Saguaro Astronomy Club

Metro Phoenix, Arizona

SACNEWS

September 1992 — Issue #188

Getting Started in Amateur Radio Astronomy

by Jeffrey M. Lichtman

In EVAC's June newsletter, there was a picture of a large radio telescope with the caption "There aren't bothered by clouds! Who wants to chip in and buy one?" Then a couple of days later while putting together the August SACNEWS, I came across a reference to this article. So after seeing how desperate we've become, with club members taking pictures of lightning or doing solar astronomy, I decided to print this article.
This article is from the February, 1990 (Volume 1, Number 7) issue of the Electronic Journal of the Astronomical Society of the Atlantic (EJASA) and is Copyright © 1990 by the Astronomical Society of the Atlantic (ASA). It is reprinted here with permission.

The Society of Amateur Radio Astronomers (SARA) regularly surveys each of its members regarding their interests in the field of radio astronomy, as well as how SARA 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. We will deal with both general and specific information and recommendations.

Radio astronomy … the examination of ripples riding upon waves, above an entire sea of noise.

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

1. Indirect method studies of solar phenomena, meteor infall, and Jupiter noise storms, for example. 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, requiring 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 (Direct Current) 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 upon Earth's radio telescopes would not equal

Quick Calendar

SAC Meeting
7:30, Friday, September 11

Deep Sky Meeting
7:30, Thursday, September 17

Star Party
Buckeye Hills Recreation Area
Saturday, September 19

SAC Meeting
7:30, Friday, October 9

Kitt Peak Tour
Saturday, October 10

the energy in a single snowflake.

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 achieved, 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 phased 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 of very low-noise receiving equipment using gallium arsenide field effect transistors (GaAsFETs). The large market generated by ham radio operators and television 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 Kelvin 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 canceled out. This is usually accomplished by converting all 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 canceled 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 canceled 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 well as long as there is no appreciable drift of gain in the receiver. Long-term observations will 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 Dicke switching method improves the receiver sensitivity 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 is 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. Please use the address at the end of this article for obtaining more information on SARA.

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 Twentieth 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 noise of the Milky Way Galaxy.

…change a standard FM set to AM reception, the receiver may be used for crude imaging…

This may have been punctuated by radiation from some 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 radio astronomer looking at this planet from interstellar space would find it brighter than the Sun in some regions, due to the very high megawatt power of television and radar transmitters operating at about one meter (3.3-foot) wavelengths 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 some 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 in violation of federal law.

Bands Allocated for Radio Astronomy Use (MHz)

25.55 – 25.67	1660 – 1670‡	31300 – 31800
37.5 – 38.5	2655 – 2700	51400 – 54250
73.00 – 74.60	4990 – 5000	58200 – 59000
406.1 – 410	10680 – 10700	64000 – 65000
608 – 614	15350 – 15400	86000 – 92000
1400 – 1427†	22210 – 22500	105000 – 116000
	23600 – 24000	

†21 cm hydrogen radiation ‡OH molecule radiation

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 centimeter 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 of just what kind of work can be usefully done, and the type of 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 thirty to sixty dollars. 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 ef-

Bus Trip to Kitt Peak

The bus trip is set up for Oct 10. We will leave the Phoenix area at 9:00 AM and make our way to Kitt Peak for lunch and a tour by Dean Kettlesen, President of the Tucson Amateur Astronomy Association. The bus will leave the mountain around 4:00 PM and go to the Mirror Lab at U. of A. Dean works at the Lab and will conduct a one hour tour of the Mirror Lab facility. We then return to Phoenix around 9:00 PM. There will be short stops on the way down and back.

SAC members are invited to "get on the bus" to Kitt Peak for \$20 per person. The bus is now half full with positions going fast. Send your check, payable to SAC, to our Treasurer, Bob Dahl, or bring it to the August meeting. Please don't send it to Steve Coe, he is only setting up the tour, Bob has agreed to handle the money. Thanks, Bob.

fective 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 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 sub-second 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 at this 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 four mechanisms proposed for the production of this noise. Three of these involve the effect of the giant planet on its innermost Galilean moon, Io. It is believed that at least some of this noise originates as material ejected from Io's volcanoes interacts with Jupiter's very powerful magnetic field. Data gathering in this band may be gathered approximately eight months of the year, when Jupiter is not too close to the Sun from our perspective on Earth.

10–26 MHz and 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 (CB) 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 and Cygnus A. 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 400 MHz). 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 thirty 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 Earth's atmosphere. The galactic arms and the center of the Milky Way Galaxy 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 (AMS), 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 detection with suitable AM receivers. The bursts are usually most easily detected at the lower frequencies. As the observational frequency becomes higher, improved sky resolutions result 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 some components such as I.F. amplifiers designed for television sets, because of their low cost in mass production. Antennas used are Yagis and Helicals at the low end of the spectrum, and paraboloid dishes at frequencies above about 400 MHz. Use of a dish permits the observer to predict his circular 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 availability of equipment designed for TV satellite reception. Encoding of desirable movie channels is causing enough disapproval 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 professional SETI (Search for ExtraTerrestrial Intelligence) observations are also conducted in these bands, due to the belief that advanced alien life would choose to announce their presence in the so-called "water hole," where galaxy noise is at its minimum. The sky background noise is very low in this "hole." Antennas used are mainly 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 digital 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 detect. 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 observational frequency increases. This makes possible good imaging of the Sun, which is observed mainly in its very hot corona. Interferometry also makes possible sectional imaging of the solar area.

About the Author

Jeffrey M. Lichtman, a long-time amateur radio astronomer and active Society member, is president of the national Society of Amateur Radio Astronomers (SARA), an organization of nearly 250 radio hobbyists. To contact SARA for more information: SARA Membership Services, Vincent Caracci, 247 N. Linden St., Massapequa, NY 11758 Telephone: (516) 798–8459

Perseid Storm in Eastern Europe...

by Peter Brown

This is a follow-up of the May issue of SACNEWS. Peter Brown is a Council Member of the International Meteor Organization, a non-profit scientific organization. The International Meteor Organization produces a journal/magazine devoted to amateur meteor astronomy with about 250 pages per year, included with membership, for 18 US dollars a year. To subscribe, send payment through: Peter Brown, 181 Sifton Ave., Ft. McMurray, Alberta, T9H 4V7, Canada. *Also see Peter's* **Focal Point** *letter in the September issue of Sky & Telescope.*

Data from Hungarian meteor observers and several radio amateurs in the USA and Finland have revealed the strong possibility that the expected strong return of the Perseids in 1992 **did** take place. The observations in question suggest 19–20 UT on Aug 11/12 as the time the outburst occurred. This is several hours earlier than predicted since the prediction was based on the assumption that the activity which took place over Japan in 1991 would recur again at the same position in the Earth's orbit, namely at 138.86 (1950.0). As was pointed out by Marsden if the the shower recurred at precisely the node of P/Swift-Tuttle the storm would occur several hours before the 22-23 UT Aug 11/12 shortly after 19 UT, as seems to have happened. This is **very** strong evidence to suggest that P/Swift-Tuttle is very nearby and searches for the comet should certainly go into high gear. This outburst occurred at 138.74 (1950.0) and if it recurs again within a few tenths of degrees of this position then we can expect a nice meteor shower in 1993 on Aug 12 at about 1–2 UT. This means North America might catch some of the activity early in the evening and the moon will be only 4 days from new!! Since many details are still missing it is **imperative** that observers either radio or visual who have data in the interval 18–20 UT report it as soon as possible so a complete picture of what happened can be constructed. Further details can be found on IAUC 5586.

Newsletter Deadline

Mail items at least two weeks before the end of the month. Items arriving too late for an issue will be included in the next newsletter.

The Passing of Richard Lines

by Steve Coe

It is with much sadness that I must report the passing of Richard Lines, an Arizona astronomer for many years and a dear friend. Richard and Helen Lines built an observatory in the small town of Meyer, near Prescott. The observatory and some great photos by them are in an article in the Sept. 1968 Sky and Telescope. They were the folks in the AAVSO who got the tough variables that nobody else wanted. Their dogged persistence at staying on a star has provided professional astronomers with data that otherwise would not be available. Before they got hooked on doing photometry of variable stars, Richard and Helen Lines spent many years as expert deepsky observers and photographers. Several photos by them appear in the book "The Messier Album" by their friend Evered Kreimer. Richard discovered a comet near some galaxies he was observing in 1962. Comet Seki-Lines became bright and developed a very nice tail in the Winter of 1962. Several photos of the comet are in April and May 1962 Sky and Telescope.

A.J. Crayon and I have been invited to the Lines' Observatory to observe a wide variety of objects in their excellent telescope. The dome originally contained a 16″ $f/8$, but that was replaced by a 20″ Newtonian-Cass. to make it convenient to use the photometer. The views of Mars when it was at its' closet approach to Earth were stunning. At 350X the detail on the face of the Red Planet was too much to try and draw. I counted 15 stars embedded within the Dumbell Nebula on a nice sharp night in 1980. Any Messier globular in the Lines' telescope was spectacular.

Richard had a wry sense of humor that was always fun. Bill Anderson told Richard that I was considering buying a very large mirror, a 50″, from an observatory that had no use for it. Bill then said that he thought I did not have the money for a 16″, much less a mirror three times that size. Richard's replay was "well, you might as well not be able to afford something big as something small."

Richard Lines was a quiet man, but he loved to talk about astronomy. His knowledge, expertise and friendship will be missed by all who knew him.

Directions to SAC Events

SAC General Meetings 7:30 PM at Grand Canyon University, Fleming Building, Room 105 — 1 mile west of Interstate 17 on Camelback Rd., north on 33rd Ave., second building on the right.

Such-A-Deal

SUCH-A-DEAL is a place to advertise equipment, supplies, and services related to amateur astronomy. This is a free service for SAC members and friends. SAC is not responsible for the quality of advertised items or services.

Telescope—Meade 2080LX3 8″ schmidt Cass. w/ H.P. tripod, wedge, 8x50 polar finder, eyepieces, filters including Skyglow, camera adapters, etc. Worth about \$2000. Excellent condition not used for a year, too old! \$1000 including hand control, barlow etc. Wyman Osborn 832–9069.

Telescope—8″ $f/6$ Newtonian, Dobsonian mount, Truss tube, easy to transport, easy to setup, Meade mirrors, Novak Cell and Spider. Has Alt-Az Circles to make it easy to find dim objects. Package includes a Casio Pocket Computer for calculating Alt-Az positions from the circles. Includes: Telrad zero power finder, 3 eyepieces: 32mm Erfle, 10mm Plössl and 6mm Kellner. Entire package: Scope, Eyepieces, Telrad and Computer. \$700 Steve Coe 878–1873.

Mirror—"Ready to coat" 6″ $f/5$ mirror with a good 1/16th wave surface and an exquisitely smooth surface. Guaranteed beautiful diffraction rings at 150X. It will sell for \$200 to the first interested party. M. Leon Knott, 1021 S. Revere, Mesa, AZ 85210.

SAC Star Parties at Buckeye Hills Recreation Area — Interstate 10 west to Exit 112 (30 miles west of Interstate 17), then south for 10.5 miles, right at entrance to recreation area, one-half mile, on the right. No water and only pit toilets. Please arrive before sunset; allow one hour from central Phoenix.

SAC Deep Sky Subgroup Meeting at John & Tom McGrath's, 11239 N. 75th St., Scottsdale, 998–4661 — Scottsdale Rd. north, Cholla St. east to 75th St., southeast corner.

Comet Comments

by Don Machholz

(916) 346-8963 August 6, 1992

Three faint returning comets have been recovered lately, while Comet Shoemaker-Levy and Comet Machholz fade from our view. Unless a new bright comet is discovered soon, there is not expected to be much comet activity for the next few months.

Periodic Comet Giclas (1992l): T. Seki of Japan recovered this comet at magnitude 18 on June 30. Its seven-year orbit will bring it to perihelion in mid-September at 1.85 AU.

Periodic Comet Wolf (1992m): T. Seki also picked up this comet, on July 10. It was then at magnitude 20.

Comet Wolf was discovered more than a hundred years ago. It takes 8.3 years to complete an orbit and will be closest the Sun on Aug. 28 at 2.4 AU. It might brighten to magnitude 15 by then.

Periodic Comet Schuster (1992n): On July 28 T. Seki recovered this comet. It was then magnitude 18. It might brighten to 15th magnitude by the end of the year.

Bits and Pieces

Coming Events

The Kitt Peak tour is October 10, see details in this newsletter.

The All Arizona Star Party, originally scheduled at the Empire Ranch, has been moved to EVAC's Deep Sky site. It is still a two night event October 23, 24. Friday night's session starts at sundown. Saturday's session will begin with a Potluck followed by the observing session. For further information and directions see either the October issue this newsletter or contact Dick Simmon at (602) 949–1110.

September's Speaker

The September speaker is Jeff Hester from ASU. He is an investigator on the Hubble Space Telescope and will talk about his experiences with it.

Deep Sky Meeting

The Deep Sky Group is made up of people that like to observe celestial bodies out past the far reaches of our Solar System. These bodies include stars, nebula and galaxies. If you are interested in sharing your observations, or knowing what they look like in telescopes — then by all means come join us at the next meeting. We will discuss Deep Sky objects in Cetus — the whale. The meeting will be held at John McGrath's house and the directions will be found elsewhere in the Newsletter.

You don't need to RSVP, we don't extend special invitations to anyone — ourselves included. If you are interested show up, we'd love to have you.

The Deep Sky meeting will take place on Thursday, September 17 at 7:30pm.

1992 SAC Meetings
September 11
October 9
November 6
December 12 Party

1992 SAC Star Parties
September 19
October 24
November 21
December 19

Minutes of the August Meeting

Vice-President Steve Coe called the meeting to order at 7:40 PM. He reminded everyone about upcoming calendar events listed on the board. He asked any new members or visitors to identify themselves and welcomed them to the meeting. He read a letter from Piet Burggraaf offering a Shareware copy of Earth Centered Universe for Windows. If anyone is interested, please contact Piet.

A.J. Crayon announced that the Deep Sky Group would sponsor the "Heck with the Monsoons" Star Party on Aug. 29 at the Dugas site. They will take the credit if it is a success, but if it is a failure, then Steve Coe has the credit. For the Deep Sky meeting on Sept. 17, they will talk about the constellation Cetus. Members are not obliged to bring detailed drawings, just the date, setting, conditions and impression of the observation. A.J. did not have any awards to give and reminded the members that he will not beg for reports.

Bob Dahl gave the Treasurer's report but did not have any unusual sales pitch for SAC T-Shirts or caps, because all the shirts have been sold. He would collect the money for the Kitt Peak trip in October. Because the space on the bus is limited, members are encouraged to make their reservations early. *Sky and Telescope* has agreed to give the club a group rate for magazine subscriptions and members should try to get their requests in by October or November. Bob will order the new 1993 R.A.S.C. Observer's Handbooks, but will not take advance orders.

Steve led off the "show 'n tell" portion of the meeting with some recent slides of sunspots, using a new solar filter from Pierre. Next, he presented some great shots of the lightning display from the Buckeye Hills site. Tom Polakis also showed some of his beautiful slides of the lightning and nebula using new film.

Unfortunately, the main speaker, Ken Ziegler did not arrive and after the break, Rick Rotramel showed slides of the University of Arizona's Mirror Lab. A visit to the lab is scheduled to be part of the Kitt Peak trip.

—Susan V. Morse, SAC Secretary

SAC Officers

President	Paul Lind	863–3077
Vice President	Steve Coe	878–1873
Secretary	Susan Morse	934–7496
Treasurer	Bob Dahl	582–5526
Properties	Rich Walker	997–0711
SACNEWS Editor	Paul Dickson	841–7044

SAC Electronic Mailing List

by Paul Dickson

The world is getting smaller and smaller. Computers are making it shrink even faster. Using a computer, the far side of the world is within instant reach of your finger tips, even Earth orbit is obtainable. The article for next month's SACNEWS is coming from the West Coast of Australia. It's now time to publish a list of Electronic Mail (Email) addresses of those members who have one.

Currently I have Email addresses for seven people: Steve Coe, A.J. Crayon, Paul Lind, Pete Manly, Tom Polakis, Chris Schur, Dan Ward. I'm sure there are other SAC members that have Email addresses. If your name is not on this list and you have an Email address, whether it's Internet (Usenet), Compuserve, BIX, Genie, People Link, etc. please let me know and I will add you to the list.

I'll publish the list of addresses in the October newsletter.

SACNEWS Articles

If you've noticed the increase of large articles in SACNEWS, then you've probably noticed that most of them have from EJASA. I have obtained permission to use their articles in our newsletter. So I now have some interesting articles to fill the void when I wouldn't have something to print.

But this doesn't let you off the hook. I also promised the editor of EJASA that I would send him articles from club members, items of interest to those outside the club. So far I have only sent one and have a possible second article that I just received. As of this issue, I have used six EJASA articles with another planned. It would be nice to be able to send more than one or two articles each year.

So if you write an article, here are some details that might interest you. A full page of text in SACNEWS is about 6000 characters or about 850 words. After you have written the article, you can send it as a printed text (if it's not too long), or as a text file on a IBM, Mac, or Amiga disk. For those of you lucky enough to be able to send E-mail via the Internet, it can be E-mailed directly.