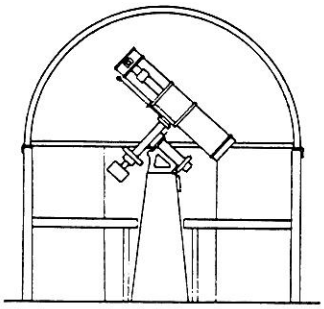
THE SPECTRUM

elg

MAY JUNE



1990

BUFFALO ASTRONOMICAL ASSOCIATION, Inc.

OFFICERS

Doris Koestler - - - - - - - - - - - - - - - - - President
Rowland Rupp - - - - - - - - - - - - - - - Vice President
Ken Biggie - - - - - - - - - - - - - - - - - Secretary
Jack Empson - - - - - - - - - - - - - - - - Treasurer
Ed Lindberg - - - - - - - - - - - - Fellow Representative
Dr. Jack Mack - - - - - - - - - - - Museum Representative
Marilou Bebak - - - - - - - - - - Board Member at Large
Dr. Fred Price - - - - - - - - - - Board Member at Large
Bob Hughes - - - - - - - - - - - - Board Member at Large
Diane Borowski - - - - - - - - - - - - - - - Membership
Dan Marcus - - - - - - - - - - - - Observatory Director
Darwin Christy - - - - - - - - - - - "SPECTRUM" Editor

The Beaver Meadow Observatory now has a telephone. The number is (716) 457 3104. See Observatory Report further on in this "SPECTRUM".

TAXACOM
COMPUTER BULLETIN BOARD
Phone - 896 7581

For further information about TAXACOM, call Jack Empson - 694 3814.....

The "SPECTRUM" deadline for the SUMMER 1990 (July-August) issue is no later than June 8, 1990. All Star Parties will be in by that date and any other articles of the current times must be in by that time. Your editor will thank you much!!!!

MEETING NOTICES

MAY 11, 1990 - the Annual Dinner Meeting will be held at the Lord Amherst, 5050 Main Street, Amherst, NY. Cash Bar at 7:00 PM and Dinner at 7:30 PM. Price is $12.00 per person. Advance tickets sales only. NO tickets sold at the door. Our guest speaker for the evening will Mr. Ernst Both, Director of the Science Museum. Ernst's topic will be on the "Voyager." There will also be a "Door Prise" given out to some lucky person.

JUNE 8, 1990 - our Annual Meeting will be held in the New Science Building Auditorium, Buffalo State College. This will be our annual business meeting before we break for the summer and the ensuing "Star Parties". The meeting will begin at 7:30 PM with the election of officers and two short talks by BAA members. Marilou Bebak will talk on the "Voyager" and Bob Hughes will tell us, "How Sun-Spots affect the Ionosphere." Everyone is encouraged to attend this meeting and VOTE for your future officers. Refreshments will follow.....

Doris Koestler.

N F C A A A

The Spring meeting of the Niagara Frountier Council of Amateur Astronomical Associations will be hosted by the Rochester Astronomy Club on May 5, 1990 at St. John Fisher College, 3690 East Avenue, Rochester, N.Y. - registration is from 12 Noon to 1:00 PM - Business meeting 1:00 to 2:00 PM - Afternoon Paper Session, 'til 5:30 PM - RELAX - Dinner at 6:30 PM followed by the main speaker at 8:00 PM The speaker, Rick Albrecht, will tell about, "George Hale's Last Giant Step". For more information, call Ed Lindberg 633 6725.....

We are sorry to learn of the death of Esther Goetz last February in Altamonte Springs, Florida; just a year and one month after Irv Goetz passed away. We will remember her kindness, wit, intelligence, her wonderful poetry, and her fun loving nature.

Our deepest sympathy goes out to daughter, Mary, and sons, Tom, and Peter Michael.

elg

PRESIDENT'S CORNER

There is still time to purchase your dinner tickets. The deadline is May 4, 1990. No tickets will be sold at the door. Tickets may be purchased by check made payable to the Buffalo Astronomical Association, Inc. and mailed to Jack Empson, 7021 Nask Rd., No. Tonawanda, NY 14120.

Many thanks to Dave Sepulveda for printing the May dinner tickets.

There will be a Board meeting on May 8, a990 at 7:30 PM at the home of Dr. Fred Price.

volunteers to recruit nominees for the offices of President, Vice President, Secretary and Treasurer. If you wish to run for one of the offices or know of someone who is willing to do so, call Edith Geiger - 649 7965; Cathy Sepulveda - 694 5361; or Melissa Marcus - 773 5015.

BECOME INVOLVED IN THE BAA ! We need you !!!!!

Doris Koestler

FOR SALE: Celestron Firstscope Refractor 80mm f/11. Comes with altazimuth mount, slow motion controls, and Celestron 26mm eyepiece. Also includes TeleVue 32mm Plossl and 45 degree correcting diagonal prism. (All are 1.25 inch.) Brand new condition. Buy new $754--asking $625. Open to all reasonable offers. Call Capt. Tom Fritschi Ransomville NY, 716-791-4265.

SPY AND TELL

Joan and Ed Eschner are sailboaters and are members of the U.S. Power Squadron of Hamburg. The Eschners are using their astronomy in celestial navigation.

In early March a brilliant fireball streaked through the atmosphere around 7 p.m. and apparently was seen by a very few people. Ernst Both was a witness to this spectacular sight as he drove home from work. His account of the happening was reported in the Buffalo News.

Leonard Chrosniak is studying ancient Egyptian life in a museum class led by Donald Licht. He is also bustling around the house doing insulating, paneling, and remodeling the upstairs.

Tom and Betty Wood were in California this spring to attend the wedding of their daughter, Katherine, who was married in Yosemite National Park. The Woods spent ten days on the west coast.

Robert Milec has set up a new business called STARBOUND. He has designed a dew shield that fits Telrad mounts. It will be manufactured elsewhere, but Bob will sell and wholesale it to other dealers. Congratulations!

Bill Hoffman is an amazing fellow involved in exciting hobbies. He took tennis lessons during the winter to be ready for the courts this summer. He was also an active skier, appearing about twenty times on the slopes at Holiday Valley and Kissing Bridge. Last year he visited every New England state and went scuba diving off the coast of Maine. There is also a strong possibility that he will join a judo class.

While he was in Manchester, Vermont, he toured the Robert Todd Lincoln mansion, and visited the observatory where Robert Lincoln enjoyed his hobby of astronomy. Bill has a Parks 12.5" scope with which he is hoping to get a good look at Pluto. He is also thinking of building a refractor.

Ernst Both will be going to Austria sometime in May.

Gene Witkowski took a great picture of Jupiter on January 20, 1990, including Ganymede's shadow on Jupiter. I hope you will get to see this fine photo. Gene was seen at a Gem and Mineral Exhibit which shows he's also down to Earth.

BAA member, Christopher Terpin, is president of the University of Buffalo Astronomy Club. The Club is holding Public Nights every clear Saturday night from 7 to 11 throughout the summer at the UB Amherst Observatory located at the end of Skinnersville Road, off of Sweet Home Road, near Bizer Creek. The observatory has a 10" Newtonian.

Dan Marcus had made arrangements with Marilou Bebak to set up the solar scope at the museum so he would be able to take some super pictures. Marilou had everything in readiness when Dan arrived enthusiastically anticipating forgotten to bring his adapter. Forgetful Dan returned at a later date (with adapter) and took his special pictures.

Memory problems continue. Dave Sepulveda apparently has forgotten the name of the Director of the Buffalo Museum of Science. As all of you know, Ernst Both is the Director, and he is also our speaker for the May dinner meeting. Well, Dave had the tickets printed for the dinner with the name of our speaker appearing on the tickets as someone by the name of Booth.

I'm sure you've wondered why Marilou Bebak's "Kellogg Observatory Report" was missing from the March-April Spectrum. Guess what. She FORGOT!

Edith L. Geiger

BAA ANNALS

5 YEARS AGO - May 1985 was our first, and probably most successful, dinner meeting. It was held at the Wilcox Mansion. The DiLapos provided the buffet dinner. Ernst Both provided the astronomy - Astronomical Foibles". In June Darwin Christy spoke on light pollution.

Fred Price contributed a biographical sketch for the SPECTRUM on Thomas William Webb, author of "Celestial Objects for Common Telescopes", an observers' book still in use today, more than a century after his death. An extensive list of deep sky objects that would normally be difficult to find except for the fact that they are near Messier objects was provided by Bill Smith. All these objects are within 1.5 degrees of the better known Messier object.

According to Spy and Tell, Marilou Bebak had applied to NASA to be the teacher passenger aboard the Space Shuttle CHALLENGER. She didn't get the job. Dari Milazzo and Tristan DiLapo saw 70 deep sky objects in a single night of viewing at Beaver Meadow. The NGC objects were brilliant and spectacular, according to Spy and Tell. How about that!

10 YEARS AGO - Dr. J. Gibson Winans spoke at our June meeting on his observations of the 1980 solar eclipse in India. In June two club members combined to report on their visit to the Riverside, California convention. They were Tom Dessert and Miro Catipovik. Tom also contributed a SPECTRUM article describing how to design a guiding telescope.

15 YEARS AGO - Club member Fred West, a professional astronomer on the Buffalo State faculty, presented "The Solar Neighborhood" at our May 1975 meeting. We held a bake sale at the meeting to raise funds for the Beaver Meadow observatory construction project. For June there was no talk, just business.

Dr. West also contributed an article for the SPECTRUM on the famous Bode-Titius Law, regarding the spacing of planets and the resonances of asteroids. The relationship between the two topics is that the first asteroids discovered vindicated the law, but also that Kirkwood gap resonances, later discovered in the asteroid belt, may arise from a similar mechanism.

25 YEARS AGO - In May Ed Lindberg spoke on his trip around the world. The club scheduled a bus trip to Allegheny Observatory for the June meeting. According to the SPECTRUM, only twelve seats remained. What kind of bus was that? Today we can't fill a car to take a trip to an observatory. Notices of meetings of the Instrument Section, Advanced Study Section and the Lunar Section appeared in the SPECTRUM in those days.

The June SPECTRUM carried a biography of Rudolf Buecking, a member of the College of Fellows, now deceased. The SPECTRUM was monthly then. Lists of nearby stars, prominent double stars and the brightest stars also appeared in that issue.

Rowland A. Rupp

Observatory Report

Public Nights: I need help! As usual, only a select few show up to help. I hate to keep picking on the same people all the time. So how about giving them a hand? Astronomy is more fun with friends, and public night is a great place to learn!

June 11: Mt. Saint Joe's is visiting the observatory with about 50 people. If you are interested in bringing a telescope, give me a call at 773-5015.

Photographic Sessions: Well, it has been cloudy for the last two, our luck has to change. The next photo sessions will be on May 19, and June 16 after public night.

TELEPHONE: The NEW Observatory telephone number is **457-3104.** By the time this goes to press, the Beaver Meadow Observatory Hot Line will be in service! I will try to list upcoming astronomy events like meetings, Observatory happenings, as well as comets, super novas, major sunspot activities. At the sound of the beep, people can leave their questions, or comments. The message will be updated on the weekend.

Rules for our new phone!! We are billed for every call made on this phone!! A donation of $.50 for the first 3 minutes, and an additional $.10 for each additional minute. Please **log** all long distance phone calls in the telephone log, along with your name, and number called. The Observatory Director will bill you for the cost of the call. If you call Skyline 1-617-497-4168 it is $1.50 for the first time through, and an additional $1.50 if you listen to it the second time around. Oh yes, **EMERGENCY** calls are free. Just log your name, number called, and reason. Your cooperation will be much appreciated.

Daniel R. Marcus

KELLOGG OBSERVATORY REPORT

The Kellogg Observatory is open for public nights on Fridays through May 25th from 7:00-9:45 pm. The Observatory will close for public nights through the summer, and reopen again for nighttime viewing on Friday, September 7th. All BAA members are welcome to stop by for a look through the Museum's 8-inch refractor.

Summer Sun Shows run Mondays through Fridays from July 9th until August 24th, 11:00 am-1:00 pm. BAA member Nancy Adams will be your host for spectacular views of our sun during this period of maximum solar activity. You can view sunspots and the solar spectrum in the solar lab using the Museum's heliostat and spectrograph, plus see prominences through the H-alpha filter on the 8-inch refractor. Now is the time to do some solar observing - the current sunspot cycle is the second most active cycle ever recorded!

Also, photos and/or sketches are needed for the Museum's "Astronomy Current Events" case located in the Gibson Hall of Space. Anyone interested in displaying their work should call Marilou at 896-5200 ext. 214. **New members are especially welcome!**

Save this date! A "learn-to use, clean-up, fix-up your telescope" session will be held for the general public at the Buffalo Museum of Science on **Sunday, May 20th from 1:00 - 3:00 pm. Your help is needed!** This is your chance to share your expertise, promote astronomy, and the BAA all at once, or you can come and pick up some tips on telescope use. Call Marilou at 896-5200 ext. 214 if you can come to "talk telescopes and/or backyard astronomy".

ML. Bebak

INSTRUMENT NOTES

Some years ago Olga and I attended an eclipse meet on Wauchusetts mountain in central Massachusetts. The eclipse, a sunrise special, was completely fogged out. So we just headed for home. To add to our list of troubles, our car broke down in the town of Athol in the Berkshires The engine was running but there was no forward drive. From long experience in piloting incipient wrecks I was able to coast our chariot to a safe parking spot along the curb. Then our luck took a upturn. We were parked almost right across the street from a Buick repair specialist and he promised us a new universal joint that very same day. And down the street was a huge plant with a familiar name - Starrett.

We hastened (one of us eagerly) over to the handspme Starrett plant. This world famous establishment makes fine tools for the toolmakers of the world. We asked if they would give us a plant tour. They would - and did. The tour was very complete and the tour guide took great pains to show us a good time. The great machines used to make fine tools were a pleasure to see. The great variety of products was impressive. I had seen their catalogs and marvelled at the number of items. But to see them all in the flesh and in great quantities was breath taking.

Most enchanting were the areas where the finished tools are tested. In one area they were testing and adjusting micrometers. They had a huge wall display of all of their sizes. I have micrometers at home that will check dimentions to two inches. Here was a range of sizes from one inch to 8 FEET! We were told that the giants were used to check locomotive drive wheels. They had to be massive to hold their accuracy and they were supported by an aurcraft cable clipped to a built-in ring. A small crane held them in position.

Then there was a department where a craftsman was testing and correcting straight edges. These are similar in cross section to a household yard stick, but those under test were of steel and about six feet long. These straight edges are clamped together in a group on to a magnetic vise and edge ground on a precision grinding machine. The craftsman corrects small bulges with a cloth faced mallet and takes out the longer bulges by bending them on his knee. Then he checks the edge accuracy by holding them against a master straight edge fitted with a long bright light. Corrections are made with a hand stone. When the craftsman is satisfied with the agreement with the master he puts the finished piece into a box according to its quality classification. Our tour was most inspiring and our misfortune had turned out to be a lucky turn of events.

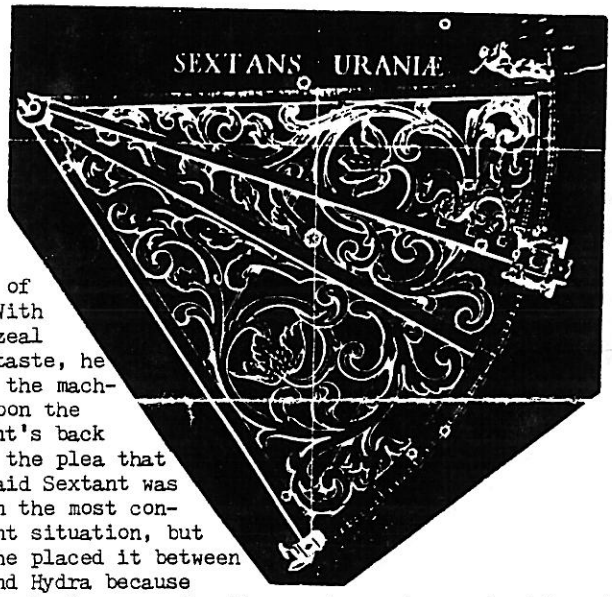
As I think about this tour and the many other fine industrial products that are to be seen in plants and museums my thoughts go back to the early days of the Industrial Revolution. The craftsmen were testing straight edges against a master. But how did they make the first master straight edges? There was at one time no such thing in existance. A mathematician is satisfied to say that a straight line is the shortest distance between two points. But a toolmaker has to have a solid edge. The toolmaker defines a straight edge as one of three edges, any two of which will be in perfect coincidence on any region. To make a master straight edge

the craftsman must make three blanks and finish them by scraping and grinding to as nearly straight as possible. They can then be given separate designations, as A, B and C. A and C may be brought separately into coincidence with B. Then they are tested against each other. They may both be concave or both convex. Half the error is taken out by working them against B. The material is probably most easily taken off by scraping. The edges are periodically tested against each other most work put on the one showing the greatest discrepancy. The work must be tedious and require great patience and perserverance. When the work is finished there will be three fine master straight edges to brighten the tool shops of the world..

Ed Lindberg

SEXTANS

The SEXTANT, sometimes called Sextans Uraniae, is 300 years old. It was to be published in the new star catalogue in 1690, thus making it a 'modern' constellation as compaired to the ancient ones, time wise. The instrument was used by Helevius, which he so successfully made stellar measurements at Dantzig from 1658 to 1679. He wished to commemorate this instrument by placing it among Leo and Hydra, using twelve stars, unclaimed, in the area.



As Smyth wrote of it, "With more zeal than taste, he fixed the machine upon the Serpent's back under the plea that the said Sextant was not in the most convenient situation, but that he placed it between Leo and Hydra because these animals were of a fiery nature, to speak with Astrologers, and formed a sort of commemoration of the destruction of his instruments when his house at Dantzig was burnt in September, 1678; or, as he expressed it, when Vulcan overcame Uranis.

Sextans is bordered by only three other constellations, which are Leo, Hydra and Crater.

OPHIUCHUS

Thee, Serpentarius, we behold distinct
With seventy-four refulgent stars.
---Eudosia

OPHIUCHUS, the Serpent Bearer, (Serpentarius in LATIN is Ophiuchus) is perhaps as old as 5,000 B.C. It was discovered in the ancient atlases as standing on the scorpion. He is depict as holding across his knees, a wrtihering serpent. The latter being that of Serpens, another constellation which is now split into two distinct constealltions, Serpwns Caput, the head and Serpens Cauda, the tail.

Also, Ophiuchus has been called Serpentarius, representing the giant he is. And-- according to a Greek legend, Ophiuchus is supposed to represent AEsculapius, the renowned physician, the inventor of medicines. The modern Caduceus, the staff which is a symbol and attribute of the Greek God Hermes and the Roman God Mercury. This staff which is adorned by two serpents entwining it, got its name from Aesculapius.

The Caduseus has been adopted as the emblem for the United States Army Medical Corp.

AEsculapius was educated by either his father, Apollo or Chiron the Centaur. He is said to be the earliest of his profession and was the ship's surgeon of the Argo. When their famous voyage was over, he achieved such great skill that he could even restore life after death. Among those was Hippolytus, of whom King James wrote:- "Hippolyte. After his members were drawin in sunder by foure horses, Esculapius at Neptun's request glewed them together and revived him." On attempting to revive Orion from the dead, this achievement alarmed Pluto, the reigner over the nether world, so much that he persuaded Zues to take AEsculapius and give him a distinct place among the stars. In another short version, Pluto feared the continuance of his kingdom that he induced Jove to strike AEsculapius with a bolt of lightning and put out of the way, his presence, among the constellations.

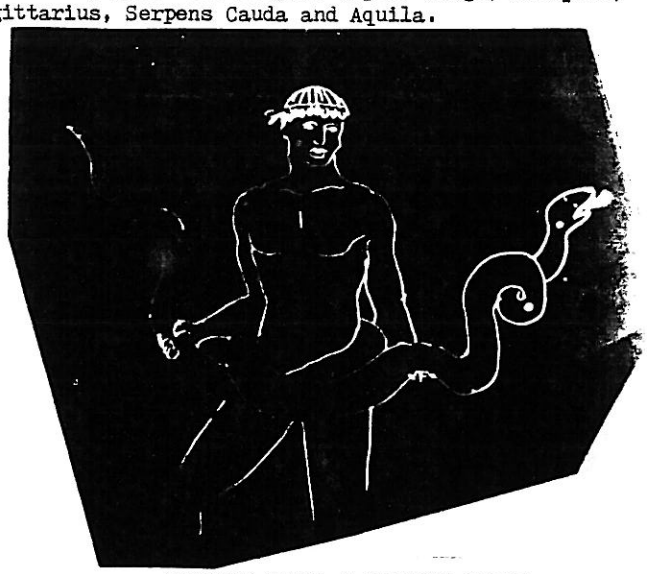
Ophiuchus was sometimes regarded, in the middle ages, to represent Moses with the Brazen Serpent. He was also supposed to represent Laoccon, the son of Antenor.

Two serpents were sent out to attact him for having thrust a spear into the wooden horse at Troy. The serpents were to strangle him in their folds together with his two sons, but they came to rescue him from the serpents. In the Vatican Museum there is a statuary denoting this trajedy.

. . . the length of Ophiuchus hugs
In th' arctic sky.
from Milton's Paradise lost

Sometimes this constellation depicts it as an elderly man, perhaps from the celebrated statue at Epidaurus; and from the planisphere of the monk Geruvigus as it is representing an unclad boy holding a writhering serpent while standing on the head of a scorpion.

Although this constellation is NOT one of the members of the zociac, it does lie on the zodiacal belt. It is in reality a more noteable zodiacal constellation than is Scorpius as the sun takes some 25 days to pass through it as compared to only 9 days through Scorpius. Ophiuchus is bordered by Hercules, Serpens Caput, Virgo, Scorpius, Sagittarius, Serpens Cauda and Aquila.



SERPENS CAUDA & SERPENS CAPUT

The starry Serpent . . . .
Southward winding from the Northern Wain,
Shoots to remoter spheres its glittering train.
STATIUS

Serpens is perhaps as old as Ophiuchus because its stars were originally combined with those of Ophiuchus. And as one large snake, today, it has been split into two separate constellations, Serpens Caput (the head) and Serpens Cauda (the tail).

In the book of Job (in the Old Testament) chapter 26, verse 13, we read of the serpent, "By his spirit he hath garnished the heavens; his hand hath formed the crooked serpent." This may have been a direct result of Renan's remark about this Serpent (from the Hebrews), being the "Fugitive Dragon", while others thought it to represent Draco rather than the Serpent held by Ophiuchus. To which it was probably more ancient and widely known, being ever visible from its circumpolar position. The scholars of the Bible contend that it was the serpent seducer of Eve.

Further into the chapters of the Bible, from the book of 2Kings, chapter 18, verse 4, it reads, "He removed the high places, and brake the images, and cut down the groves, and brake in pieces the brazen serpent that Moses had made;-------". This refers to the brazen staff Moses erected in the wilderness which was preserved until the days of Hezekiah.

Further: Biblically, Satan assumed the form of a serpent. And among the Egyptians, Typhon was the evil diety. Today we can still find on Asian tablets in Hieroglyphics of both Chinese and Mexicans this evil doer. The serpent whose head the Messiah was to smash, was the hydra which Hercules slew and finally another monster in Roman mythology finds the snake with 100 heads which was finally put to death by Jupiter.

There are son many stories about this animal, the Serpent, that it is very hard to figure out which one is the real story of Serpens, the writhering snake held by Ophiuchus.

The head of the serpent is bordered by Hercules, Corona Borealis, Bootes, Virgo, Libra and Ophiuchus. The tail of the serpent is bordered by Aquila, Ophiuchus, Sagittarius and Scutum.

Darwin Christy

GETTING STARTED IN AMATEUR RADIO ASTRONOMY

Jeff Lichtman, President, SARA

Journal of the Astronomical Society of the Atlantic
November 1979

We regularly survey each new SARA (Society of Amateur Radio Astronomers) member with regard to their interests, and how the society may address these interests. Invariably most every new member asks the question, "How do I get started?" It is to these people that this article is addressed. It deals with general and specific information and recommendations.

Basically, amateur efforts in this discipline fall into two general categories:

1. Indirect method studies of solar phenomena, meteor infall, Jupiter noise storms, etc. This type work is usually done at the low radio frequencies, with relatively narrow band receivers. It does not involve sharp imaging of the radio noise source. This work is conducted mainly with communications type receivers, with only a minimal need for auxiliary equipment. The expansion equipment usually takes the form of a strip chart recorder or computer as a readout instrument, and a suitable DC amplifier required to drive the readout. This work, of course, does require a quiet radio band in the spectrum of interest.

2. Imaging radio astronomy. This work makes up the bulk of amateur radio astronomy efforts. It is, by its very nature best practiced in the VHF,UHF, and EHF radio spectra with receiving equipment of relatively broadband design. The reason for the broadband receivers is that all discrete radio objects radiate over a very broad spectrum, and the bandwidth of the receiver equates to the energy received from the object.

Discrete radio sky objects are very weak emitters. A power flux unit has been adopted for radio astronomy. It has to do with the tiny incremental power falling from the sky upon one square meter of earth surface, per cycle per second. This unit is called the Jansky, after the original radio astronomy pioneer. By common accord, one Jansky is defined as: 10-26 watt/(meter^2*Hertz), a very small flux indeed. Upon examination, one would think this infinitesimal amount of power impossible of detection at all. Radio astronomy has indeed been described as the examination of ripples riding upon waves, above an entire sea of noise It is estimated that all of the energy which has fallen up on the earth's radio telescopes would not equal the energy in a single snowflake. And yet radio astronomers have refined the sensitivity of their equipment such that these small powers are not only detected but also evaluated into information about the universe which has been both illuminating and exciting. This, despite the fact that the receivers used to make these measurements typically generate as much as a million times the noise signal as the energy from the desired object. How is this accomplished? The assault on the problem is multi-directional and is conducted in the following ways:

One begins with as large an antenna as can be mustered, in order to trap as much energy as is possible from the desired object. This usually involves a radio-quiet location, but does not necessarily require huge single antennas. The problem may be successfully addressed with phase antenna arrays.

The receiver is designed to be of low internal noise, very high gain, and of wide bandwidth. The stability of such receivers represents a continual challenge to the radio design engineer.

Happily, the design of low-noise radio equipment has been made easy with the arrival on the market of very low-noise receiving equipment using Gallium Arsenide field effect transistors. (GaAsFETs). The large market generated by ham radio operators and TV receive-only satellite stations has encouraged manufacturers to invest in this type of research. Input noise temperatures of GaAsFET antenna amplifiers typically fall to 25 degrees K at room temperature and without any attempt at cryogenic cooling of the devices. The noise temperature of the input amplifiers pretty well determines the sensitivity of the total instrument. Mass production of these devices has brought their cost down to well within the budget of the average radio astronomy amateur.

Additionally, the balance of the radio astronomy receiver is designed such that the internal noise is cancelled out. This is usually accomplished by converting the receiver noise plus the desired signal, into a fluctuating DC voltage. A counter voltage is then introduced such that the internal receiver noise is cancelled out. The residual desired signal is then amplified to a very high level in order that it may be measured by the readout device. In practice, the cancellation of the receiver noise is accomplished in one of two ways:

1. In so-called total power receivers the full power of the instrument is delivered to the DC amplifier, and the receiver noise is cancelled out by the introduction of a back-biasing voltage at this point. This permits the DC amplifier to greatly amplify what is left - which is, of course, the desired signal. This practice works quite wel as long as there is no appreciable drift of gain in the receiver. Long-term observations inevitably show gain drift of the receiver. In such cases where the zero reference line deviates, a known calibration signal is introduced at the start, sometimes during, and at the end of the observation. This permits quantitative evaluation of the received data.

2. There is yet another type receiver which is designed to automatically cancel out its own internal noise. In practice, this is accomplished by circuitry which causes the receiver to alternately 'look at' the signal plus the noise, then at its own internal noise only. This is usually done with the introduction of a square wave generator which functions as an on-off switch. In one instant of time the receiver is connected to the antenna system; at another instant the receiver input is terminated into a load resistor such that only the internal noise is present at the receiver output. A phase-sensitive detector circuit, driven by the same square wave generator is then employed to deliver the difference to the DC amplifier used to drive the readout instrumentation. Here, again, this difference represents the desired signal. This so-called

by one to two orders of magnitude. Because the receiver only looks at this difference, the effects of gain drift are largely erased.

In consideration of all of the above, it becomes obvious that the design of radio astronomy receivers has a great deal to do with just what the observer is after in the data. It therefore follows that each project must be begun with a firm idea of just what the observer has in mind as a project. The equipment is either acquired or built, and tailored to do the job. The story of all modern science, regardless of the specific discipline, proceeds as follows:

1) Conceive the project.
2) Build or otherwise acquire the instrumentation to do the work.
3) Conduct the measuring of observations in a clear-cut and methodical way, giving attention to all observing parameters.
4) Analyze the data without the introduction of personal bias.
5) Publish the results.

Are negative observing data useful? The answer is most assuredly yes; if for no other reason than to prevent other observers from duplicating effort which in unlikely to bear fruit.

The purpose of the Society of Amateur Radio Astronomers is to provide sufficient technical information to enable amateurs to do this kind of work, commensurate with the antenna aperture which may be acquired. This involves the free circulation within the society of technical information. Such information is regularly published in SARA's monthly 24-page journal, Radio Astronomy. Additional specific information is also available from SARA's technical advisors, many of whom are radio engineers. The technical advisory staff is regularly published on page two of each journal issue. In addition to the above, SARA also operates a nonprofit laboratory (SARALAB) which continually develops state-of-the-art receiving equipment. The services of the lab are offered free of charge to SARA members both in an advisory capacity and also for the rendering of assistance in helping observers to get their equipment into usable operation.

For the benefit of those who are still trying to define a receiving/observational project which fits the individual's span of expertise, the balance of this publication is devoted. We invite you to survey the potential of each radio band, and to evaluate your own technical potential. Specific design information may then be secured from the SARA Journal office, or from any of SARA's many technical advisors.

The tabled information below is taken from the Radio Astronomy Handbook, 1986, by R.M. Sickels.

WHICH BAND? WHICH RECEIVER? WHICH OBSERVING PROGRAM?

At the turn of the century anyone listening to a modern-day all-wave receiver would have heard nothing but natural noises; static from lightning, and at very high frequencies the Galaxy noise. This may have been punctuated by radiation from a little man-made machinery, but little else. Today however, the world has gone information crazy and the radio spectrum is almost entirely filled up with some kind of radio broadcast. An alien looking at this planet from outer space would find it brighter than the sun in some regions - do to the very high megawatt power of TV and radar transmitters operating at about one meter wavelength and below. Add to that the motor brush noise of our appliances, the arcing of power insulators, ignition noise from automobiles, and even the neighbor's lawn mower, and the situation seems hopeless.

Nevertheless, there are clear radio bands allocated to radio astronomy. In addition there are radio bands which are unused in the VHF and UHF TV spectrum. Anyone operating transmitters in these unassigned bands is violating federal law.

RADIO ASTRONOMY BANDS

25.55 - 25.67 MHz	37.5 - 38.5
73.00 - 74.60	406.1 - 410
608 - 614	
1400 - 1427 (21 cm hydrogen radiation)	
1660 - 1670 (OH molecule radiation)	
2655 - 2700 MHz	4990 - 5000
10680 - 10700	15350 - 15400
22210 - 22500	23600 - 24000
31300 - 31800	51400 - 54250
58200 - 59000	64000 - 65000
86000 - 92000	105000 - 116000

Of course, some of these extremely high frequency bands are out of the question for the average radio astronomy observer - unless one also happens to be a microwave engineer. Nevertheless amateurs are now beginning to explore the 21 and 23 cm radiation bands of neutral hydrogen and the oxygen/hydrogen molecule with equipment of considerable sophistication.

Let us now explore the entire spectrum of radio frequencies with the idea in view of just what kind of work can be usefully done, and the type receiving equipment necessary to do the job.

20-100 kHz

This noisy radio band is useful in observing solar flares. The plan involves simple receivers of very inexpensive design and which are usually home built. Antennas may be longwires, loops, and in some instances, amplified whip antennas for those who lack the space for more elaborate arrays. The cost of the basic receiver may range from $30-$60. To this must be added the cost of a strip recorder, which may be bought quite cheaply at some of the ham-radio flea markets - but may range from $350-$700 if purchased new. The observing technique involves the continual monitoring of earth-produced atmospheric noise (mainly equatorial lightning discharges) for any enhancements due to solar flares. This is an indirect method of doing solar studies - but nevertheless a very effective one. These observations are regularly conducted by a dedicated group loosely affiliated with SARA (the VLF Experimenter's Group) and the data are useful to professional solar observatories and to all others who have an interest in our closest star. Another observing technique in this band is to tune up on a marginally received radio beacon and to observe any enhancement of the signal due to a solar flare. Either of these basic methods is equally effective and the results are identical. The flare is recognized on strip charts as a sudden enhancement of signal rising to full amplitude in seconds and slowly decaying as the effect of the flare diminishes and the ionosphere once again reaches its state of equilibrium. This is also very interesting work if conducted as a team effort with someone who has an optical telescope coupled to an H-alpha red filter. Here, the effects of the flare may be simultaneously observed in the radio as well as the optical window. Delayed effects from large flares are also observed as heavy particles arrive at the earth's surface 24 to 36 hours later. These not only produce radio enhancements but also the well-known auroras. The data are also of interest to ham radio broadcasters because the condition of the ionosphere determines the distance of received transmissions.

18-24 MHz

This band is used by amateur radio astronomers to monitor radio noises from the planet Jupiter. These noises are not always present and are sporadic in nature. It is quite possible that anyone who owns a modern day sensitive shortwave receiver has already heard these sporadic noises without realizing the source. When present they have a characteristic wavering structure not unlike the rushing of a rapid ocean surf. This is punctuated by a wavering subsecond structure. These noises when present are of very high intensity and may be detected with communications type receivers tuned to an inactive portion of this band. Antennas used are identical with any antenna system resonant

[illegible] frequency. The noises are so powerful that the antenna need not necessarily be resonant. Most communications receivers nowadays have a control to resonate any antenna in use. There are at least 4 mechanisms proposed for the production of this noise. Three of these involve the effect of the giant planet on its inner moon Io. It is believed that at least some of this noise originates as material ejected from Io's volcanos interacts with Jupiter's very powerful magnetic field. Data gathering in this band may be gathered approximately 8 months of the year, when Jupiter is not too close to the sun.

10-26 MHz, 28-80 MHz

The reader will note that the 27 mHz band has been deleted due to the very high level of citizen's band traffic. Solar flare monitoring in these bands may be conducted with shortwave communications receivers and appropriate antenna systems. Two methods are in common use. Enhancements of radio noise may mark an event. Flares also cause fadeouts of shortwave transmissions and therefore monitoring fadeouts is also useful. The radio receiver used must be operated without automatic gain control or any other filtering which would mask the effect of a flare. The data are gathered either by strip recorder, computer, or both. Here again, the data are of interest to professional solar observatories and to hams. The sun is continually studied and all of our knowledge has been mainly derived from phenomena occurring on the sun's surface. Carefully prepared and evaluated data are always useful and frequently outlive the observer.

88-108 MHz

This may be recognized as the commercial FM radio band. There are local portions of this band which are unassigned for transmission. If a simple conversion is made to change a standard FM set to AM reception, the receiver, together with a suitable antenna and low noise amplifier, may be used for solar flare studies and also crude imaging of some of the more powerful discrete radio sources such as Cassiopeia A, Cygnus A, etc. In this work a clear band is sought out and no limiters of any kind are used in the receiver. The antennae used are usually helicals or Yagis. (Dishes only become viable at frequencies above about 400mHz) This is a very inexpensive way to get started in radio astronomy with the intelligent modification of a cast-off FM receiver. The cost of suitable recording equipment must of course be added to the instrumentation budget. The overall gain is boosted by the use of a low-noise antenna amplifier and the quality of this device also determines the sensitivity of the instrument. Operation of a converted FM receiver as a radio telescope in this band produces typical sky resolution of about 30 degrees of arc - a very broad observing beam indeed. Nevertheless, the poor resolution is at least partially offset by the ease of detection of some of the discrete powerful radio objects. Cassiopeia A and Cygnus A are very strong radio emitters at these frequencies, and are therefore quite easily detected. Scintillations are also observed as these point sources are disturbed by the earth's atmosphere. The galactic arms and also the galaxy center are very strong and extended sources of radiation which are quite easily detected in this radio band. This project would make an inexpensive and thoroughly worthwhile science fair type effort, and also provide useful experience in the taking of data.

75 MHz

This may be recognized as the aircraft beacon band. If a suitable receiver and directional antenna system are tuned up in this band to a marginally received aircraft beacon, the arrival of an infalling meteor will be recognized as a characteristic "ping" sound after a simple conversion to audio output. This method of meteor detection produces tenfold the optical visual count. It is also useful in the daylight hours when optical counts are impossible. Directional antenna systems might permit ranging of a large meteorite's fall to earth. These objects are of very high monetary and scientific value to museums and research institutions, who study them for clues to the chemical composition of the early solar system. The data are also of importance to the American Meteor Society, an organization wholly devoted to these phenomena.

88-890 MHz

The high frequencies, very high frequencies, and ultra high frequencies are useful bands for solar burst detecti with suitable AM receivers. The bursts are usually most easily detected at the lower frequencies. As the observational frequency becomes higher, better and better sky resolution results from the typical amateur antenna systems, making possible the imaging of discrete radio sources. Use of the VHF and UHF bands where they are unoccupied by local broadcast allows the saving of money on sor components such as I.F. amplifiers designed for TV sets, because of their low cost in mass production. Antennas used are Yagis and Helicals at the low end of the spectr and paraboloid dishes at frequencies above about 400 mHz. Use of a dish permits the observer to predict his circula beam resolution by a simple formula.

1-4 GHz

Though not formerly used by amateurs because of equipment cost, this band is opening up due to the ready avail ability of equipment designed for TV satellite reception. Encoding of desirable movie channels is causing enough disgust that amateurs will soon reap a bonanza of dishes and low-noise receiving equipment designed for satellite TV reception. This band also encompasses the 1420 and 1660 mHz spectral line channels. Amateur and professiona SETI observations are also conducted in these bands because of the belief that extraterrestrial life would choc to announce their presence in the so-called "water hole" where galaxy noise is at its minimum. The sky backgrounc noise is very low in this "hole". Antennas used are mair dishes although arrays of smaller antennae are quite viable. Reduction of data in these bands can keep a computer hacker very busy. Very inexpensive analog to digi conversion techniques have recently been developed by SARALAB which enable an observer to cheaply interface a microcomputer to the radio telescope output. Discrete radio sources, due to the synchrotron mechanism of radiation, become weak emitters at the extremely high frequencies, and thus require suitable antenna aperture to detec This problem is partially offset by the increased resolution at these very short wavelengths, with the consequent rejection of surround-sky noise. Thermal radiators increase dramatically in radiated power as the observationa frequency increases. This makes possible good imaging of the sun, which is observed mainly in its very hot corona. Interferometry makes possible sectional imaging of the solar area.

Jeffrey M. Lichtman, a long-time amateur radio astronc mer, is president of the Society of Amateur Radio Astronc mers, Inc. (SARA). Jeff recently joined the Society afte moving to Atlanta from Maryland. He will be delighted tc provide information on SARA, both at his Society presenta tion this month, or at the following address:

1425 Parkmont Dr.
Roswell, Georgia 30076
(404) 992-4959

STAR PARTIES!

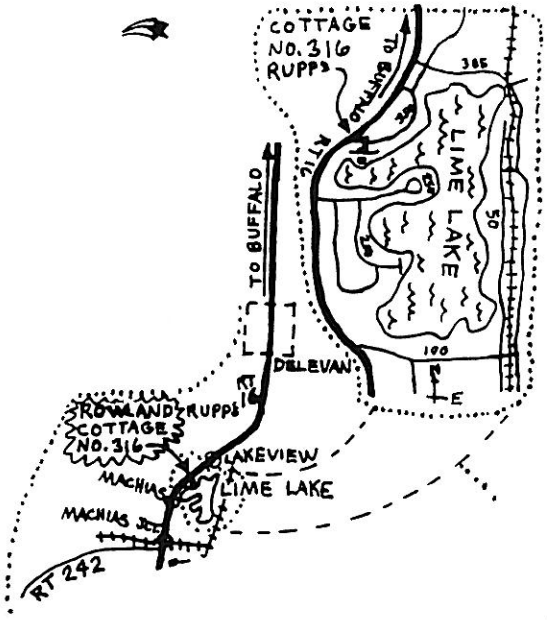
What you have not booked your's yet? July 28, August 11, and August 25 are still open! As usual all events are rain or shine...

June 2: Public Night at Beaver Meadow Observatory.
June 16: Public Night, followed by Photo Session

June 23: Jack and Jane Mack's Star Party. 1 Hunters Lane, Williamsville, tel 632-6210. Starts at 7:00 pm. Theoretical astronomy at its best. As usual there will be lively discussions, bring a scope, bring your

test site.

June 30: Rowland and Irene Rupp's Star Party at their cottage #316 Lime Lake by Machias. Starts at 1:30pm, they will supply the hot dogs, the drinks, and request you bring a dish to pass. Daytime activities include loosing at horseshoes, (unless you are on Rowland's team) romantic cruises around Lime Lake, tennis and swimming (or falling off dock).
home tel# 839-1842
cottage tel# 353-4636



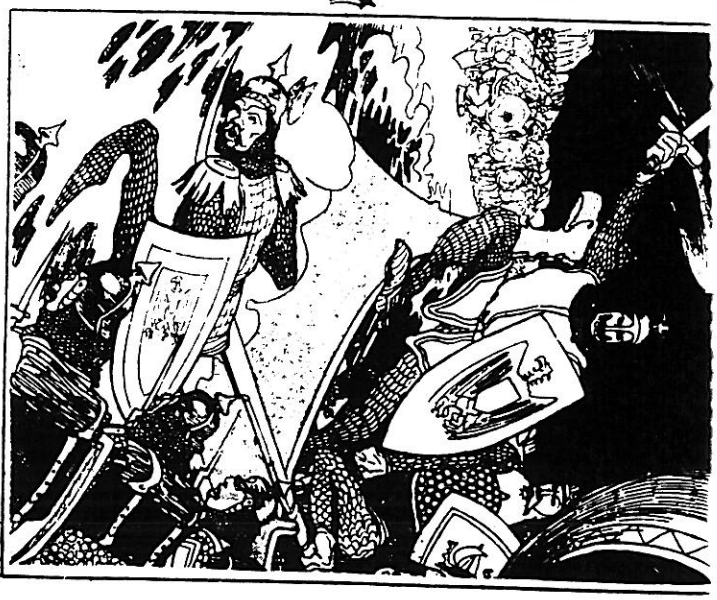
"ASTRONOMER from the PAST"

LAUGIER (pronounced - Lo zhya), Paul Auguste Ernest Laugier, was a French Astronomer, born in 1812 in Paris. He sturied at the Polytechnique and at the Paris Observatory under Arago. In 1843 he was elected to the Academy of Sciences, and was afterward attached to the Bureau of Longitudes.

He was favorably known for his work on the subjects of the Solar Equator and Sun-spots. His studies also led him to the use of a photometer to compair the mysteries of light and reported an ocular micrometer for measuring the Sun's angles.

At the age of 60, he died while at work in the University Observatory.

Darwin Christy



* THE SPECTRUM *

BUFFALO ASTRONOMICAL ASSOCIATION, INC.

DARWIN CHRISTY, EDITOR
216 KOHLER ST.
TONAWANDA, N. Y. 14150

FIRST CLASS
MAIL