

Charter Members Due to Renew

Our early supporters have now enjoyed Charter Membership privileges for as much as two years, depending on when they joined. But all good things must end. Charter Memberships are subject to renewal, else they will expire on December 31, 1996.

Consider what your League has accomplished during the two years since its inception. We have built up a membership base of nearly 500 supporters; developed prototype radiotelescopes for continuing the search for intelligent life in space; helped to popularize SETI through more than a hundred of radio and TV appearances, magazine and newspaper articles, and public presentations; officially launched *Project Argus*, the most comprehensive all-sky microwave survey ever undertaken without government equipment or funds; seen over two dozen amateur SETI stations go on the air around the world, with hundreds more anticipated during the next two years. Our award-winning World Wide Web site on the Internet is frequently visited and widely linked. And we have published three books (two technical, one just for fun), eight newsletters (including this one), and several Director's Letters. We are off to quite a good start.

But only a start. We have much left to accomplish in the scientific arena. We look forward to the day, early in the next century, when we will achieve real-time, all-sky microwave coverage. We continue to develop hardware and software to make our search more sensitive. And we strive to publicize, and hopefully popularize, the scientific Search for Extra-Terrestrial Intelligence.

None of this can be accomplished without your help. Won't you fill out the enclosed membership renewal form, and return it with your check today? Only with your continued support can we hope to demonstrate that We Are Not Alone.



**433 Liberty Street
PO Box 555
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Search**Lites**

**the Quarterly Newsletter
of The SETI League, Inc.
Volume 2 Number 4
Autumn 1996**

Introducing:

The SETI League's President

In October of 1993, the US Congress terminated all funding for two scientific endeavors: the multi-billion dollar Superconducting Supercollider, and the somewhat more modestly funded NASA SETI program. New Jersey entrepreneur Richard C. Factor was dismayed, as were many other individuals. Richard, however, decided to do something. He reasoned that he lacked the resources to save the Supercollider, but perhaps he was in a position to help resurrect SETI.

A longtime amateur radio operator (WA2IKL), Richard felt the world's radio amateurs might be just the resource needed to keep SETI research going. He founded the SETI League as a non-profit, membership-supported, educational and scientific organization, and now serves in a volunteer capacity as the League's first president. He also has a seat on the corporation's Board of Trustees.

Richard is fifty years of age, has an expansive vocabulary, has read just about every science fiction book ever published, owns a Cessna 172 which he hardly ever finds time to fly, and has an acknowledged addiction to chocolate. Professionally, he heads Eventide Inc., manufacturers of advanced electronic equipment for the broadcast, recording and aviation industries. When not running his business or privatizing SETI, Richard is busy maintaining his position near the top of the ARRL DXCC Honor Roll.

Membership Meeting Scheduled

In accordance with Article IV, Section 1 of our duly approved Bylaws, the Trustees of The SETI League, Inc. hereby schedule our Third Annual Membership Meeting for 2 PM Eastern time on Saturday, March 22, 1997, at SETI League Headquarters, 433 Liberty Street, Little Ferry NJ 07643. Please mark your calendars. As attendance by one percent of the League's membership constitutes a quorum, all members in good standing are encouraged to attend.

Members are encouraged to submit Old Business and New Business items for inclusion in the Agenda. Please email your agenda items to n6tx@setileague.org, as soon as possible. In accordance with our Bylaws, written notice of this Meeting, along with an Agenda and driving directions to SETI League headquarters, will be mailed to all members in good standing, not less than ten days nor more than sixty days prior to the meeting date.

Editorial

The Sky Is Filling! The Sky Is Filling!

by H. Paul Shuch, Executive Director

SETI efforts have been plagued from the start by the reception of intelligently generated signals of decidedly terrestrial origin. In 1960, early in the listening phase of *Project Ozma*, Frank Drake received a rather strong signal from the apparent direction of Epsilon Eridani. After tracking it through several orbits, he concluded that he was most likely receiving interference from a military satellite. It was operating right on the Hydrogen Line, now a supposedly protected spectral region (but try to tell the military that!). Harvard University's *Project META* and *BETA* sky surveys have mapped numerous Radio Frequency Interference (RFI) sources from navigation satellites. These signals (see Figure 1) are many MHz wide, and right in the middle of the SETI Water-Hole. During its 1995 Australia deployment, the SETI Institute's *Project Phoenix* targeted search experienced scores of hits, which had to be weeded out by a sophisticated Follow-Up Detection Device (FUDD).

And now, The SETI League's *Project Argus* sky survey has a bona fide RFI hit of its own. On May 10, Trevor Unsworth, one of our British members, detected an anomalous signal at 1471.5 MHz (see Figure 2), using his homemade 3.5 meter dish. The signal exhibited some sort of digital modulation, with a 270 Hz bandwidth, and its Doppler shift of -25 Hz/min clearly marked it as RFI from a Low Earth Orbit (LEO) satellite.

At the recent SARA meetings in Green Bank, I showed a slide of Figure 2, and asked for help identifying the source of the signal. Several others had seen signals of this type in that same spectral region. One radioastronomer informed me that the US Navy apparently has LEO satellites using that particular frequency region, but no further information was available. The military doesn't publicize its classified satellites to our satisfaction!

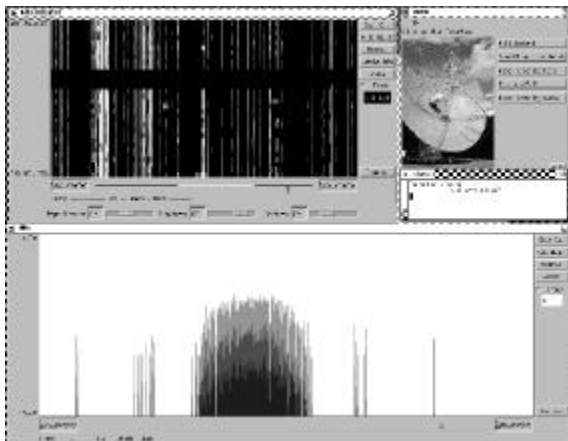


Figure 1

(Project BETA image courtesy of Dr. Paul Horowitz)

Actually, I am greatly encouraged by Trevor's "hit" for several reasons. The signal is from a relatively weak source, which indicates that his system has reasonable sensitivity. Our member contacted SETI League headquarters first, not the BBC or the London Times, which suggests that our verification protocols are being respected. And the Doppler shift (indicated by the slope of the line in the spectral display) was clearly not consistent with Earth rotation rates, which told us that the signal was *not* moving with sidereal time, hence must be considered RFI. This first test of our ability to weed out RFI by its Doppler signature was entirely successful.

But the situation will only get worse. Despite its FUDD technology, there were wide gaps in *Project Phoenix's* frequency coverage, regions where satellite RFI made monitoring for ETI sources impossible. New communications and navigation satellites, operating smack in the middle of the Water-Hole, are being launched every month. Barney Oliver used to fear that politics and paranoia might cause us to draw a curtain across the sky. That curtain is forming, but it's being caused by our own technology.

At the Observatoire de Paris, Jean Heidmann is putting forward a proposal for a SETI observatory on lunar farside, in Saha Crater. In Italy, Claudio Maccone has for years been proposing a Solar Sail mission to 550 AU, which would use our Sun as a gravitational lens for surveying the cosmos. These attempts to escape Earth's RFI are serious scientific proposals which deserve our full support. But they are also missions for well into the next century. In the interim, it falls to us in The SETI League to pioneer techniques for working around the ever-increasing RFI which surrounds our planet, cutting right across our prime radioastronomy band. Your thoughts and suggestions are encouraged.

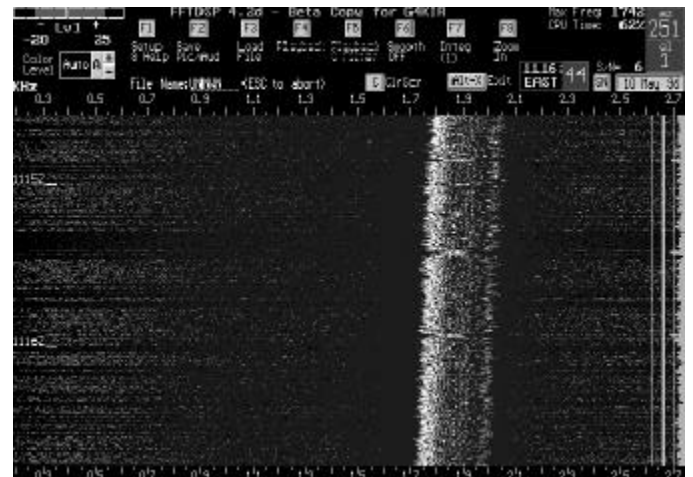


Figure 2

(Project Argus image courtesy of Trevor Unsworth)

Where Do I Start?

What Should I Build?

What Must I Buy?

A SETI League member recently asked our Executive Director:

"I joined The SETI League a few months ago. Please tell me how I may come by the simplest information that will tell me in recipe-like form how to set up my own search effort. I need this to be ultimately simplistic.....You connect a to b to c and flip the switch, etc...I very much like the idea of SETI but I have minimal background in such things."

Dr. Shuch replies:

I wish it were that simple, but then, if it were, someone would have done this years ago. Your inquiry is typical of a number we have received since we kicked off our Project Argus search and, although we welcome such queries, the answers may well disappoint some of our members. I am reminded of the early days of satellite TV. Many people asked then exactly what equipment to buy, where to obtain it, and how to hook it up. Although my colleagues and I conducted classes and wrote articles aplenty, there were no easy answers then, any more than there are for SETI now.

The first commercial home satellite TV system, which I helped to produce in about 1978, was something of a hodgepodge. I developed the microwave circuitry, and married it to a video demodulator circuit designed by Stanford University's Prof. Tay Howard. For an antenna, we used a 4.7-meter dish designed by John Kinik of Kintech Technology, a feedhorn from Bob Taggart of Chapparel Communications, and a 180 Kelvin low-noise amplifier designed by Art Kawai of Dexcel. We put the first prototype together in my backyard on about a \$4000 budget, and managed to receive marginally noisy video. That early system was probably duplicated a couple of thousand times, but no two systems were configured exactly alike. Early TVRO experimenters used their considerable expertise to improve on existing technology, and in due course a whole industry was born. Today, you can walk in to any Sears, Radio Shack or K-Mart store and buy a complete package for about \$500. But it took two decades of commercial development following the pioneering efforts to reach that point.

The state of amateur SETI today pretty well coincides with those exciting early days of the satellite TV business. Only it's not an industry, but a scientific cause which we are attempting to champion. Now, as then, there is no cookbook, no set of recipes, no blueprint, no road map to guide the pioneer. No two of the first half-dozen Argus stations are very much alike. And The SETI League assiduously avoids telling its members exactly what equipment to buy, and how to hook it up, lest we stifle their creativity.

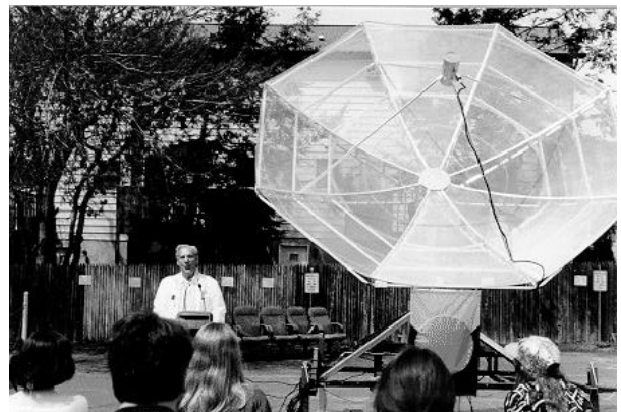
On the other hand, not every one of our members has the engineering expertise necessary to design a SETI station from the ground up. Nor is that a prerequisite to good science. Many people with more enthusiasm than formal training are in a position to make major technical contributions. I still maintain that when The Signal is detected and verified, it will have been an amateur, not a professional radio astronomer,

whom we will have to thank. And many of these amateurs, like the member who asked the question which opened this discussion, are seeking assistance and guidance. The SETI League fully intends to provide the required help. Only as these systems are still evolving, the answers will be tentative and the designs cast in jello.

Let's start by defining the minimum equipment necessary to do a credible job at microwave SETI. I'd recommend reviewing Dan Fox's very fine System Block Diagram, seen in the last issue of *SearchLites*. You will need, of course, an antenna and feedhorn, a low-noise preamplifier, a microwave receiver, and a suitable computer running some kind of digital signal processing software. A number of useful accessories will round out the SETI station. There are sections in the Technical Manual corresponding to each of these areas, but the choices are so diverse as to boggle the mind. Is there anything we can do to narrow things down a bit?

In fact, there is. I can tell you exactly what hardware and software I used in the first Argus station at SETI League headquarters. I didn't go with the least expensive choices in each category, or necessarily the best. I opted for expediency in order to get a station on the air in time for our April 21, 1996 launch ceremonies and, yes, I cut a few corners in the process. You probably won't want to duplicate my station exactly as I implemented it, but at least this will give you a starting point. As more stations come on the air, better solutions to the problems of amateur SETI will make themselves known. Some of these will come from you, and I hope you'll share them with your fellow League members.

The headquarters station is depicted in the accompanying photograph. Though just about any surplus satellite TV dish in the 3- to 5-meter diameter range would suffice, the antenna we chose for our first system is a Paraclipse Classic 12, with horizon-to-horizon mount. This 3.7 meter diameter dish has a focal length to diameter ratio which makes it easy to illuminate with a simple cylindrical waveguide feedhorn (in our case the Lichtman feed), at about 50 percent efficiency. As the antenna is slightly under-illuminated, sidelobes and antenna noise temperature are reduced. We are exploring the possibility of adding a choke ring to this feedhorn in the future, to improve both illumination efficiency and sidelobe performance. The robust Paraclipse mount and chain-drive rotor were modified for meridian transit mount with full 180 degree elevation rotation.



Our own SETI League GaAs MMIC low-noise amplifier, as manufactured by Down East Microwave, is mounted directly on the feed with a male-to-male type N coaxial adapter. The next generation preamp, now in the design phase, will employ a GaAs PHEMT device in front of the existing MMIC stage, for a significant reduction in front-end noise. At present, no bandpass filter is being used behind the preamp, although in RF polluted areas it might be wise to add one. Though not yet commercially available, the microstrip filter depicted in the Technical Manual is probably a good bet. We will probably add such a filter to our station at a later date.

Twenty-five feet of RG-8 coaxial cable, with type N connectors installed, connect the LNA to an Icom 7000 microwave receiver. We hope to replace this receiver later with a home-brew downconverter driving a VHF scanner, although the Icom is performing so well that we would be hard pressed to recommend any other approach at this time. Receiver audio output is applied to the microphone input of a Texas Instruments model 560CDT multimedia laptop computer, which uses a 75 MHz Pentium CPU. In fact, much less costly computers of the 486DX variety would be perfectly acceptable, at a fraction of the price. The DSP software we are currently using is Spectra Plus, although, again, any of the low-cost shareware programs discussed in the Technical Manual are certainly suitable.



We have yet to obtain suitable SETI logging software, so at present one must stare at a computer screen and evaluate the incoming signals. This is a weakness in the first Argus systems which we hope our members will help us to overcome.

It must be emphasized that this station is not the only, indeed not necessarily the best, approach to amateur SETI. It does, however, achieve the design objectives of full Water-Hole coverage at sensitivities adequate for the detection of Wow! type signals. If all components are purchased new, it can be duplicated in its entirety at a cost of about \$7,000 US. (Half of that cost is tied up in the particular multimedia laptop computer we chose.) This is certainly quite a bit more than one need spend for an effective SETI station. In fact, using a more modest computer and dish, the price quickly drops in half, for no discernible difference in performance. And if one uses an existing computer, a surplus dish, and builds some of the RF hardware from kits rather than purchasing it assembled, then the basic design is duplicable for well under \$1000 US. Thus, the system just described should be considered as a proof-of-concept effort, nothing more.

All that said, you may still feel yourself in need of some hand-holding, and that's OK. Unfortunately, there are hundreds (soon thousands) of you and only one of me. But the level of technical expertise found within The SETI League is truly impressive, as is the spirit of cooperation prevalent. There are a number of ways in which you can collaborate with your fellow SETI enthusiasts, to mutual benefit. For starters, you should turn to the Technical Manual, either on the Web or in print (see ordering information on the back page of this issue). A SETI League Membership Directory (first published in July of 1996) has been distributed to all members, and will be updated annually. It is sorted by country and state, so you can easily locate other members in your region. In England and Germany (and soon, we hope, in other areas), volunteer Area Coordinators have accepted the task of assisting their countrymen in getting up and running. These individuals will be indicated in future Directories.

Don't overlook your local amateur radio club, or regional microwave society. Many of these organizations have Web sites which you can access through our Other Web Resources pages. Attend some of the meetings listed in our Conference Calendar. Review the various amateur radio magazines available in your country and language, for other meetings of which we may be unaware. Check also into regional astronomy societies, or any local college or university which might have applicable classes or clubs. There's a wealth of information and assistance available, but you have to be willing to seek it out.

And above all else, when the day comes (as indeed it will) that you have become a senior SETIzen, please be willing to share your expertise with others, as others will have shared theirs with you. This may well prove a multi-generational enterprise. If we don't start training the next generation now, we (as an organization, and a civilization) may not be around when The Call comes in.

Ask Dr. SETI

About a year ago, I watched a show on the Discovery channel which showed a printout of the famous "Wow!" signal. As an electrical engineer, I began to question the format. I waited for almost six months until that particular show came on again and taped it, attempting to get a better look at the printout. I could not find an answer to my questions about the received 'transmission.' I have played out my own scenarios as to what 6EQUJ5 actually stands for: i.e., a sequence in need of completion, a matrix in need of expanding, a computer malfunction, etc. Can I assume that 6EQUJ5 is the ASCII equivalent to the following binary codes? Namely;

6 = 00110110

E = 01000101

Q = 01010001

U = 01010101

J = 01001010

5 = 00110101

Thank you for your help. This has been an unanswered question for over a year and a half.

R. Z., Bensalem, Pa

Your curiosity and creativity are to be commended, RZ. Unfortunately (or maybe fortunately), it's nothing quite so complicated.

The best known and most tantalizing SETI "hit" to date, the "Wow!" was received on the neutral Hydrogen frequency, at the Ohio State University Radio Observatory, on 15 August 1977. The name derives from one word written in the margin of the computer printout by investigator Dr. Jerry Ehman, when he saw (and understood the significance of) the sequence you cited above. After 19 years and over a hundred follow-on studies, the signal has never repeated.

Let me emphasize that the "Wow!" sequence itself is **not a message**. What was received appeared to be a CW (unmodulated) signal. The numbers and letters in the much-reproduced computer printout are merely a time-series representation of the signal *amplitude*, as received at the Big Ear radiotelescope.

Specifically, the symbols represent the number of standard deviations by which the received signal exceeded average background noise, on a scale of 0 to 35. So a 0 means no stronger than background noise, 1 is one sigma above noise, 9 means nine sigma above noise, an A would be ten units, and U (the strongest peak of the actual signal) is 30 standard deviations above the mean background noise in the receiver. If you graph the sequence as amplitude values over time (each time increment is about twelve seconds), you get roughly a Gaussian distribution, consistent with the antenna pattern of the Big Ear in drift-scan mode.

For info on the *real* significance of the "Wow!" signal, as a benchmark for calibrating the sensitivity of our systems, see the newest research article on The SETI League's Web site, at <http://www.setileague.org/articles/capri.htm>.

Send your questions to Ask Dr. SETI, PO Box 555, Little Ferry NJ 07643, or email askdrseti@setileague.org. Remember, he's not a real doctor (rather, he's the kind who actually has to work for a living!). For health questions, consult a competent medical professional.

Conference Calendar

SearchLites' readers are apprised of the following conferences at which SETI-related information will be presented. League members are invited to check our World Wide Web site (www.setileague.org/) under Membership Services and Activities, or email to us at info@setileague.org, to obtain further details. Members are also encouraged to send in information about upcoming events of which we may be unaware.

November 8 - 10, 1996: 1996 AMSAT Annual Meeting and Space Symposium, Tucson AZ.

November 22 - 24, 1996: Philcon '96, Philadelphia Science Fiction Society, Philadelphia PA.

December 20 - 22, 1996: Winter Solstice Regional Gathering, Central Pennsylvania Mensa, Lancaster PA.

February 14 - 16, 1997: Boskone 34, Framingham MA.

March 7 - 9, 1997: Lunacon '97, Rye Brook NY.

March 22, 1997: SETI League Third Annual Membership Meeting, Little Ferry NJ.

April 6 - 7, 1997: Southeastern VHF Conference, Atlanta GA.

May 16 - 18, 1997: Dayton Hamvention, Dayton OH.

May 30 - June 1, 1997: Rochester Hamfest and ARRL Atlantic Division Convention, Rochester NY.

July 24 - 27, 1997: Central States VHF Conference, Hot Springs AR.

August 28 - September 1, 1997: Lonestarcon 2 / 1997 Worldcon, San Antonio TX.

May 15 - 17, 1998: Dayton Hamvention, Dayton OH.

May 29 - 31, 1998: Rochester Hamfest and ARRL Atlantic Division Convention, Rochester NY.

July 23 - 26, 1998: Central States VHF Conference, Kansas City KS.

August 5 - 9, 1998: BucCONeer / 1998 Worldcon, Baltimore MD.

May 14 - 16, 1999: Dayton Hamvention, Dayton OH.

September 2 - 6, 1999: Aussiecon Three / 1999 Worldcon, Melbourne Australia.

Ham SETI-Net Initiated

LITTLE FERRY, NJ., September 6, 1996 -- Peter Wright, The SETI League's volunteer coordinator in Germany, has suggested that League members who are licensed radio amateurs might wish to meet on the air on a weekly basis to compare notes and share ideas. Wright, who is licensed as a ham radio operator under the callsign DJ0BI, reports that several European members are monitoring 14.204 MHz (exactly one percent of the popular Hydrogen Line radio astronomy frequency) on Sundays at 1000 UTC. Although the scheduled time favors communication between Europe and Asia, interested hams worldwide are invited to check in. Look for DJ0BI, or try calling "CQ SETI." Member hams in other parts of the world are encouraged to organize similar nets, at convenient times, on this same frequency. SETI enthusiasts lacking on-the-air capability are invited to check The SETI League's Internet site on the WorldWide Web, <http://www.setileague.org/>.

SearchLites, Volume 2, Number 4, Autumn 1996.
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To:

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Holiday Renewal Special - Gift Memberships 30 percent off!

Renew your own SETI League Full Membership between now and January 1, 1997, and you may give your friends, relatives and associates Guest Memberships at a 30 percent discount. No complicated forms to fill out; just send us the name, address, phone number, ham call and email address (if any) of each of your gift recipients, along with your name, and a check for your \$50 renewal, plus \$35 for each Gift Membership. But you must act before New Year's Eve! Both renewals and Gift Memberships constitute tax-deductible contributions.

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<i>Sing a Song of SETI</i> (Songbook)	\$10	\$12
<i>SETI League Technical Manual</i>	\$10	\$12
<i>Project Cyclops 2nd Printing</i>	\$20	\$24

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