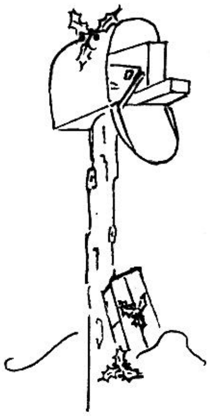
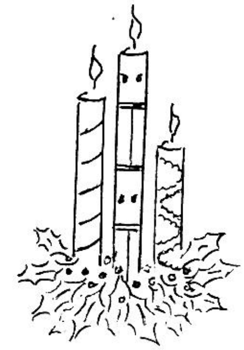


THE SPECTRUM



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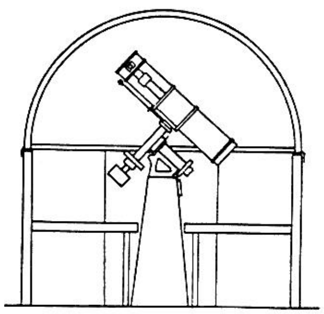

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"SPECTRUM" DEADLINE

The deadline for the JANUARY-FEBRUARY issue fot the "SPECTRUM" will be DECEMBER 14, 1990. PLEASE write this date down for a reminder.......

MEETING NOTICES

NOVEMBER - The November meeting will be held in the auditorium at Buffalo Statae College on November 9, 1990 to begin at 7:30 PM!!! Our speaker for the evening will be Larry Carlino, a member of the BAA who will present to us "Observing Mars." This talk will include the history of observing Mars as well as present day technics on observing the Red Planet. Refreshments to follow.

DECEMBER - The December 12, 1990 meeting will also be held at Buffalo State College in the Auditorium starting at 7:30 PM sharp!!! Our speaker for the evening will be our own Bob Hughes. His topic, "Observing Geomagnetic Systems" should prove to be very interesting. He will explain what they are and how they can be observed. We will also enjoy Edith Geiger's "Candid Camera" quips of which you might be a part. They should be good for a laugh or two. Remember too, that this is our "Annual Christmas Party." Joe Provato would surely appreciate any cookies or goodies you might wish to bring in. The refreshments will include cheeses of sorts and wine.

!! MERRY CHRISTMAS !!
&
!! HAPPY NEW YEAR !!

OBSERVATORY REPORT *457-3104*

September Public nights and Nature Festival were a bit of a washout. We had over 75 people visit the Observatory for the Nature festival even though it rained both days. I had 10 people wait around for the sun to emerge on that Sunday (5:30pm), and treated them to a magnificent set of spots. October was better, the 20th was clear, and we had over 30 people show up. Fortunately Conrad, and Rolland showed up to help. We managed to show them Mars, Saturn, Uranus, and Neptune. Of course we showed them the usual nebula until the near full Moon showed up.

NOVEMBER EVENTS: Nov. 10, and 11 the Observatory will be open 1-5 pm in conjunction with the Nature festival. The Observatory will also be open Nov. 10 at 7-10:30 pm for viewing Mars. As usual **HELP IS NEEDED.** (see bribe (?) next paragraph)

PARTY: November 10 at 5 pm we are having a **MARS** party rain or shine. We will be importing pizza, wings, and possibly chili along with a microwave to keep them hot(?). The cost of the pizza and wings will be split amongst those who attend. Please let me know in advance if you are coming so we can order the right amount. PS if you decide at the last minute, **457-3104** just call before 3pm so we can get the order in!!

PHOTO SESSION: Novembers will be after the Mars party. As usual there will be none in December, as it is usually cloudy. We will resume in January.

Daniel R Marcus

INSTRUMENT NOTES

The reflecting telescope dates back to a theoretical article written by James Gregory, a Scottish mathematician in 1663. He described a dual reflecting system using a perforated parabolic cancave mirror, later called the primary, and an elliptical concave mirror, now known as the secondary. The assembly was theorectically perfect but it could not be built as there were no optical workers with the necessary knowledge and skill to make the special mirrors. It was not until 1723 that John Hadley, a skilled optical worker made the first Gregorian telescope. This must have been a great achievement back in the days of metal mirrors and testing the figure on the stars.

Shortly after Gregory's a paper appeared, Issac Newton built a 6-inc reflecting telescope. This was in 1675. It does not appear that this instrument was ever extensively tested. Newton who was a leading theoretical and practical optical worker may have tested the mirror on an optical bench with test targets. We do know that Newton was led to the study of reflectors because of his dismay at the dispersion effects noted in refracting telescopes.

Before the reflecting telescope could take its place as a worthy companion to the refractor several developments intervened. The first great impetus came when William Herschel, a skilled musician, took up astronomy and telescope making. He learned the art of casting mirror blanks from bell metal alloyed with arsenic to give a whiter metal. He developed high skill in figuring, testing the progress on the stars. He brought observaional astronomy to many by making and selling many high grade telescopes. In 1781 he discovered the planet Uranus using a 6-inch telescope of his own construction. This brought fame and increased the interest in astronomy and also telescope making.

The second major break through came in 1856-7 with the development of the method of depositing a silver coating on glass. This was an independent development by Liebig, Steinheil and Foucault. The coating was much more reflective than speculum metal and when it tarnished it could easily be removed chemically and replaced without any effect on the figuring of the glass support.

The third great advance came in 1859 with the invention of the knife edge test by Leon Foucault of France. Instead of using a star at infinity as a light source, Foucault used an illuminated pinholw at the center of curvature of the mirror as the light source. This test made it possible to figure the mirror in the shop regardless of the time of day or weather conditions. The method revolutionized the production of fine parabolic mirrors.

From the invention of the reflecting telescope in a663 to the acquisition by the world of the glass silvering process and the knife edge mirror test two centuries had passed. But now the reflecting telescope was ready to do its part in the world's work. And more and more mirror tests were developed. In addition to the famous knife edge test there was the variation invented by the famous Ronchi of Argentina. He passed the light from a broad source through one part of a screen of parallel wires and had the return beam pass through another part of the same screen. This produced a diffraction pattern of parallel lines. If the lines were straight the surface was a sphere. A later variation used a glass plate etched or ruled with fine parallel lines. This increased the precision of the test. For a spherical mirror a pattern of straight lines was obtained. For a parabola judgment had to be used. But distorted areas could easily be seen.

The knife edge test gives a good null for a spherical mirror but in testing for parabolization it is necessary to advance the position of the knife edge by stages and match a shadow on the left with another in the corresponding zone on the right. Then a curve of focal length versus radial position on the mirror is obtained. This can be compared with the true parabolic curve and any variation noted in units of wavelengths of light. The method is very accurate and has stood the test of a century of use. But the method is very slow and tedious.

The difficulties of the zonal test method led Horace Dall of England to devise his well known Null test. This was claimed to produce a good null when the true parabolic surface was reached. The test was set up like the Foucalt test except that the incident beam passed through a plano convex lens before striking the mirror. The spherical lens surface introduced spherical aberration. When the mirror is a true parabola it will cancel this aberration and produce a null. I made some extended t trials of this method. But I found that the shadows produced varied with the relative angle of the incident and returning beams. The procedure seemed to be testing the method rather than testing the mirror. Dall notes are not clear on this point.

A variation of the Dall Null Test is the recently announced Ross Null Test. Here the parallax problem is avoided by letting the return beam pass through the same lens as the incident beam. This method looks very interesting and will be an interesting project for a few of our instrument meetings.

Ed Lindberg

SPY and TELL

Jack Empson has had endless problems, demanding a great deal of repair work. The thermostat in his refrigerator went kaput, and instead of being frost free, it was full of ice, so that he had a real job fixing it. Then the dryer wouldn't heat; that meant more repair work for Jack. He was changing a window and the handle knob came off. He picked up a window crank on his way home from work, and on arriving home found that his wife's car had died. With the major problem being the engine, he ended up having to work on the car for a week. On top of all this, one of his daughters wanted a pet rabbit, and that meant building a little hutch for bunny. Adding to this, Jack had to have a tooth fixed, and also suffered a horrible allergy attack. Hope your luck will improve.

Terry Cantwell, who makes satellite hardware at Moog, Inc., is working on a few of the components for a system that will refuel satellites in orbit. He is also a part time ski instructor at Kissing Bridge.

As Dave Junkin's birthday was on October 9th, he and Marty celebrated by going to Hawk Mountain Sanctuary on Kittatiny Ridge in Pennsylvania, to watch the hawk migration.

Marguerite Aiple spent the summer enjoying the cultural events in the area and Canada. She attended several lectures and plays at Chautauqua; saw Can-Can and a ballet at Art Park; Les Misérables at Sheas; went to the Shaw Festival where she was delighted with the ballet; saw Phantom of the Opera in Toronto, and a few happenings at Melody Fair. She continues her pursuit of cultural enrichment throughout the year.

Heartiest congratulations and a warm welcome to the new arrivals: Ryan Alexander Johannes Sigurdson, weighing 7 lbs. 5 oz., was born to Wade and Lynn Sigurdson on August 7th, and Brianna Laura Sepulveda, weighing 8 lbs. 4 oz., was born to Dave and Cathy Sepulveda on September 6th.

Luann Szucs, the lovely young lady who has done such fine work on our membership tags, is a graduate of Buff. State with a B.A. in Art. She is enjoying a course at the Buffalo Museum of Science under the direction of Susan Quindy, who is a scientific illustrator. The class is drawing animals using the mounted specimens at the museum. Luann was a T-shirt artist in Florida for awhile. She worked at the Rat Hole for a boss called "Big Daddy Rat."

Ruth Christy casts a mean reel. She caught a 44" muskie. Congratulations. Strong man, Darwin, helped lift the catch into the boat.

Bob Hughes, Jack Empson and Dave Sepulveda were very busy being marshals at Watkins Glen for a number of this year's races, including the Winston Cup NASCAR Races.

Dr. Cliff Stoll, former Buffalonian, who assisted Ernst Both in the Kellogg Observatory when he was a student at Hutch Tech, was seen in October on the TV program, Nova, in "KBG, the Computer and Me," a dramatization of how he cracked a major computer spy ring in West Germany.

The Geigers went whale watching out from Provincetown, Cape Cod, in early September. It was a great experience.

Edith L. Geiger

ASTRONOMICAL HAPPENINGS

SOLAR: The Sun will be making its journey out of Libra into Scorpio on November 17th and then into Ophiuchus on November 24th. On December 14th the Sun will enter Sagittarius and remain there into 1991. Three conjunctions with the Sun will occur: Pluto on November 10th; Juno on December 10th; and Uranus on December 31st.

LUNAR: The phases of the Moon are Full (Hunter's) Moon on November 2nd, Full (Cold) Moon on December 2nd and Full (Snow) Moon on December 31st. The senond full moon in December is also referred to as the "Blue Moon". Last Quarter Moons are on November 9th and December 8th; New Moons on November 17th and December 16th; and First Quarter Moons on November 25th and December 24th.

LUNAR CONJUNCTIONS: Mars - November 4th and December 1st & 28th; Jupiter - November 9th and December 6th; Mercury November 18th; Antares - November 18th; Neptune - November 21st and December 18th; and Saturn - November 21st and December 19th.

LUNAR OCCULTATIONS: Antares - December 15th.

PLANETARY EVENTS: Venus in superior conjunction - November 1st; Mars & Aldebaran conjunction - November 13th; Vesta at opposition - November 15th; Mars' closest approach to Earth - November 20th; Mars at opposition - November 27th; Jupiter stationary - November 30th; Mercury at greatest elongation (21° east) - December 6th; a double conjunction of Mercury & Uranus - December 10th & 18th; Mercury stationary - December 14th; Mercury & Venus conjunction - December 18th; Venus & Uranus conjunction - December 19th; Venus & Neptune conjunction - December 22nd; and Mercury at inferior conjunction - December 24th.

METEOR SHOWERS:

November - 2nd - Quadrantids
3rd - Cepheids
10th - Northern Taurids
11th - Mu Pegasids
12th - Arietids
14th - Bielids
16th - Leonids
28th - Andromedes
December - 5th - Phoenicids
10th - Monocerotids
10th - Chi Orionids (northern)
11th - Rho Hydrids
11th - Chi Orionids (southern)
11th - Delta Arietids
13th - Geminids
22nd - Ursids

BAA ANNALS

5 YEARS AGO - Halley's Comet was the big excitement five years ago. If you have a copy of the November-December 1985 SPECTRUM, re-read Jack Mack's amusing review of one of the many books published to capitalize on the event. Darwin Christy contributed an article on Sir Edmund Halley and his comet. An anonymous article on the risks and benefits of sending a space craft to annihilate the comet needs to be read, not described, to be appreciated. Beaver Meadow was open on Sundays during the fall months for public veiwing of the "once in a lifetime" visitor.

In November Tom Dey, the active amateur astronomer and astrophotographer from Rochester, spoke on gas-hypersensitized astrophotography. For December Edith did her annual Candid Camera exposure followed by Carl Milazzo and Clare & Bill Owens' slide show report on the fiftieth anniversary of Stellafane.

10 YEARS AGO - BAA member Gil Brink spoke on "The Interstellar Medium" at the November 1980 meeting. The Christmas meeting was traditional: Candid Camera and short talks from Ken Kimble on his solar telescope and Darwin Christy on past club members and activities. A new holiday event was introduced by Joe Provato - wine and cheese. It seems to have stuck. (The cookies and cake help too—don't forget to bring some this year.) Edith Geiger had a biographical sketch of Larry Carlino, a long time member and an accomplished observer and speaker.

15 YEARS AGO - In November 1975 Ken Brown from the Rochester Astronomical Society spoke on "Why Not an Armchair Astronomer". Ken has an enviable collection of historical astronomical literature. For December Ed and Olga Lindberg gave an illustrated talk on "Astronomical Clocks and Time Pieces". Ernst Both, who was SPECTRUM editor in those days, had the first installment of a two-part article on a telescope built by two Yale students in 1838, which was the "largest telescope on this side of the Atlantic", a reflector all of 12 inches in aperture.

We were promoting a second Pops concert to help finance Beaver Meadow Observatory. Tickets were $5 in 1975. I think that gets you into the parking lot these days; that is, if they have concerts at all.

25 YEARS AGO - Four BAA members gave brief reports on the activities of the Observing Section. They were: Ernst Both - Visual Observations of Mars, Dick Zygmunt - Measurements of Lunar Features, Fred Price - Lesser Known Lunar Formations and Edith Geiger, who discussed her astronomical sketches. The Advanced Study Section, headed by Ron Clippinger, discussed the life cycle of main sequence stars. In December Olga Lindberg was our speaker on "Women in Astronomy".

Rowland A. Rupp

Continued from the September-October issue

VISUAL METEOR OBSERVATION FOR AMATEURS

by

R. D. Manners

For Presentation at the 1967 Annual Convention
Northeast Region of the Astronomical League,
Buffalo, New York, May 26 - 28, 1967.

In addition, to complete the record we need to note the time of appearance, the magnitude referred to comparison stars or planets, and the duration of the meteors flight in tenths of a second. The estimation of short periods of time with this accuracy is again a matter of personal training. Any special records such as unusual colors, trails, trains, bursts of light, should be added at this juncture. Thus, for the three meteors in question:

1967 April 22nd. Zenith Magnitude 5.5, sky clear.

1)	2050½ U.T.	mag 4.3	dur 0.7s	weight LA
2)	2124	2.1	0.9	IW
3)	2138	1.7	0.6	LA

The weight of the observation is a simple but effective method of classifying the accuracy and the system used above in the last column is as follows:

LA: Looking at or near the place where the meteor appeared (not disappeared) and the results considered accurate and reliable.

LW: Meteor appeared a little wide (say 10 to 20°) from the center of attention, but results considered satisfactory.

VW: Meteor appeared in an area very wide from the center of attention and results therefore unreliable.

Experience will enable the observer to apply weights to other aspects of the observation, such as the accuracies of the various reference points of the flight direction and the length of path. Constant critical self evaluation is necessary to maintain accuracy, especially in a watch lasting several hours.

It will be appreciated that accurate recording entails quite a tax on the memory. Experience shows that it is best to study your meteor during its brief period of visibility using this second or two to form an intense mental image. The next step is to put up your string onto the flight direction and memorize the various elements in the following order:

1) Flight direction
2) Length of path
3) Magnitude, referred to comparison star
4) Duration of flight
5) Time of appearance

Thus the observations are made in a definite chronological sequence beginning with the most important parameters of flight direction and length of path and ending with the least important parameter of the time of appearance. Further experience will allow you to deduct an estimated figure for the time spent in memorizing the various elements, and the clock should be checked both before and after the watch against radio time signals. Of course, a chronometer and tape recorder can be used to excellent advantage, and permit an undivided attention to the sky resulting in many more meteors being recorded.

A small percentage of meteors will be observed to have curved flight paths and they must be rejected. Stationary meteors are also quite rare, but the astute observer can often record their position quite accurately in a rich star field.

Other details which should be noted are the times of beginning and ending the watch, times off for cloud, rest, etc., so that the time actually spent in observation can be determined. This data is valuable in determining hourly rates. For similar reasons, data on the state of the sky is important, and the magnitude of the faintest star visible in the zenith should be noted, together with the amount of cloud cover or amount of sky obscured, such as 'cloud 1/10th', together with the times of any meteors seen which you were unable to record.

3. MULTIPLE OBSERVATIONS

The above is a brief discussion of the well proven and accurate method used for meteor work by the BAA. It will prove quite adequate for the single observer working alone to use this method to determine radiants and hourly rates. The true value of the method is seen however when two or more observers work in unison at distances of about 50 or 100 miles apart and coordinate their area of watch so that they are looking at the same space above the earth. Any meteors appearing in this space will hopefully be recorded by two or more observers and information can be obtained from these sufficient to permit the accurate determination of the actual flight path in the earths atmosphere and the orbit. The single observer working alone cannot tell how far away a meteor is nor the angle of foreshortening and therefore the radiant and height in the atmosphere remain unknown. But for multiple observers the apparent path differs according to the real position of the meteor relative to the observers station and the data can be reduced by well known computational methods, e.g., Ref 2.

Another advantage of multiple observations is that the probable errors of each individual observation can be determined, thus paving the way for really accurate positional work on the complex structure of radiants.

4. OBSERVATION OF FIREBALLS

The observation and recording of the pertinent details of the flight of a fireball in no way differs from the method outlined for meteor work. There may however, be additional details which can be recorded and this should be attempted wherever possible. Unusual colors, appearance of rotation, form and features of the train, noises and apparent magnitude should be recorded. Most fireballs are exceedingly bright, and it will be necessary to compare their magnitude with either a bright planet or even with the moon in exceptional cases. An unusual feature which sometimes occurs is that the fireball will leave a long enduring train in the sky. Records of the position and movement of the train are of exceptional value in upper atmosphere studies and every effort should be made to obtain the necessary data. Trains move very rapidly, and it is essential therefore to obtain positional data at intervals of at least one minute and preferably shorter. If sets of maps are available, the position of the train can be sketched in together with measured positions of the ends, using the same method as is used for recording the beginning and end points of the flight of a meteor. Observations should be continued for as long as possible. A pair of binoculars can materially extend the available observation time.

As in the case with meteors, multiple observations of fireballs and their trains are valuable in determining orbits and atmospheric paths. This data is more important in those cases where the fireball is large enough that portions of it fall to earth. Accurate observational data on fireballs would result in the recovery of many more meteorites for scientific investigation. There have been cases where bright fireballs were seen by many thousands of people, yet the scarcity or even the absence of accurate positional data has made the recovery of the object an impossible task.

5. DAYLIGHT FIREBALLS

Brilliant fireballs are occasionally seen during daylight hours and it is of interest to examine how accurate positional and orbital data can be obtained for these objects.

Jan 26th, 1967, 5.26 p.m., U.T. Fireball observed in early evening when no stars were visible. The flight direction of the fireball was noted as (1), 1° below top of fir tree, (2), 2° above antenna mast, (3), 1° above top of oak tree, (4), 2° below top of second chimney. Magnitude 2 x Jupiter, duration 2.5 secs, no train. Observations reduced to star positions by timing transits to give the great circle track. Data is recorded as follows:

U.T.	Transit of	R.A.	Elapsed Time Δt	R.A.- t	Decl.
6h 15.2m	Rigel	5h 12m	0h 49.2m	4h 22.8m	-8° 15'
6h 25.3m	Aldebaran	4h 33m	0h 59.3m	3h 33.7m	+16° 25'
6h 52.9m	γ Ori	5h 22m	1h 26.9m	3h 55.1m	+6° 16'
7h 25.2m	Betelgeuse	5h 52m	1h 59.2m	3h 52.8m	+7° 24'

The flight direction coordinates are given by the last two columns.

Figure 2 DAYLIGHT FIREBALL OBSERVATION

Firstly, it is necessary that the flight direction of the fireball is referenced to a set of known and easily recoverable points. Figure 2 is a record of such an observation, and it will be seen that I have used trees, chimneys and an antenna, these being the most easily accessible objects at the time. As in meteor work, the first essential is to form an intense mental image of the flight direction of your fireball. Then note the relationship of this flight direction with any available reference points. If a string or straight stick is available to extend the flight path, so much the better. Make your records of the flight path, the beginning and end points, duration of flight, magnitude, unusual effects, and the time of appearance. Then make a careful note of the point from where the observation was made. This may entail marking the can be recovered later.

Return to or remain on the site until such time as stars become visible. Then using a small telescope or a pair of binoculars, time the transits of several stars as they pass across the previously noted flight direction of the fireball. Suitable reduction of these transit times will then provide the great circle track of the fireball. The procedure is completely illustrated by Figure 2.

The last two columns in the table give the coordinates of the flight direction of the fireball. The beginning and end points of the flight can be defined in a similar manner by noting the time at which a star has the same azimuth as was noted during the flight. Now if you will plot the Right Ascensions and Declinations given in the last two columns, you will rapidly become familiar with the method and will also see that quite good accuracy is easily obtainable. As in meteor work, estimates of flight directions should be referenced to points that are no more than one or two degrees from the flight path. If any greater distances are attempted, errors are sure to creep in and the resulting flight direction may be quite useless for accurate reduction of the flight path and orbit.

Since this type of observation can be made without any specialized equipment and can provide accurate results, observers should attempt to use it whenever a daylight fireball or other object is seen in the sky.

6. THE OBSERVING PROGRAM

Meteor work may be undertaken by one person working alone or by a large group intent on multiple accordances and reduction of the data as previously described. A large group of about ten observers would permit a comprehensive observing program capable of excellent results. Observing should be limited to moonless nights and observing times and directions of watches should be coordinated throughout.

The number of meteor radiants available for observation is not limited to the few that appear in most astronomy textbooks. The radiants and structure of these major streams is well known, and the amateur desirous of contributing to the science would be well advised to look elsewhere for his material. The work of W.F.Denning will serve as an excellent starting point, and, since it is not too easily available, I have added as an Appendix a copy of his Catalog of the Radiant Points of Meteoric Showers, which originally appeared in 1899 as a Memoir of the Royal Astronomical Society (Ref 3). This monumental work contains no less than 4,367 meteor radiants grouped about their mean centers of radiation and is still an important reference work in the visual and theoretical study of meteors. Denning himself was of the opinion that there are at least fifty meteor radiants observable on any and every night of the year. Many of his radiants have never been confirmed, primarily due to the lack of observers, and similarly there are many hundreds of additional radiants waiting discovery by the astute and dedicated amateur.

The data provided in Dennings catalog should be used with discretion since many of the radiants are mean positions obtained over long periods of time. It was not until many years after Denning that radiants were discovered to have complex structures and to disappear and be replaced by others in very short periods of time. It is therefore necessary to establish definite periods of time for the allocation of a meteor into any particular radiant.

A brief glance at the enormous amount of detail in the catalog should be sufficient to explain why the pioneering work of Denning has not been followed in the same or greater detail by others. Any advances in the state of our knowledge of the thousands of minor meteor radiants will require a dedication to the task which is rare in our present age. This is one area where our knowledge can be advanced significantly and the field is wide open for new and important discoveries.

7. RECOMMENDATIONS FOR FURTHER STUDY

The identification and correlation of meteor streams with cometary orbits began in 1866 when Schiaparelli announced that the orbit of the August Perseids was identical with that of comet 1862III. Table I is a list of those meteor showers known to be associated with certain comets, while Table II lists several theoretical meteor radiants derived from the orbital data of comets passing sufficiently close to the earth. The connection between the December Ursids and comet Tuttle was proven in 1950, while the May Aquarids were identified with Halleys comet about thirty years ago. There is also a possible connection between the Taurids and Encke's comet, although this has not been satisfactorily proven. The necessary observational data is still lacking to permit the correlation of more than a few streams, as will be seen from the Tables. This is one typical area where significant contributions to our knowledge can be made,

Shower	Comet	Date	Radiant	
Coma Berenicieds	1913 I	Jan 17	186°	+20°
Lyrids	1861 I	Apr 21	271	+34
η Aquarids	Halley 1910 II	May 4	336	- 1
June Draconids	Pons-Winnecke	June 30	204	+56
α Capricornids	Honda 1948n	Aug 1	309	-10
Perseids	1862 III	Aug 11	45	+58
Giacobinids	Giacobini-Zinner	Oct 10	262	+54
Orionids	Halley 1910 II?	Oct 22	94	+16
Leo Minorids	1739	Oct 24	162	+37
Leonids	Tempel 1866 I	Nov 11	147	+24
μ Pegasids	1819 IV	Nov 11	335	+21
Andromedids	Biela 1852 III	Nov 28	23	+42
Ursids	Tuttle 1926 IV	Dec 22	219	+74

Table I Confirmed Cometary Meteor Radiants

Date	Comet	Period,yr.	Radiant	
Feb 11	1743 I	5.4	350°	-10°
Mar 30	Grigg-Mellish	164	308	-61
Apr 26	Grigg-Skjellerup	5.0	109	-37
July 5	Lexell 1770 I	5.6	272	-21
Sept 29	Finlay	6.7	278	-37
Nov 14	1743 I	5.4	21	+ 3
Dec 5	Lexell 1770 I	5.6	256	-25
Dec 15	1917 I	145	103	+ 9
Dec 17	Denning 1881 V	8.5	277	-35

Table II Unconfirmed Cometary Meteor Radiants

Many other questions remain to be answered and typical among them are the following:

1) Do any meteors arrive at the earth with hyperbolic velocities? This would imply that the meteor originated in interstellar space and several notable attempts have been made to show that such interstellar meteors do indeed exist. The question presently remains unanswered. (A small number of hyperbolic velocities must be expected due to perturbations by the major planets.)

2) Where and why do fireballs originate? Are they connected with meteor streams? Can their appearance be predicted with any accuracy? What is the exact nature of the strange hissing noises often heard in connection with fireballs? Several tentative answers to these problems have been suggested, but further work is still required.

3) What is the origin of meteor streams? This question is closely related to that of the origin of comets and a solution would have a direct bearing on theories of the origin of the solar system.

4) Do meteors originate from the moon? What is the origin of tektites? Are there any meteor streams that may be remnants of matter distributed around the earths orbit when the moon was captured?

5) What are the factors governing the diurnal variation in hourly rates of meteors? The usual explanation is that more meteors are seen when the apex of the

earths way is above the observers horizon, thus giving rise to the same effect as the disproportionate numbers of raindrops striking the windshield and rear window of a moving automobile. But it is a fact that the actual observed enhancement in hourly rates is much greater than can be accounted for by this simple explanation. This question may be considered together with those regarding the distribution of meteoric matter in the earths orbit.

6) What is the exact correlation between the elongation of the meteor radiant and the height of appearance and disappearance of the meteors? Such an effect has been noted and recorded and it is almost certain that magnitude and velocity play a part. But here again a great deal of work remains to be done.

The study of meteors by visual means has become a sadly neglected science with only the major streams receiving any attention. Many questions remain to be answered, and many important discoveries remain to be made. This area of astronomy should receive greater attention from amateurs in the future. No expensive equipment is needed, but the attributes of patience and dedication are absolute necessities. This paper forms the briefest introduction to meteor work, but its purpose will have been accomplished if it causes you to take a second look at your next 'shooting star'.

Acknowledgements.

Much of the information contained in this paper was obtained during several years of meteor observing with the Meteor Section of the B.A.A. under the patient and tireless guidance of J.P.M.Prentice.

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An 'appendix' will continue in the JANUARY-FEBRUARY issue of the "Spectrum" and will conclude the article.

ERIDANUS

The scorched waters of Eridanus' tear-swollen flood
Welling beneath the left foot of Orion.
-Aratos

ERIDANUS, or the River Po was called the "King of Rivers" by Virgil. It also has been borne the following titles: the "River Euphrates," the "River Nile," the "River Jordan," and the "river Po."

Phaethon, the son of Phoebus and Clymene, desired to guide the chariot of the sun for one day. His father was loath to grant his request, realizing the danger, but finally gave his consent, and carefully instructed his son how to drive the feiry steeds.

Phaethon started out on his wild career, but was unable to restrain the horses of the sun. They bolted and there was danger of a great calamity. Jupiter sensed the danger to the world, and shot a thunderbolt, which struck Phaethon, hurling him into the River Po. His body was recovered, and buried by the nymphs beside the river. Phaethon's sisters were grief-stricken, and spent their days weeping at his grave. Jupiter in pity changed them into poplar trees that they might be near their brother always to protect him.

. . . the starry Stream
For this a remnant of Eridanus,
That stream ot tears, 'neath the god's feet is borne.
Brown's Aratos

In every ancient culture, the constellation Eridanus has been identified with a river. The long curving shape of the constellation certainly lends itself to the image of a river better than to anything else. The Egyptians called the stream of stars the Nile; the Babylonians named it the Euphrates. Eridanus is the real name of a river in Turkey, now known as the Strong River. Modern Greek mythology gives it the identity of the River Po in Italy.

Other tales deal with an original, the River Padus where seats of the amber trade, thus relating the story of the Heliades, whose tears were shed at the death of their brother Phaethon. Those tears turned into amber as they fell into "that stream of tears" on which the unfortunate was hurled by Jove after the disastrous attempt to drive the chariot of the sun. This was a theme of favorites with the poets, from Ovid to Dean Milman. The story of the river was the foundation for it to be transferred to the sky and to console Apollo for his sons loss.

None of these comparatively northern streams seem to fit the stellar position of Eridanus, as it is basicly a southern constellation which would seem that its earthly counterpart should be found in a corresponding quarter. The only possible representation would be that of the River Nile from the notes from Eratosthenes and the scholiasts on Germanicus and Hyginus, the one noteworthy river which flows from south to north, as this is said to do when rising above the horizon.

Records alluding to the stellar stream which may be Eridanus, is from the Euphrateans, -it could even be the Milky Way, another sky river. Yet- it is to the former that the passage translated by Fox Talbot which possibly refers:-

Like the stars of heaven he shall shine;
Like the River of Nights he shall flow;

and its title has been derived from the Akkadian Aria-dan as the Strong River.

Eridanus is surrounded, clockwise starting on the north by Taurus, Cetus, Fornax, Phoenix, Tucana, Horologium, Caelum, Lepus and Orion.

ORION

Behold Orion rise,
His arms extended measures half the skies.
-Manilius

ORION, the Giant Hunter, decried by Homer, is "the tallest and most beautiful of men." It is said that he had claimed superiority over every creature on earth. The Gods sent out a scorpion to attack him as punishment for his conceit. The scorpion bit Orion in the foot causing his death. Diana requested that Orion be transported to the sky only to be placed opposite the scorpion so that it could never again harm Orion.

While far Orion o'er the waves did walk
That flow among the isles.
Shelley's "The Revolt of Islam"

Other legends, such as the story that Orion fell in love with Merope. Attempting to elope with her, her father, King Oenopion, interferred and was so incensed at Orion that he caused his eyes to be put out. The blind giant wandered aimlessly about until he came to the forke of Vulcan. Vulcan took pity on him and had him taken to the top of a high mountain. Here Orion faced the rising sun and his sight was restored.

The sailors dreaded the presence of Orion as this constellation being present in the sky presaged stormy weather.

A story of similar means, in Greek mythology, has Orion as being the prototype of a big, good-natured, well-meaning and clumsy youth. Orion was a giant and estremely powerful. He had fallen in love with Merope, a daughter of King Oenopion of the island of Chois. The king did not have a very high opinion of his daughter's suitor, though Orion made himself useful around the place ridding Chois of all its wild beasts. With that, the king kept putting off the wedding date. Orion became tired of the matter and, being a fairly simple and direct sort of fellow, decided to take matters into his own, including the hand of Merope. Oenopion, using very subtle methods, managed to get Orion extremely intoxicated and threw him into the ocean. He then persuaded Diana to try her marksmanship upon the head of Orion, which sho could see only as an unidentified black object in the sea. She scored a bull's eye and with proper remorse, placed Orion among the stars.

Orion with his glittering belt and sword
Gilded since time has been, while time shall be.

Thou splended soulless warrior! What to thee,
Marching along the bloodless fields, are we!
Lucy Larcom's "Orion"

Most of the ancient cultures pictured this constellation as a giant. The Egyptians thought it to be Osiris; the Arabians a mighty giant; and the Chinese called Orion "The Three Kings," from the three bright stars in the Belt of Orion. From the Germans it figured the three stars as "Three Ice Men," perhaps because they being present in the winter months. A great hunter was the description given by the Greeks, as he was holding the hide of a lion draped over his left arm. In his right hand he is pictured as flourishing a mighty club.

Orion, the object of a vast number of stories, will perhaps, never see the end of the myth tales.

Orion can be found surrounded by Taurus, Eridanus, Lepus, Monoceros and Gemini.

ANCIENT ASTRONOMERS

ARYABHATA or ARYABHATTA

Born in Pataliputra in 476 A.D., this ancient astronomer and mathematician had only one known work. That work was the "Aryabhtiya", a mathematical treatise in verse. Reference is made to his writings by later Hindu scholars. In the solution of quadratic equations and the application of algebra to geometry and astronomy he anticipated some of the discoveries of modern algebra. He announced the correct theory of the diurnal rotation of the earth and the correct explanation of solar and lunar eclipses.

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CALIPPUS

Calippus was a Greek astronomer of ancient times. He was the first to discover the inaccuracy of the golden number or period invented by Meton. He attempted to remedy it by the invention of a new cycle of 76 years which would be only 6 hours less than the quadruple of Meton's period. This theory contained a steady number of leap years, nineteen, while the Metonic cycle had a variable number. This commenced around 331 B.C. and being adopted by astronomers in giving tha date of their observations and its frequency mentioned by Ptolemy. Even though it was more perfect than Meton's period, it was shown to be inaccurate by Hippocrates for which he substituted a cycle of 345 years for it.

Darwin Christy

THE FOCAL POINT

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SOLAR ECLIPSE 1991: A REPORT

by Ralph L. Buice, Jr.

During August three members of the Atlanta Astronomy Club, Steve Gilbreath, Mark Lancaster, and myself went to the big island of Hawaii to check out firsthand the hotels, airlines, and viewing sites for the total solar eclipse of July 11, 1991. It is pretty clear that the travel companies have "locked in" all accommodations and car rentals on the island. Whether or not this will continue to be the case as the day of the eclipse approaches depends upon the advance bookings and the ability of the travel agents to come up with the sizable deposits necessary for them to continue to hold their reserved blocks. For the moment, the appetites of the travel agencies have been voracious. The day after our plane reservations were made for the eclipse, for example, some 230 seats on our plane were reserved. On the big island itself, four wheel drive vehicles, necessary for travel on the Saddle road, are now unavailable (any bids for ours?).

The question of traffic congestion during and before the eclipse is of some concern throughout the island, and there is quite a bit of discussion about making certain roads (including the Saddle road) one-way on the day of the eclipse, as well as whether or not to mobilize the National Guard for a few days. The road to the top of Mauna Kea will be closed to almost all traffic several days before the eclipse. My guess is that only selected scientists conducting specific solar eclipse experiments and VIPs associated with astronomical funding will gain access to the summit without a lot of effort. Even the technicians who normally run the telescopes and equipment for the astronomers on the summit are being excluded from the complex of observatories at the top of the volcano during the eclipse. I am pleased to report, however, that the Keck facility is almost completed, and looks magnificent, and that the access roads have been redone, and in some cases rerouted, to make travel a little easier.

After talking with a number of the technicians and astronomers on the summit, several areas were checked out as possible eclipse viewing sites, using our trusty four wheel drive vehicle. The prevailing opinion is that the Hilo side of the island has a good chance of being overcast, while the Kona/Waikoloa side has an excellent chance of being clear. The weather around the Saddle road, which cuts across the middle of the island, as well as that of lower Mauna Kea, is highly variable — one minute, clouds, the next minute, sun. Just a few miles travel to either side of a location can mean the difference between rain and sunshine with clear blue skies. Using a four wheel drive vehicle, several areas were investigated where surely no one has gone before, at least, in a long time! The best bet seems to be the Waikoloa coast, where the chance of having an unobstructed view of the eclipse is about 90 per cent. The eclipse should be clearly visible between two giant volcanoes, Mauna Loa on one side and Mauna Kea on the other. Next to the hotel where we will be staying on the Waikoloa coast is a large golf course which provides an unobstructed view of the horizon, and arrangements have been made to make this area available to the guests of our hotel during the eclipse. Besides, who would be playing golf at 7:28 in the morning besides Mark Lancaster, anyway? The view between the two volcanoes is magnificent (I took a number of slides), and if Pele cooperates, we will have reason enough for a luau the evening after the eclipse.

ASTRONOMICAL GLOSSARY

DO YOU KNOW WHAT THE FOLLOWING MEAN????

APHELION - APOGEE - CONJUNCTION - ELONGATION - EQUINOX - SUPERIOR - PERIGEE - OPPOSITION - PERIHELION - SOLSTICE - STATIONARY - OCCULTATION - ECLIPSE - DECLINATION - RIGHT ASCENSION - ANNULAR - SOLAR - LUNAR - INFERIOR - NODE - TWILIGHT - SUN FAST

THE EXPLANATIONS WILL BE IN THE NEXT "SPECTRUM" ACCOMPANIED WITH THEIR SYMBOLS.

* THE "SPECTRUM" *

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