The Spectrum

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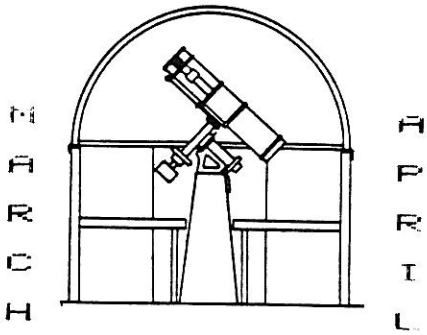

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!! MEETING NOTICES !!

MARCH 11, 1988:- At the Buffalo Museum of Science, 7:30 PM Our guest speaker will be Dr. Jack Mack, Physics and Astronomy Professor at Buffalo State College, and a long time member of the Buffalo Astronomical Association. His topic will be, "The 1987 Super Nova." Lets all give Jack a warm welcome, and remember refrshments will follow his presentation.

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APRIL 8, 1988:- At the Buffalo Museum of Science, 7:30 PM Our feature speaker will be Bob Hughes, our Beaver Meadow Observatory Director, giving us, "Sounds of Astronomy in Short Wave." This is sort of an aspect towards "Radio Astronomy" a relatively new part in astronomy. Lets welcome Bob. Refreshments again following.

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MAY 13, 1988:- Our 4th Annual May Dinner Meeting. This year's May dinner meeting will highlight a talk by Trudie Brown from the Astronomy Section, Rochester Academy of Science. Trudie's talk is entitled, "The Stars for Great-Gran-Dad." Please start making plans for this event early. The ,ocation will probably be where it has been for the past 2 years - at Buffalo State College's Moot Hall. However, we are also looking into renting the Roosevelt Memorial site where we had our first dinner meeting, 3 years ago and enjoyed so much. Many of our members like to enjoy a little wine or a cocktail before dinner (not a necessity but nice if possible) and because of insurance requirements, this is not allowed at the Buffalo State campus. Stay tuned for further details.

Ken Biggie, President

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IT'S COLD OUT THERE

One element of astronomy has been measured accurately for decades. It is the solar luminosity given as the number 39 followed by 32 zeros in units of ergs per second. Knowing this unimaginably large number enables us to calculate how much energy falls on each of the planets and what their temperatures should be.

Determining the theoretical temperature of a planet is greatly complicated by several factors peculiar to each of them, such as: its reflectivity, rotation rate, and atmosphere. As a first approximation one can calculate what the temperature of a small area of the planet's surface would be if it were perpendicular to the line of sight to the sun, and if it absorbed all the solar energy it received and then radiated it back into space. This is called the subsolar temperature because it is the theoretical temperature at a point with the sun directly overhead. It is obtained by using Stefan's Law, which states the temperature required to radiate a given amount of energy from an area per period of time is proportional to the fourth root of that energy. In other words, twice the temperature causes sixteen times the energy to be radiated. In practice, the solar energy, emitted primarily in the visible portion of the electromagnetic spectrum, is absorbed by the planet and is reradiated in the infrared. It is still electromagnetic energy, but its frequency has been greatly reduced. The planet's temperature adjusts to balance exactly the incoming energy with the outgoing energy, creating a state of thermal equilibrium.

Obviously, only one point on a planet's surface can be at the subsolar point. The rest of the planet receives oblique rays from the sun or, on the night side, no rays at all. The rest of the planet should be colder than the subsolar

point unless some process distributes the solar energy more evenly around the planet. Two mechanisms are available. One is the atmosphere, which can store and distribute heat; the other is the rotation of the planet, which constantly exposes different areas of the planet to the sun's radiation. The relationships are complex and are a function of the planet's rotation rate, wind velocity over its surface and atmospheric depth and pressure. Nonetheless, if energy is radiated uniformly over all of the planet's surface, the average equilibrium temperature can be calculated by assuming the solar energy incident on the daylight side of the planet is radiated into space by its entire surface. This temperature is just over 70% of the subsolar temperature.

Not all the radiation directed toward the planet is absorbed by it. Solar energy may be reflected from the planet's atmosphere, particularly its clouds, or from its surface, or both. This reflectivity is the planet's albedo and, with the exception of Earth, is an easily measured parameter. Finding the value of Earth's albedo is somewhat complicated because we can't observe our planet at a great distance, and also it is variable because of changing degrees of cloud cover. For each planet the average theoretical temperature is somewhat lowered from the equilibrium temperature because of reflection.

The following table shows the values calculated for subsolar temperature, Tss, equilibium temperature, Tp, and equilibrium temperature taking albedo into account, Ta. All temperatures are given in degrees Kelvin. Absolute zero is 0 degrees on this scale, the freezing point of water is 273 degrees and its boiling point is 373 degrees. Lead melts at 607 degrees K. The column headed by AU indicates the planet's mean distance from the sun in astronomical units. The right-most column gives the temperatures actually measured. For the inner planets this is the surface temperature; for the Jovian planets it is the temperature measured at their cloud tops. The temperature for Pluto is uncertain, and for Ceres it is unavailable.

Planet	AU	Albedo	Tss	Tp	Ta	Measured
Mercury	.387	.06	635	445	438	103 to 623
Venus	.723	.76	465	318	228	750
Earth	1.000	.40	395	277	244	183 to 333
Moon	1.000	.07	395	277	272	120 to 390
Mars	1.524	.16	320	224	215	133 to 293
Ceres	2.77	.054	237	166	164	--
Jupiter	5.203	.51	173	121	102	163
Saturn	9.54	.50	128	90	75	93
Uranus	19.18	.66	90	63	48	57
Neptune	30.07	.62	72	51	40	57
Pluto	39.44	.40	63	44	39	50

How quickly the effect of the sun's warmth diminishes as we leave the inner solar system! On Mars the temperature seldom reaches the melting point of ice. (Even when it does, water never liquifies; it sublimates directly into the Martian atmosphere because the surface pressure is so low.) Because carbon dioxide, the chief component of Mars' thin atmosphere, solidifies at 195 degree K, it freezes out over the winter pole forming the famous polar cap. If the Earth were located at Saturn's distance from the sun, the common gases of our atmosphere, nitrogen and oxygen, would liquify. The outer planets, only a few light-hours from the sun, are intensely cold. The sun's warming benefit is insignificant here by our standards. By the standards of interstellar space, however, fifty-seven degrees K is quite balmy.

We might speculate about how far we have to travel from the sun before the temperature caused by solar energy is equivalent to the cold of interstellar space. Normally this temperature is accepted to be about 4.2 degrees K, the temperature of the microwave remnant of the Big Bang that permeates all of space. A rotating planet located 4200 astronomical units from the sun, roughly a distance of one light-month, would have this temperature. The sun's brightness would be a bit brighter than -8 magnitude at this distance. The sun's contribution to heating this hypothetical world, a few light-weeks distant from it, is no greater than that of the Big Bang that occurred some 15 or 20 billion years earlier.

Leslie Martin

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MARCH -- APRIL CONSTELLATIONS

CARINA - The Keel is a part of what was once known as "Argo Navis". It is bordered by Puppis and Vela on the north; Chamaeleon and Volans on the south; Musca and Centaurus on the east; & by Volans and Pictor on the west.

As I have been giving you many of the southern constellations in the past "Spectrums", again I find some more. I had planned to write up on all 88 since being editor, and thus far have succeeded. Maybe we cannot see them from this area, it is nice to know that they do exist.

Some objects to be found in 'Carina' are:- NGC's 2369, 3059 & 3136 which are galaxies. Diffuse nebulae include NGC's 3199, 3324, 3372, 3503, 3576, 3579, 3581, 3582, 3584 & 3586. Open Clusters to be found are NGC's 2516, 3114, 3293, 3532, 3572 & 3590 as well as I,2581 - I,2602 & I,2714 and Mel-101 & Mel-105.

Planetary Nebulae are:- NGC's 2876 & 3211 also I,2448 - I,2501 - I,2553 & I,2621. One Globular Cluster NGC 2808. Double stars are:- C, B-1, D & Upsilon. Variable stars include:- AC, V, X, RW, IW, R, L, RR, S, SZ, EV, CK, HW, BZ, T, AG, IX, U, BO, GM, HR, VY, GI, XZ, RS (N-1895), EM & XY. One Nova can be seen, N-1985.... The bright star, Canopus, is magnitude -0.73 with an absolute magnitude of -3.1 and is about 98 lightyears from us.....

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VOLANS - The Flying Fish displays his graces along side of Carina. It is bordered by Pictor and Carina on the north; Mensa and Chamaeleon on the south; Carina on the east; and Dorado on the west.

Not much in the way of deep sky is in this southern constellation, although there are three NGC galaxies, 2397 2434 & 2442. Epsilon, Theta, Delta, Gamma^1 & Gamma^2 are double stars and UU, R & S being variable stars in the constellation's boundary.

Darwin Christy

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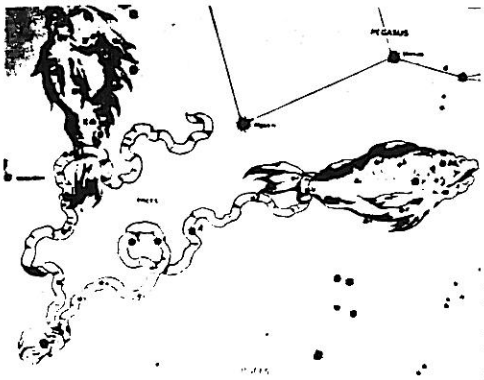
'SPECTRUM' DEADLINE FOR THE NEXT ISSUE

APRIL 8th 1988 !!!

ANCIENT CONSTELLATION

ANTARAH, The Cord or Flaxen Thread tying two fish (Pisces) together was first introduced by Al Asma'i about the year 800 AD. It was later split into two separate constellations, "LINUM BOREUM" & "LINUM AUSTRINUM", by the Arabs, although they had originally called it, "Al Rescha", as derived from "Al Risha" - The Cord. In reality it had reference to the star which was the 'knot' tying the two threads together (Alpha Piscis). Another mention of this tie by the Arabs in ancient times was the cord was a part of a well, the cord being attached to a bucket at the bottom.



This cord or knot has been described by many; Aratos and Geminos described it as "knot of the fishes" or "thread'. Even Hipparchus and Ptolemy had given its name as such much before. It was described by Cicero as 'Vinsa' the bonds. But as time went on, it was finally devided into two parts as before mentioned - Linum Boreum and Linum Austrinum. These two were created by Hevelius.

The ancient Chinese had thought that the butterfly had woven 'silk threads' to help them catch fish in their nets by pulling on the 'kmotted' end tightening the net about their catch. Similarly, the Egyptians thought along the same lines, but they used a thread made of flax. When throwing their nets over the water, they would draw on the the flaxen lines closing the nets with many fish.

The two cords being connected by Alpha Piscis, stretch northward through Omicron, Pi, Eta to Rho and reach to the west through Xi, Upsilon, Mu, Epsilon, Zeta and Delta to Omega. Alpha is a 3.94 magnitude double star whose components are 4.9 and 5.2 magnitude.

Today this (these) constellation is only known as the two fish, Pisces.

Darwin Christy

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MORE ADVICE TO A NEW MEMBER

YOU HAVE PROBABLY NOTICED THAT THERE IS A MILD WAR GOING ON BETWEEN THE ARMCHAIR ASTRONOMERS AND OBSERVERS. WHILE THIS IS A BIT SURPRISING, I INTERPRET IT AS SIMPLY ZEAL FOR ONE'S AREA OF EXPERTISE. NEVERTHELESS, YOU'LL PROBABLY HEAR SOME INTERESTING DEFENSES FOR VARIOUS FIELDS OF ASTRONOMY OVER THE YEARS.

THERE ARE, ESSENTIALLY, FOUR BASIC AREAS OF SPECIALIZATION IN AMATEUR ASTRONOMY: ARMCHAIR ASTRONOMY (STUDY), INSTRUMENT MAKING (TELESCOPES, EYEPIECES, AND ADDITIONAL APPARATUS), OBSERVING AND PHOTOGRAPHY. ALL ARE FINE WAYS TO ENJOY OUR HOBBY AND NO AREA SHOULD BE SEEN AS PURER OR MORE LEGITIMATE THAN ANY OTHER. MANY AMATEURS ENJOY MORE THAN ONE AND SOMETIMES ALL FOUR. WHETHER YOU GRIND YOUR OWN MIRROR OR NOT, OR WHETHER YOU OBSERVE OR READ ABOUT GALAXIES AND QUASARS, THESE FOUR BASIC AREAS ARE ALL PLEASANT WAYS TO EXPLORE THE UNIVERSE.

WE ALL DO SOME ARMCHAIR ASTRONOMY. THERE'S JUST NO GETTING AROUND IT - OUR HOBBY NECESSITATES STUDY. I HAVE SEEN MANY A BEGINNER BUY AN IMPRESSIVE (AND EXPENSIVE) COMMERICAL TELESCOPE ONLY TO LEARN THAT IT TAKES MUCH PREPARATION TO MAKE THE MOST OUT OF YOUR OBSERVING TIME. YOU SHOULD BEGIN WITH A BASIC TEXT. MY FAVORITE IS ABELL'S EXPLORATION OF THE UNIVERSE. I ALSO ENJOY ENCYCLOPEDIA OF ASTRONOMY, ED.COLIN RONAN. BURHAM'S CELESTIAL HANDBOOKS VOLS. 1,2 & 3 ARE NOT ONLY A GREAT AID IN OBSERVING BUT ALSO A GREAT INTRODUCTORY TEXT FOR ALMOST ALL ASPECTS OF ASTRONOMY. I CONSIDER THE FIRST 97 PAGES TO BE THE BEST INTRODUCTION TO ASTRONOMY I HAVE EVER READ.

OTHER BOOKS I HIGHLY RECOMMEND ARE :
THE RED LIMIT - TIM FERRIS (AN EXCELLENT INTRO TO THE HISTORY OF ASTRONOMY.)
THE COLLAPSING UNIVERSE - ISAAC ASIMOV (A GOOD, GENTLE INTRO TO THE EVOLUTION OF STARS AND THE MYSTERY OF BLACK HOLES.)
BLACK HOLES, QUASARS, AND THE UNIVERSE - HARRY SHIPMAN 2ND EDITION (A MORE ADVANCED INTRO TO THE ITEMS IN THE TITLE.)
THE FIRST THREE MINUTES - STEVEN WEINBERG (A DIFFICULT BOOK ON THE FIRST MINUTES OF OUR UNIVERSE.)
THE MILKY WAY - BART BOK (A SUPER CLASSIC ON THE TOPIC.)

ASTRONOMY BOOKS ARE AVAILABLE AT THE U.B. AND BUFF STATE TEXTBOOK STORES, THE SCIENCE MUSEUM AND IN SOME OF THE LOCAL GENERAL BOOKSTORES. THERE IS ALSO AN ASTRONOMY BOOK CLUB (ASTRONOMY BOOK CLUB, RIVERSIDE, NJ. 08075-9889) WHICH OUR MEMBERS HAVE HAD MIXED SUCCESS WITH. FEEL FREE TO ASK AROUND FOR ADVICE.

THERE ARE TWO MAJOR ASTRONOMY MAGAZINES - "SKY & TELESCOPE" AND "ASTRONOMY". WHILE BOTH ARE FINE MAGAZINES, I PREFER "SKY & TEL". IT HAS FAIRLY UP-TO-DATE ASTRONOMY NEWS, ADS FOR MOST OF THE MAJOR EQUIPMENT SUPPLIERS, OBSERVING NEWS, FEATURE ARTICLES AND THE OCCASIONAL GREAT ARTICLE. "ASTRONOMY" IS BETTER SUITED FOR THE BEGINNER. "SCIENTIFIC AMERICAN" ALSO CARRIES ASTRONOMY ARTICLES EVERY MONTH OR SO. WHILE THEY ARE A BIT DIFFICULT, THEY'RE USUALLY WORTH THE EFFORT. YOU SHOULD SUBSCRIBE TO "S&T" OR "AST" TO ASSURE YOURSELF OF SOME SOURCE OF CURRENT ASTRONOMY NEWS.

ONCE YOU HAVE DONE SOME STUDYING YOU MIGHT GET THE DESIRE TO SEE SOME OF THE OBJECTS YOU HAVE READ ABOUT. THE BEST WAY TO ACQUIRE OBSERVING SKILLS IS TO LEARN YOUR CONSTELLATIONS. YOU PROBABLY WILL WANT TO SEE MORE THAN STAR PATTERNS, BUT CONSTELLATIONS ARE THE ROAD MAPS OF THE SKIES. ONCE YOU KNOW WHICH CONSTELLATION AN OBJECT IS IN YOU HAVE A GOOD CHANCE AT FINDING IT. AMATEURS REFER TO OBJECTS AS BEING "IN" A CONSTELLATION.

THE BEST WAY TO LEARN CONSTELLATIONS IS WITH EDMUND SCIENTIFIC'S MAG 5 STAR ATLAS. THE "MAG" IN THE TITLE REFERS TO THE LIMIT OF THE ATLAS - 5TH MAGNITUDE STARS, WHICH IS ROUGHLY THE LIMIT OF NAKED EYE OBSERVING. THE ATLAS ALSO PLOTS THE "M" OBJECTS - OBJECTS NAMED AFTER A FRENCH ASTRONOMER, CHARLES MESSIER. THESE ARE THE "DEEP SKY" OBJECTS THAT AMATEURS START OBSERVING - AND WITH GOOD REASON, THEY'RE TRULY SPECTACULAR.

ANOTHER GREAT METHOD OF LEARNING CONSTELLATIONS IS TO OBSERVE WITH AN EXPERIENCED OBSERVER. SOME MEMBERS I HAVE LEARNED MUCH FROM ARE CARL MILAZZO, LARRY CARLINO, ALAN MOHN AND TRISTAN DILAPO. HOWEVER, DON'T LET THEM DO ALL THE WORK, ASK THEM HOW THEY FOUND EACH OBJECT. WHILE IT IS ENJOYABLE TO SEE A LARGE NUMBER OF SPECTACUAR OBJECTS IN ONE NIGHT, EVENTUALLY YOU WILL NEED TO LEARN HOW TO FIND THEM YOURSELF.

ONCE YOU KNOW YOUR BASIC CONSTELLATIONS YOU CAN BEGIN TO FIND "M" OBJECTS WITH BINOCULARS OR THE CLUB'S 12" TELESCOPE. MOST AMATEURS START WITH 7 X 50 BINOCULARS. AT THIS POINT YOU WILL PROBABLY BE TEMPTED TO PURCHASE A TELESCOPE. I ADVISE YOU TO WAIT UNTIL YOU DEVELOP A PREFERENCE FOR A CLASS OF OBJECTS - PLANETS AND THE MOON, OR NEBULA, OR GALAXIES. IT TURNS OUT THAT DIFFERENT TELESCOPES ARE BETTER FOR DIFFERENT OBJECTS. ONLY EXPERIENCE WILL ENSURE THAT YOU BUY THE TELESCOPE THAT BEST SUITS YOUR SPECIFIC APPLICATION. THE GOOD OBSERVERS OFTEN WAITED SEVERAL YEARS BEFORE THEY BUILT OR BOUGHT.

IN THE NEXT INSTALLMENT OF THIS SERIES I WILL DISCUSS ADVANCED ATLASES, EYEPIECES AND BUYING AND BUILDING TELESCOPES. LET ME END WITH THREE MORE BOOK RECOMMENDATIONS:

MAG 6 STAR ATLAS - DICKINSON ETC. (ALSO BY EDMUND SCIENTIFIC. A MORE ADVANCED BEGINNERS ATLAS THAT'S A GOOD BUY FOR ITS PRICE.)
MESSIER ALBUM - MALLAS & KREIMER (AN EXCELLENT, BUT EXPENSIVE WAY TO CHECK TO SEE IF YOU HAVE THE RIGHT OBJECT. IT CONTAINS PHOTOS AND DRAWINGS OF ALL THE "M" OBJECTS. AVAILABLE THROUGH SKY PUBLISHING CO.)
A FIELD GUIDE TO THE STARS AND PLANETS - MENZEL & PASACHOFF (PART OF THE PETERSON FIELD GUIDE SERIES. A GOOD VALUE, BUT MAKE SURE YOU GET THE 2ND EDITION.)

ALPHONSE KOLODZIEJCZAK

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? ! FOR SALE ! ?

" 10" Cave Astrola reflector with rotating tube and clock drive " FOR SALE - H. Engelhardt, 941-3549.

Thank you,

(Rev) Herbert G. Engelhardt

STELLAR MATTER

No matter how you use the letters to "STELLAR MATTER" just once, its still stellar matter.....

ALL TERM TREATS - dark sky, good seeing, balmy temperature.
TALL ARM TESTER - a 10 foot Newtontian.
RE SMALL TATTER - ripped your shirt on your telescope mount again.
ALL TERM TASTER - eating yourself silly at a star party.
TAMEST TALL ERR - I saw Pluto with the naked eye.
START ME TALLER - an eleven foot Donsonian.
LA RATTLE TERMS - a shaking Los Angeles observation site.
LET MARS RATTLE - didn't know it made a noise.
ALERT STAR MELT - 1987-A ?

Bruce Newman

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ASTRONOMICAL HAPPENINGS

SOLAR----- The Sun will be crossing the vernal equinox on March 20th, but an eclipse will occur a couple days before on the 17th. Totality will be seen throughout the Pacific Ocean, although the partial phases can be seen from Alaska and north-west Canada.

LUNAR----- The Moon's phases for March and April follow--- March 3rd, the Full (sap) Moon will be eclipsed by the Earth but will not be visible from our area. On April 2nd the Full (pink) Moon will obliterate deep-sky observing. Last Quarter Moon will occur on March 11th & April 9th.
New Moon occur March 17th & April 16th.
First Quarter Moon - March 24th & April 23rd.

CONJUNCTIONS BY THE MOON----- Spica - March 6th.
Antares - March 10th.
Uranus - March 11th.
Saturn, Neptune & Mars - March 12th.
Mercury - March 16th.
Jupiter - March 20th.
Venus - March 21st.
Spica - April 3rd & 30th
Antares - April 6th.
Uranus, Neptune & Saturn - April 8th.
Mars - April 10th.
Venus - April 19th.

PLANETARY CONJUNCTIONS----- Venus & Jupiter - March 6th
Uranus & Neptune - March 7th.

METEOR SHOWERS----- The Corona Australids on March 16th are an annual type radiating from Right Ascension 16h 20m and declination -48 degrees. Not many can be observed from our latitude, but some have been seen. They produce about a 4th magnitude yellowish, short fast trail. Probably only 5 hourly, unless we can observe them from down-under, where they radiate from. Other showers in March are the Zeta Bootes of the 11th and the well known Virginids of March 26th.

The Rho Leonids is another not so great of meteor shower. It radiates from right ascension 13h 00m and declination -05 degrees. On the 17th, in the middle of a ten day period, one might see five or more 5th magnitude meteors. They produce a whitish hue, and should you see these fast meteors, you might find that the radiant may have changed some to the north, perhaps near the celestial equator. Other showers in April are the Alpha Virginids of the 9th, the famous Lyrids on the 21st, Mu Virginids of the 25th & the Alpha Bootes on the 28th.

Darwin Christy

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? ! SPY & TELL ! ?

Larry Carlino has built a 6" telescope for a neighbor and is thinking of getting a larger scope for himself, perhaps a 30". He continues to sketch deep-sky objects, and also finds time for jogging and other athletic activities.

Miro Catipovic is working on a fork mount for his 16" telescope.

Rowland Rupp gave his excellent talk on "Extraterrestrial Intelligence" at the February meeting of the Niagara Center RASC.

Dina Adimey will be one of the nuns in the production of Sound of Music at Tonawanda High School in March. She is also a member of the ski club at school.

Hugh Pettit's broken arm is repairing itself nicely.

Former member, Larry Hazel, who is planning to rejoin the BAA, is busy doing gas-hypering. We'll look forward to seeing his astrophotos.

Bill Kirst has given his lady love a ring and he and his fiancee are going to be married on July 30th.

Carl Milazzo is making a Dobsonian mount for Adrienne Morris' 6" reflector, as its equatorial mount, being heavy, is not too portable.

Marguerite Aiple is interested in the theater and goes to many movies, the Lancaster Opera House, Toronto theaters, Chautauqua, Melody Fair and Art Park. She also takes in many lectures at the UB campus, and is very happy that she managed to hear Carl Sagan when he spoke at UB awhile back. She was very impressed.

Darwin Christy has been appointed Chaplain for the Tonawanda Lodge No. 247 F.and A.M. for 1988.

Terry Farrell will receive his associate degree in accounting from Bryant and Stratton in March. Terry and his wife are expecting their first child in August.

Jack Mack was recruited by the enrichment teacher at Maple West Elementary School in Williamsville to assist in celebrating the Month of the Future. Twenty-three 5th grade students prepared a program which was performed for parents and faculty at the Williamsville North High School planetarium. The children were very enthusiastic and did all the visual, script, and music, with the assistance of Bob Reilly, planetarium director and BAA member. They also made robots and space pictures. Alice Mack is a member of the class that produced this program. Jack had lunch with the students at school one day where he talked to them about astronomy and answered their questions. On February 19th Jack, assisted by Bob, conducted an evening of stargazing for the children and their parents in the parking lot. The Month of the Future project was a very rewarding experience and lots of fun.

Edith L. Geiger

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HEAVENS ABOVE! BMS 101
Rowland Rupp, Edith Geiger & Alphonse Kolodziejczak

No previous knowledge of astronomy is required for this comprehensive survey of the heavens. Planets, moons and stars will be presented along with nebulae, galaxies and the evolution of the universe. Theories related to pulsars black holes, quasars and the Big Bang will be discussed as well as observing skills and telescope selection.

TUESDAY EVENINGS 7:30 - 9:30 MARCH 15 to MAY 10 (NO class April 5th) B.A.A. Memebrs - $39.00 - Non-members $47.00

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* NOTE ON THE FORMULAR FOR A MIRROR'S RADIUS OF CURVATURE *

As mentioned in the last issue of the "Spectrum", a follow up about a formula for a mirror's radius of curvature would be written in an article of clarification by Dr. Fred West, a past member of the B.A.A. This article is presen ed with a diagram and formulae and is a reprint from the June 1971 "Spectrum".

In the April 1971 issue of the "Spectrum", Robert Burdick quoted a formula for the radius of curvature 'R' of a mirror which should read, when correctly typed,
$R = r + 7P^2$ ----- Where r is the radius of a ball rolling on the mirror's curved surface and P is the period of time for the ball to roll across the mirror's surface and back to its initial position. In the equation the units of R and r are inches, and P is in seconds of time. While reading Burdick's interesting article, I became curious about the physical basis for the equation and after some thought I was able to derive this equation from the laws of mechanics.

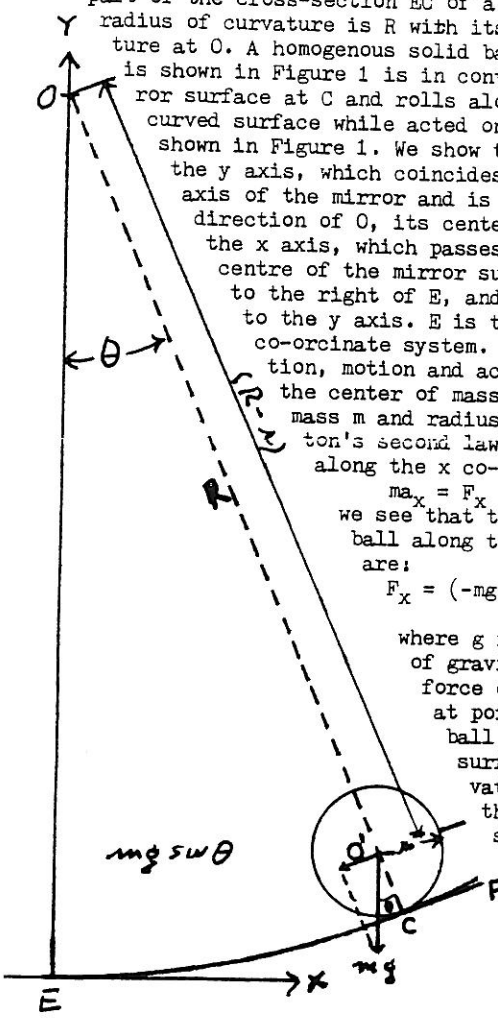
The derivation will start with Figure !. Here we see part of the cross-section EC of a curved mirror whose radius of curvature is R with its center of curvature at O. A homogenous solid ball whose center O' is shown in Figure 1 is in contrast with the mirror surface at C and rolls along the mirror's curved surface while acted on by the forces shown in Figure 1. We show two co-ordinate axes the y axis, which coincides with the optical axis of the mirror and is positive in the direction of O, its center of curvature, and the x axis, which passes through E, the centre of the mirror surface, is positive to the right of E, and is perpendicular to the y axis. E is t e origin of the co-orcinate system. Consider the position, motion and acceleration a_x of the center of mass O' of the ball of mass m and radius r. Writing Newton's second law for the ball along the x co-orcinate,

$$ma_x = F_x \quad (2)$$

we see that the forces on the ball along teh x direction F_x are:

$$F_x = (-mg \sin\theta + F)\cos\theta \quad (3)$$

where g is the acceleration of gravity and F is the force of friction acting at point C between the ball and the mirror surface. In this derivation we assume that the mirror is horisontal, and therefore that the y axis points to the zenith. The angle θ is the angle that the mirror surface radius OC makes with the y axis.



If the ball is rolling (with no sliding) along the mirror surface, we can write the following equations for the torque τ about O' on thebball: $\tau = I\alpha$ (4a)

$$\tau = Fr \quad (4b)$$

where α is the angular acceleration of the ball and I is its moment of inertia. Furthermore, we see from geometry in Figure 1, $\alpha r \cos\theta = -a_x$ (5)

For a homogeneous solid sphere, $I = \frac{2}{5} mr^2$ (6)

Equating equations (4a) and (4b), then substituting for I and α from equations (6) and (5) respectively, we find

$$\frac{2}{5} mr^2 \left(-\frac{a_x}{r\cos\theta}\right) = Fr$$

$$-\frac{2}{5} m \frac{a_x}{\cos\theta} = F$$

Here and in equation (5) the minus sign is used because an angular acceleration in Figure 1 is associated with a deceleration (negative acceleration) along the x axis.

Substituting for F in equations (3) and (2) we get:

$$ma_x = -mg \sin\theta \cos\theta - \frac{2}{5} ma_x$$

$$\frac{7}{5} ma_x = -mg \sin\theta \cos\theta \quad (7)$$

If θ is smaller than 5°, as is the case for mirror focal-ratios of 3 or gretaer, we can approximate $\cos\theta$ by

$$\cos\theta = 1 - \frac{\theta^2}{2!} + \frac{\theta^4}{4!} - \ldots\ldots \quad (8)$$

and with good accuracy (since all but the first term are less than 0.01) we can write $\cos\theta \cong 1$. Equation (7) then becomes $ma_x = -\frac{5}{7} mg \sin\theta$ and since from the geometry of Figure 1 for point O'

$$\sin\theta = \frac{x}{R - r} \quad (9)$$

$$ma_x = -\frac{5}{7} mg \frac{x}{R - r}$$

or dividing out m,

$$a_x = -\frac{5}{7} \frac{g}{R - r} x \quad (10)$$

so that within the accuracy of the approximations made, the acceleration a_x is directly proportional to and opposite in sign to the displacement x of the ball. There is a well-known class of systems in mechanics for which a simislar relation holds between a_x and x, and the motion that such systems describe is known as simple harmonic motion. The simple pendulum and a mass oscillating at the end of a spring are perhaps the two most common and well-known examples of systems which perform simple harmonic motion, whose displacement x in one co-ordinate with time varies (ignoring fridtion) as a sine or cosine function of a system constant, times the time. For example, from equation (10) we could, given suitable boundary conditions, derive and write the following equation for x:

$x = A \cos \sqrt{\frac{5}{7} \frac{g}{R - r}}\, t$ .....(11) where A is the ball's amplitude of roll across the mirror, and t is the time. Here t=0 is taken to be an instant of maximum x displacement of the ball. The period P for the ball to oscillate across the mirror and back to its initial position on the mirror is given by the formula

$P = 2\sqrt{\frac{7}{5} \frac{R - r}{g}}$ .....(12) which is solved for (R-r):

$$R - r = \frac{5}{7} \frac{g}{4\pi^2} P^2 \quad (12a)$$

If one sets $g = 386.4$ inches/sec^2 to get lengths in inches and time in seconds, then equation (12a) becomes

$$(R - r) = 7P^2 \quad (12b)$$

which is the same as equation (1)

* * * * *

PROFILE

David J. Sepulveda

Dave was born in Buffalo. He started his elementary school education at St. Columba's School and after moving to the Lovejoy area, received most of his grade school education at St. Agnes School. In seventh grade he entered the school Science Fair with a crystal radio he had built, and won the first prize. He also entered the radio in the Western New York Science Congress at the museum and received an honorable mention.

From grade school he went to Seneca Vocational High School in Buffalo, majoring in electronics. He enrolled in the school apprentice program with the city of Buffalo Department of Housing and Urban Development. He was a drafting apprentice for four months of his senior year, spending three days working on the program and the remaining days at school.

In the summer of his junior-senior year, he attended the New York Telephone Company class on telephone cable

splicing. The company pulled out students, Dave included, who showed a special aptitude along these lines, and they proceeded to rewire the high school's telephone communications.

While at Seneca Vocational, he played tennis for four years and did some weight lifting in his senior year. In his junior year he was assistant editor of the school newspaper, and was transferred to darkroom editor for his senior year, ending up in the photography end of it.

He went on to Erie Community College, North, enrolling in the electrical technology program. He did some out of school work to help finance his education. He was employed by the Buffalo & Erie County Public Library system as a page where he reshelved books, put them back into the Library of Congress order, and charged out books. He worked at the James M. Mead, Cazenovia, and East Clinton branch libraries. After a year he changed his job and became a guard at ECC, North. For financial reasons he was not able to finish his course at ECC at that time, but remained a guard at the college for almost a year after withdrawing from school. He credits his ability as a guard to his weight lifting club in high school.

As a guard, his life became more interesting when he went to Melody Fair for three years as a uniformed personal guard for the stars, including Tom Jones, Johnny Cash, Florence Henderson and Tony Orlando. Florence Henderson was impressed with Dave that she asked if he would accompany her as her personal guard. He turned down her offer as he didn't want to leave the area. Dave became very friendly with Tony Orlando who, at the end of his Melody Fair engagement, in an impulsive frame of mind, autographed the back of Dave's shirt. The next morning, when Dave was sleeping, his mother noticed the shirt and figured it was dirty, so proceeded to wash it. A cherished autograph went down the drain. When Melody Fair closed, the staff members were allowed to keep their badges.

Dave met Catherine Snyder who was working at Melody Fair as an apprentice. She helped out with stage lighting, set locations and sound. Catherine received her Associate degree in theater arts from Niagara Community College. Dave and Cathy organized and presented Hair at NCC, and it was such a success that they were asked to put on the production at Art Park for one week. Dave took care of the props, stage and set design.

After going together for three years, Dave and Cathy were married on August 9, 1980. Dave had had an interview for a job with Radio Shack and they wanted him to start work right away, but he said "no way," for he was going on his honeymoon.

When he returned, he became a Radio Shack manager trainee at the Summit Park Mall, and in six months he had his own store. They gave him the Main and Tupper store, and after two weeks he wanted to leave that store, and was given the Radio Shack store at Clinton and Rossler Plaza for one year, and was then given a brand new store at Gardenville Plaza for nine months. He became the manager at the Bailey Avenue store and was to train salesmen who wanted to sell electronics. He also used to fix any equipment that needed repair. The management from Fort Worth, Texas, gave Dave an ultimatum, to stop fixing things or get out, so Dave asked to transfer to the computer repair department. He was told it was a different branch of the company and he would have to apply and be tested, and all this time he was still manager of the Bailey Avenue store.

------(SEPULVEDA) to be continued in the next "Spectrum".

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** OBSERVATIONS **

On January 11th, the 1,000th deep sky object I have observed was the galaxy NGC 1019 in Cetus. It is of low surface brightness, with a slightly brighter hub. It is 1 x 1 arc minutes in size and 13.5 magnitude.

The variable star, Mira in Cetus, was seen at maximum on January 15th at magnitude 4.3 which was a magnitude below its average. This orange star is invisible to the naked eye for 11 months of the year.

Also seen that night was the Orion Nebula, M-42, with an Oxygen 3 nebula filter on a 22.5" Dobsonian from the clear winter skies of Niagara County. This filter made the nebula look like a distorted soap bubble. Its dimentions were larger that I have ever seen and its outer edges were sharp and slightly brighter than the neighboring low surface brightness area. More towards the center were filaments and patches of still higher surface brightness, and finally the bright central region that most amateurs see. On the edge of that region, was the dark nebula known as the 'fish mouth' which was very prominent which helped make M-42 look even more 3-dimentional.

With an 18 inch Dobsonian on February 8th, a colorful double star near the center of the Pleiades open cluster, M-45, was seen. It is a 7th and 8th magnitude orange and blue double named Burnham 536, tehy are separated by 36 arc seconds.

That same night the Integral Galaxy was seen in Camelopardalis. That 13th magnitude galaxy is known as UGC-12-7-28 and UGC-3697. It is 1 x 3 arc minutes in size and of medium surface brightness, it is located $\frac{1}{4}$ of a degree west of a 6th magnitude star.

Carl Milazzo

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We are saddened by the death of former member, Alfred Ricciuti, who suffered a couple strokes in the last few years, and died in a fire in his home. He graduated from UB in 1931, majoring in philosophy with a minor in journalism, and kept close contact with his alma mater. He had many interests including poetry, astronomy, science, photography, plants, flowers, and entomology, and was very well read. He wrote many poems which he shared with UB students. He worked for Niagara Frontier Transit for 21 years and was known as the poet-philosopher bus driver. He was a very friendly and unusual man.

elg

NEW MEMBERS

Lets welcome two new members since the last "Spectrum"---

David Quagliana & Willard Murr

* * * * *

The 'Membership List' and 'By-Laws' will be available at the next regular meeting. Any contribution will be greatly appreciated to defray any expences.....

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KELLOGG OBSERVATORY REPORT

All quiet on the observatory front has been the situation since Christmas time. A plague of cloudy and cold winter nights has kept observatory attendance down to about 20 hardy visitors per Friday evening. Observations have been limited to the moon and Jupiter due to partly to mostly cloudy conditions. Hopefully as spring approaches, the clouds will depart. The "Evenings with the Stars" film series will begin in March with a classic science fiction movie on alternate Fridays in the Museum's auditorium, including a visit to the Kellogg Observatory by the movie goers. Volunteer schedules have been distributed. Anyone wishing to help can contact Marilou at 896-5200 ext. 214.

Girl Scout volunteers are being trained for the Kellogg Observatory as part of their service project. 4-H of Erie County is looking for interested people with an astronomy

background to assist with a new program called "Blue Skies Under My Feet". Anyone interested in sharing their own expertise with young people should contact Linda Frontera at 876-7900.

ML. BEBAK

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OBSERVATORY REPORT

As of December 1987, I am the new Beaver Meadow Observatory Director. During the past year under the directorship of John Yerger and with the assistance of Hugh Petit, Ed Czapla and others, the observatory has been well maintained. Thanks to the donation of an off-axis guider by Gene Witkowski, the observatory now more than ever is well suited for astrophotography. However, more work needs to be done to make the telescope easier to use. The polar axis friction clutch is slipping badly, however using a "C" clamp to hold the polar axis, the telescope can be kept steady. The roof motor pulley belt is slipping during cold weather, so a push will be needed to help start the roof moving.

If anyone has any comments or would like to be checked out to use the observatory call me at 833-2407.

Bob Hughes

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INSTRUMENT REPORT

INSTRUMENTS SECTION MEETINGS:- They met on January 15th & 22nd, also February 18th. We were able to get a one hour exposure on Hypered Technical Pan of the 'Horsehead' nebula using prime focus with the 12" telescope. We are pleased to report that the off axis guider works perfectly and is reasonably easy to use. Please note, to help in guiding when using a double crosshair reticle, it helps to put the guide star out of focus enough so it fills the central square formed by the double crosshairs. Since Konica Color print 3200 ASA film only needs an 8-10 minute exposure for prime focus on the 12". We will be experimenting with this film on the next clear session. Its shorter exposure time will enable more people to try out the scope. The next scheduled meetings of the Instrument Section will be Fridays March 18, April 15, May 6 and Saturday June 11. All will start at 8:00 and end ???? except June 12, which will start after Public Night. If anyone wishes to try any other type of astrophotography, i.e., modifications, darkroom work, moon, planets, sun, etc. feel free to contact either Ed Lindberg or Dan Marcus if you want assistance.

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INSTRUMENTS NOTES:-

Our Instrument Section meetings this winter have largely devoted to observation and photography. The meetings for February and March will be held at Beaver Meadow on the third Fridays (regardless of weather)... Additional meetings are scheduled for the fourth Fridays (weather dependent)....

It is during observing sessions that instrument makers become aware of the entire optical path involved in an observation. They note that there is a body of information leaving the object being observed. This bundle strikes the objective of the telescope where it is converted into a real image in space, just in front of the eyepiece. The observer examines this image much as a collector would examine a postage stamp using the eyepiece as a magnifier. If the eyepiece is located correctly it will produce an image on the observer's retina.

Assuming that the telescope is well built and provided with the correct eyepiece for the particular object, it is the observer's eye that is the most critical link in the optical chain. If the visual acuity of he eye is normal then it is the iris of the eye which may help or hinder observations.

The iris of the eye acts as a diaphragm trying to minimize variations in the light it lets through. When the observer looks at a bright light source the iris closes down to protect the retina. If the eye is then used to look through the eyepiece it may cut some of the light scattered by the objective.

For best performance, the iris should be of the same diameter as the exit pupil of the telescope. The exit pupil is the diameter as the pencil of light rays leaving the eyepiece. The exit pupil diameter equals the diameter of the objective divided by the power of the telescope. As an example, a 7 by 35 pair of binoculars has an objective 35-mm in diameter and is 7 power. Its exit pupil is 35 over 7 or 5-mm in diameter. If the iris is 5-mm in diameter all the light gathered by the objective will enter the eye. But if the eye has been desensitized by action of a strong light source, the iris might have closed down to 3-mm for instance. 3 times 7 is 21-mm, diameter of the objective is being used or less than half the area of the objective is utilized. If instead of exposure to a bright light source the eye had been in darkness, the pupil might be as large as 7-mm and it would let in all the light from the objective. The action of he eye in adjusting itself to a low level of illumination and thus increasing in sensitivity is called 'dark adaptation'. When completely dark adapted the eye is at maximum sensitivity.

The process of dark adaptation is a slow, gradual one. Anyone who has worked in a photographic darkroom has noticed that after perhaps a half hour in total darkness the eyes become very sensitive. The faintest light leaks can be detected very readily. The same thing occurs at an observing site under low level illumination.

The dark adapted state seems to be a rather frail, transient condition. A flash of stray light will undo several minutes of dark adjustment. To prepare for an evening of deep sky observing, first determine the location of all light sources in the surrounding area. If the moon is out note its position for the remainder of the evening. It is possible to do limited deep sky work on a moonlit night if the sky is very clear and the area of interest is far away from the moon's direction. By establishing the location of the light sources they can be avoided during the rest of the session. Of course, only red light should be used for illumination.

To speed up the process of dark adaptation, try the method pioneered by Vic Stryker of the AAVSO (Variable Star Observers). While standing in the darkest part of your observing area, look as hard and as rapidly as you can down at your feet. Then blink your eyes for a count of 15 seconds. Stryker caustions against using this method if you wear contact lenses. I have not found the method equal to half an hour in the darkroom. But it does give a quick result. The method improves with practice.

The method works better for some observers than for others. You will also note the fragility of dark adaptation. If you glance at the moon you will need another session. A white light such as a flashlight will also greatly reduce the sensitivity of the eye. A flourescent lamp is still more effective in cancelling your efforts. A flashbulb (not used much anymore) is an oxygen fired magnesium light of great potency and is white like the light from the moon. Worst of all is the electronic flash, a xenon source rich in blue light. A direct hit by a xenon flash on the cones of the eye will wipe you out for perhaps an hour or even longer. Then you can head for the coffee and doughnuts, hopefully provided. After the coffee, look at the moons of Jupiter and the polar caps of Mars. You can enjoy Albireo and other beautiful double stars. Or------- bite the bullet and look at the moon with a dark neutral density filter and/or high power. Better luck on another night.

Ed Lindberg

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COMPUTER SECTION

One of the questions that I've been asked lately is, where can you get astronomy related programs and the data needed to run them. The largest collection of programs available at the moment is on the Compuserve computer service. At last count there are over 150 astronomy programs and related files available to subscribers. The information available in the Astronomy Forum ranges from tips on

naked eye observing to the latest news from Sky & Telescope, solar reports, and current satellite data. All that is needed to use this and many of the other data bases that are available is a modem and a terminal program for your computer. A sign up kit for Compuserve can be obtained from most computer dealers or call 1-800-848-8990 for more information.

For those that are interested in tracking satellites, Amsat, the amateur radio satellite organization has a program for almost any computer on the market past or present. For a software catalog just write:-

Amsat
Post Office Box 27
Washington, D. C. 20044

If your an IBM type computer user and you need to know the exact location of an object, the U.S. Naval Observatory has the program for you.

The Flopy Almanac will compute the apparent and astrometric locations of the Sun, Moon, planest and stars. It will also compute set and rise times for any location on this planet. The data base on the disk contains a catalog of 1536 stars and 233 compact radio sources. The program is good until the year 2000 and the cost of the disk is 20 dollars. To order you must include the following information:- 1986 or 1987 coordinates

13-cm (5 inch) disks with or without coprocessors

9-mm (3 inch) disk without co-processor support.

The address to send to is:-

Nautical Almanac Office
Code FA
U.S. Naval Observatory
34th & Massachusetts Ave, N.W.
Washington D. C. 20390-5100

One of the most important parts of any astronomical pr program is to determine the day of the year. The following sub-routine should make that task much easier.

```
5 CLS
10 INPUT"ENTER YEAR (87, 88 ETC) ";Y
20 Y=Y/100:Y2=INT(100*(Y-INT(Y))+.1)
30 IFY2/4=INT(Y2/4)THENF9=1 ELSE F9=0
40 INPUT"ENTER MONTH (1-12)";MM
50 INPUT"ENTER DAY (1-31)";DD
60 FORI%=1TO13
70 READD9:IFI%=MMTHEN D8=DD+D9
80 NEXTI%
90 IFMM>2THEND8=D8+F9
100 PRINT"JULIAN DATE = ";D8
110 DATA 0,31,59,120,151,181,212,243,
120 DATA273,304,334,0
```

This program will calculate the day of the year for any year including a leap year and should work in almost any computer with minor changes.

Thats it for this time around. If you have a question, need a program or have one to share, just call me any day after 7 PM at 694-3814.

Jack Empson

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Features to be seen in the next issue will include the continuation of the 'Profile' on Dave Sepulveda, "What is and Amateur Astronomer?" and "Observations on a Comet Lately Discovered" and many others. (dpc)

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* THE SPECTRUM *

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