SearchLites

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The Quarterly Newsletter of The SETI League, Inc.

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SearchLites, ISSN 1096-5599, is the Quarterly Newsletter of **The SETI League, Inc.**, a membership-supported, non-profit [501(c)(3)], educational and scientific corporation, dedicated to the electromagnetic Search for Extra-Terrestrial Intelligence. SETI League, Dr. SETI, and the above logo are all registered service marks of The SETI League, Inc.

Postcards from Beyond

Since early in the last century, amateur radio operators have observed a tradition of exchanging postal cards to commemorate their on-the-air contacts. So-called QSL cards (named for the International Morse Code signal for 'confirmation') are used as proof of successful radio contact with stations in rare and distant locations. Many operators in exotic lands employ the services of a QSL manager to distribute their much sought after cards. Now, as the world's radio hams prepare for the eventual reception of signals from civilizations in space, the question arises as to how those succeeding at the Search for Extra-Terrestrial Intelligence (SETI) will ever receive a QSL card.

The SETI League, Inc., a grassroots, international body of radio hobbyists trying to accomplish the ultimate in long-distance communication, is pleased to announce that it will henceforth serve as QSL Manager for ET! In fact, to encourage amateur participation in the growing fields of radio astronomy and SETI, they are offering special cards to commemorate confirmed reception of a variety of extra-terrestrial signals: manmade, natural, and even alien.

Any SETI enthusiast documenting radio reception of an artificial satellite, manned or unmanned space probe, natural astrophysical phenomenon, or Earth transmission bounced off the moon or another planet, is eligible to apply for a QSL Card from The SETI League, Inc. Reception must have been accomplished with equipment normally used for, or capable of being used for, radio astronomy. "Many amateurs have the capability to receive such signals," says SETI League executive director Dr. H. Paul Shuch, who is licensed as amateur radio operator N6TX. "We expect to send out many such cards. But the holy grail of SETI is a verified transmission from our cosmic companions. That QSL will be a rare one, but we stand ready to send it out when The Call is confirmed."

Amateur radio astronomers seeking a QSL card should send reception reports (including date, time, frequency, coordinates, nature and origin of signal) to SETI League headquarters, along with a stamped, self-addressed business size envelope. Please state whether the signal received was natural, manmade, or alien (and be prepared to justify any claims of the latter). QSL requests from outside the US should include two International Reply Coupons.

SETI scientists seek to determine through microwave and optical measurements whether humankind is alone in the universe. Since Congress terminated NASA's SETI funding in 1993, The SETI League and other scientific groups have been attempting to privatize the research. Experimenters interested in participating in the search for intelligent alien life, or citizens wishing to help support it, should visit us on the Web at <http://www.setileague.org/>, email to join@setileague.org, send a fax to 1 (201) 641-1771, or contact The SETI League, Inc. membership hotline at 1 (800) TAU-SETI. Be sure to provide us with a postal address to which we will mail further information. The SETI League, Inc. is a membership-supported, non-profit [501(c)(3)], educational and scientific corporation dedicated to the electromagnetic Search for Extra-Terrestrial Intelligence.

For full QSLCard rules, see <http://www.setileague.org/awards/qslcard.htm>. ❖

Moonbounce Beacon Operational

Little Ferry, NJ, March 2001 -- With financial assistance from the American Astronomical Society, The SETI League, Inc., grassroots leaders in the privatized Search for Extra-Terrestrial Intelligence, has placed on the air a transmitter that bounces microwave signals off the surface of the Moon, for use in testing Earth-based radio telescopes. Operating under the callsign W2ETI at an allocated amateur radio frequency of 1296.000 MHz, the EME (for Earth-Moon-Earth) beacon enables amateur and professional radio astronomers alike to calibrate their receiving systems, by providing a stable reference signal emanating constantly from a known point in the sky.

The SETI League's EME beacon received its first shakedown this month, providing scientists at the Arecibo Observatory in Puerto Rico with a weak, well calibrated test signal for use in conjunction with the Project Phoenix targeted search for extraterrestrial intelligence. Project Phoenix scientists had formerly used a microwave transmitter aboard the Pioneer 10 spacecraft for this purpose. Twenty-nine years after its launch, Pioneer 10 is now outside our solar system, seven billion miles from Earth, its eight-watt beacon too weak to be received even by Arecibo, the world's largest radio telescope.

"Well, we DID see [The SETI League's moonbounce beacon]," emailed astronomer Seth Shostak from Arecibo during the March 9th tests. "It took a while, and it was a lot weaker than I had anticipated, but it was definitely there. And easily found by the system. It was drifting slowly to lower frequencies." That frequency drift is the Doppler shift caused by the motion of the Moon with respect to the Earth, and is a key feature by which SETI scientists differentiate between extra-terrestrial signals and terrestrial interference.

The SETI League's more than 1200 members in 60 countries have collectively assembled over 100 small radio telescopes, constructed by individual members out of discarded satellite TV dish antennas, along with sensitive microwave receivers and powerful home computers. Traditionally, radio telescopes are used to study the structure of the universe, by analyzing microwave radiation emitted by natural astrophysical phenomena. In the SETI application, it is artificial radiation from other technological civilizations that the telescopes seek to identify. In either case, test signals such as the one now being provided by the moonbounce beacon enable radio astronomers to confirm the proper operation of their equipment. ❖

European Amateur Receives Bruno Award

Little Ferry, NJ, 28 April 2001 -- The SETI League, Inc., grassroots leaders in the privatized Search for Extra-Terrestrial Intelligence, has awarded its highest honor to one of Europe's foremost amateur radio astronomer. Engineer Peter Wright, licensed in Germany as amateur radio operator DJ0BI, today received the coveted Giordano Bruno Memorial Award for his efforts to promote amateur radio astronomy and SETI throughout the European continent.

Wright, who hails originally from Scotland, was a member of the US-based Society for Amateur Radio Astronomy when, recognizing the need for a similar organization in Europe, he founded the European Radio Astronomy Club. With the help of his wife Angelika Gherke he publishes "The European Bit," an extensive quarterly newsletter, and chaired the first two European Radio Astronomy Congresses in Heppenheim Germany. Peter built the radio telescope which is the basis of the ERAC club station, was the first European participant in The SETI League's Project Argus sky survey, and volunteered to serve as one of The SETI League's first Regional Coordinators.

The Bruno is awarded annually for significant contributions to the art and science of SETI. It is dedicated to the memory of Giordano Bruno, the Italian monk burned at the stake in 1600 for postulating the multiplicity of inhabited worlds. This award was first suggested by sociologist Donald Tarter at a SETI dinner held at the American Association for the Advancement of Science meetings in Atlanta on Feb. 17, 1995 (coincidentally the 395th anniversary of Bruno's death). Past recipients include physicist Dr. D. Kent Cullers, WA6TWX; software volunteer Daniel Boyd Fox, KF9ET; English amateur radio astronomers Trevor Unsworth, G0ECP, and Ken Chattenton, G4KIR; Australian coordinator Noel Cedric Welstead, VK4AYW; and photonics engineer Dr. Stuart Kingsley. ❖

2001 Bruno Award winner Peter Wright, DJ0BI

< < Project Phoenix reception at the Arecibo radio observatory of The SETI League's 1296 MHz EME beacon, 9 March 2001, 04:03 UTC. (Seth Shostak / SETI Institute)

Guest Editorial:

Communicating Across SETI Time

by Valdemar Phoenix, KG2PM
email vphoenix@mindspring.com

I have recently read several articles and books written on SETI. Some of them have speculated about how we'll communicate with extra-terrestrial intelligence (ETI) once its presence is discovered. While these discussions are interesting, my present musings are that "communication with ETI" may be misleading because of a concept I'll call SETI time. This concept takes into account the speed of light, which also equals the speed of communication. Our physics of today is limited to this speed, so there is no point as yet arguing about black hole or worm hole communication possibilities. SETI time also relates to the age and technological level of civilizations and this limits our possibilities of ever "communicating" with ETI, even if there are many ET civilizations.

In standard astronomical usage, a light year is primarily a measure of distance, not of time. But SETI concepts do not necessarily conform to standard astronomical usage, and therein lies the problem. In SETI, a light year is also a measure of time, the amount of time since the signal left its source. A signal which has traveled one light year is now one year old. A signal from 1000 light years distant is 1000 years old, etc. If we assume, simply as a baseline, that a received SETI signal originated from its source at a time when its technology was approximately at our technological level today, then we can use the concept of SETI time as a measure of how advanced such a civilization would be. An ET signal found to be emanating from a distance of 100 light years, with a corresponding SETI time of 100 years, could therefore be assumed to have come from a civilization now 100 years more advanced than we are today.

1000 or even a 1,000,000 light years is nothing in standard astronomy. But in SETI, its implications are enormous! Let's put some SETI times into anthropological perspective. If we hear a signal that is 1000 light years distant in time and space, then its senders will now be 1000 years more advanced than we are, at a minimum. Compared to them, we are still in the Dark Ages.

If we detect a signal with a SETI time of 100,000, we are Neanderthals or Early Modern Humans at best, still making stone tools and wearing bear skins.

I have heard estimates of the size of the Milky Way Galaxy as 70,000 to 100,000 light years across. Any intelligences that we detect from that far away will dwarf our technology and probably our brains as well. A signal of SETI time 1,000,000 puts us back to Homo Erectus, just learning to use fire. A 10,000,000 light year ET signal means that we as a species don't even exist yet, by comparison, and our ancestors are still in the trees. It's unlikely that we'll ever be able to hear an ET signal from such a distance, but ETI may be out there nevertheless.

What are the implications of SETI time for our SETI searches? Surely one effect is that we'd better limit our searches to 100 light years or less if we have any hope of actually communicating with ETI, and even this is unlikely. Recognizing SETI time as a factor, we need to be cautious and precise when we talk of "communicating" with ETI. Borrowing from short-wave radio terminology, maybe "listening" is the best we'll ever do.

This doesn't mean we won't have some learning opportunities. SETI is likely to end up being a kind of paradoxical "archeology of advanced technological civilizations," and possibly of long dead civilizations. Archeologists and anthropologists dig up remains of ancient beings and civilizations that preceded us and were primitive by comparison. SETI may uncover civilizations far in advance of our technological level. We may indeed find signals once our equipment is sensitive enough. But real-time communications? I think not. ❖

Event Horizon

SearchLites' readers are apprised of the following conferences and meetings at which SETI-related information will be presented. League members are invited to check our World Wide Web site (www.setileague.org) under *Event Horizon*, 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.

May 5 - 6, 2001: *Trenton Computer Festival*, Edison NJ.
May 18 - 20, 2001: *Dayton Hamvention*, Dayton OH.
May 18, 2001, 0700 hours: SETI Breakfast, Marriott Hotel, Dayton OH.
May 25 - 28, 2001: *Balticon 35*, Baltimore MD.
June 22 - 24, 2001: Dr. SETI ® to appear as Toastmaster at *Conterpoint Four* Filk Music Convention, Rockville MD.
July 14, 2001, 1600 hours: Frank Drake delivers *Friedman Lecture* at Penn State University.
July 15 - 18, 2001: *20th Anniversary SARA Conference*, NRAO Green Bank WV.
July 26 - 29, 2001: *Central States VHF Conference*, Fort Worth TX.
August 30 - September 3, 2001: *Millennium Philcon* World Science Fiction Convention, Philadelphia PA.
September 27 - 30, 2001: *Microwave Update*, Sunnyvale CA.
November 16 - 18, 2001: *Philcon 2001*, Philadelphia PA.
October 1 - 5, 2001: *52nd International Astronautical Congress*, Toulouse France.
October 5 - 6, 2001: *19th AMSAT Annual Meeting and Space Symposium*, Atlanta GA.
April 27 - 28, 2002: SETI League *Technical Symposium* and *Annual Membership Meeting* (location TBA).
May 17 - 19, 2002: *Dayton Hamvention*, Dayton OH.
July 8 - 12, 2002: *Bioastronomy '02*, Hamilton Island (Great Barrier Reef) Australia.
August 29 - September 2, 2002: *ConJose* World Science Fiction Convention, San Jose CA.
October, 2002 (date TBA): *Microwave Update*, Washington DC.
April 26 - 27, 2003: SETI League *Technical Symposium* and *Annual Membership Meeting* (location TBA).
May 16 - 18, 2003: *Dayton Hamvention*, Dayton OH.
August 28 - September 1, 2003: *Torcon 3* World Science Fiction Convention, Toronto ON Canada.
October, 2003 (date TBA): *Microwave Update*, Seattle WA.
April 24 - 25, 2004: SETI League *Technical Symposium* and *Annual Membership Meeting* (location TBA). ❖

SETI League Introduces New Operating Award

To promote excellence in the growing fields of radio astronomy and SETI, The SETI League, Inc. announces the Extra-Terrestrial Century Club (ETCC) award program. This program, patterned after the DX Century Club (DXCC) and VHF/UHF Century Club (VUCC) awards of the American Radio Relay League, rewards confirmed reception of a significant number of distinct extra-terrestrial radio emissions: manmade, natural, and even (dare we hope?) alien!

Eligibility:

SETI enthusiasts documenting radio reception from beyond Earth of a suitable number of artificial satellites, manned or unmanned space probes, natural astrophysical phenomena, Earth transmissions bounced off the moon or another planet, or confirmed electromagnetic evidence of another civilization in space, are eligible to apply for ETCC Awards from The SETI League, Inc. The program is open to SETI League members and non-members alike, although interested parties are encouraged to join the nonprofit SETI League, Inc.

Criteria:

The initial ETCC Award is issued for the properly documented detection of five unique extra-terrestrial radio sources, as defined below. Endorsements are issued for the documented detection of a total of ten, fifteen, twenty-five, fifty, and one hundred such unique sources.

Categories:

Detection of extra-terrestrial radio sources in the categories of Natural, Human, Moonbounce, and Alien, in any combination thereof, as defined in the Rules and Regulations for the SETI League Extra-Terrestrial QSL program, will be accepted as qualifying for ETCC initial certificates and endorsements.

Documentation:

For the purpose of this award, successful ET radio detections will be evidenced solely by the submission of valid Extra-Terrestrial QSL Cards issued by The SETI League, Inc. The total number of cards required for each award or endorsement (that is, all five, ten, fifteen, twenty five, fifty, or one hundred cards, as applicable), must be physically submitted to The SETI League, Inc., along with the name and full postal address of the applicant. All cards will be returned to the applicant, provided that the administrative fee specified below accompanies the submission.

Fees:

The SETI League, Inc. will levy an administrative fee of $10 US for US applicants, and $15 US for non-US applicants, for each ETCC initial certificate and each ETCC endorsement awarded. Such fee is intended to cover the costs of administering this award and of returning all submitted QSL Cards. The administrative fee is payable in US dollar check (drawn on a US bank or US Correspondent bank) or postal money order only, and must be remitted at the time QSL Cards are submitted. Participants are welcome to make additional voluntary contributions to the nonprofit SETI League, Inc., which may be tax deductible to the extent allowed by law.

Fraudulent Claims:

Any submitted QSL cards which The SETI League, Inc., in its sole discretion, deems to be false, fraudulent, or in any way altered, will be disqualified from consideration, and the submitter excluded from future participation in this or any other SETI League program. *Hoaxes will not be tolerated.*

Interpretation of Rules:

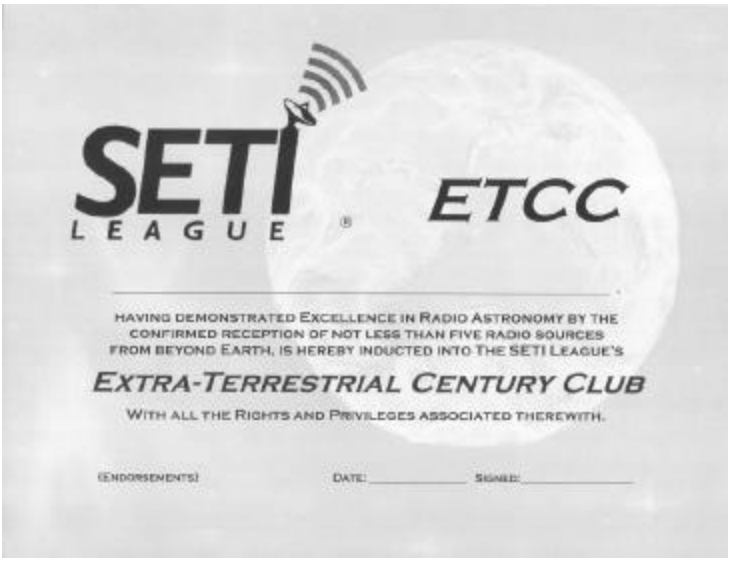
All decisions of the Board of Trustees of The SETI League, Inc., with respect to interpretation of the rules presented herein or subsequently amended, shall be final.

Response Time:

Because this program is administered solely by volunteers, participants should expect a time lag of several weeks for the processing of ETCC awards. The SETI League thanks program participants for your patience and understanding.

Effectivity:

These Policies shall have the force and effect of Bylaws of The SETI League, Inc. They may be amended as necessary from time to time by the Board of Trustees. Amendments or revisions shall become effective as of the date of their posting to the World Wide Web site of The SETI League, Inc. ❖



SETI League Thanks Prize Donors

Nobody went home empty handed from The SETI League's first Awards Banquet, thanks to the generosity of several SETI League members, vendors, and supporting organizations. In what we hope will become a precedent to be followed at future such events, everyone attending the banquet, held April 28th in conjunction with the *SETICon01* Technical Symposium and Annual Meeting, received a door prize. We thank the donors listed below for their generosity, and urge SETI League members to favor them with your business. We also respectfully request that all prize recipients send the donor of their prize a letter or email of acknowledgment and thanks.

Our Grand Prize this year was a WiNRADiO 1550e receiver, generously contributed by WiNRADiO Communications of Australia, through SETI League member Milan Hudecek. Lesser (but still significant) prizes included:

1420 MHz Weak Signal Source
Contributed by Down East Microwave, Inc.

1420 MHz Cylindrical Feedhorn
Contributed by Radio Astronomy Supplies.

1420 MHz LHCP helix dish feed
Contributed by Olde Antenna Lab of Denver.

NOVA for Windows (2 copies)
Contributed by the author, member Mike Owen.

SETIFox for Windows (3 copies)
Contributed by the author, member Dan Fox.

ARRL Handbook for Radio Amateurs, 2001
ARRL Repeater Directory, 2000-2001 Edition
ARRL Antenna Book, 19th Edition
Contributed by the American Radio Relay League.

Sharing the Universe (2 copies)
Are We Alone? (2 copies)
Contributed by the SETI Institute.

After Contact (2 copies)
Spacefaring: The Human Dimension (2 copies)
Contributed by the author, Prof. Al Harrison.

Extraterrestrial Encyclopedia (2 copies)
Life Everywhere (2 copies)
Contributed by the author, David Darling.

Assorted SETI books
Contributed by member Alfred A. Aburto.

Assorted SETI books
Contributed by member H. Paul Shuch.

Assorted membership premiums
Contributed by The SETI League, Inc. ❖

SETICon01

Proceedings Now Available

The Proceedings of *SETICon01*, The SETI League's first Technical Symposium, have been compiled and published by the American Radio Relay League as Publication Number 270 of the Radio Amateur's Library (ISBN: 0-87259-830-6). All attendees at the April 2001 Symposium received copies of the Proceedings as part of their Symposium registration.

The following papers appear in the Proceedings:

- Welcome from the College of New Jersey (Dr. George Facas, Dean, School of Engineering)
- SETI Week Proclamation, Township of Ewing (Alfred W. Bridges, Mayor)
- A Message From Our President (Richard C. Factor, WA2IKL)
- Vision and Mission Statements
- The Giordano Bruno Memorial Award
- Preliminary Program--SETICon 01
- Greetings, Carbon-Based Bipeds! (Sir Arthur C. Clarke)
- SETI: The Amateurs Go For Pro DX (Prof. Philip Morrison, ex-W8FIS)
- Overview of the First 100 Project Argus Stations (Harry Kimball, NØTOU)
- A Third, Complementary, Microwave Search Strategy for SETI (Richard Factor, WA2IKL)
- Array2k: Sixteen Dishes, Five Designs (H. Paul Shuch, Ph.D., N6TX)
- SETI Below 1 GHz (Marko Cebokli, S57UUU)
- SETI Innovations (Prof. Allen Tough)
- Some Algorithms for Lunar Archaeology (Dr. Alexey V. Arkhipov)
- Observing the Christmas 2000 Solar Eclipse at 3.8 GHz (Bill Black, K4BSN)
- Project QUANTA: Optical SETI Monitoring & Event Recording System (Noel C. Welstead, VK4AYW)
- Near-Infrared (IR) Spectrometric Imaging Using a One-Meter Fresnel Telescope (Robert A. Lodder, WD8BTA, and Cynthia L. Banyon)
- A Hierarchy of Civilizations in the Universe (Nikiforos A. Sideris)
- Making Noise Figure/Temperature Calculations (Edward R. Cole, AL7EB)
- Radio Telescope Calculations and Measurements (Edward R. Cole, AL7EB)
- Optical SETI for Academics and Amateurs (Andrew Howard)
- Thermal Cooling of a SETI Low-Noise Amplifier Using a Solid-State Peltier-Effect Cooling Device (C. Lee Kitchens, KB9PIP)
- Earth Moon Earth Basics for the SETI Experimenter (Dr. Allen Katz, K2UYH)

Those who missed the Symposium can still obtain the Proceedings from SETI League headquarters, for $20 US postpaid to US addresses, and $25 US postpaid elsewhere. See the order form on the back page of this issue of *SearchLites*. ❖

SETI: The Amateurs Go For Pro DX

by Prof. Philip Morrison, ex-W8FIS, ex-W8NKI

By post, I recently received IAU Information Bulletin 88, recounting activities at the Manchester triennial General Assembly of the International Astronomical Union. I was pleased to read there of a grant by American sources to our own H. Paul Shuch to help establishment of a "lunar reflective calibration beacon for global coordinated radio astronomy, for use by researchers, both amateur and professional, worldwide." Here IAU serves worldwide notice to its members in 67 countries, that any interference arising from this modest 1296 MHz illumination of our moon (believed, after a careful study, to be not much of an issue) can and will be remedied through Dr. Shuch. Quiet and effective sympathy among astronomers of every nation and in every waveband is a core IAU goal for which we all are grateful. Though its founders knew only the optical sky, IAU generously welcomed the spectacular widening of sky-gazing.

SETI Leaguers propose to search for signals in pieces of frequency space over the whole surface of the celestial sphere, and have no choice but to search in time. The evident analogy to astronomy as a whole is clear. A standard test signal in relevant bands is useful indeed, and the moon is an easier target than those few distant satellite probes, which are much less easily located or scheduled. This is one more step toward the technical environment of the pros, who pursue diverse goals by constrained if powerful action.

As both an antique ham and an atypical astronomer (retired), I want to suggest a variety of tasks SETI amateurs might consider, better fitted for them than for the pros. Begin with the proposition that the spotty coverage an amateur effort provides is in itself a gain to SETI. Time is the most taxing of all the dimensions of signal space: will the good receiver and the sender's pattern meet in *time*? Directions, frequency, and intensity are easy by comparison. It is time that forces us to plan an enduring search. There is no downside to new, willing coverage of the flow of time.

The added value to our species of amateur contributions is definitely positive, but it is surely increased by adding effort to sweep corners where Arecibo and Hat Creek dishes don't often look. Even simple repetition is worthwhile during a grand search; grand lotteries are won by buying many tickets. The more powerful watchers might have been unlucky, for the time stream carries many little and fewer big fish.

Here is a suggested list of sky directions most worth looking at again and again, with a few unlikely gambles thrown in for the lucky. The presence of many possibilities in a small solid angle deserves more attention. What we are seeking is the result of long time scale. Thus very bright stars that will last only millions of years, or swift violent events of any sort, are hardly as attractive as older potential sources. Not all of those are to be caught by most star-target lists, for they may elude deeper area searches dwelling by bad luck over the wrong times.

Binary stars: The nearest sun-like star to the sun is Alpha Centauri. Its far southern declination (-61 degrees) blocks it from most northern observers. Good lists of binaries exist, optically chosen. Those with widely spaced pairs, one being sun-like in type, suggest repeated looks. The oldest deserve first attention, with late F or G V stars by spectral class.

Globular clusters: Within these the stars crowd by the hundred thousand. But, they are of a dissimilar star mix from the known recipe out here where the sun lives. Most of them are far away, down hundredfold in signal expected here from a given effective power.

Galaxies of the Local Group: The splendid unaided-eye galaxy in Andromeda called M 31 is the best in the northern skies, a faint patch of several square degrees, some 10E 11 stars at once, all in a single beam. A generation back Drake and Sagan scanned it from Arecibo for the first time; no signal. Here the transit time span is formidable. It is 2 million light years distant, a thousand times the distance to that local sphere full of stars we will comb through for years to come. No one here has proposed a good way to reach out over so long a time. How often will they scan the Milky Way, with what beam width, seeking in vain so far for an answer? How long can any species continue? A few other galaxies of the score within the Local Group are somewhat similar, but made less likely by distance and star number. The Clouds of Magellan are about 150,000 years off, small satellites to our own Milky Way, with an order of magnitude fewer stars, and reserved for southern viewers.

New stars: These do appear in galaxies, and not so rarely. We also encounter a nova every few months, a supernova every few decades. These may even offer some time marker for senders (see below), and merit attention.

Galactic Center: This lies a long way behind the constellation Scorpio, not too far south for lower northern latitudes, about 25,000 light years away. It appeals to those who favor a guess from logical principles, but not to me. The physics of star formation near there does not suggest our counterparts. But the symmetry of a source there is genuine. Possibly a remote-controlled source might have been emplaced there by *really* powerful actors as a unique target direction for all the Galaxy, though deliberate signals are hard to justify.

Exoplanets: The pros will keep an eye on the direction to every new exosun. Still, it seems irresistible to look from time to time among the fifty-odd new exosystems, once located in the growing list. That should not be difficult with the beams now prepared. You can see the very star you monitor from a dark site even by eye, perhaps using a small telescope. It takes reasonable skill and an experienced observer to pick out the right faint star among the nearby crowd of stars, unless coordinate settings are excellent.

Since 1939, I have been hoping for exoplanets. Before then, the best theorists thought -- quite wrongly -- that such systems were non-existent. From the present locally valid statistics I infer a minimum of thirty million such systems in the Milky Way, after excluding both the central bulge and the star-sparse outskirts, where the distribution of star masses is unlike the local starry mix. Note that we do not have one piece of evidence for earth-like planets around any other sun-like stars. The only planets our present method can physically detect are gas-giant planets more akin to Jupiter. By 2010 we should have examined more deeply many exosystems capable of finding Earthkind from space.

The Time Dimension -- Life on earth is about 3.8 giga-years old, though our own competent species is not much more

than 0.1 megayear old, and radio astronomy among stars is only 65 years old. Presumably, such power as interstellar communication requires a long evolutionary time. That colors all issues in SETI. The travel time for radio or optical signals to cross the entire local Group is only some 10 megayears. The time to formation of the first galaxies is about 15 gigayears, and our Milky Way is perhaps 10 gigayears old.

We long for a short-time subdividing marker, a natural time signal perceptible widely over the Galaxy, to help synchronize senders and receivers on the scale of our patience, but we know of none. Big events visible widely repeat indefinitely, though at far-spaced sites. The light of a supernova around maximum (SN type II, the core collapse sort, are most common) is a sharp time marker seen widely. However, the time of detection depends on relative position. The thin shell of peak light, weeks thick, expands out as part of a sphere into space. Anyone can see it over a good fraction of the Galaxy (and throughout all of the Milky Way using dust-penetrating infrared). The distance we would like to search initially for other astronomers, nominally one or two thousand light years, encompasses millions of stars.

Look at one SN event in more detail. Our unknown partners see a supernova at a good distance of a few thousand light years. They know from its direction that every competent observer out there along that single radius has seen the giant flash on the way in. So they can send their signal promptly straight back. Eventually, if we monitor the direction of the ray back to the source, we will hear from them - -after up to a thousand years of delay. Or they may have sent their CQ both ways, one backwards and one forward along the supernova ray. Some day we would get both signals together, after an average of a millennium. But how unlikely that the three events, a supernova, the ETI transmission, and our receivers sit on a single straight line!

The correlation can in fact be extended sideways, but not very far. For we don't know what supernova is the one they are marking; others will explode every so often in different places. One can calculate out the ellipsoidal locus of points that will get both star and radio signal at nearly the same time. But we can only do this over a narrow region. So, not much spatial volume searched for so rare an event, even allowing for the fuzz due to the width of the radio beam. (In school, we learned to draw an ellipse as the locus of a point that remains at the fixed sum of its distances from two points, the foci. A circle is a special case of the ellipse: the locus of distance from two foci that occupy a single point, the center.) Distance frustrates quick results. We have found no easy way to use a natural signal to significantly shorten the search time.

Time on the starry scale is not like time on earth. It does minutely depend on position here on Earth. Witness GPS, turning the problem around. But GPS time works through synchronized clocks. Absent the interaction provided by actual contact, space-time is not synchronized. All events float down time's unending stream, but that dimension, as far as we know, bears no universal marks of its own.

The best we can do is multiply efforts towards a sweeping search, for a century or more, unless we much reduce the expected mean distance to another IAU -- hardly likely. SETI is a multiple effort, much like that of a group of friends who band together to win a lottery. Sooner or later, the signal we seek may appear. Repeated listening pays dividends. ❖

OTA (summarizing on-the-air Ham Radio activities)

Moonbounce Report

As mentioned elsewhere in this issue, The SETI League's Lunar Reflective Calibration Beacon became operational in early March 2001. Since achieving First Light, our modest microwave transmitter has been operating continuously, whenever the Moon is above the horizon at its northern New Jersey location. For the benefit of those members wishing to attempt reception, here are the technical specifics:

Location: Grid Square FN20tp; Kinnelon NJ USA
(Lat=40.99306, Lon=-74.37111)

Transmitter: currently 20 watts output on 1296.000 MHz
(with a planned increase to 100 Watts later in the year).

Frequency Accuracy: better than +- 2 Hz.

Feedline: 20 meters of 7/8 inch Heliax (estimated loss 3 dB).

Antenna: quad helix array, RHCP uplink; gain +24 dBic.

EIRP: estimated at +64 dBm.

Path Loss: nominally 245 dB, including round-trip free space isotropic propagation and lunar reflective losses.

Incident Isotropic Power: -181 dBm nominal.

Sensitivity of typical Project Argus station: -197 dBm
(assumes 12-foot dish, illumination efficiency 50%;
100 K system noise temperature, 10 Hz bin width DSP).

Potential Signal-to-Noise Ratio: +16 dB (!)
(assumes perfect Moon tracking, and Doppler compensation during integration).

April QSO Party

This year's SETI League Ham Radio QSO Party was pretty much a bust, with most stations reporting high levels of noise and poor propagation conditions due to intense solar activity on April 21. The following comments were received from participating members:

"Hardly heard anything. I heard what sounded like an all day *talk about nothing* net running on 14.202 or 203 that bled over onto 204. I think one of our SETI stations talked to them, because I could hear someone talking about a dish and an Icom 7000 receiver but the fading was so bad that I could only hear about every 5 words of so." *WA5RAY*

"I did some calling on 14.204 from 1720-1800 UTC, but I don't think conditions were favorable. I did listen an hour later to find that the band had pretty much closed down. Later I saw a posting that there had been another solar event. That usually shuts things down up here in the auroral zone." *AL7EB*

"I monitored 20 for hours, and the other bands briefly. Never heard the word SETI even once." *WA2IKL*

"I heard W6QJL , WA9BVS , & WA3GHM. But unable to get back. I'm just running 100 watts; I guess I will have to go QRO." *VE3EYR*

"I tried all 3 frequencies 5:00 PM local Phoenix Friday for 30 minutes calling "CQ SETI" but no contact. Tried about five times Saturday until 5:00PM local, calling but no response, and did not hear any traffic." *KB9PIP*

"Listened every hour or so on all three frequencies --- condx really terrible here on the west coast. Heard several stations calling CQ SETI, but didn't call --- temporary lost my voice from bad cold! Solar Flux 135, A index 8, K index 3 at 2118Z. Better luck next year!" *W6QJI*

Next year's QSO Party is again scheduled for April 21. ❖

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