BUFFALO ASTRONOMICAL
ASSOCIATION, INC.

The Spectrum

Darwin Christy, Editor

MAY - JUNE 1980

May meeting---The May 9, 1980, meeting will be held at the Buffalo Museum of Science on Humboldt Pkwy., Buffalo, N. Y., at 8:00 p.m. Our speaker will be Dr. J. Gibson Winans, who will give us his observations of the February 16, 1980, Solar Eclipse from India. For anyone who has seen an eclipse of the Sun, it will be a review, but those who have NOT seen an eclipse will surely enjoy the next best thing, a photographic account of one. Let us welcome Dr. Winans.

Obituary---Dr. Fred Price's father, Mr. William George Price, passed away 21 April 1980 in England. The Buffalo Astronomical Association membership wishes to express deepest sympathy to Dr. Price and his family.

??????? True or False QUIZ ???????

1) Markarian galaxies are objects discovered by the Russian astronomer B. E. Markarian in the early 1970's.
2) Radio source 3C 231 has several compact emission regions marked A, B, & C associated with the active center of galaxy M-31.
3) Globular clusters are tightly packed groups of stars adorning our galaxy, the Milky Way.
4) The two clouds in the southern latitudes called the Magellanic Clouds were first discovered by Columbus while discovering America.
5) The 'Red Shift' tells us the position of the galaxies in space.

* * *

June meeting---The June 13, 1980, meeting will be conducted in the Museum of Science at 8:00 p.m. This is the business meeting and election of officers. Besides just a routine business meeting, the board decided to have a regular speaker to try to increase the attendance of our membership. Two of our members will give us their account of the meeting they attended at Riverside, Calif. This is the Stellafane of the West. You will not only see many new telescopes, but many things that happen astronomically on the west coast. Let us welcome Tom Dessert and Miro Catipovic. Where else can you get an education in astronomy besides right here at the BAA meetings!!!!!!

MERCURY continued from the last "Spectrum"

Other sources gave more familiar statistics for Mercury. In 1871 its diameter was given as about 3000 miles (Elias Loomis, Elements of Astronomy, N. Y., 1871). Since then this figure has changed very

little; 3021 miles is a recent one (Sky & Telescope, Sept. 1974, p. 157). By the beginning of the twentieth century the case for Mercury having an appreciable atmosphere began to lose ground. Even the long-standing 24 hour rotation was replaced with a new value of 88 days, or once per revolution. Giovanni Schiaparelli determined this rotation by observing the movement of surface markings during the 1880's. You remember Schiaparelli--he was the fellow who first observed "canali" on Mars. This equality between rotation and revolution was supported by the American astronomer Percival Lowell who soon had the planet's surface crisscrossed with dark lines. Lowell had a penchant for confirming Schiaparelli's observations and finding lines on planets.

Now that it was evident that Mercury kept the same face toward the sun, it became popular to comment that the sunlit side of Mercury would be the hottest place in the solar system, while the dark side would be the coldest. Authors explained that libration, due to Mercury's eccentric orbit, would cause about a third of Mercury's surface to alternate between sunlight and darkness. During Mercury's year, the sun would rise slightly above the horizon and then dip slightly below it near the terminators. This left a third of the surface exposed to constant sunlight and another third to perpetual night. By 1940 astronomers using a thermocouple had measured a temperature of 600°F on the sunlit side (Clark Fisher & Marian Lockwood, Astronomy, 1940).

Literature in the 1950's and 1960's placed the temperature above 700°F on the sunlit side and colder than -400°F on the dark side. (Robert H. Baker, Astronomy, N. Y., 1955, and Edith Geiger, Our Family Worlds, Buffalo, 1963). According to Robert Baker, no radiation at all was measured from the dark side. But Baker came close to the truth about the surface of Mercury. Noting its low albedo (reflectivity) of 0.06 and the substantial change in reflectivity between quarter phase and full phase, both Moon-like properties, he predicted a mountainous surface similar to the Moon's. Two decades later Mercury 10 flybys confirmed this topography.

Mercury's true rotation was finally found in 1955 using the huge Arecibo radar in Puerto Rico. By measuring the Doppler frequency shift from the planet's radar reflection, Mercury's rotation was found to be roughly 59 days. Later refinements in accuracy yielded a rate of 58.65 days, exactly two-thirds the planet's period of revolution. Clearly Mercury's rotation has been slowed by the sun's gravitation, but not quite to the point where the planet always presents the same side to the sun. To an observer on Mercury's surface, a day would last two years, or 176 of our days.

Actually this faster rotation didn't catch astronomers entirely by surprise. In the early '60's radio astronomers measured the radio flux radiated from the dark side; from it they computed the temperature and found it much higher than expected. Either the rotation was not synchronous with the revolution or heat was being transferred from the sunlit side by an atmosphere. Now we know the former explanation is correct.

Many uncertainties about Mercury have been resolved by the three encounters of Mariner 10 with the planet in 1974 and 1975. The night time temperature was indeed warmer than expected 15 years before, if you call -280°F warm. (Sky & Telescope, Nov. 1974, p. 309). Directly below the sun, at the subsolar point, the temperature approached 800°F. Hopes of finding an atmosphere have finally been laid to rest; Mercury's atmosphere is helium with approximately a millionth of a millionth the pressure found on Earth.

Its surface features closely resemble the Moon's, just as Baker said, with craters, bright rays, basins and evidence of volcanic flooding. (Clark R. Chapman, The Inner Planets, N. Y., 1978). Mercury

is thought to have an extensive molten iron core. This explains its density of nearly 5.5 times water--about the same as Earth's, and the previously unsuspected magnetic field found by Mariner 10. How the slowly rotating planet can generate a field about 1% as strong as Earth's is not presently understood, but molten iron in its core seems essential. A topographical feature not found on the moon also points to a past period of high temperature. These are cliffs called lobate scarps. They run hundreds of miles and are believed to have formed when Mercury's mantle cooled and its crust contracted and wrinkled.

How much we know about this planet today, thanks to our sophisticated technology. We, laymen in astronomy, can look back on mistaken observations and bad guesses made by eminent astronomers and gifted authors of yesterday with amused indulgence, pleased with our own superior knowledge. We should beware. What state-of-the-art observations and risky speculations will their counterparts chance today that may bring a smile to the lips of later generations?

DESIGNING THE GUIDING TELESCOPE

by Mr. Thomas L. Dessert

The guiding telescope or guidescope is a telescope whose principal function is to give the photographer the capability of correcting tracking errors of the photographing telescope or photoscope. With proper consideration, there will be no problems with image quality, guidestar selection, mounting flexure, or picture composition.

All the operating limits should be carefully reviewed before matching the photoscope to the guidescope. Picture quality can be considered adequate if the star image error is .2mm or less on a typical 8 x 10 enlargement of the 35mm negative. For each photoscope the error tolerance can be found as follows

$$E_t = 213/F_p$$

where E_t = error tolerance of photoscope in seconds of arc

F_p = focal length of photoscope in inches

Having derived the error tolerance of the photoscope, the minimum diameter of the guidescope may be computed:

$$D_g = 13.68/E_t$$

The minimum magnification of the guidestar for control of E_t is dependent on the diameter D_g of the guidescope as indicated in the formula:

$$M_g = 3600/E_t - (4.56/D_g)$$

This magnification will result in the observation of an apparent angle equal to or greater than 30 minutes of arc between the guidestar and an imaginary circle whose diameter equals E_t. In theory, increasing the diameter of the guiding telescope will reduce the apparent size of the guidestar image in relation to E_t thereby allowing a higher factor of control over the guidestar. In practice, however, one finds that guidescopes larger than 6" are more adversely affected by seeing conditions thereby limiting magnification for amateur telescopes to less than 2000.

It would be generally unsatisfactory to assemble a high power magnifier system employing a Barlow lens, projection tube, and a very short focal length eyepiece. This would result in erratic performance due to projection tube flexure and fatigue from poor eye relief. Many professionals rely on a technique referred to as "Micro-guiding". The micro-guider consists of a microscope objective lens coupled by a short tube or diagonal to a telescope eyepiece equipped with an illuminated

crossline. The magnifier works by examining the aerial image formed by the guidescope with a moderate power microscope. While there are many possible combinations of components that will yield the desired magnification, some do have design limitations. Most microscope objective lenses are designed to project into 160mm tubes. Drastic shortening of the projection tube might cause deterioration of the guidestar image. The following equation will be useful in determining the possible combinations necessary for deriving the required magnification:

$$L_m = \frac{160 M_t F_e}{F_g M_o}$$

where M_t = total guidescope magnification required

F_e = focal length of eyepiece in millimeters

F_g = focal length of guidescope objective in millimeters

M_o = microscope objective magnification stated by manufacturer

L_m = distance in millimeters between eyepiece and microscope objective.

When the guidescope is either a cassegrain or a refractor, the micro-magnifier can be built with a star diagonal and an empty Barlow tube.

Many commercial telescope mountings are hard put to adequately drive the photoscope by itself, let alone the additional mass of the guiding telescope. Unless you rebuild the basic R.A. and declination motor drives using larger gears and more massive housings you should probably use the minimum size guidescope as derived earlier. The cassegrain guidescope with its short length and smaller mass is possibly a best choice for meeting minimum size requirements. Cost-wise, the Dall-Kirkham cassegrain is perhaps the most practical design. For those of us who have the more massive basic drives, the larger refractors and very economical reflectors will suffice.

The guidescope must be mounted at two points since differential flexure of less than .001 inch will cause intolerable error on the film. The author's guidescope has proven to be flexure free and yet extremely convenient to use. It is provided with offset adjustments that allow positioning within 2.5 degrees of the photoscope target. This permits use of the main finderscope, with its 5 degree field, for guidestar selection. Each of the offset adjustments are fine-threaded for ease of operation at high magnification. Adjustment locking clamps are also provided for rigidity while guiding. The guidermount should be firmly attached to the tube of the photoscope and carefully counterbalanced to minimize flexure.

A guidescope finder will be the last additional piece of necessary equipment to complete the package. I have found that a well mounted 6 x 30 finderscope, when properly aligned, will place the guidestar in the field of my guidescope at 1500 power.

At this point you will have made a substantial investment in both time and money. To realize additional value, the guidescope can be adapted for photographic use also. Although it will have a larger focal ratio than the photoscope, it may have a shorter focal length and therefore a larger field on 35mm film. When photographing the larger open clusters, this is aesthetically beneficial.

My most sincere thanks to Mr. Robert Mayer of the Buffalo Astronomical Association Instrument Section for his efforts in building the equipment described in this article. Also to Dr. John E. Mack, Associate Professor of Geosciences, State University College at Buffalo, my

gratitude for his invaluable assistance in deriving the mathematical proofs required in this design.

SPY AND TELL — Edith L. Geiger

Al Kolodziejczak recently paid a visit to the art galleries in Washington, and also spent some time at NASA headquarters.

Phil Cizdziel will soon be college bound again. With offers from several universities, he must shortly decide on which one to accept. He has been a very active student at U.B., being on the basketball team and in charge of the U.B. Astronomy Club. He also planned the club's observation of Astronomy Day.

Bob Reilly and Joe Milazzo, who are enthusiastic motorcyclists, enjoyed a day's spin to the Iroquois National Wildlife Refuge, Batavia, and Beaver Meadow.

Bill Kirst is excited about his new Celestron 8 which he has had since the end of February. In spite of poor observing weather, he has kept an eye on the planets and M 51, 81 and 82. He's a hard worker in the Kirst family business in Hamburg which is a wholesale/retail distributing company selling cigarettes, candy, tobacco, paper, etc.

Gary Herrnreiter is working on a solar heating unit for his apartment, and is looking forward to the time when he can manufacture solar heating collectors.

Irv and Esther Goetz flew to Santabel Isle for some spring relaxation and a visit with prominent vacationing actor, son Peter.

The Buff State Planetarium was officially opened on April 12 after being completely restored following the destructive fire in Nov. 1978.

BAA ANNALS — Rowland A. Rupp

5 YEARS AGO - Dr. Fred West spoke on "The Solar Neighborhood" at our May 1975 meeting. He talked about stars and star systems near the Sun. Fred also contributed an article on "The Bode-Titius Law and Resonances" to the Spectrum. His article explains how Jupiter causes gaps in the asteroid belt because of orbital resonances and, surprisingly, how Earth and Venus set up resonances with some of the Apollo asteroids.

10 YEARS AGO - "Television Astronomy" was Dr. Martin Green's topic in May 1970. In June, the topic was "Photoelectric Observations of Variable Stars". John Ruiz of Erie, Pa., was our speaker.

Comets were the subject of the May Spectrum. Ernst Both wrote on Comet Bennett and Kurt Erland!! on Halley's Comet. Fred Price reported on his observation of the transit of Mercury of May 9, 1970. Fred saw the rare event of Mercury occulting a sunspot.

15 YEARS AGO - Ed Lindberg spoke in May on his trip around the world and, especially, on his work in Thailand. In June, members took a bus trip to Allegheny Observatory. The bus ride took 5 hours each way! That's dedication.

Edith Geiger wrote an article on Rudy Buecking. Rudy was a member of the Amateur Telescope Makers, a forerunner of the BAA before WWII. He helped reform the group after the war and led classes in telescope making.

25 YEARS AGO - Dr. Olsen of Linde Air gave a talk on the spectral properties of light in May 1955. A star party at the Grover Cleveland Golf Course at Main and Bailey was scheduled for June.

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Non-credit course at State University of New York at Buffalo----- "Descriptive Astronomy". Instructor, Dr. Gilbert O. Brink.

Course starts Monday, June 2, 1980, for 8 weeks. One night per week, 8-10 p.m. Course is for people with NO astronomy background. Observing sessions will use a 10" Newtonian Reflector. . . .

A TRIBUTE TO ROBERT S. MAYER

In every worth-while organization a few members stand out with a special brillance. Bob Mayer is one of those unique people. His willingness to help others with astronomical needs of changes, additions, repairs and devices for various telescopes is a fine example of his sincerity and his desire to serve. Through his outstanding ability to perceive both the problem and solution to enigmatic mechanical situations, he has enabled many members to get the best performance from their instruments, and to extend the astronomical horizons, in many cases, beyond the average scope's capabilities.

Many years ago, Bob, who is an excellent craftsman, founded Precision Patterns, Inc., employing ten men. He took charge of the metal department and his partners, Joe Ellman and Norbert Pohlman took care of the wood department. After twenty-three years, the company was liquidated and Bob's son, Robert, a graduate of the Rochester Institute of Technology, bought some of the remaining machinery and built a shop in the backyard of their home with the idea of serving professional photographers. Robert's untimely death in a car accident at 24 years of age ended a promising career. The workshop, however, with lathe, milling machine and various equipment, has enabled Bob to continue to use his talents as an artisan.

Bob is a very modest man and it is difficult to get him to enumerate the many undertakings to which he has given his time and effort. Through a bit of prodding, he finally consented to cite some of the projects that he has found to be interesting and challenging:

For James McCartney, Pres. of B.A.A. 1949:

Bob made his first piece of astronomical equipment: an extension for an eye-piece holder.

For Beaver Meadow 12.5" scope:

Worked for almost a year correcting facilities which did not function properly

Made new ring mount to allow tube to rotate conveniently

Installed clutch and thrust bearing on polar axis

Made and installed a 4" guide scope with original design adjusting device

Made new drive motor proper reduction gearing for R.A. drive

Adapted scope for photography with standard threads, and bracket for camera

For Tom Dessert:

Adapted 10" Dynascope for photography, standard mounting as on Beaver Meadow scope

Installed proper drive gears to give good tracking

Made and installed 4" refractor guide scope, with photographic capabilities

Made entire new mount with R.A. and Dec. drive over shafts, etc.

Made new guide scope mount as on Beaver Meadow scope

For John Riggs:

Rebuilt equatorial mount with enclosed gears and constant sidereal clock for 10" scope

Made new square tube 6" f/4 R.F. scope with flat mounted focuser which allows smallest possible diagonal mirror

Worked on 6" f/8 and a 3" refractor

For Miro Catipovic:

Made two declination setting circles 10" dia. with 360 graduations and figures, and one right ascension dial with 720 graduations and figures for scaled up Celestron 20"

For Dave Steinagle:

Made original guide scope mount and adjusting device for 10" scope

Made many gears and various other parts for Dave's clock business

For Mike Dlugosz and William Gehrke:

Mike and Bill had built 3" refractors of an original design. The man who machined them did not do so well so they were brought to Bob for corrective work

For Rowland Rupp:

Installed set of tangent arms for 6" RV-6 which was later motorized

Made small gadgets

For Robert Schneider:

Improved mount for 8" Newtonian scope which Bob Schneider had made

Made an adapter for giant eyepiece

Various small jobs

For Father Englehardt:

Given old 6" mount by Bob Mayer

Made an adapter to mount a 10" Cave mount to the pier in his new observatory

For Gordon Rees:

Many small items for use on his lens grinder and vacuum apparatus

For Tim Coons and friend:

Machined two small mounts for 3" and 4" scopes

For Al Ricciuti:

About a dozen lens mountings for his collection of large lenses

For Charles Meiss:

Guide scope adjustable mount for 12" scope Charles is making

For Irv Goetz:

Installed a R.A. drive for a commercial 8" model which required some minor adapting

For Edith Geiger:

Fitted for photography with standard size mount

Installed large worm gear and constant sidereal time dial for 12.5" scope

For Buffalo State College:

SUCB received a 16" Ealing Educator telescope from Orange County Community College in June of 1979 in exchange for a number of small telescopes, numerous astronomical slides and a faculty workshop by Dr. John Mack (see Spectrum Profile on Dr. John E. Mack, Nov.-Dec. 1979). Both the polar and declination drives had all of the vital parts removed. No drawings were available. It took longer to survey the situation and design new parts than to produce the actual parts, which included the following:

Two 11½" worm gears
Two worm shafts with stainless steel worms
Four ball bearings with caps
Two clutches
New 6" guide scope photographic adapter with usual adjustable mount

(Ed Lindberg is doing the very complex electrical control work)

Bob has also worked on innumerable small scopes and mounts which might, otherwise, have ended up in the junk heap. With a small amount of work they were made useful.

Robert Mayer has made enormous contributions to celestial observation in our area by successfully filling the needs of many viewers for better more effective equipment. We take off our hats to this fine gentleman; a very kind, genial, thoughtful, generous human being, blessed with the creative touch of genius.

Edith L. Geiger

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ASTRONOMICAL DISTANCES — Dr. Jack Mack

On a scale where the sun would be the size of a medium grain of sand, the earth the size of a microbe an inch from the sun and the distance to the moon the thickness of this paper, a nearby globular cluster is at the distance of Australia, and the Coma Cluster of Galaxies is farther than the real sun.

As astounding as these figures are, we who share an interest in astronomy have all heard them in some form, and have perhaps become slightly immune to the fascination of their sheer size. Yet, it is perhaps even more fascinating that we know these facts at all. How do we measure such immensities?

Essentially, four measureable quantities lie at the foundation of distance measurement in astronomy; angular motion, angular size, brightness and radial velocity. Let us examine each in turn.

Angular motion causes displacement of a star in the sky. Measured in the tiny units of arc-seconds per year, it is caused by two physical motions: the orbital velocity of the earth and the relative motion of the sun and the stars. The first causes the familiar (but rarely measureable) annual parallax. One component of the sun-star velocity causes proper motion. Both effects share the common property of diminishing with distance, so can be used to measure distance.

The parallax effect is well known, so I won't dwell on it. The earth's journey across one astronomical unit causes a star to wobble in position a tiny amount, given in arc seconds by 1/d, where 'd' is in parsecs. This can be used to measure d if d is less than about 30 parsecs, or 100 light years (ly).

A star with zero proper motion is generally extremely distant, and vice versa. (Hence, when Van Maanen reported a finite parallax for stars in spiral galaxies around 1920, it fouled things up for a few years!)

The proper motion of a star is non-cyclic unlike parallax, so a 20 year survey gives 20 times the accuracy of a one year measurement. Hence, we know the proper motion of some fairly distant stars. The problem is to their physical velocity, to make the conversion to distance. Surprisingly, this can sometimes be found.

In open clusters of stars, the directions of motion are correlated giving us the actual, three dimensional direction of motion. To see this, imagine that the stars appear to be converging to the cluster center. We would conclude that the cluster is moving directly away from the sun. If the convergence point is 90° away in the sky, the

cluster is moving tangentially to the sun-cluster line, and so forth. Now if we know the direction of motion, and measure the radial velocity we can find the tangential velocity of the cluster. This is the component of the velocity along the sky 'plane'. It is what we need to relate proper motion and distance. This moving cluster method is very important for intermediate distance clusters, around a few hundred parsecs away.

The second observable is angular size. This implies a distance, provided we know the physical size. We know the physical sizes of some things, like orbits of binary stars of known periods, giant emission nebulae, and open star clusters. In these cases, measurement of angular size allows a distance determination. This is a powerful method, as even nebulae in other galaxies have measurable angular sizes.

Of course, the fundamental observable in astronomy is brightness. This translates into distance if we know the power of the source. Here the problem is that those objects powerful enough to be useful are so rare that none are close enough to get a parallax. Hence, we need proper motion methods to yield power estimates, which in turn lead to great distance measurements. We lift ourselves by our bootstraps, and eventually reach the stars.

Sometimes these observables don't quite correlate. For instance, in 1930 Trumpler found that distances to open clusters measured by angular size diverged from those measured by brightness. As it turned out this wasn't bad at all. He concluded that the brightness measurement was more susceptible to interference than was angular size, and deduced the cause of the interference: Interstellar extinction. So discovery of interstellar dust arose from the discrepancy. It never hurts to check, does it?

The ultimate distances are measured by radial velocity. This is possible because for galaxies outside our local group, distance is proportional to velocity of recession. Most astronomers believe this means that the universe is expanding. Can this rule be used to imply great distance from great radial velocity, in the absence of other distance indicators? In the case of the quasars, this relation gives pretty outrageous figures for the power, yet most workers assume these figures are real.

Thus, we have a hierarchy of distance estimates. Nearby objects are used to estimate the distance to farther ones, by techniques which are more and more powerful yet more and more uncertain. As this is written, I have heard of, but not seen a paper claiming to cut the large distance scale in half. Perhaps it will be convincing, perhaps not. Even in our enlightened age of grace, these are foggy regions, out at the boundary of the universe.

STUDY GROUP MEETING

The May meeting of the Study Section will be in the Humboldt Room at the Museum of Science. Most of the regular study group has volunteered to assist Ernst Both with the public viewing nights (Fridays) in May. By meeting at the museum we will be assembled in one place, and in case of bad weather we will have our normal discussion period. The scheduled topic for May is star clusters. Members will each research star clusters, open and globular, and report to the group after which we will have an open discussion. If the weather is clear and we help at the observatory, the same topic will be carried over to the June meeting which will be back at the science building at Buffalo State.

- Ken Kimble

STAR PARTY - Saturday, June 14th, (no alternate date) at Tom & Marty Dessert's, S-1286 South Anne Dr., Alden. For info, call Tom, 652-5530.

BEAVER MEADOW OBSERVATORY

There will be a seven week program on basic astronomy from June 6th through July 25th each Friday starting at 8:00 p.m., excluding July 4th. The programs will be at the Beaver Meadow Environmental Education Center, Java Center. Talks will be given by Jack Mack, 'Cosmology'; Larry Carlino, 'Planets'; Ken Kimble, 'Stars and Matter'; Al Kolodziejczak, 'Star Clusters and Nebulae'; Phil Cizdziel, 'Galaxies'; Rowland Rupp, 'Basic Astrophotography'; Tom Dessert, 'Telescopes and their Uses'. The fees will be $15 for BAA and BAS members and $20 for all others.

- Tom Dessert

Answers to QUIZ

1) True. 2) False (M-82). 3) True.
4) False (They were first discovered by the survivors of Magellan's voyage around the World in 1516.
5) False (It tells us approximately how fast stellar objects are traveling away from us.

FOR SALE: 10" reflector, f/5.2, tube, mirror mount, eyepiece holder and diagonal, finder, equatorial mount (fork). Mirror & diagonal need alum. Assembly required. Price $50.00. Call Orrin Christy, 692-8190.

FOR SALE: High vacuum goodies. CENCO HYVAC 2 mechanical w/motor, two oil diffusion pumps plus misc. hardware. $125.00. Call Orrin Christy, 892-8190.

DEADLINE FOR THE JULY-AUGUST (SUMMER) "SPECTRUM" is June 7, 1980.

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FIRST CLASS