vision must necessarily terminate at the retina. That to the observer the telescopic image appears projected on a plane somewhere between the ocular and the objective, can only be hinted at as the result of mental processes transcending the limits of human understanding.

4331 Thackeray Place,
Seattle, Wash.

Comet Peltier—1936A

Additional information has just been made available which is of interest to the casual observer. This comet is approaching the earth and will come within a distance of 0.2 astronomical unit or approximately 20 million miles. At that distance it will appear as bright as a third magnitude star, visible to the naked eye. The end of July is given as the time of nearest approach.

Here is where the variable star observer steps in and finishes the job in some cases. The most favorable case is that of the eclipse of a spectroscopic binary star where both spectra are visible. In the study of the light curve, the angle of inclination is accurately determined. Then using the minimum masses, $m_1\sin^3 i$ and $m_2\sin^3 i$, the mass of each star may be found.

Aitken in his book on the binary stars lists 22 cases of masses as well as dimensions and densities of eclipsing systems. From the visual hinaries where the mass-ratios can be found, 29 cases are known. In 1926 Eddington used about 33 cases and found a definite relationship between the mass and the total amount of light of a star. That is, the more massive stars are brighter than the less massive, and the curve representing the relationship is nearly linear. At present we know of masses of stars 100 times greater than the sun and others which are only about 1/100 as massive. The sun, therefore, is average as regards quantity of material.

With the aid of the mass-luminosity curve, the mass of any star may be found as soon as its brightness is known. The information concerning stellar masses is therefore advanced by this method. But after all, the accuracy of determination goes back to the problem of obtaining as many fundamental determinations of mass and luminosity as possible —which means combining observations of parallax and double star positions, spectroscopic observations of stellar velocities, and photometric measures of brightness, particularly for accurate light-curves of eclipsing stars. Thus astronomy is a science demanding cooperation between observers of its various branches.

Washburn Observatory,
Madison, Wis.

Saturn's Rings

B. J. DURYEA

Only once every 15 years are the rings of Saturn seen edge-on. Hence every amateur who can borrow the use of a telescope, or who has one of his own, should be alert for a good view of this unusual sight the last of June. It will give him an idea of the feelings of Galileo the second year he had his "homemade" telescope,—and "could not find the appendages."

Saturn will rise about 11:00 p. m., June 28, 1936. Three hours later, at about 2:00 a. m., June 29, the earth's center intersects the ring plane and the rings will be seen edge-on. With keen eyesight, a clear night and a good telescope, a thin dark line along the planet's equator may be seen. But the phenomenon is interesting for two or three nights before and after June 29.

At this time careful observation of the planet's elongation should be made. The equatorial diameter is 7,890 miles greater than the polar diameter. The absence of the glare of the rings will enable the observer to see greater detail in the cloud belts. A spot at the center of the disk one night will be at the center again a few hours earlier two nights later. (Saturn makes nearly five rotations to the earth's two.)

Another unusual sight will be Saturn's moons. They will be nearly in a straight line, instead of scattered around the planet as they are at other times. It will be interesting to know how many amateurs can see seven of Saturn's satellites.

333 Montgomery St.,
San Francisco, Calif.

Comet Peltier—1936A

JAMES S. ANDREWS

On Friday morning, May 15, a comet was discovered by the indefatigable Leslie C. Peltier, garage employee of Dolphos, O. Upon reading of it in the newspaper, Irving Meyer and James S. Andrews telephoned to Harvard College Observatory to obtain exact position and then went searching for it with Mr. Meyer's 12-inch reflector. It was located after about five minutes search as a 10th magnitude object in the constellation Cepheus, not far from the star Gamma. The two positions already observed are as follows:

5/17/.19 U. T.	$23^h\ 53.^m5$ R. A.	73° 21′ N Dec.
5/18/.13 U. T.	$23^h\ 54.^m8$ R. A.	73° 16′ N Dec.

Epoch 1936.0

The comet is easily seen, having a bright nucleus and moving about 10′ of arc a day. It appears to be about four or five units from the sun. If later observations bear this out, then we might have a brilliant naked eye object in the sky later in the year. Let us hope for it. The present generation of young people has not yet seen a comet, and for those of us who checked Halley's 1910 comet, the spectacle is inspiring.

33 Franklin Place, Rutherford, N. J.

Occultations

R. D. COOKE

OCCULTATIONS VISIBLE AT MILWAUKEE DURING JULY

Date	Star	Magnitude	Immersion	Pos. Angle
June 30	42 Librae	5.1	10:03 PM	140°
July 28	41G Scorpii	6.3	9:51 PM	63°
July 29	137B Ophi	6.3	11:52 PM	123°
July 30	9 Sagitt	5.9	9:13 PM	22°
July 31	168B Sagitt	6.3	9:05 PM	87°

The following tables gives the reductions of occultations observed in 1935 by members of the MAS. The reductions were computed by Sister Mary Felice, S. S. N. D., of Mount Mary College and by R. D. Cooke :

Observer*	Star**	Date 1935		G. C. T.			χ		$\chi-\rho$		$\sigma'-\sigma$
				h	m	s	°	′	°	′	″
C	BD+19° 362	Mar.	9	0	28	04	52	12	—20	09	—2.7
C	26 Arietis	"	9	0	47	29	74	34	2	09	—1.7
A	26 Arietis	"	9	0	47	31	74	40	2	15	—1.8
C	O_2 Cancri	"	16	6	22	37	93	48	—17	11	—3.2
C	O_1 Cancri	"	16	6	35	24	158	10	47	09	—1.6
A	O_1 Cancri	"	16	6	35	25	158	08	47	07	—0.1
C	43 Leonis	"	18	3	08	45	124	27	9	09	—2.5
C	83B Leonis	May	11	5	09	58	80	0	—34	09	—3.8
A	83B Leonis	"	11	5	10	01	80	2	—34	7	—3.7
C	89B Leonis	"	11	6	37	00	168	23	54	8	+1.1
C	A Scorp	July	13	1	06	27	120	32	24	50	—4.0
C	116B Scorp	"	13	2	16	01	124	20	29	1	—1.6
C	λ Capr	Sep.	11	5	21	06	117	32	50	59	—1.6
C	σ Capr	Oct.	7	1	23	00	57	21	—15	0	—3.5
C	18 Aquarii	"	8	6	32	36	41	42	—26	4	—1.3
C	κ Piscium	Dec.	4	4	25	05	83	3	+18	8	—2.9
K	κ Piscium	"	4	4	25	9	83	13	+18	8	—1.4
C	9 Piscium	"	4	4	44	58	132	50	+67	55	—0.5

* A = L. E. Armfield; C = R. D. Cooke; K = G. Knott.

** Star positions (not shown) are from the American Ephimeris and Nautical Almanac.

6811 Cedar Street
Wauwatosa, Wis.

Photographic Notes

LYNN MATTHIAS

The photography of meteors is a recreation that can be indulged in by anyone who possesses a hand camera. Practically no additional equipment is required since even a stationary camera, altho it will record the stars as trails, is suitable for the photography of meteors. All that is necessary is a solid support that can be adjusted to direct the camera to any desired area of the sky. The new minature cameras are particularly suited for this work since the chance of recording a meteor is much greater with the high speed lenses normally used on these cameras, than with the ordinary camera.

It is of course desirable to photograph the stars as points and the meteors as trails. This requires some form of equatorial mount and drive for the camera, or the camera may be fastened to an equatorially mounted telescope in the manner as has been recommended for the patrol comeras; the telescope being used to keep the camera centered on some one star while the photograph is being taken. If two similar cameras, one stationary and the other driven to follow the diurnal motion, are used to take simultaneous photographs of the same field, the time at which a meteor passed thru the field can be determined, if the time at which the exposure is begun is noted. This may be done by superposing the meteor trails on the two negatives, and noting the length of the star trails from their beginning to the corresponding star image on the negative from the camera that was guided. The length of the trail in terms of the scale of the plate gives the time elapsed from the beginning of the exposure to the time when the meteor passed thru the field.

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Meteor Section

FRANKLIN W. SMITH

The Lyrid and Eta Aquarid meteor showers are now over but to date no reports have been received. Perhaps other observers encountered the same unfavorable weather conditions which prevailed here. The writer saw a single probable Lyrid in an hour's watch from 9:30 to 10:30 on April 20, but conditions were not favorable for observing at other times. Conditions were still less satisfactory at the Eta Aquarid epoch and for that reason no observing was done.

Because of the importance of the Eta Aquarid shower, it seems that a redetermination of its epoch of maximum might be advisable. It is usually assumed that the maximum occurs on May 4, but observations obtained here in recent years seem to suggest at least that it may come later. A summary of these observations follows:

Year	Date	Rate per hr.
1930	May 3-4	3
1932	May 2-3	1
1933	May 4-5	2
1935	May 7-8	7
1935	May 11-12	1

(continued on page 75)

AAAA Notes

The Association is deeply grateful to Thomas L. MacDonald, F. R. A. S., secretary of the West of Scotland Branch of the British Astronomical Association, and author of the following article which appeared in the April 1936 issue of The Journal of the British Astronomical Association. The AAAA also takes this opportunity for expressing its sincere appreciation to the B. A. A. for its kindly wishes and for devoting space in The Journal for the publication of Mr. MacDonald's article.

The American Amateur Astronomical Association

"The rising interest in amateur astronomy in America has been one of the encouraging features of recent years. Doubtless the fashion for telescope construction very often ended only in the neglect of the instrument on which time and care had been spent; but it also produced some excellent observers, and still more who were ready to be interested in practical work. The relative isolation of amateurs in many parts of U. S. A. has doubtless hindered the establishment of anything comparable with the B. A. A., but the success of the R. A. S. of Canada shows what is possible. (It has now nine branches scattered across the Dominion—the B. A. A. and its West of Scotland Branch must feel a special interest in the London and Hamilton Centres!) The work of the A. A. V. S. O. and the groups for meteor observations under the Olivier-Hoffmeister programme are well known on this side. But during the past few years a considerable number of popular astronomical societies and groups have sprung up in different parts of the states, many of which have issued more or less comprehensive cyclostyled bulletins. One of the most attractive of these, the Texas Observers' Bulletin, starts the new year with No. 53, and has put on record a large amount of interesting information, especially on meteors. This society, with headquarters at Fort Worth, is affiliated to the B. A. A. At the end of 1933 the Missouri and Southern Illinois Observers group started the Astronomical Discourse, published from the Locksley Observatory, Webster Groves. At the beginning of 1934 the Milwaukee Astronomical Society commenced a printed bulletin, the M. A. S. Bulletin; observing sections for occultations, meteors, etc., were organized. A year later the two last-mentioned societies joined forces with the newer Madison Bulletin (Wisconsin) to form the American Amateur Astronomical Association, or A. A. A. A. The publications throughout 1935 consisted of the separate bulletins inserted loose in a cyclostyled cover; the Junior Auxiliary of the Milwaukee Astronomical Society, and later in the year the Amateur Telescope Makers of Chicago, contributed sections. With the beginning of 1936, Amateur Astronomy appears as a single printed magazine, to which societies in Norwalk, Conn., Pittsburgh, Pa., and Rutherford, N. J., also contribute. Notes are contributed by the sectional directors for photography, occultations, variable stars, planetary work, etc. The new publication is issued from 2046 S. 59th St., Milwaukee, Wis., at one dollar a year. The following sentences from the first issue of the joint publication should be of interest: 'Turn for a moment to Great Britain—they have their British Astronomical Association: this association embodies practically every prominent and active amateur astronomer in Great Britain, and some of those from other countries. Its organization is such that its inauguration in similar form here in America would offer a solution to the rapidly increasing problem of how to take care of the many amateurs and their multitude of troubles.' We can only hope that the new venture will find itself securely established in as short a time as did the B. A. A.—T. L. M."

Milwaukee News Notes

MILWAUKEE ASTRONOMICAL SOCIETY

HERBERT L. GRUNWALD, Correspondent

The Milwaukee group acknowledges the pleasure of a visit with Dr. Huffer of the Washburn Observatory, Madison, on Thursday, May 7, at its regular meeting. He was accompanied by Mrs. Huffer, Mr. and Mrs. William Binney and Mr. Baird. Mr. Binney, president of the Madison Society, commented on the benefits of close cooperation between their group and ours. The title of Dr. Huffer's address was "Weighing the Stars." Determination of stellar masses is the primary interest of the associates at the Washburn Observatory at the present time.

On May 13 several members visited the bi-weekly meeting of the Round Table Conference composed of employees of the Wisconsin Telephone Company. The purpose of their organization is to exchange ideas on the personal interests of the members. Luverne Armfield, a member of the group, presented a talk on astronomy and its relation to wireless communication, referring mainly to signal strength as affected by solar phenomena. Digression to interesting bits of popular astronomy made the lecture exceedingly entertaining. The group was especially enthusiastic about Harold Stamm's work in teaching astronomy and telescope building at the West Allis High School. Harold presented his motion picture film and explained the advantages of visual and practical education in the field of science. The meeting was followed by a dinner at a nearby restaurant after which observations of popular objects were made with telescopes owned by Arthur Peck and Herbert Grunwald. These members also conducted the observation program.

It is always pleasing to make announcements in regard to the progress of our members in their field of activity. Our interest at the present time is attracted to Miss Helen Pillans, who was an active member in our society until last September when she accepted a teaching position in an elementary school in Michigan. Miss Pillans has recently been chosen as an assistant instructor in the physics department of Hollins College located near Lynchburg, Va. Additional preparation for her work, which is to begin at the opening of the 1936 fall term, will include an advanced course in physics at Oxford University, England.

Edward Halbach has just presented another new instrument of his manufacture for trial by observing members of the society. Like many of his works, it is for the measurement of time intervals. The dimensions of the entire unit are 3¼ x 1¾ x 2¾ inches, and it is intended for use at the eyepiece of the telescope. The reading on the dial indicates the duration of time from the moment the clock is set into motion until it is stopped. A small push button manipulated at the eyepiece starts and stops the timer. Calibrations are such as to allow accuracy to 0.1 of a minute through a period of 1000 minutes. In variable star observing it can be used to determine the time necessary for studying each individual field. He suggested that a variable star observer, although not primarily engaged in meteor observation, can actually contribute to this work by reporting his observations of telescopic meteors. The new "electric stop-watch" can be of advantage in determining the duration of time spent in such meteor observation by allowing it to be in action while the eye is at the telescope. Our observing members will give it a trial and further comments will undoubtedly be published.

2431 N. 46th Street,
Milwaukee, Wis.

Meteor Section

(continued from page 71)

The 1930 rate was obtained after the radiant was above the horizon.

These observations are of course too meager to permit the drawing of any definite conclusions, but they seem to indicate that the problem is worth following up.

Last month the determination of the radiants of minor showers was discussed, and the advisability of having these determinations checked by a comparison of independent observations made at about the same time, was pointed out. The writer would like, therefore, to hear from observers who worked on the night of Feb. 28-29 or March 22-23, because he obtained a possible radiant on each of these occasions.

The epoch of the Pons-Winnecke shower falls on June 28. While there is no reason to expect a shower from this stream this year, it is hoped that observers will cover the period if possible. On a number of occasions during recent years isolated and unconfirmed reports of showers at this epoch have appeared. It is extremely difficult to evaluate such reports, but if a number of observers will watch we shall at least know definitely whether a shower does or does not take place.

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