



SearchLites

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The Quarterly Newsletter of The SETI League, Inc.

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When Will We Reach India?

by H. Paul Shuch, Ph.D.

When, one well may ask, will SETI succeed? We've been at this business for about a half century now, searching for radio evidence of our cosmic companions, and so far without success. Is this an open-ended enterprise, or is success in our sights?

At the SETI Institute, our friend and colleague Seth Shostak (you may know him as radio amateur N6UDK) has been grappling with this question, and he has proposed an answer. In 2004, he submitted an article to the prestigious scientific journal *Acta Astronautica* titled "When Will We Detect the Extraterrestrials?" Not one to shrink from controversy, Seth hung it all out there by proposing a definitive answer: within twenty years.

What led a respected scientist to take such a bold step, to go on record predicting SETI success within a single generation? Certainly, I'd never make such a prediction. (I, who about a dozen years ago predicted 5,000 Project ARGUS stations would be online by the year 2000 ... the actual number turned out to be -- just over a hundred ...) No, I would have counseled caution, but Seth just had to go out there and make his numbers public. Did he pull his prediction out of a hat?

Hardly. What Dr. Shostak did, what we all do, is take the measure of the problem, state a set of assumptions, and attempt a plausible extrapolation from where we are now to where we need to arrive. Based upon his assumptions about the nature of ETI (which are just as valid as anyone's), and his knowledge of technological trends (which is extensive, given his close involvement with the development of the Allen Telescope Array), he made a reasonable leap: at the rate our observational capacity is growing, if they're there and like we think they are, we should have succeeded in detecting ETI by 2025.

You can quibble about the specific assumptions, but the methodology is sound. It reminds me of the prediction Chris Columbus offered to Queen Isabella, just as he was leaving port: "If our assumptions are correct, then I should reach India in sixty days."

Of course, Columbus never reached India. Instead, he bumped into a land mass the existence of which he had no reason to anticipate, no way to predict. Unwittingly, unknowingly, Columbus discovered the New World. So I guess you'd have to call his quest a failure.

So too may the SETI enterprise end up a total failure. We may never pull that elusive radio beacon out of the aether. But, in trying, we are developing some incredible new technology, the very technology Seth considered in making his bold prediction. And nobody can say what great new discoveries that technology might enable, along the road to SETI success or failure.

I find the title of Shostak's article especially interesting, because it underscores a paradigm shift that has occurred within his and my lifetime. In SETI science's formative days, the deeply held perception in scientific circles was that life on Earth is unique. Today, the overwhelming majority of experts envision a universe teeming with intelligent life, just waiting to be discovered. It is no wonder, then, that the article in question is titled not "Will We Detect the Extraterrestrials?" but rather "When?" The existence of intelligent alien species is now accepted as a given. What remains to be determined is the When and the Where. Seth Shostak has already made a guess as to the When. So, I will now venture a prediction about Where:

We won't find them in India, but rather in some previously unknown New World.



Book Review:

Television's Pirates – Hiding Behind your Picture Tube

by Robert B. Cooper, ZL4AAA

reviewed by H. Paul Shuch

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At the May, 2006 Dayton (Ohio) Hamvention, the world's largest amateur radio convention, I had the pleasure of running into an old friend, journalist and TV technologist Bob Cooper, K6EDX/ZL4AAA. Although never a SETI League member, Bob is owed a huge debt of gratitude by those of us who repurpose surplus satellite TV dishes to our particular interest. Almost single-handedly, Bob gave birth to the industry that created our dishes. This book, his personal memoir and a history of the satellite TV revolution, is must reading for those of us who point parabolic reflectors at the stars.

"Television's Pirates" traces the development of satellite TV from the early days of cable television (Coop was himself an early cable TV system designer and operator), all the way through to today's ubiquitous half-meter offset-fed dishes feeding Direct Broadcast video to hundreds of millions of households worldwide. Along the path, he reveals inside secrets of the pirates who brought about this technological revolution, motivated by fame, fortune, and the challenge of the game. It should surprise no reader that many of the original satellite pirates are now SETI League members. But some of what happened along the road, as revealed by Coop for perhaps the first time, impresses even me (and I was there!)

During the 1970s, a handful of hams (your humble reporter included) vied for the honor of becoming the first to intercept and decode video-modulated photons from space. It's reminiscent of our present race to be the first to detect ETI, and the parallels will amaze you. One of our number (now sadly departed) early declared himself the Father of Satellite Television. Bob Cooper examines Tay Howard's claim, and makes a good case that the title rightly belongs to our very own life member and Advisory Board stalwart, Sir Arthur C. Clarke. Coop also makes public the intrigue, subterfuge, competition, and cutthroat commercialism that have led to competing claims and counter-claims, even up to the present.

On a personal note: in his book, Bob Cooper generously helps me to secure my own small place in Satellite TV history. Most of his facts are accurate. Most of his words are eloquent (even those that are unfortunately misspelled, due in part to this publication having been rushed to market without the benefit of proofreading). Most of his recollections are clouded by Coop's peculiar brand of selective memory. And most of his pages are so engaging that you won't want to put the book down until you have devoured them. All 928 of them.



Ask Dr. SETI:

Lifetime of Brown Dwarfs

Dear Dr. SETI:

Margaret Turnbull of the Carnegie Institution of Washington. recently published a list of the top 100 stars most likely to harbor life. The stars were chosen based on a number of criteria, including size, composition, age and color, that would make them similar to the sun and enable planets resembling Earth to orbit them. But brown dwarfs have even a longer time available to evolve life, right? Could you comment on why brown dwarfs are apparently not listed as likely to harbor planets with life? I thought they were.

Dick H. (via email)

The Doctor Responds:

From your question, Dick, it is apparent that you have an excellent understanding of stellar evolution and diversity, and hence, probably already have formed your own opinion as to an answer. Considering how much is presently known about extra-solar life (practically nothing), your answer (whatever it might be) is certainly no less likely than anybody else's!

One reason that brown dwarfs do not appear in Turnbull's list of SETI candidate stars is that we have catalogued so few of them. Their very existence was first postulated only in the 1970s, and since the first confirmed brown dwarf detection in 1995, we have detected only a handful of these elusive neighbors. Thus, given the hundreds of billions of stars in our Galaxy, it is hardly surprising that no brown dwarfs have made the "top 100" list. Still, speculation abounds as to whether brown dwarfs in general (as opposed to any specific brown dwarf in particular) might warm a companion planet long enough to nurture life. See, for example:

Andreyeschchev, A. and Scalo, J. "Duration and Habitability of Brown Dwarf Planets." Bioastronomy 2002: Great Barrier Reef Conference Proceedings (2002)

It is my understanding that, unlike most stars, brown dwarfs are scarcely warmer than hot planets, with surface temperatures on the order of 1000 K. It is unclear whether such low temperatures can warm a planet sufficiently for the development of life. Further, although the lifetime of a brown dwarf may indeed be greater than that of a typical sun, the period of its radiant output may be very short indeed. It has been suggested that once they use up their meager supply of deuterium (perhaps in as little as 10 million years), they fade to black. So, with respect to sustaining life, their *useful* period may be far shorter than their *functional* lifetimes.

Of course, Turnbull's candidate list (and others like it) are a useful tool for Targeted SETI, searches that concentrate on known stars. But, since there are far more stars than there are known candidates, SETI science embraces a second strategy, the All Sky Survey, in parallel with the targeted search. A sky survey could indeed turn up life in the neighborhood of a brown dwarf, the existence of which is not even known to us!

Whether or not brown dwarfs warm good life-sites, they are important to SETI science for an entirely different reason: their very existence was first postulated (and their name

coined) by a young grad student at the University of California, Berkeley, as part of her doctoral research. That student, Jill Tarter, went on to become one of the world's most visible, passionate, and respected SETI proponents. So, for Jill's sake, I hope your hypothesis has merit!

Size of Nanobacteria

Dear Dr. SETI:

This question should actually go "Dr. Astrobiology", but I couldn't locate any such website. For that reason I'll take a chance and ask you:

are the purported microbes found on mars meteorite ALH 84001 smaller than any similarly shaped organisms found here on Earth? I've heard the argument that the "worm-like" fossils found in ALH 84001 are too small to be living organisms. Is that true? If the "wormlike" objects in ALH 84001 are not micro fossils, what else could they be? Are there non-organic objects on earth that resemble these Martian structures? Finally, assuming that rocks from the surface of Earth have found their way to the surface of Mars, is it possible that primitive Earth organisms could have survived the trip?

Robert (submitted via The SETI League website)

The Doctor Responds:

First off, please remember that SETI can be considered a sub-branch of Astrobiology. At one time, the acronym SETI was thought to encompass all scientific research into life in the Universe. Then, the political winds blew foul, and SETI became a four-letter word. Eventually, NASA had to excise the term entirely from its various missions, lest it run afoul of the budgetary watchdogs. The recent popularity (in NASA circles, at least) of the new label, Astrobiology, is a reflection of pragmatic thinking within the agency. If anyone is to lay claim to the Dr. Astrobiology monicker, it should be somebody within the NASA Astrobiology Institute. But, I am not affiliated with NASA; hence it is still safe for me to designate myself Dr. SETI!

Now, on to your question. The assertion you cite was certainly believed to be true, Robert, at the time the structures in ALH 84001 were first announced. In fact, the size issue was one of the strongest arguments against these artifacts being biological in nature. Shortly after NASA made its big-splash announcement, however, nanobacteria of similar size were discovered on Earth, apparently giving some credence to claims that these structures were fossilized microorganisms.

Unfortunately for astrobiology, other arguments against the microfossil hypothesis have since surfaced, and they are compelling. So, the jury is still out as to the true nature of these structures. If they do indeed represent crude, unicellular life, then the theories of panspermia articulated by Hoyle, Wickramasinge, and others gain added strength. But if the ALH 84001 evidence is refuted, this in no way refutes the theory of interstellar panspermia -- it merely means we will have to look elsewhere for direct physical evidence.

The detractors suggest that the structures found in the meteorite could be inorganic byproducts of some chemical proc-

ess. But, to my knowledge, no similar structures have been observed on Earth, originating from inorganic processes. And yes, of course, exchange of biological material from Earth to Mars is theoretically possible. But the trip from Earth to Mars is "uphill", while that from Mars to Earth is "downhill". That is, the energy required to carry ejecta mass from Earth to Mars is considerably greater than the opposite direction. Thus, I consider it more likely for life to have originated on Mars and spread to Earth than vice-versa.

Bear in mind, however, that these are merely my opinions, and not necessarily authoritative. After all, I am *not* "Dr. Astrobiology"!

What Were They Covering Up at Roswell?

Dear Dr. SETI:

I'm still trying to figure out exactly what the Government was trying to cover up at Roswell. How can our (wonderful, trustworthy) United States Government have so many different "official" explanations over the years to this one, single event?

John A., Missoula, MT

The Doctor Responds:

First off, what follows is only my opinion. I do not represent the United States government (except to the extent that I pay taxes to it). I was not in Roswell at the time, and had I been, I would have still been a toddler in diapers, not much able to sort out any nefarious doings that might have been going on. And, your opinion is probably worth as much as mine. That said, here goes:

It's clear enough to me that the US government was definitely covering *something* up (their ultra-secret test firings in New Mexico of captured German A-4 rockets, most likely). After all, we now know that such missiles were shipped to New Mexico from Penamunde at the end of the Second World War. At the time, this was a closely guarded secret.

One fact that's no secret at all: things sometimes go wrong with test launches. Clearly, *something* fell to the ground on a sheep farm near Roswell, the night of 3 July 1947. There were many witnesses, and it was reported widely in the press. But what was it?

Now the story gets interesting. First, the government let slip, "we've recovered part of an alien space ship." *Then*, they retracted that story, said "it was a weather balloon" (which it clearly *wasn't*), and "we never said it was an alien spacecraft!" So, of course, through all that denial, they convinced most folk that it really *was* an alien spacecraft after all -- wonderful cover for what they were **really** doing (and they never even had to deny that they were firing German missiles. In fact, that was the farthest thing from folks' minds.) This is what I call the Red, White, and Blue Herring hypothesis. Conclude whatever you will.

Alien spacecraft crashed at Roswell? Alien bodies kept on ice? Massive government cover-up, to "protect" us from the truth? As a SETI proponent, I'd like to believe it. Unfortunately (or fortunately, depending upon your perspective), the evidence just doesn't add up. ❖

Is SETI a Religion?

by Dr. David Darling

Is SETI — the Search for Extraterrestrial Intelligence — a religion? This is one of the topics that Jill Tarter, Director of the Center for SETI Research at the SETI Institute, and I discussed on "Are We Alone?", the SETI Institute's weekly radio program on Wednesday May 17.

The discussion by Jill and I was in response to a claim made by George Basalla (professor emeritus of history at the University of Delaware) in his book *Civilized Life in the Universe* (Oxford University Press: 2006) that SETI is more of a faith-based enterprise than a genuine science. He points to SETI's failure to make "contact" after more than forty years of trying and its continuing efforts in the absence of any positive evidence as a sign that it relies more on a kind of religious zeal than anything else. (Incidentally, Basalla was invited to appear on the show but declined.)

Needless to say, Jill Tarter is less than impressed by this argument, as indeed am I. Firstly we know that there's intelligence in the universe. As I pointed out on the show there are dolphins and great apes. And you might even throw *Homo sapiens* into that mix on the rare occasions when we live up to our self-proclaimed species name. It isn't an unreasonable hypothesis that if intelligence has come about on one planet that it may also have arisen elsewhere, especially given the vast number of stars in this and other galaxies. SETI serves as a test of that hypothesis. But beyond that it's one of our noblest and most exciting scientific quests: to discover if we are alone and represent the high-water mark of intelligence and technology in the cosmos or, alternatively, if we're simply one member of a community of minded races, many of them perhaps vastly more ancient and advanced than ourselves.

Religions are characterized by two factors: worship—in other words, some system of devotion directed toward one or more omniscient and supranatural beings—and faith in the absence of material evidence. SETI qualifies as a religion on neither of these counts. Unless I'm very much mistaken no SETI researcher offers prayers to the subject of his or her quest (although it would be fascinating to know what spiritual traditions might have grown up among the civilizations of other stars). And any faith that's involved in SETI is only the kind of non-religious "faith" that any scientist adheres to—faith in the scientific method, the equipment she uses, the all-important peer review process, and so on. As I've mentioned, we already have material evidence for intelligence in the universe: it consists of the brains you're using right now to assimilate these thoughts. Unlike a religion which relies on pure faith that a god exists, we don't need faith that intelligence and technology exist.

To address Basalla's argument, that it's time for SETI advocates to lower their expectations and even admit they may be on a wild goose chase, I'd like to point to a parallel with the search for extrasolar planets - worlds that are in orbit around other stars. Until quite recently we had no evidence for planets beyond our own solar system; it was simply a hypothesis, like the hypothesis that there may be ETI. The practical search for extrasolar worlds kicked off back in the 1930s with the pioneering work of the Dutch-American astronomer Peter Van der Kamp. Although he collected data that seemed to suggest there were worlds in orbit around Barnard's Star and a few

other nearby stars, this evidence proved to be unfounded (some of it due to tiny systematic wobbles in the telescope he was using). Only in the 1990s, sixty years after Van der Kamp began his investigations, did scientists find conclusive proof that there are other planets out there. Over the past decade or so, more than 180 extrasolar planets have been found.

If we were to follow Basalla's line of reasoning, the search for extrasolar planets also qualifies as a kind of religion. Shouldn't we simply have given up after four decades of looking? Surely that's enough time to have found something if it really existed? Isn't continuing beyond that a sign of misplaced faith and over-optimism? Fortunately the quest did go on and we're now reaping the rewards—new planets by the bucket-load.

Historically, the question of whether extrasolar planets existed and, if they did, how common they were and what they might be like, finds an interesting parallel with the central issues in SETI. There used to be two big theories about the origin of the planets in the solar system. One of these was called the catastrophic hypothesis.

It suggested that the planets had formed in the aftermath of a near collision between the Sun and another star from a swathe of gas ripped out of the Sun by the stellar intruder. If this were the case then planetary systems could be expected to be very rare because such close encounters between stars almost never happen. The rival theory of planet formation was the nebular hypothesis which argued that the planets of the solar system coalesced from a cloud of gas and dust left over from when the Sun was formed. The nebular hypothesis suggested that the birth of planets might be a routine business throughout the universe. Of course, this is the theory, in updated form, that astronomers believe in today and the discovery of numerous other planets is good confirmation of it.

The parallel debate going on in SETI and astrobiology concerns how often primitive life, such as bacteria, serves as the precursor of complex, multicellular life, and, ultimately, advanced intelligence. Supporters of the "Rare Earth" hypothesis think that it happens only very, very rarely. Others, including myself, think that intelligence offers a big survival advantage and that it will come about whenever it's given a reasonable chance. SETI is a first step towards resolving this issue. But it still has a very long way to go. Forecasting how intelligence will evolve is a hazardous business. We don't have much to go on. What we do know is that as soon as high technology takes hold, evolution is fantastically rapid and virtually unpredictable. Does anyone have a clue how the Internet or genetic engineering are going to develop over the next 10, 20, or 50 years? How about the next million years?

SETI researchers know their limitations. They're restricted at present to searching for radio and optical signals—our own best, fastest means of getting messages across interstellar distance. Who knows what our galactic elders, if they exist, may be using to communicate with? We have no idea what is out there or what forms alien intelligence may take. We are, as Seth Shostak pointed out during the radio interview, like Columbus sailing into uncharted waters. We don't know what we'll find. But the quest is extraordinary, exciting, abundantly worthwhile, and true to the methodology and spirit of science.

This editorial first appeared on space.com, and is used here by the kind permission of the author. ❖

Guest Editorial:

Past - Present - Future

by Dr. Alexander Zaitsev, IRE (alzaitsev @ yahoo.com)

*There is only a moment between past and future,
Just it is called the Life.*

Leonid Derbenev, Russian poet.

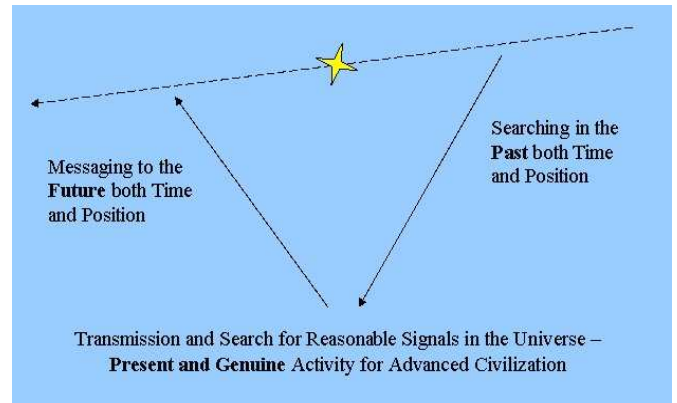
SETI, the quest for reasonable signals from Space, is aimed at the Past. We are really searching for signals that were sent to us (if any actually were) many, many years ago. Thus, we often search in the location where known exoplanets *were* at the time they transmitted toward us. In fact, the starry sky, as observed by us, is an image of the past, in the sense that we see celestial objects there where they were when they emitted the light now reaching the Earth. At present, each celestial body observed by us is actually in a slightly different place. This slight difference is related to PM, the proper motion of the celestial body, and is defined as the product of PM [in arc sec per year] times distance D [in Light Years] to the given body.

In contrast, any transmission of signals from Earth for reception by extraterrestrial civilizations (known as METI - Messaging to Extra-Terrestrial Intelligence) is directed toward the Future - our addressees will discover our messages (if they actually do discover them) only many, many years later, and in a location not where they are now, but where they *will be* at the moment our signals arrive. It is necessary to consider, when transmitting a directing a beam, that the target star will have moved slightly, between "now" and "then." This is similar to the proper motion considered for SETI, but with an opposite sign.

From here on Earth, we can say with good reason that conducting both searches (SETI) and transmission (METI) of reasonable signals, we appear poised just halfway between the Past and the Future: namely, in the Present! It is rather indicative of our place in time that in the Russian language, the concept "*nastoiashchee*" has two distinct meanings: it denotes "present," and "genuine."

An advanced civilization, terrestrial or extraterrestrial, may at some point attain such a high level of intellectual and technological development that it starts to feel the need to engage in both searches (SETI) and transmission (METI). The latter can be thought of as a purely messianic, unselfish activity, seeking to help our neighbors learn, that they are not alone in the boundless Universe. Such a socially mature civilization is worthy to be called "genuine." In implementing both SETI and METI, this civilization appears poised equidistant between the Past and Future, namely in the Present. Acting altruistically, unselfishly, not expecting any momentary benefits, caring only to enrich the existence of Others, such a civilization is engaged a worthy, genuine deed!

The figure below illustrates the concept of "Past - Present - Future."



Consider OSETI, in which an optical system for transmitting and searching for reasonable signals in the Universe consists of lenses or reflectors for focusing either a beam of the powerful laser (during transmission), or radiation coming in from space (when searching). Accounting for the proper motion of a celestial body must be carried out at both ends! In the "Search" mode, we direct a telescope at the visible ("previous") position of the transmitting celestial body, and in the "Transmission" mode we enter a correction by pointing so as to hit where our target will be during the moment our signal arrives. It is interesting to note that our correction when transmitting is thus *twice* the product of PM and D.

In the case of transmission of radio signals, all of the above mentioned considerations will hold, except perhaps for the necessity to re-aim the antenna between the "Transmission" and "Search" modes. Consider that the beamwidth of even the largest radio antennas will be significantly larger than the angle of correction on antenna pointing. Therefore, the radio antenna can be directed continuously "on the center," that is, toward that point of space midway between "Past" and "Future," where there is actually a celestial body *now* ("at Present").

In the XVII century, French philosopher Blaise Pascal shared this emotional insight: "Eternal silence of these infinite spaces horrifies me!" The mature planetary consciousness, having felt as Pascal did, and having realized that this silence frightens not only us, but also all who inhabit the Universe, comes to an understanding that its mission is to contribute whatever it can to overcoming the silence of Space.

This editorial was submitted in response to Their Past, Our Future, by SETI League executive director emeritus H. Paul Shuch (SearchLites, Vol. 12, No. 2, Spring 2006, p. 6).

Disclaimer: The opinions expressed in editorials are those of the individual authors, and do not necessarily reflect the position of The SETI League, Inc., its Trustees, officers, Advisory Board, members, donors, or commercial sponsors.



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.

August 23 - 27, 2006: *L.A.Con IV World Science Fiction Convention*, Los Angeles, CA.

August 25 - 27, 2006: *International Astronomical Union XXVth General Assembly*, Prague, Czech Republic.

August 25 - 27, 2006: *EME Conference 2006*, Wuerzburg Germany.

September 8 - 10, 2006: *EuroSETI06*, in conjunction with the *Fourth International Congress for Radio Astronomy*, Heidelberg Germany.

October 2 - 6, 2006: *57th International Astronautical Congress*, Valencia Spain.

October 6 - 8, 2006: *AMSAT Space Symposium*, San Francisco CA.

October 20 - 22, 2006: *Microwave Update 2006*, Dayton OH.

November 17 - 19, 2006: *Philcon 2006*, Philadelphia PA.

April 21, 2007, 0000 UTC - 2359 UTC: Eighth annual SETI League Ham Radio QSO Party, 14.204, 21.306, and 28.408 MHz.

May 18 - 20, 2007: *Hamvention 2007*, Dayton OH.

June 1 - 3, 2007: *Rochester Hamfest*, Rochester NY.

June 2007 (dates TBA): *Society of Amateur Radio Astronomers Conference*, NRAO Green Bank WV.

July 26 - 29, 2007: *Central States VHF Conference*, San Antonio TX.

August 30 - September 3, 2007: *65th World Science Fiction Convention*, Yokohama Japan.

September 24 - 28, 2007: *58th International Astronautical Congress*, New Delhi, India.

May 16 - 18, 2008: *Hamvention 2008*, Dayton OH. **May 30 - June 1, 2008:** *Rochester Hamfest*, Rochester NY.

June 2008 (dates TBA): *Society of Amateur Radio Astronomers Conference*, NRAO Green Bank WV.

July 24 - 27, 2008 (Tentative): *Central States VHF Conference*, Wichita KS.

September 30 - October 4, 2008: *59th International Astronautical Congress*, Glasgow, Scotland.

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

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

June 2009 (dates TBA): *Society of Amateur Radio Astronomers Conference*, NRAO Green Bank WV.

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

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



Three SETI Myths

by Dr. Peter Backus

Observing Programs Manager, SETI Institute

Many common ideas about SETI just aren't true, but that doesn't prevent them from popping up in popular articles, blogs, books, and even movies. Here are three of my favorite fallacies about SETI.

Myth #1: The "National SETI Agency"

Remember the scene in the movie *Starman* when government officials examine a crashed spaceship? One late-arriving character, flashes a badge, says "I'm from SETI" and is immediately let through the police line. This is my favorite portrayal of a mythical "National SETI Agency;" maybe it's the badge. Sadly, far more common examples of this myth abound in most media reports on a particular SETI project. A typical such article will report that "SETI is using millions of personal computers" or "SETI opened a new search for laser signals." As a result, many people believe there is an organization called simply, "SETI" that coordinates and controls all SETI work around the world. Some people are certain that it is a semi-secret, US government organization -- basically the interstellar version of the National Security Agency.

In reality, SETI is a field of research pursued by a handful of independent groups conducting SETI projects in a few countries. World-wide, there are about 30 scientists and engineers working more or less full time in SETI. The largest SETI research group, roughly a dozen people, is at the SETI Institute. However, the SETI Institute is not the "National SETI Agency." There is no such agency or organization.

Myth #2: "All radio telescopes do SETI, all the time"

The idea of dedicated radio telescopes searching the cosmos for sign of ET has long been the persistent siren song of SETI research. In the early 1970s NASA funded a summer research study to design a system to detect interstellar signals. The study, *Project Cyclops*, produced a report outlining an ambitious system, an array of antennas and signal processing electronics that could be expanded in stages as needed over many years. Dramatic artwork showing the various stages of the project accompanied both the report and a plethora of popular articles about *Project Cyclops*, all of which used the most dramatic image showing a thousand large antennas in the desert. The artwork was so memorable that many people assume the array was built -- but it was not.

Perhaps the power of the imagery and myth it inspired also led many people to believe that all radio telescopes spend most of their time doing SETI, with occa-

sional breaks to look at a pulsar or quasar. (I once talked with a man who is convinced that the rest of radio astronomy is just the "cover story" and that we are already communicating with many civilizations.) In reality, astronomers use very little telescope time for SETI. Project Phoenix used about 5% of the time at the Arecibo Observatory (a total of 2,400 hours) during the period from September 1998 through March 2004. Ironically, while that may not sound like much, it was the largest allocation for a single project at Arecibo. Project SERENDIP optimizes its search time on the Arecibo telescope by observing the sky wherever the telescope happens to point during other research projects, but these other projects control the instrument.

SETI programs on radio telescopes are rare. The VLA (Very Large Array), used in the movie *Contact* and sometimes confused with *Cyclops*, has done only a single, very short SETI project. In Australia, a "Southern SERENDIP" program operates part of the time on the Parkes radio telescope. "SETI Italia," a group at the University of Bologna, uses a 32 meter VLBI telescope part of the time. So the actual amount of SETI observing done around the world is much, much less than most people assume, and a tiny (vanishingly small) percentage of radio astronomy observations world-wide.

Myth #3: "SETI has been listening for nearly 50 years..."

Actually, this is not really the myth — what it implies, however is. A recent book by historian George Basalla and an article by political scientist Peter Schenkle have inspired a flurry of articles about the "failure" of SETI. The argument goes as follows: SETI has been listening for nearly fifty years and hasn't discovered ET, so SETI is a failure. This conclusion is based on Myths 1 and 2 combined with many incorrect assumptions of how telescopes and signal processing systems actually work.

Since 1960, when Frank Drake searched a few radio channels in the direction of two nearby stars, about 100 independent SETI projects have carried on searches of various levels of capability, for various periods of time, and most with very limited sensitivity and frequency coverage. In aggregate, the searching has been, well, spotty. To say that SETI (Myth #1) has been listening for nearly fifty years conveys the image of continuous listening (Myth #2). The phrase "listening for ET" may evoke the SETI goal, but does not accurately describe how SETI is done. In the first *twenty years* of "listening," twenty-three targeted radio SETI projects conducted a total of *ninety days* of searching.

Assumptions hide in the verb "listen." As an analogy, consider this statement: "Pablo Picasso painted for over fifty years." Common sense tells us that Pablo put down the brush at least to eat and sleep. What are these

hidden assumptions? "Listen" automatically conveys the idea of continuous listening; after all, our ears are always listening. Our ears also hear sounds with a wide range of pitch, from a deep rumble to a high-pitched squeak, coming from any direction. We also listen to the radio and for most people, SETI means listening with radio telescopes. "Radio" is another assumption loaded word. In most locations we can easily tune in dozens of stations on a small portable radio.

So, we need to forget what we know about familiar terminology when it's applied to SETI. Telescopes are not like ears nor AM/FM radios. Radio telescopes are extremely directional. The Arecibo antenna is very sensitive to radio waves coming from one ten-millionth of the sky, the direction where it points. It is thousands of times less sensitive to signals from other directions. High tech receivers and electronics process the radio waves from a relatively small range of frequencies (the pitch in audio terms). For SETI, the prime real estate of the radio spectrum, the "microwave window," extends from roughly 1 GHz to 10 GHz and contains about 9 billion channels. Current SETI signal processing electronics can "only" process about 100 million channels at a time. This means that each sky position searched needs at least 90 observations to cover all channels. So, SETI observations are not as easy as the term "listening" implies.

There's one final incorrect assumption hidden in Myth #3: "all SETI projects are equal." The vast majority of the roughly 100 projects were very limited in frequency coverage, directions searched, and/or sensitivity. If you consider the number of stars (or sky positions) observed and the number of frequency channels searched at high sensitivity, only two projects have done a significant amount of searching. UC Berkeley's SERENDIP project (parent to SETI@Home) has searched the sky visible with the Arecibo telescope (about 30% of the entire sky) in the radio spectrum's *water hole*. In a complementary approach, the SETI Institute's Project Phoenix searched about 800 stars out to a distance of about 250 light years, covering six times as many frequency channels, with sensitivities up to ten times that of SERENDIP. And even with impressive statistics such as these, we've only scratched the surface.

New SETI projects offer deeper searching of more of the sky at more frequencies. SERENDIP is working with a new feed system at Arecibo and will get more sensitivity. The SETI Institute's SonATA (SETI on the Allen Telescope Array) will observe a million stars over an unprecedented range of frequencies at high sensitivity. The idea that we've been listening for decades is indeed a myth but the future holds promise. We are just beginning to *really* listen.

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