

Conference Calendar

SETI League members are apprised of the following conferences at which SETI-related information will be presented. SETI enthusiasts are invited to check the web at <http://www.setileague.org/general/confrence.htm>, or email info@setileague.org, to obtain further details. Members are also encouraged to send in information about upcoming events of which we may be unaware.

* = SETI League participation confirmed

September 28 - October 2, 1998: *International Astronautical Congress*, Melbourne Australia.
September 28 - October 7, 1998: *IARU Region 2 Triennial Meeting*, Caracas Venezuela.
* **October 3, 1998:** *Western States Weak Signal Society VHF+ Conference*, Sunnyvale CA.
October 3, 1998: *Mid Atlantic VHF Conf.*, Horsham PA.
* **October 16 - 18, 1998:** *16th AMSAT Annual Meeting and Space Symposium*, Vicksburg MS.
October 25 - 27, 1998: *Microwave Update*, Estes Park CO.
* **November 8, 1998:** *Martlesham Microwave Roundtable*, England.
November 12 - 15, 1998: *Molecular Nanotechnology Conference*, Santa Clara CA.
* **November 13 - 15, 1998:** *Philcon '98*, Philadelphia PA.
* **March 28, 1999:** *Annual Meeting*, Little Ferry NJ.
* **April 2 - 4, 1999:** *Balticon 33*, Baltimore MD.
May 14 - 16, 1999: *Dayton Hamvention*, Dayton OH.
August 2 - 6, 1999: *6th Bioastronomy Conference*, HI.
September 2 - 6, 1999: *Aussiecon Three / 1999 Worldcon*, Melbourne Australia.
* **March 26, 2000:** *Annual Meeting*, Little Ferry NJ.
May 12 - 14, 2000: *ARRL National Convention and Dayton Hamvention*, Dayton OH.
August 7 - 19, 2000: *XXIVth International Astronomical Union General Assembly*, Manchester University, UK.
September, 2000 (date pending): *European Radio Astronomy Club International Convention*, Heppenheim Germany.



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Membership Has Its Privileges

"What is The SETI League doing in my town (region/state/country)? What can I do if I join?" These are questions frequently heard at SETI League headquarters.

Local participation is limited only by the individual member's time and commitment. We have a network of volunteer Regional Coordinators to assist our 800 members in 44 countries on 6 continents. Those joining are invited to contact their nearest coordinator to find out about local activities or to start some themselves.

Our major activity, of course, is *Project Argus*, a coordinated search of the heavens for signs of intelligent life. We are proud to be conducting this search on just 1% of the former NASA SETI budget. Your membership dues make it all possible.

Members and nonmembers alike are invited to participate in our email discussion list. If you are a licensed radio amateur, you may wish to join one of the ham SETI nets. Members wishing to buy, sell or swap equipment are invited to participate in our Equipment Exchange, and to attend our annual Membership Meeting. Members in good standing who have their own Web pages will be linked from our Members' Page and are invited to display our logo. Members also receive discounts on selected membership premiums, and several of our commercial sponsors extend hardware and software discounts to our members in good standing.

Our Conference Calendar lists meetings you may wish to attend. You are invited to recommend others and, as an active SETI League member, to speak at appropriate meetings as you desire. And around the world, hundreds of our members, acting either individually or collaboratively, are setting up the kinds of private SETI receiving stations depicted on the web. We invite you to involve yourself directly in hardware design, software design, publicity, observing -- wherever your skills and interests take you.

In the final analysis, The SETI League is what you make it. We are a membership-supported, nonprofit, educational and scientific organization receiving no Government funding whatever. We depend upon your membership dollars to keep our Search alive. Without your support, there would be no extensive website, no hardware and software designs, no technical manual, and no coordinated global search. With it, if we make contact, you will have the most valuable membership privilege of all: your rightful share of the credit.

Should SETI Protocols Consider Interstellar Travel?

by Dr. Peter Schenkel (schenkel@ecnet.ec)

The question is far less academic than it may appear. It has been argued that because of energy requirements, interstellar travel is "Impossible." Also for other intelligences. But most space propulsion specialists disagree. According to a preliminary CIESPAL survey, 80 percent of those interviewed feel confident that we will reach low c velocities in less than two centuries. NASA director Dan Goldin spoke of plans to send a craft to Alpha Centauri in 20 to 25 years. Therefore, to think that civilizations thousands or millions of years more advanced technologically and scientifically than we would not have a spacefaring capability seems extremely farfetched, to put it mildly. Both Carl Sagan and Arthur C. Clarke have emphatically advocated a much more optimistic view. If we have reason to believe that much older intelligences abound in the universe, then we must admit that the probability that such aliens might send spaceships or automatic probes to explore the Galaxy and stray upon our expanding electromagnetic wavefront is neither greater nor smaller than the chance to find "the needle in the haystack" via radio astronomy. Contact could occur either way. While no solid evidence backs the UFO myth, the possibility should not be ruled out that an alien craft or probe may enter our solar system and attempt an encounter with us.

The principles of Protocol Two, elaborated by the IAA SETI Committee, apply only to the scenario of the reception of a verified alien intelligent radio signal. But what if an alien spacecraft really approaches us, as I posit in my forthcoming book *Contact with ETI: Are We Ready For It?*, or if we detect a scouting alien probe, as Alan Tough proposes? Since the impact and consequences of this contact scenario would be incomparably greater than in the former case, it seems to be not only legitimate but urgent to formulate a similar Protocol. We need to be prepared for this eventuality with an adequate legal framework binding nations. A first proposal was submitted by me to the Conference on Bioastronomy in Capri in 1996 [Legal Frameworks for Two Contact Scenarios, P. Schenkel, *JBIS*, July 1997]. It is always better to have a plan for facing a critical emergency situation, than to be caught by it unprepared without any plan.

Quite erroneously it has been argued that a Third Protocol would "tarnish" Protocol Two because of its "association with UFOlogy." This allegation has even less merit than the one stated in the beginning. At its root is the fear that discussing the hypothetical case of an alien visit or probe may offend and scare off benevolent funding of SETI. But Carl Sagan postulated that the dangerous avalanche of pseudoscience makes it imperative for science to help the public "distinguish between what SETI stands for and the fraudulent claims of UFOlogy." Neither should we capitulate to the UFO gurus nor subordinate a genuine scientific inquiry to expediency. Hopefully SETI via radio astronomy will hit paydirt. But mankind should be prepared politically, legally, communicationally and psychologically for all Contact scenarios, not just for one.

SETI League Acquires Monster Australian Antenna

BRISBANE, AU., April 25, 1998 -- Noel C. Welstead, Eastern Australian coordinator for the nonprofit SETI (Search for Extra-Terrestrial Intelligence) League, has reached an agreement with the Australian Commonwealth Scientific & Industrial Research Organization (CSIRO) to take possession of a 60 ft radio telescope that is currently located at the Parkes Radio Observatory in New South Wales, Australia.

The radio telescope is presently mounted on railway tracks where it served as a prototype design instrument for the Australia Telescope Array also operated by the CSIRO. The dish has been mothballed for a number of years and will need extensive refurbishment to get it on line again after it is moved to Noel's home state of Queensland. A 2 acre site has been selected at Boonah, a small rural town about 80 km south of Brisbane. Boonah was selected as the new home for the radio telescope because it is well shielded from urban radio interference, being surrounded by mountains.

The SETI League operates *Project Argus*, a global search for intelligent signals in space which will ultimately employ 5000 small amateur radio telescopes worldwide. When asked why he requires such a large dish, Welstead replied, "Even though the instruments used around the world for Project Argus are large enough to detect radio signals out to about 200 light years, when a signal is eventually received by one of our stations, it will need verification. Our new 20 meter facility in the Southern Hemisphere can provide the ETI Verification system that we presently lack."



Where Is Everybody?

by Sir Arthur C. Clarke, SETI League Technical Advisor

Despite the impression given by films like *Contact*, no government in the world - apart from Argentina - is supporting the search for alien life. The quest is left to grass-roots outfits like the SETI League. I have contributed financially towards some of these efforts and have a wide network of friends working towards SETI-related research and fund raising. Unfortunately, although we've tried to find intelligent life in Washington DC, so far we've failed.

But what happens if we do receive a signal? There has been extensive discussion on the social, cultural, religious and psychological impacts of the detection of an ET signal from outer space, but what happens after a signal will depend on who receives and decodes it. If the scientists are left to themselves, I think the wider scientific community and, very quickly, the general public will get to know about this. I cannot imagine anything more profound than the detection of a signal which can only have an artificial origin, i.e. from another intelligence. The International Astronomical Union (IAU) has an expert committee which is trying to work out protocols to be followed when such a signal is first detected. I am a member of this committee, and we are hoping that we can prevail upon the governments of the world to have a common understanding on this crucial matter.

Then there's the possibility we've already seen evidence of intelligent life without recognising it. Some years ago, I suggested that supernovae are industrial accidents of civilisations whose technological advancement has far surpassed ours. This is an interesting hypothesis, but it's very difficult to test!

Another possibility is that alien asteroid defence systems might produce some kind of detectable signal. In my 1993 novel, *The Hammer of God*, I described the possibility of a gigaton bomb being exploded in Earth orbit, but on the other side of the Sun, so that microwaves from that explosion will sweep right across the solar system, in all directions. Thus Project EXCALIBUR helped detect not only all the known satellites, comets and asteroids, but every object more than a metre in diameter. It is entirely plausible that advanced civilisations will try out something similar. I remain optimistic that we would be able to communicate with intelligent ETs when we finally encounter them. The chances are that such an encounter will initially take place over vast distances, and not in person. Whichever way it occurs, we will need a common language or medium to understand one another. Mathematics is an obvious possibility, but some have also suggested music as another common medium, as was done in the movie *Close Encounters of the Third Kind*.

Until then the closest we can get is communicating with fellow intelligent mammals like whales and dolphins. There has been considerable research done but I sometimes wonder if these gentle creatures are too disinterested in exchanging messages with us; they may be too playful and not bothered by our attempts.

Of course, one can only guess at the effects of alien contact. Even if the aliens are benign, the sheer differences between our civilisations could wipe us out. We know that in

the past, civilisations that once thrived were marginalised and/or wiped out by colonisers.

As for hostile ETs... Like Steven Spielberg, I, too, cannot imagine hostile aliens for the simple reason that a truly space-faring race will have to overcome more primitive traits such as violence, or they would destroy themselves in a relatively short time. You might argue that this is wishful thinking, and that there could indeed be greedy and vicious aliens roaming the universe. Well, for all our sakes, I hope you are wrong.

Editorial: Nothing Is Impossible

by Dr. H. Paul Shuch, Executive Director

Several members of the SETI community have recently proposed that we develop means to search for intelligent interstellar nanoprobes. This research is certainly unconventional (in fact, that is its very appeal to many of us!). Prof. Ron Bracewell's similar suggestions of 25 years or more ago were also considered by many to be outside of the scientific mainstream. In fact, for many years that description fit what we now think of as "conventional" microwave SETI. The nature of breakthrough thinking is that it challenges the dominant paradigm.

One possible reaction to such novel proposals is to dismiss them as impossible, beyond the laws of physics, or outside the realm of engineering feasibility. This is the classic reaction of those with limited vision. Instead of expending energy on dismissing the unconventional, true visionaries embrace the very real challenge of overcoming its difficulties.

I am pleased to note that most SETI League members fall into the category of visionaries. Otherwise, we would have long ago abandoned our foolish quest of SETI. Let us then remember that what we scoff at today may tomorrow gain respectability, and next year enter the realm of the scientific mainstream. It is not the laws of nature which change over time, but rather our perspective and our understanding of them.

I salute those of our colleagues who dare to propose the impossible. They have challenged the rest of us to expand our minds. Let's not disappoint them by dwelling on the negative or rejecting the unknown out of hand.

Own A Piece of SETI History!

In 1998 the Big Ear Radio Telescope at Ohio State University, home to the world's longest running and best known SETI (Search for Extra-Terrestrial Intelligence) program, was demolished to make way for a commercial golf course. We have salvaged 100 small pieces of the metal mesh which once covered the surface of this great antenna.

The mesh sections, each a resonant half-wavelength square at Big Ear's operating frequency of 1420 MHz, are mounted on a wooden plaque for public display, along with a depiction of the August 15, 1977 "Wow!" signal which made OSU SETI world famous. These sections of antenna reflector were actually illuminated by the "Wow!" signal, the most tantalizing (yet unconfirmed) evidence to date of extra-terrestrial intelligence.

You can own one of these artifacts for a minimum \$100 US tax-deductible contribution to The SETI League, Inc. All proceeds will be shared equally by The SETI League, Inc. and the Ohio State University Radio Observatory.

Technical Feature:

Don't Rule Out Interstellar Probes

by Gerald Nordley (GDNordley@aol.com)

Editor's Note: *The following excerpts are from a much more complete discussion which Mr. Nordley contributed to The SETI League's website. The full document may be found at <<http://www.setileague.org/articles/probes.htm>>*

One of the problems in not getting around to writing a paper I promised a couple of years ago is work that doesn't get in the literature. Three years ago, I organized a panel at "Intersection," a world Science Fiction Convention at which we designed a starship to carry a crew of twenty on an arbitrary journey of 20 years (12 years on board). Our radiation safety guy, Steven Howe of Los Alamos National Labs, came to the somewhat surprising conclusion that it was ambient cosmic radiation and not the radiation of passage that drove shielding considerations, and he wanted two meters of water or the equivalent around the people. Our ship ended up with three redundant hulls and weighing 10,000 tonnes.

We didn't have time on the panel to do the engineering trades needed to beat an order of magnitude out of that; it seemed simpler to just let our solar power station-makers consume a few more asteroids. Part of my problem with doing the paper is that the panel was far too conservative on the medical side (ruling out cold sleep or genetic engineering) and while we came up with an interesting point design, it is driven by technology assumptions that are already proving obsolete. But I regret that Steve's radiation input isn't in the literature. Anyway, radiation exposure issues for interstellar travel appear to be about the same as for long term solar system missions, and may not generate that many papers for that reason.

Many of us concerned with interstellar travel don't bother with trip times in the thousands or millions of years because, if sent, such missions would be passed by faster missions built a few years later. Based on the criterion of soonest arrival at a target star, one probably doesn't send a mission at all until one's technology is up to sending it at better than half the speed of light, and in that regime, stars are "only" on the order of twenty years apart or so.

I will at this point make a somewhat Clarkian prediction that the first human probe to reach the Alpha Centauri system will spend about the same on-board time in transit as the surviving ship of the Magellan expedition took to circle the Earth or the Galileo Probe took to reach Jupiter. Most conventional wisdom in the community would be an order of magnitude more than that (get data back within a human lifetime).

By the way, JBIS (the Journal of the British Interplanetary Society), while liberal, is a peer-reviewed publication and is probably the best source of innovative thinking on interstellar travel issues.

There seems nothing wrong with Dr. (Mario) Zadnik's description of radiation environment, nor its affects on the kind of probe he assumes. However, anyone sending interstellar probes would be well aware of all that and design their probes accordingly.

It is somewhat presumptuous of us to discuss the technology of races with millions of years more experience in space travel than ourselves (and, perhaps, even more presumptuous to project our current or near-term technological limitations on them). But if our understanding of the laws of physics is approximately correct, we can use that and our own limited experience to bound the problem and guess at enough solutions to establish some confidence that the problem can be solved.

Like our own cells, the CPU's of intelligent probes utilizing nanotechnology would be expected to have error checking and correction mechanisms. As an example of what is possible, consider the radiation toleration abilities of certain bacteria. This alone probably solves the problem, but there is more fun to be had.

Magnetic fields can be used to deflect charged particles and lasers can charge any particles that aren't already charged. The magnetic fields can be generated by superconducting loops that need little en route power to maintain their fields.

The energy requirements for interstellar travel are large, but not in relation to the energy available from any central star, energy which is accessible to advanced spacefaring civilizations. What follows is fairly crude, unoptimized and cursory, but it should give a rough idea of what a civilization like ours might be able to do, starting in a half-century or so.

We can already see the beginnings of the development of self replicating machines. Such machines could use space resources to build solar power stations in space and copies of themselves. The exponential growth of such power resources would provide the energy and power needed for interstellar travel at relativistic velocities in a few decades. Other options for obtaining the energy needed, notably mining giant planet atmospheres for fusion power fuel, have been proposed as well.

There are a variety of propulsion systems already in the literature that could be applied to relativistic flight. The best, in my view, involve projecting particles or pellets from a base anchored to a large asteroid. The pellets strike a spacecraft which reflects them and absorbs their momentum and kinetic energy. In principle, by proper choice of the projection velocity, nearly all the energy of this stream of mass can get into the spacecraft. The particles can be guided by lasers along their route, or, given advances in nanotechnology, steer themselves to their collision. Photon-pushed light sails are another option. The trick is to leave most of the propulsion system hardware mass and momentum at rest.

Our descendants (and any alien observers) will inevitably regard the (*omitted*) analysis as quaint as they will have much better tricks up their sleeves. But it is fairly easy to see from the limited knowledge we have accumulated on such subjects that there is no requirement for alien interstellar spacecraft to withstand "millions of years" of uncorrected cosmic radiation damage.

The real question before us is the one that Fermi asked: "Where are they?"

The more I consider engineering approaches to interstellar flight, the more I appreciate the synergism between the microelectronic and computational revolution we are going through and interstellar flight. It seems enabling.

Software Corner: Modeling Fresnel Antennas

by Henry Wallace (ultrasonic@worldnet.att.net)

There has been much discussion on the SETI email list of Zone Plate (reflecting) Fresnel antennas. The following BASIC program allows one to predict the locations of the borders of the zones:

```

10 REM Fresnel Zone Plate Reflecting Bullseye
20 R0=12.92 :F0=1420E6 :C= 3E8 : LA=C/F0 : N=1
30 FOR S=0 TO R0 STEP R0/10000
40 R=sqr( R0*R0 + S*S )
50 IF ( R-R0) < N*LA/2 THEN 70
60 PRINT N,S : N=N+1
70 NEXT S
80 END
    
```

Here F0 is the frequency (1420 MHz), LA is the wavelength, R0 is the height above ground to the 45 degree feedhorn (40 feet or 12.92 meters). And S is the distance from the center of the bullseye to the border, in meters.

When RUN, this program produces about 56 borders, or about 23 concentric bands, with alternating bands reflecting or absorbing. Wayne S. (or Aleph Null on SETI net) suggested placing such a reflecting array 1/4 wavelength (about two inches) above a reflecting groundplane. This will probably work, but I have yet to fully simulate it.

Actually, this is only the most rudimentary beginning of the simulation which sums the contributions from all these zones at the feedhorn. However, the remainder of the program will just add up the contributions from alternate zones, using Cos(Kr), Sin(kr) terms (K is just wave-number $K=2*\pi/ LA$) and the area of each contribution ($da=2*\pi*s*ds$). Once the Cos terms are all added up, and the Sin terms are added up, the net amplitude is $a=sqr(Cos^2+Sin^2)$, which is the "zero order" straight-up amplitude. The off-axis terms just add a linear phase- term in X (or Y), if the bullseye is in the X,Y plane.

Here is the first Zone Plate antenna simulation:

```

10 REM Fresnel Zone Plate Antenna
20 DIM S(100)
30 Pi=3.14159
40 R0=13.55: F0=1420E6: C=3E8 : LA= C/F0 : N=1
50 FOR S=0 TO R0/2 STEP R0/10000
60 R= SQR(R0*R0+S*S)
70 IF (R-R0)<N*LA/2 THEN 100
80 PRINT N,S
90 S(N)= S : N=N+1
100 NEXT S: S(0)=LA
110 K= 2*PI/LA
120 FOR DG=0 TO 100 STEP .1 : TH=DG/57.325
130 N=1: CT=0 : ST=0 : GOSUB 1000
140 FOR N=3 TO 100 STEP 2 : PRINT N;" ";
150 IF S(N)=0 THEN 180
160 GOSUB 1000
170 NEXT N
180 A= SQR( CT*CT+ST*ST)
190 PRINT DG, A
200 NEXT DG
210 END
1000 REM Do a Band
1010 FOR RD= S(N-1) TO S(N) STEP LA/100
1020 R= SQR( R0*R0+RD*RD) : P7=K*(R-R0)
1030 TS= LA / (RD*100)
1040 FOR AD=0 TO Pi STEP TS
1050 X=RD*COS(AD) : PH= K*X*SIN(TH)
1060 CT= CT+COS(P7-PH) : ST=ST+SIN(P7-PH)
1070 NEXT AD
1080 NEXT RD
1090 RETURN
    
```

The groundplane is not included in this simulation. All dimensions are in meters, angles in radians, except for DG which is the off-axis pointer, and is in degrees. R0 is feedhorn height above the bullseye, and is also approximate bullseye outer diameter. LA is wavelength. A is the computed amplitude of the received signal. It is expressed as linear: to "normalize" the beam pattern response, each off-axis A should be divided by the A for zero degrees, and $20*\log$ of this term be taken.

Lines 10-100 set up the "borders" between the zones, and load these radii into the array S[N], and prints out these borders with their corresponding index N.

Lines 1000-1090 (the "Do a Band" subroutine) does most of the work. The most nested loop rotates the angle AD (for Angle in Disc) in steps of size determined by line 1030, which is set at a step size of 1/100 wavelength. Rotation of AD through Pi radians is sufficient, as continued rotation only duplicates. The outer loop in "Do a Band" repeats the process for all eight active zones of this design, skipping those zones from which energy reaching the feedhorn is out-of-phase. Line 1010 sets the step size in radius at 1/100 wavelength.

This program was written and debugged on an Apple II computer in Apple Basic. The variables used in debugging were for a 10 foot diameter antenna with only ONE zone surrounding the central disc, and step sizes were 1/10 wavelength. This was done so that this program could be debugged and presented to the Group within a reasonable time. The Apple II is REALLY SLOW. We suspect ET will come before the Apple II finished the simulation above.

O.K., you Computer Masters: rewrite this thing in "C" and use the math co-processors for the Sin, Cos. The simulation is accurate, and produces the expected tight beams and sidelobes. While I have been working on the Zone Plate simulation, I have been aware of some of the discussions about gratings/etc.

I am concerned that the simulated disc may not perform as well as the simulation predicts. If it were constructed with a "specular" metallic surface, composed of hills/valleys on the order of 1/4 wave high, I would expect it to act nearly as good as the simulations predict. But with entirely "flat" construction techniques, I am not entirely sure.

I originally thought because the thinner zones are further removed from the feedhorn, they would scatter the incident RF enough so that a large portion would enter the feedhorn. The outer zone is only 1.1 wavelength wide, and such a narrow metallic surface might scatter the energy sufficiently.

Several approaches suggest themselves if it is determined that the "specularity" of these surfaces needs to be increased. I have seen the suggestions of a sinusoidal surface, and noted the suggestions of "tilted" surfaces. In optics, this is called "blazing." An approach might be to divide each of these zones into many smaller (thinner, say 1 cm wide) "mini-zones." There was work done in the 1950's using foam plastics as lenses. The increased dielectric constant of certain foams could be used to produce what today we would call a "phase grating."

Many good graduate-level EE labs have HP microwave benches capable of measuring the scattering angles of 21 cm radiation from test surfaces. But as with all scientific progress, experimentation will be the key.

Introducing:

**The SETI League's Membership
Services Committee Chair**

Growing up in darkest Cambridgeshire, in England, **Amanda Baker** devoured every book of physics, astronomy and science fiction that she could lay her hands on. Winning a place at Imperial College, London, in 1987 changed her life and set her on the course to a career in astrophysics which she is now striving to pursue, armed with a PhD in infrared studies of quasars from Cambridge University. She is currently working on data from the Infrared Space Observatory, based near Paris in France.

As a physics student in London, Amanda was introduced to science fiction fandom and to SETI League Executive Director H. Paul Shuch, whom she met at the Glasgow World Science Fiction Convention in 1995. Long fascinated by the possibilities of life on other planets, Amanda was delighted have found a way to get involved in the search.

In the intervening years, Amanda has been an impoverished student in London and Cambridge, an impoverished post-doctoral researcher in Germany and France, and is looking forward to being in the black and settled, ready to start working on a Project Argus station. In the meantime, she's been adding value to her SETI League membership with presentations and interviews with amateur astronomers and journalists, and with being a Regional Coordinator until someone fluent in French could be found to take over.

Dr. Baker will calculate redshifts for food - preferably chocolate!

Editor's Note: For a complete listing of SETI League volunteer Regional Coordinators and Committee Chairs, look up this file on The SETI League's award-winning website: <<http://www.setileague.org/admin/volunter.htm>>, or check the latest Membership Roster.

Why Project Argus?

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SETI League Membership Services Chair**

In Greek mythology, the many-eyed guardian god Argus scrutinized every direction simultaneously. When Argus was dead, his eyes were put on to the peacock's tail. In the search for extraterrestrial intelligence, The SETI League's Project Argus will be similarly all-seeing, constantly surveying the entire sky at radio frequencies. But Project Argus is a confederation of amateurs. How can it compete with professional SETI searches? In a word, coverage.

Professional telescopes are sensitive to very weak signals. But sensitivity requires a large collecting area (typically, 2 - 4000 square metres), which can only look at a small piece of sky (about the size of the moon). Such SETI searches also have to compete with professional astronomy projects, and can observe for only a few weeks each year. Meanwhile, 5000 dedicated home SETI stations (based on a TV satellite dish [collecting area up to about 10 square metres] and a personal computer) can cover the entire sky for 24 hours every day.

Huge numbers of amateur astronomers and ham radio enthusiasts around the world have the interest and skills which will make Project Argus a reality. The first Argus station went on-line in April 1996, and there are already 50 working stations (see <http://www.setileague.org>). Project Argus will be fully operational within the next few years, constantly searching the radio frequencies known as 'The Waterhole' across the whole sky for any artificial signals of non-terrestrial origin which might arrive at our planet.

If we do detect a signal which is neither natural (astronomical) nor resulting from human activity, this will be a discovery of immense philosophical importance. We will finally know the answer to an age-old question: Is humanity the only intelligent, technological, civilized race in the Universe? Are we alone?

SETI League Adds New Email Lists

In an effort to provide our members with yet another communications option, The SETI League has expanded its Internet email offerings to four separate lists, as follows:

Seti@sni.net, the original open SETI email list, is hosted by Internet Services Committee chairman Bob Cutter. It continues to be an un-moderated forum for discussions of SETI history, philosophy and technology, and is open to SETI League members and non-members alike. For sign-up details, see <<http://www.setileague.org/admin/setilist.htm>>.

Volcor@setileague.org is a closed, moderated forum for the use of SETI League officers, trustees, committee chairs, advisors, and volunteer regional coordinators. It is to be used for coordination of the day-to-day administrative details of running The SETI League. Sign-up details may be found on-line at <<http://www.setileague.org/admin/volcor.htm>>.

Argus@setileague.org is a newly established moderated email list for the use of our members. The purpose of this closed list is to provide a forum for technical discussions related to design, construction, operation and maintenance of Project Argus receiving stations. All SETI League members in good standing, whether enrolled in Project Argus or not, are invited to participate. For further sign-up details, see <<http://www.setileague.org/admin/arguslst.htm>>.

And finally, **Hits@setileague.org** is our closed email list for those actually participating in the Project Argus search. The Hits list is intended to be used for those coordination activities associated with verifying candidate signals, and as such should be an extremely low-volume list. All SETI League members in good standing who have registered their Project Argus stations by completing a Participant Survey may register to use this list. For further sign-up information, see <<http://www.setileague.org/admin/hitslist.htm>>.

Ask Dr. SETI

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

Dear Dr. SETI:

Could you please give me an indication of how far away we could detect a civilization with Earth-like technology? That is, if there were a society with radio, television, radar, etc., transmission power at a level equal to our own, radiating from omnidirectional antennas on an Earth-like planet, what would be the maximum distance in lightyears that we could detect these signals with our current SETI receiver sensitivity?

*I would appreciate any clarification you could provide.
J. McA., Richmond, VA*

The Doctor Responds:

My calculations indicate that incidental radiation from Earth-like technology could be detected out to at least 1000 LY by our larger SETI telescopes (such as the ones used in the SETI Institute's Project Phoenix targeted search). Because our members' privately owned and operated radio telescopes are much smaller and less sensitive, it is unlikely that we would be able to detect such incidental radiation from any but the very nearest stars. For example, a one Megawatt transmitter driving a 100 meter diameter antenna can be detected by the typical amateur SETI station at a distance of one parsec, which is slightly less than the distance to the nearest star. Our private search hopes to encounter either significantly more powerful transmissions, or highly directional beacons. Thus, the two approaches (sky survey and targeted search) are complementary.

The actual range over which we can hear a signal depends upon the transmit power and antenna gain of the civilization we are trying to detect -- factors over which we have no control whatever. It is interesting, however, to speculate and to test the results of our best guesses as to extra-terrestrial technology. The spreadsheet programs "linkanal.xls" and "ranganal.xls" allow you to evaluate your own "what if" scenarios. They may be downloaded from our website. Using such mathematical tools as these, your guess will be as good as mine!

Dear Dr. SETI:

I have heard often about the Drake equation, but have never heard estimates of how soon SETI expects some kind of contact in the event these Drake estimates are accurate. If there are indeed 10,000 communicative civilizations in the Milky Way galaxy alone, shouldn't the sky be alive with non-natural radio signals? What does SETI's lack of success to this point say about the Drake equation? At what point does experimental evidence (no contact) affect the theory (Drake Equation)?

YV (via email)

The Doctor Responds:

Some years ago, Frank Drake estimated SETI success "By the end of the century." Now that that's drawing near,

he's re-evaluating. This taught me never to attempt prophecy. Besides, we're not allowed to -- The SETI League is a non-prophet group!

The Universe may very well be abuzz with intelligently generated radio signals from those 10,000 civilizations. But there are some 400,000,000,000 stars in the Milky Way, so when you point your antenna at one of them, there's only a one in 40,000,000 chance (that's 0.00000025%) of picking up signals. And this assumes you're tuned to the right frequency and listening at the right moment. Our most sensitive searches, the targeted ones, cover only a few hundred nearby stars, not the whole sky.

Then there's the problem of range. It's likely to be hundreds of light years to the nearest civilization, and signal strength diminishes with the square of distance. Our very best current systems can probably detect out to perhaps 1000 light years, if they happen to know exactly where to point (but they don't, of course). So, we really need better sensitivity.

I wouldn't call our outcome to date a lack of success, rather a lack of instantly verifiable results. We're just in the shakedown phase of developing our capabilities. Nobody seriously expected that we would have detected any signals by now. That would be like Orville and Wilbur having expected to fly supersonic. (Of course, we have a better chance of getting lucky than they did!)

The lack of firm evidence to date more or less confirms the theory that communicative civilizations are modestly rare (after all, 10,000 out of 400,000,000,000 is not a huge ratio). The late NASA all-sky survey only observed for a total of 1000 hours before Congress pulled the plug. The privatized searches are doing a little better, but we still have a very long way to go. Not only have we not yet scratched the surface, we haven't even felt the itch.



SETI League Website Achieves HTML 4.0 Compliance

The World Wide Web Consortium (W3C), guardians of Internet standards, has deemed The SETI League's extensive website <http://www.setileague.org/> to be in compliance with the newest version of the Hypertext Markup Language, HTML 4.0 Transitional. As far as we know, ours is the world's first SETI website to validate against this latest Internet standard.

Our website, which has grown to over 1200 documents totaling more than 40 MBytes (!) of technical and membership information, links to most of the world's major SETI and radio astronomy sites, and serves as a jumping-off point for journalists, researchers, scientists and students interested in learning more about SETI. Its four major sections (Membership Services, Publications, Tech Support, and Press Relations) offer information for the technical and non-technical SETIphile alike. The site contains hundreds of downloadable images of SETI people, systems and signals, but is still accessible to text-only browsers.

HTML 4.0 validation means our site will continue to work well with the very latest Web browser software. We thank SETI League member and Internet guru David Woolley of England for holding our Webmaster's hand, and helping us through the validation process.

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