



SearchLites

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UNESCO and SETI

by Kathryn Denning and Elisabeth Piotelat

In planning for an upcoming SETI conference in Paris, members of the International Academy of Astronautics have recently sought sponsorship and sanction from UNESCO, the United Nations Educational, Scientific, and Cultural Organisation. The logical question raised is, how does SETI fit within UNESCO's charter and worldview?

Given that UNESCO's ultimate purpose is "to build peace in the minds of men" via education, science, culture, and communication, and that it is concerned with global thinking, and "the universal heritage of humanity":

- SETI fits well because it is inherently international/global in scope, encourages big-picture thinking about our planet, encourages international cooperation, requires profoundly cross-cultural thinking, and provides an arena for debates about the Earth's future, and discussions about multivocality ('who speaks for Earth?')

- Key debates in SETI today (about Active SETI in particular) are precisely on the subject of "universal agreements on emerging ethical issues", which is a UNESCO mandate.

UNESCO's constitution supports "the unrestricted pursuit of objective truth" and "the free exchange of ideas and knowledge." Any proposed SETI conference would certainly pursue similar goals.

A few years ago, the SETI@home distributed computing experiment proved itself a good tool "to build peace in the minds of men." The early adopters who installed SETI@home on their personal computers in May, 1999 were mostly young boys who downloaded it as a game. Their main objective was to get a higher peak, or to appear in the listings. They saw strange words such as "fast Fourier transform" and "Gaussian," but few of them wondered about their meanings. On SETI League email lists, the typical questions posted were "how can I increase the speed of my computer?" and "I have found such a peak; is it *the* signal?"

After a few months, those discussions began to take on a different tone. SETI@home users spoke about philosophy, science, and so on. Users began inquiring who Gauss and Fourier were. We were treated to some "café des sciences" about life in the universe, and some SETI@home users began to attend scientific lectures.

Today, SETI@home software has been replaced by an expanded version, BOINC, the Berkeley Open Infrastructure for Networked Computing. BOINC users can choose the project to which they care to donate computer cycles. SETI@home remains a favourite among French speaking people, but many of them have also downloaded the MalariaControl software, primarily because they saw it as a "French speaking" project, having been developed by people in Switzerland, Cameroon, Mali, etc. Thus, international cooperation, SETI-inspired!

Even if SETI@home finds no signal, it's great to see that, indirectly, it is helping humanity to fight malaria.

UNESCO, like the United Nations itself, was born in the wake of the Second World War, to facilitate understanding between nations through the best of human culture (including science). SETI is a logical extension of that mission.



Guest Editorial

Stonehenge and SETI

by Dennis Price

Surely one of the most frequently asked questions about Stonehenge is: what was it used for when it was first built? Is there one way in which we can describe an original function of these mesmerising ruins with confidence? Furthermore, would this be a description that the visionary and engineering geniuses who built Stonehenge would agree with, if we were able to have a conversation with them? In my opinion, the answer is yes.

One of my favourite observations on Stonehenge was made by Sir Arthur C. Clarke, who once wrote, "Only one thing can be stated with certainty about such structures as Stonehenge: the people who built them were much more intelligent than many who have written books about them." I entirely concur with this observation about the intelligence of the builders of Stonehenge, but I believe that it's possible to state at least one other uncomfortable truth about Stonehenge.

In a discussion with the archaeologist Professor Vance Tiede, the late astronomer Gerald Hawkins spoke of Stonehenge in the following terms: "There seems to be no practical value in what was going on at Stonehenge. One does not need Stonehenge to know when to plant seeds or when to breed cattle. Perhaps part of the purpose might have been for the handmaiden of astronomy - astrology."

Astronomy has grown out of astrology, though we may hate to face that fact. Uncanny powers were placed on celestial objects, and predictions were made which directly related, whether they came true or not, to human lives and events. There may have been some prognostication at Stonehenge.

I could quote examples at great length, but there's no doubt whatsoever about the fascination that the night sky held for our ancestors who built Stonehenge. All the evidence I've seen, and all the eminent sources I've researched, speak of our ancestors gazing at the heavens and fervently calling out to the black void in an attempt to make contact with sentient beings in the form of gods, spirits and ancestors. At the same time, they were trying to make sense of the Earth and Sky around, beneath and above them, all the while wondering at the true nature of striking phenomena such as comets, shooting stars and other visitors from the depths of space.

In other words, if Stonehenge was anything, it was a place where our ancestors undertook a prolonged search for extra-terrestrial intelligence, whether you define intelligence as information that we glean from repeated observation, or whether you regard it as any form of sentient existence in the gulf of space beyond this world.

Of course, the term "the search for extra-terrestrial intelligence" immediately conveys images of visiting alien spacecraft or of distant civilisations on worlds orbiting other stars, which is probably why no other archaeologist would dream of using such a description of Stonehenge, but is a highly accurate one nonetheless. In exactly the same vein, no one argues with highly evocative but entirely appropriate terms like "The Pillars of Creation" to describe distant cosmic wonders such as those captured by the Hubble Space Telescope.

Our modern SETI programme began life in 1960, using an increasingly sophisticated array of technology to scan the heavens for signs of intelligent life elsewhere, whereas the people who built Stonehenge used the naked eye to seek out supernatural entities such as gods and stellified ancestors, as well as omens like inverted rainbows, portents, harbingers and a meaningful design behind the celestial bodies and phenomena they observed. To my mind, given the gap of 5,000 years or so between the two sets of "watchers of the skies", the two activities are virtually indistinguishable.

The late Carl Sagan frequently emphasised the need for a scrupulous examination of the facts, and rightly so. The description of Stonehenge as a manmade structure where our ancestors searched the skies for signs of extra-terrestrial intelligence or non-human entities had long seemed a blindingly obvious one to me, but rather than run the risk of persisting in a delusion, I decided to get a second opinion.

The Vatican has an observatory in Arizona that regularly organises international conferences on astronomy. While the staff at the Vatican Observatory are self-evidently men of profound religious beliefs, they also possess extensive qualifications in their chosen field, so I thought that this combination of learning, experience, science, religion and highly disciplined thinking would be the sternest possible test of my ability to make a convincing case for Stonehenge to be defined or classified as an early SETI structure.

I wrote to Christopher J Corbally, the Vice President of the Vatican Observatory and a man with an impressive list of qualifications that includes a Bachelor of Science degree in Physics with Honours, a Master of Science in Astronomy, a Doctorate in Astronomy and a Bachelor's Degree in Theology with Honours, in addition to the various posts he's held, such as Dean of the Vatican Observatory Summer School.

I pointed Chris toward my website, as well as inviting him to make whatever enquiries about me he chose to, on the internet and elsewhere, and he was good enough to find the time to reply. As the time period under discussion is prehistory, a period without written records, he naturally qualified what he had to say by pointing out that "this is speculation, based on a sense that humans have been asking the same kind of questions over the ages, even though our scientific tools have changed".

I wouldn't expect anyone applying themselves to a serious consideration of this matter to ignore the aspect of a lack of written records, but Chris also wrote "I think that you are correct in thinking those people who built Stonehenge would have pondered about life, and intelligent life, elsewhere."

When I presented my case to Chris, he observed, "From the Greek Atomists on (and no doubt before them), it seems that anyone who thought that our Earth was not unique would have entertained ideas about extraterrestrial life."

Does the classification of Stonehenge as Britain's earliest manmade SETI structure conflict with any other strongly held views about the place? On the contrary - to my mind, it complements them all.

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Ask Dr. SETI ®

Black Holes and FTL

Dear Dr. SETI:

In your response to an interested party's question on the attainability/feasibility of the speed of light, you mentioned "not one shred of verifiable evidence" of anything traveling faster than the speed of light. What about a black hole? Would not anything that crosses the Event Horizon be doing exactly that (traveling faster than light)? Could a gravity-assist maneuver propel a spacecraft to such a speed?

Portland Reader

The Doctor Responds:

An interesting question, dear reader. First off, I must stipulate that black holes are a little outside of my personal experience. I expect the same is true for you (even in Portland).

That said, it is my understanding (which is admittedly limited) that the immense gravity well represented by a black hole warps spacetime. Such distortions will have effects upon electromagnetic radiation which can only be described as wierd. It may appear that the 'c' limit is violated. On the other hand, if it is space that is distorted, rather than velocity, it's hard to say whether an *apparent* acceleration is genuine or illusory. And if it is time that is distorted, it becomes equally difficult to discern velocity when viewing the event from within an inertial reference plane. So, no, I would have to say that, at least from the perspective of viewers outside the event horizon, the 'c' limit is preserved.

But, what about what happens *inside* the event horizon? Could not a particle sucked into a black hole attain superluminal velocity? I am willing to concede the possibility, although how we will ever verify or refute that hypothesis without being sucked into the black hole ourselves is beyond me.

As I read it, the thrust (that sounds more dynamic than 'gist,' doesn't it?) of your argument deals with accelerating spacecraft (a practical application involving harnessing the black hole's gravity gradient in some way). I would speculate that, as long as the event horizon is not breached, the universal speed limit would be preserved for any gravity assist maneuver. Once inside the event horizon, any object which is accelerated beyond c will cease to exist, from our vantage point. I find it hard to imagine how we could harness this effect in any practical way.

But, what do I know? Not only have I never actually seen a black hole, I'm not even a real doctor...

Shouldn't Earth Temperature Dominate?

Dear Dr. SETI:

Say I have an antenna consisting of a parabolic dish reflector, which is pointed away from the earth. Imagine I have

a low noise amplifier, say 30K, and the signals from space are reflected from the parabolic dish into a feedhorn, and then into the preamp and receiver. Why doesn't my receiver see the 273 K temperature of the reflector, instead of the low temperature in space (plus atmospheric noise)?

David (via email)

The Doctor Responds:

That's a very illuminating question, David. ;-)

A properly designed, well fed parabolic reflector acts as a thermal mirror, rather than a thermal blackbody. Let's answer by way of an analogy involving colors. Imagine a perfect, flat optical mirror that's shiny silver in color, lying on the green grass, and pointing up at blue sky. Now, look into the mirror, and what color do you see? Blue sky reflected back to you, of course, not the green of the grass or the silver of the surface.

Perfectly illuminated parabolic reflectors do something similar to color temperatures. Only, they're not ideal reflectors (because their surfaces are imperfect), nor are they perfectly illuminated. So, the system temperature you actually see is a combination of mostly sky temperature, a little noise contribution from the reflector surface (due to its imprecision), and a little noise contribution from the Earth (due to spillover, or over-illumination). Both the ground and the dish temperature contributions are (as you might expect) worse for a mesh dish than they are for a solid one. But, unless you've done a miserable job with your reflector or feed designs, sky noise will clearly dominate.

NASA Deep Space Network SETI Beacons

Dear Dr. SETI:

I recently acquired an LNA and PLL LO for reception at 8.4 GHz (the NASA Deep Space network frequency band) using my 4.9m dish. How about that as a potential SETI frequency, as extraterrestrials might pick up signals from our various spacecraft?

Ed, Alaska

The Doctor Responds:

We're always in search of interesting "magic frequencies," Ed. X-band is certainly a good part of the spectrum to monitor for intelligently generated extraterrestrial signals, and the equipment you describe could well be used for SETI, as well as for monitoring our various space probes. And, trying to second-guess ETI as to the frequencies on which they might be transmitting could well prove productive. But, do I expect ETI to be able to detect the downlinks from our space probes? Not really.

Spacecraft power budgets are extremely limited, so the downlinks use the lowest possible transmitter power, with high-gain antennas pointed back toward Earth to make up the link margin. I highly doubt that these signals can be detected over interstellar distances. Thus, listening on those frequencies

for extraterrestrial replies to our spacecraft would probably be an exercise in futility.

On the other hand, those same spacecraft receive uplink telecommands from Earth, and the NASA Deep Space Network uses very powerful transmitters to send those commands. Some of those uplink signals are also in X-band, in the vicinity of 8.6 GHz, and it is conceivable that they are powerful enough to be detected by advanced extraterrestrial SETI scientists. So, on the offchance that ETI might reply on the same frequency it receives, it certainly couldn't hurt to monitor the DSN uplink frequencies, at least occasionally.

Dark Matter Frequencies

Dear Dr. SETI:

From what I've read, you are searching for a signal using the natural frequency of Hydrogen at 1420MHz, since that is most abundant element in the Universe, and therefore a likely transmission frequency for a signal. However, according to the latest theories of Dark Matter and Dark Energy, it appears that baryonic matter constitutes only 4% of the known Universe. This implies that there must be more abundant substances than Hydrogen atoms, yet to be discovered.

By extension of the logic of searching for signals on the natural frequency on the most abundant substance in space: if that substance is not Hydrogen, but rather the main constituent particle of Dark Matter, would it be feasible to search for signals on this new (sub-atomic) particle's natural frequency, as a more likely source of transmission than Hydrogen?

Grant (Australia)

The Doctor Responds:

Your logic is unassailable, Grant. But, there is a problem:

Dark matter is, by its very nature, a mystery. It is invisible to us. We can only infer its existence by its apparent interaction with baryonic matter. We don't know exactly what it is. Therefore, we don't know what its emission frequencies might be. In fact, we don't even know if it emits at all (if it did, after all, then it wouldn't be dark matter!) So, at what frequency do we search, for signals aligned with invisible emissions from unknown substances? We just don't know!

Baryonic matter, on the other hand, is visible to us, in the radio spectrum, by the emission lines related to its various atomic transitions. We presume that it is visible to our cosmic companions as well, and that they too can observe its various emission lines. Thus, baryonic matter (such as Hydrogen) produces electromagnetic signposts. Trying to read invisible signs is difficult, even if you do know for sure that they exist.

The problem of calibrating upon hypothesized, invisible emissions from unknown, dark matter is analogous to searching for the so-called Zeta Waves which Philip Morrison hypothesized, as discussed in a previous column. But, when such emissions become visible to us, you can be sure we'll search in their neighborhood.

RF Absorption of Polystyrene Foam

Dear Dr. SETI:

Do you happen to know how much RF polystyrene foams will absorb at L-band frequencies? I know that most PVC materials, due to additives, are not RF transparent, but what about polystyrene foam?

Marcus, Canada

The Doctor Responds:

I can't answer that question, Marcus, but I can tell you how to find out. Cut a block of the foam in question, and put it in the microwave oven for about a minute. If it gets warm, it's absorbing RF. If it's cool to the touch, it's RF transparent. (Put a cup of water in the microwave oven with the foam block. It's supposedly not good for the magnetron to run the oven without a load.)

Marcus Reports:

I placed a chunk of standard DOW-Corning pink styrofoam insulation, in 1.5" thickness, alongside a glass of water in the microwave for 60 seconds on high-power. The water got hot, but the styrofoam stayed at ambient, except for a small section that was right next to the glass, which was just barely warmer than the rest of the chunk. I'm thinking this will be just fine for use as insulation at 21cm.

Tree Attenuation

Dear Dr. SETI:

I'm anxiously aiming my dish skyward, but it looks like there is quite a bit of shrubbery (courtesy of the Monty Python people, no doubt) and foliage in the way of parts of the dish area. At lower frequencies this wouldn't matter, but when viewing satellite TV at X/Ku band, it's a disaster. What about at L/S-band frequencies (1.4-2.3GHz)? Will trees significantly attenuate incoming signals?

Greg, Sweden

The Doctor Responds:

There are three different mechanisms at work here, Greg, all of which conspire to obstruct microwave signals when foliage is present. The most obvious of these is water attenuation. Trees are water-based lifeforms (as, in fact, are we). Their leaves are especially adept at storing water. Water molecules exhibit several different natural resonant frequencies in the microwave spectrum. When signals at these frequencies interact with water molecules, some of the photons transfer energy to the water by exciting various vibratory modes in it. If energy is transferred this way, some of it is obviously lost by the

photon stream, resulting in a reduction in signal strength. You've probably already observed this effect when viewing Ku-band satellites. Obviously, dry leaves are less deleterious than wet ones.

Another mechanism is thermal in nature. On Earth, trees are generally warm bodies, stabilized somewhere near 300 Kelvin. Planck tells us that any object warmer than absolute zero radiates a predictable blackbody spectrum. There will be thermal radiation components present at whatever frequency you tune. When radio telescopes are used as total-power radiometers, these thermal emissions look like signals, and in fact can obscure the actual signals we seek. Remember, thermal noise is just that -- *noise*, and when looking for weak signals (the name of the game for SETI), signal-to-noise *ratio* is critical. In the cold of the arctic (or even the Swedish) winter, this effect is somewhat reduced.

The third consideration with respect to foliage is physical resonances. Consider a pine needle, for example, that's exactly one-half wavelength at the frequency of an impinging signal. That needle is going to act rather like a half-wave dipole antenna, absorbing energy. At the familiar 21 cm hydrogen line, a 10.5 cm pine needle (fairly typical of the trees around my dish) is going to raise havoc with any incoming signal.

Obviously, it's best to chop down all the trees in the vicinity of your SETI dish. If this is not an option, you can only hope for dry trees, cold winters, and non-resonant leaves.



Dr. Steve Dick was keynote speaker at the 2008 technical meeting of the Society of Amateur Radio Astronomers (SARA) held recently at NRAO Green Bank WV. Steve, who is well known to the SETI community, is an astrophysicist with a Ph.D. in the history and philosophy of science, who spent 25 years at the U.S. Naval Observatory before becoming NASA's Chief Historian in 2003. Here, he poses with the Drake Equation plaque on the wall of what is now called the Drake Lounge, the room at Green Bank where Dr. Frank Drake first introduced his famous equation in 1961.



Quite a few SETI League members were in attendance at the 2008 technical meeting of the Society of Amateur Radio Astronomers (SARA) held recently at NRAO Green Bank WV. If you don't see yourself in this picture, be sure to attend next year's SARA conference, to be held at Green Bank from 28 June to 1 July, 2009.



At the July 2008 technical meeting of the Society of Amateur Radio Astronomers (SARA), held at NRAO Green Bank WV, executive director emeritus H. Paul Shuch presents The SETI League's 2008 Orville N. Greene Service Award to Tom Crowley, KT4XN. A Charter Member of The SETI League, Crowley has long served as a SETI League volunteer Regional Coordinator. He has served as President and Treasurer of SARA, a SETI League affiliate society, and participated in many SARA and SETI League meetings over the years. His efforts to bring the two organizations closer together have helped to legitimize SETI science as a respected branch of radio astronomy.



The SETI League Thanks:

The person who made the recent anonymous donation in the memory of Gary Schaefer. Your generosity is appreciated.



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.

September 22 - 26, 2008: *Searching for Life Signatures*, Paris, France, under the sponsorship of the International Academy of Astronautics SETI Permanent Study Group.

September 27, 2008: *Mid Atlantic States VHF Conference*, Blue Bell PA.

September 29 - October 3, 2008: *59th International Astronautical Congress*, Glasgow, Scotland.

October 24 - 26, 2008: *AMSAT Space Symposium*, Buckhead, GA.

February 13 - 15, 2009: Dr. SETI to be Featured Filker at *Boskone 46*, Boston, MA.

March 20 - 22, 2009: *Lunacon 2009*, Rye Brook, NY.

April 3 - 5, 2009: Dr. SETI to be Filk Guest of Honor at I-Con 28, New York City area.

April 18, 2009, 0000 UTC - 2359 UTC: Tenth annual SETI League Ham Radio QSO Party: 3.551, 7.0309, 7.2039, 14.084, 14.204, 21.306, and 28.408 MHz.

April 19, 2009: Fifteenth SETI League Annual Membership Meeting, Little Ferry NJ.

May 15 - 17, 2009: Hamvention 2009, Dayton OH.

May 22 - 25, 2009: *Balticon 43*, Hunt Valley, MD.

May 29 - 31, 2009: Rochester Hamfest, Rochester NY.

June 19 - 21, 2009: *Concertino '09*, Arlington, MA.

June 28 - July 1, 2009: *Society of Amateur Radio Astronomers Conference*, NRAO Green Bank WV.

July 23 - 25, 2009: Central States VHF Conference, St. Charles IL.

August 6 - 10, 2009: *Anticipation*, 67th World Science Fiction Convention, Montreal, Quebec Canada.

October 12 - 16, 2009: *60th International Astronautical Congress*, Daejeon, Korea.

April 17, 2010, 0000 UTC - 2359 UTC: Eleventh annual SETI League Ham Radio QSO Party: 3.551, 7.0309, 7.2039, 14.084, 14.204, 21.306, and 28.408 MHz.

June 4 - 6, 2010: Rochester Hamfest, Rochester NY.

June 2010 (dates TBA): *Society of Amateur Radio Astronomers Conference*, NRAO Green Bank WV.

August 2010 (dates TBA): *14th International EME Conference*, Dallas TX.

October 2 - 6, 2010 (proposed): *66th World Science Fiction Convention*, Melbourne Australia.

October 2010 (dates TBA): *61st International Astronautical Congress*, Prague, Czech Republic.



Arecibo Observatory Funding

by G. Warren Coleman, WD4NIT

The Arecibo Radio-Radar Observatory in Puerto Rico is facing a significant reduction in funding over the next 3 or 4 years. Originally (1) it was intended only for ionospheric research, mainly so the military could predict frequencies and paths for long range communications. It was therefore initially under the control of the U. S. Department of Defense. Through a number of innovations before and after operation began in November 1963, it has become a general purpose radio-radar observatory especially suited to planetary radar work. The transmitter furnishes one megawatt. The receivers are cooled with liquid helium. One of the first innovations included in the original design was the rotatable azimuth arm below the 900 ton platform. Antennas and later the Gregorian dome can move along the length of the arm to provide steering up to 20 degrees from vertical. The original ionospheric research required only vertical aiming.

In 1965 Arecibo established the rotation rate of Mercury at 59 days. Previously it was thought to present the same side to the Sun with an 88 day rotation and 88 day orbit. In 1968-69 radio pulses from the Crab Nebula discovered at Green Bank (WV, US) were confirmed and more precisely located by Arecibo. In 1969 the National Science Foundation assumed control from the DoD. However ionospheric research has continued as a mission element throughout the history of the observatory. In 1974 a new reflector surface and the planetary radar were installed. From 1974 to the present many observations of asteroids, comets, and planets and extra-solar system objects have been made. In 1996 the Gregorian dome was installed, which allowed correction for aberration of the spherical main reflector.

Some of the other large radio telescopes now in service (2) are: The RATAN-600 in Russia, Jodrell Bank in the U. K., and Green Bank Telescope in WV, U. S. The 576 meter RATAN-600 is a conical shaped structure that is fixed. Limited steering is provided by individual movable panels. The 76 meter Jodrell Bank and 100 meter Green Bank Telescope cover much lower angles than Arecibo, but have much smaller aperture areas also. The Arecibo primary perimeter diameter is 305 meters.

The NSF may be premature in reducing funding for Arecibo if no other similar planetary and Near Earth Object radar is available to replace it. Professional staff can not be expected to stay with a project doomed to be de-funded. I wrote to Congress to ask that they maintain Arecibo funding. You may wish to do the same. I did not mention SETI work (which is always "piggy-backed" with other principal research) because that can be done elsewhere and because many members of Congress have a very negative attitude towards SETI. Instead I emphasized the need for continued surveillance of (low probability, but deadly on collision) NEOs and the need to keep the finest planetary radar system in operation.

References:

1. Arecibo site www.arecibo-observatory.org
2. Wikipedia online encyclopedia article "radio telescopes"



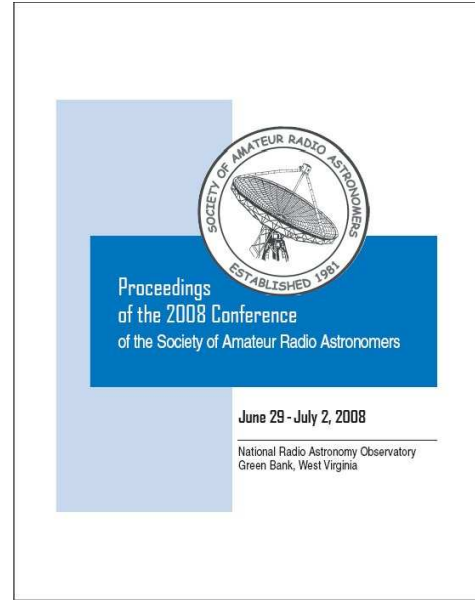
Proceedings of the 2008 Conference of the Society of Amateur Radio Astronomers

Now available from the SETI Store -- *Proceedings of the 2008 Conference of the Society of Amateur Radio Astronomers*. Many SETI League members contributed to this June 2008 Conference, hosted by our sister society, SARA. Proceedings edited by The SETI League, Published by the American Radio Relay League. ISBN 0-87259-136-0.

Suggested Contribution: \$20 postpaid in US, \$27 postpaid elsewhere.

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Radio Astronomers Offer Membership Incentive

GREEN BANK, WV., July 2008 -- At its annual technical conference held at the National Radio Astronomy Observatory, the Society of Amateur Radio Astronomers (SARA), a SETI League affiliate, has just extended an incentive for SETI League members to join its ranks. For the next year, any SETI League member choosing to secure a one-year SARA membership will enjoy full membership benefits through the group's June 2010 meeting. In addition, SETI League members joining SARA will receive a free copy of the SARA Journal CD, which includes all issues of *Radio Astronomy* published since the group's inception some 27 years ago.

At its annual membership meeting in April, the Board of Trustees of The SETI League had voted a similar membership deal for SARA members in good standing, offering a membership extension and free book for SARA members joining The SETI League at the 2008 Green Bank conference. Twelve SARA members availed themselves of this opportunity. "It's the least we can do to reciprocate," noted Tom Crowley, SARA's outgoing treasurer and incoming president. "Our interests are complementary. I belong to both organizations, and don't see why others shouldn't as well."

The Society of Amateur Radio Astronomers (SARA) is an international society of dedicated enthusiasts who teach, learn, trade technical information, and do their own observations of the radio sky. This organization is a scientific, non-profit group founded for the sole purpose of supporting amateur radio astronomy. SARA was organized in 1981, and today has hundreds of members worldwide. The group consists of optical astronomers, ham radio operators, engineers, teachers and non-technical persons. Many of their members are new to the field, and membership is extended to all who have an interest in radio astronomy. SETI League members often avail themselves of the technical information on the SARA website, radio-astronomy.org. SARA and The SETI League became mutually affiliated societies in 2002.

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Household Life Member (same address as a Life Member)	\$300
Life Member (until we make contact)	\$1,000
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Patron (priority use of The SETI League's radio telescope)	\$10,000
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Annual memberships are issued for the calendar year. Those processed in January through April expire on 31 December of that year. Those processed in September through December expire on 31 December of the *following* year. Those members joining in May through August should remit half the annual dues indicated, and will expire on 31 December of the same year.

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