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From SETI to CETI

by Poul Anderson
Member, SETI League Advisory Board

Last spring, I had the pleasure of meeting with our executive director at the annual Contact conference, which is devoted to thinking about communication with extraterrestrial intelligence (CETI) and other possible interactions. That added to the enjoyment of what is always a great learning experience.

This time there was even more to learn than usual. Seth Shostak of the SETI Institute emphasized that no serious worker is listening for messages or is equipped to receive them. First must come the identification of the carrier wave. To find the presumably broadband signal accompanying the narrowband carrier, work out its encoding, and then begin to understand its meaning, will be separate and much more difficult tasks. That alone should calm fears that every crank on Earth with access to a transmitter will at once start beaming his stuff to the stars.

It seems increasingly likely that signals are the only signs of ETI we will ever find. As technology advances, it becomes more and more energy efficient. Already, while the volume of communication grows by leaps and bounds, Earth's radio brightness is diminishing. Other forms of waste radiation should also become slight, and the need for grandiose construction projects, such as Dyson spheres or Kardashev civilizations, observable by astronomers, may well never arise anywhere. Of course, this does not mean we shouldn't be on the lookout for them, just in case. Likewise for other search strategies, such as Allen Tough's posting on the Internet (http://members.aol.com/WelcomeETI). None can yet be ruled out, none will cost much, and what else might we discover along the way?

To make contact will simply be a wonderful beginning. The work of comprehension and communication will almost certainly prove long, challenging, often frustrating, and full of surprises. When humans whose societies had never before been in touch met in the Age of Discovery, they quickly mastered each other's languages. But they were human, with no significant genetic differences, and able to point to objects and perform actions. It will scarcely be like that between ETI and us.

Even with a common language and no transmission lag, understanding wouldn't come easy. This was vividly illustrated by a simulation played out at Contact. The alien team was assumed to be here on Earth and to have learned English, sort of, by listening in. They sent messages via the Net. In the context of this year's theme, the human team knew that the aliens were probably machines of some kind. There was also input from the audience. Nevertheless, at first the humans were utterly baffled, and it seemed impossible to get the simplest questions across. Although some progress was made, it was not until everybody met afterward and shared what they had in mind that matters became clear.

If ever SETI succeeds, CETI will then stretch over a period of years, decades, or quite possibly centuries. An organization dedicated to it may become something like a church, outliving nations as it carries on its magnificent mission. ❖

SETI in the Twenty-First Century

The implications of new astronomical research

By John Wells (email jlwells@home.com)

Who hasn't gazed at the distant suns populating the night sky and wondered? For as long as we humans could think, we have thought about the stars and the spectacular, mysterious vistas the heavens presented to us each night. Today, the average person staring up at the beauty of the unfolding universe, might muse about how life began, whether there is other life out there, and if other distant beings share our awareness of the larger universe. Does other life and intelligence exist among this sea of stars in which we live? Many people think so. If we think deeply about these things, we might speculate on the origin, frequency and variety of life in our galaxy. We might also ask, how rare is intelligence and what are the fates and life spans of technological civilizations.

For much of our scientific history, the answers to such questions were beyond reach and consigned to the realm of speculation and fiction. This state of affairs started to change with the publication of the first realistic strategy for a search for extraterrestrial intelligence in 1959. "Searching for Interstellar Communications," by Philip Morrison and Giuseppe Cocconi, published in *Nature*, advocated searching nearby stars for interstellar radio signals centered on the 1420Mhz part of the radio spectrum, known as the 'Water Hole." This naturally quiet part of the electromagnetic spectrum, allowed directed microwave transmissions over vast distances using modest power levels.

Around this time, Frank Drake, a radio astronomer at the NRAO (National Radio Astronomy Observatory), also began independently planning a SETI search. Drake conducted the first systematic interstellar search for microwave signals in 1960. This search, called project Ozma, targeted two nearby star systems and listened in the 1420Mhz frequency range for possible signal carriers. This seminal work was the beginning of the scientific search for other intelligences in our galaxy.

While planning the first SETI conference in 1961 at Green Bank, WV, Drake conceived of a formula that could help guide the conference agenda. This simple linear equation (which appears in detail on The SETI League website, and in *all* modern astronomy textbooks) is used to estimate the probable number of technological civilizations that might transmit radio beacons in our galaxy. For the past forty years all of the factors used in this equation were mere speculation, guesses. However, within the present decade, we should see this situation change. The Drake equation, instead of being a vehicle for speculation, promises to become a valuable tool; it will be used to determine many probabilities and to answer fundamental questions.

New technological abilities, scientific instruments and the research programs they generate, will deal with the Drake equation in a methodical way. Let's look at each of the factors that produce the result **N**, the number of communicating technological civilizations in the galaxy. Furthermore, let's project ahead ten years and try to determine what factors will be known and how accurate those estimates of the factors might be.

R* The rate of appropriate star formation is the average number of stars born each year in the galaxy. Many stars may form each year, but only a certain percentage will live long enough or can go on to become hospitable to life and evolution. Only certain stars will do, but since there are an estimated 400 billion stars in the galaxy, there will be tens of billions of candidate stars.

By 2010, using existing data and discoveries from planned space missions and instruments, this number will be known with the most certainty. Current best guess: 1.5 appropriate stars per year. Projected year 2010 error box for the value of **R*** might be +/- 1%.

Fp The fraction of those appropriate stars that have planets. Since it is believed that planetary formation is an integral part of star formation, this number should be high. Recent extrasolar planetary discoveries indicate planets are very common. Information for determining this factor is pouring in almost monthly. Already dozens of extrasolar planets have been discovered. New detection methodologies, instruments and programs are already starting to set the outside parameters for this factor. As the database grows, overall trends should become apparent. Professional expertise, theoretical models and computer simulations will add to these predictive and detection capabilities. Reasonable conjectures on the planetary systems of more distant stars and even the entire galaxy might then be possible.

Current best guess: 90% of the appropriate stars might have planets. Projected year 2010 error box for the value of **Fp** might be +/- 5%.

Ne The numbers of earthlike (terrestrial) planets per appropriate star. Planets must be in the zone around their star where liquid water can exist. This is the habitable area around a star, where at least it's possible for life to exist and where biospheres might form, thrive and persist.

Missions currently in the planning or development stages will place very sensitive instruments into space within this decade. These instruments will be able to detect terrestrial planets, and even biospheres, several tens of light years distant. By the end of the decade we hope to actually image an extrasolar planet the size of Earth from several light years away.

Current best guess: most of the appropriate stars that have planets have terrestrial planets, though we really don't know. Projected year 2010 error box for the value of **Ne** might be +/- 10%.

Fl The fraction of the above worlds that have life. This factor currently has no known value. To a large extent it depends on the nature of life. Is life an inevitable consequence of natural processes, like the progressive formation of more complex elements in stars? The creation and mixing of complex organic molecules, amino acids and even DNA precursors, have all been observed in interstellar nebula; this appears to be a common process in the universe. How common is it for this organic sludge to form life, at least carbon-based life? We do know it happened very quickly here; life arose on Earth almost from the moment it could exist.

The fecundity of life in the galaxy is a key factor in the Drake equation. **Fl** is the factor to watch in the coming decade. If life is abundant, then the probabilities of successful SETI goes way up. If life is very rare, then the odds of finding a transmitting technological civilization are extremely small.

I estimate that there are a half billion biospheres similar to Earth in the galaxy (a guess, to be sure, but my own best guess). Dividing a high-end estimate for the number of biospheres into the volume of space our galaxy occupies, results in roughly one biosphere for every 16,000 cubic light years of galactic volume. This is approximately the volume of a sphere with a radius of 16 light years. If these biospheres are randomly spaced, some, at least, should be detectable by future space-based spectroscopic analysis of extraplanetary atmospheric gases for: ratios of water vapor, free oxygen, ozone and methane, that indicate the presence of life. It is assumed the first generation of these instruments could detect the spectroscopic signature of an extrasolar biosphere over two-dozen light years distant.

Determining if other life exists at all, let alone knowing its possible frequency of occurrence, would be a monumental scientific discovery. Whenever we find new biospheres, we will use the Drake equation to reestimate the number of potential homes there might be for higher life forms in the galaxy. We should then be able to determine the factor **Fl** with even greater accuracy over time.

NASA has its gaze firmly transfixed on the quest for life. It is looking within the solar system for signs of life and is also starting to look toward the nearby star systems. Biology is a big part of NASA's future, and it's getting almost as important as astronomy. Biology and biochemistry have made major strides during the past couple of decades in understanding the basic nature and processes of life. The detection of just one extrasolar biosphere, or other life in the solar system, will found the field of exobiology and a host of others we can't even imagine yet.

Current best guess: We don't know enough about the origin of life to even guess. Projected year 2010 error box for the value of Fl might be +/- 20% if we detect other extrasolar biospheres, and an error box would be inapplicable if we detect none.

Fi The fraction of biospheres that develop intelligence. This equation factor will be one of the most difficult to determine. On Earth, with each successive dominant species, there has been a trend towards complexity and increased intelligence, over billions of years of evolution. Increased awareness leads to more flexible behaviors and diets; this has survival value in an often rapidly and frequently changing environment.

Higher intelligence could be a lucky fluke on Earth, or it could be an inevitable consequence of rapid and frequent changes in the biosphere and therefore is quite common. We know that awareness developed as a competitive adaptation to a rapidly changing environment. Intelligence might be a faster way of adapting to changes than simple awareness or genes and might be of survival value. The jury is still very much in session and awaiting evidence on the question of other intelligences.

Current best guess: We don't know enough about life or the survival value of intelligence to even guess. Projected year 2010 error box is not applicable.

Fc The fraction of intelligence hosting worlds that are communicating. SETI optimists will tell you they expect some kind of evidence within ten years. Possible results would be more forthcoming with more effort and that comes with more money. In particular, larger radio telescopes and more dedicated observing time would allow us to see further and listen longer.

Current best guess: We will know when we hear from them. Projected year 2010 error box is not applicable.

L The average length of time a transmitting technological civilization, or its progeny (machine, genetically designed, or a mix, or something else), or its transmitting artifacts, will persist, measured in years. What's the average life time of civilizations that transmit interstellar signals? This is a question that only successful contact with other civilizations can answer and even then, they might not know.

Projected year 2010 error box is not applicable. Current best guess: We don't have one and probably never will.

So, in 2010 what will the big picture look like? Will SETI pioneers be judged scientific saints or sinners? Will the detection of a nearby extrasolar biosphere, or several, have a significant impact on the pace of SETI research? Will it cause the sudden injection of billions of dollars of government money into SETI and bioastronomy research? Should the SETI community make contingency plans for a possible deluge of government funding? Should SETI researchers plan for other career goals or ways of beating off the swarms of descending media? A wave of popular interest and speculation arising out of possible discoveries could see the pendulum swing to either extreme.

Researchers want to see any funding spent wisely and efficiently. Governments, institutions and businesses put resources behind those approaches that are likely to yield results. Though they, like all of us, are swayed by natural curiosity and the desire to experience the mysterious. Governments in particular are especially moved by self-interest and the public's attitude towards such things. The discovery of a verdant, new world has been a powerful idea in our recent past and is firmly entrenched in our mythology. Will scores of pristine biospheres serve to impel humanity forward, towards the nearby stars?

Will new discoveries motivate us to spend more money on SETI in order to listen longer, harder and more often? Or will a paucity of life in the galaxy revive skepticism about SETI research.

The advent of space travel, and the ability to put sensitive instruments like infrared interferometers into space, will impact SETI research, one way or the other. If extrasolar biospheres are found anywhere within the detection range of these new astronomical instruments, it will greatly stimulate further study along many fronts, including SETI. If no biospheres are found, or if we determine there is a paucity of life in general, it will lower the ceiling on **N**, the number of possible transmitting civilizations in the galaxy. If we don't receive a signal from the stars in the first decade of this millennium, then by the end of it we will have a much better idea of what the odds will be of ever receiving such a signal. The prospect of having the ability to determine such things as the origin and abundance of life in the galaxy, a mere 50 years after beginning the serious scientific investigation, seems almost as miraculous as receiving radio signals from a civilization living around another star.

Perhaps when we look up at the night sky ten years hence, we will have fewer things to wonder about and more things to wonder at. The magnificent night sky will not be less mysterious than before, but more. Soon we may be able to look out across the sea of stars and point to nearby harbors of life. Whatever the result of this decade's SETI and life searches might be, we will gaze upon the stars more knowingly, but certainly not less reverently. ❖

Book Review:

Life On Other Worlds And How To Find It, by Stuart Clark
(Praxis Publishing, ISBN 1-85233-097-X, 2000)
Reviewed by H. Paul Shuch for _New Scientist_ magazine
(used here by permission)

Public fascination with the prospect of life in space is evidenced by the plethora of recent books on the emerging discipline of bioastronomy. I count an even dozen such volumes on my bookshelf, published within just this past year. Unique among these is Stuart Clark's recent offering, *Life On Other Worlds And How To Find It.* Rather than attempting to answer the ages-old question "Are we alone?," Clark explores what basic knowledge we must acquire before we may even ask the question.

Accessibly written for the intelligent laymen, Clark's scholarly work is sprinkled with wit, humor, and the occasional *Star Trek* cliche. Not that this detracts at all from its scientific integrity. An astronomy educator by trade, Clark has thoroughly researched all the related disciplines before describing what he concludes to be an abundance of extraterrestrial life.

But this is not a speculative work, and Clark's personal conclusions are incidental to his broader picture. He starts by reviewing the principles and assumptions underlying any search for life beyond our sphere. In so doing he invokes the writings of Carl Sagan, Paul Davies, David Blair, Christian DeDeuve, and many another respected expert, concluding that it is time to reexamine all of the assumptions underlying modern SETI. There follows a two-chapter tutorial on cosmic evolution, from the Big Bang to the formation of possible life-bearing planets, including the obligatory smattering of thermodynamics fundamentals. These introductory chapters set the stage for a lucid discussion of biology, the emergence of life, and exactly what constitutes an hospitable environment. Throughout the first half of his book, Clark paints a picture of Earth as a commonplace among the myriad of worlds in our universe.

But just because life *could* exist elsewhere is no guarantee that it *does*. To determine that, we have to do the experiment. The historical and contemporary search for such factual evidence dominates the balance of Clark's book.

In chapter seven, Clark traces the search for life within our own solar system, from the eighteenth-century furor over supposed canals on Mars, through the more recent and still controversial detection of apparent microbial fossils encased in meteorites. Exobiologists have not rejected the prospect of finding primitive life close to home, and Clark here discusses several upcoming space missions designed to test for it. Chapter eight deals with the search for extrasolar planets, the first of which were detected just five years ago. The author tells us of several space missions now on the drawing boards, which will seek to detect planets of terrestrial size and the atmospheric gasses conducive to (and perhaps even indicative of) life. Chapter nine attempts to define intelligence and explore its role in evolution and survival. SETI implies seeking out intelligent species through their detectable technology. The more prevalent is intelligence, the greater our opportunity for contact. Thus, it is here, predictably, that Clark introduces the Drake Equation.

Of this book's chapters, the tenth will be of greatest interest to fans of SETI science. Clark traces our efforts to communicate, from Gauss's proposed deforestation message, meant to signal our mathematical prowess to our lunar neighbors, to the emergence of microwave SETI, and including recent progress in the optical spectrum (although, sadly, Clark neglects mention of Stuart Kingsley's pioneering work in this emerging field). The problem of defining what constitutes proof is juxtaposed against public suspicions regarding hidden evidence and government cover-ups. Clark discusses the recent controversy surrounding active SETI, the deliberate transmission of messages from Earth, and summarizes the several contemporary radio searches (including the latest efforts of my own fledgling organization, The SETI League). One recent false alarm is cited and a dilemma acknowledged: how to announce an alien detection to a waiting world?

Clark's final chapter restates the well-worn Fermi Paradox: *Where are they?* Several explanations are offered for the lack (so far) of solid evidence as to the existence of our cosmic companions. The anthropic principle (the assertion that we are, after all is said and done, alone in the cosmos) is most effectively refuted. Clark explores such diverse but related topics as fusion rockets, solar sails, matter-antimatter reaction engines, lunar mining, self-replicating Van Neumann probes, and instantaneous communication via quantum entangled particles. He concludes his book with a reiteration of its prevalent theme: that we just don't know, and that we never will without doing the research. I take his finale as an eloquent justification for the continuation of SETI and related research: "Only by the continued efforts and collaboration of the scientists, who approach the quest from their own unique vantage points, can we hope to find the answer to this, the most perplexing question of our existence... is anybody out there?"

Life On Other Worlds is graphically spare, as befits a scholarly work. Its limited visual tapestry will prove a disappointment to the MTV generation. Nevertheless, it is rich in language and long on clarity, as will be much appreciated by those who value substance over splash. A thorough glossary and ample bibliography precede a most extensive index of people, places and events.

As a SETI professional, I read this book quite critically, with a sharp eye out for any factual errors. I found only one, and a minor one at that. In discussing the signal detection hoax of October 1998, Clark tells of "an amateur radio astronomer who claimed to have picked up a message from the star EQ Pegasi, just 22 light years away." That claim was in fact made by an anonymous Internet hacker, *posing* as an amateur radio astronomer. As one who has long cited the discipline, integrity and professionalism of dedicated amateurs, I consider the distinction an important one. As an astronomer, Clark is well aware of the significant contributions of amateurs to his discipline. As an author, he speaks well and clearly to the educated laymen, among whose number many a proficient amateur scientist can be found. And, in fact, if you are just such a reader, you will find *Life On Other Worlds And How To Find It* an engaging and worthy read.

In his Foreword, astronomer Patrick Moore, whose *Sky At Night* is Planet Earth's longest-running television series, writes, "In my view [this book] is the best of its kind that I have seen, and it will have an honoured place on my shelf."

I couldn't have said it better. ❖

Dayton, You Honor Us All

By H. Paul Shuch, Executive Director

Editor's Note: *The following is Dr. Shuch's acceptance speech upon his receiving the Dayton Hamvention Technical Excellence Award, 21 May 2000.*

One of my favorite films from the 'eighties is Richard Benjamin's autobiographical production *My Favorite Year*. Its premise is that, in everyone's youth, there comes a pivotal moment that defines the direction of his or her life. For Benjamin, that moment came in the early 'fifties, when he was a staff writer for the Sid Ceasar Comedy Hour on TV.

My moment came a little later, in 1961. That was the year I got my first ham radio license, and took my first flying lesson, and OSCAR I (the world's first nongovernment communications satellite) was launched. I was the high school kid sitting in the back of the room at Project OSCAR meetings, saying, "This is what I want to do when I grow up."

And some day, maybe I will grow up. Meanwhile, the amateur satellite community trained me, and I rose through its ranks, from volunteer gofer to technician to engineer to technical director to board member, and ultimately to Chairman of the Board of Project OSCAR. I thought I had reached the top.

I was wrong.

For 1961 was also the year that John F. Kennedy gave a speech at Rice University, in which he said:

We choose to go to the Moon, and do those other things, not because they are easy, but because they are hard.

And right then, in my favorite year, my life's goals crystallized before my eyes:

I was going to become an aerospace engineer, and an astronaut, and win a Nobel prize.

Well, that first goal, though not easy, was certainly attainable. It required only persistence, and the drive to survive ten years of college (interrupted in the mid 'sixties by Uncle Sam's all-expense-paid Asian vacation). There were moments of doubt (such as the first time I failed Calculus). But my ham radio experience helped me to jump through all the right hoops, by giving me the big picture.

I jumped through all the right hoops again on my way to the stars: clean military service record, flying experience, a Ph.D. in a related discipline, the requisite number of publications, and research expertise appropriate for a Shuttle Mission Specialist. Then marginal eyesight bounced me out of astronaut candidacy. But better failing vision than failing Calculus.

So, I guess I'll have to settle for two out of three.

Which brings me to Dayton and this award. And if the Dayton Technical Excellence Award is as close as I ever come to a Nobel Prize, it's been well worth the ride.

When you honor me, you also honor my numerous mentors:

- Nick Marshall W6OLO, and Chuck Towns K6LFH, who taught me about satellites.
- Ian Webb K6SDE, who taught me electronics.
- Frank Pacier W6VMY, and Don Farwell WA6GYD, who taught me microwaves.
- Allen Katz K2UYH, and Mike Staal K6MYC, who taught me how to moonbounce.
- Joe Reisert W1JR, who taught me how to design receivers.
- Wayne Overbeck N6NB, who taught me how to lose contests.
- My first editor, Jim Fisk W1HR, who encouraged me to write.
- John Kraus W8JK, who taught me radio astronomy.
- And The SETI League's nearly 1200 members in 59 countries, who made it all come together.

Ham radio makes The SETI League possible.
Ham radio has been pivotal in my career.
Ham radio has shaped my life.
And it all started for me in 1961, my favorite year. ❖

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 31 - September 4, 2000: *Chicon 2000* World Science Fiction Convention, Chicago IL.
September 9 - 10, 2000: *Second Convention of the European Radio Astronomy Club*, Heppenheim Germany.
September 9 - 10, 2000: *45th Weinheim VHF Convention*, Mannheim Germany.
September 28 - October 1, 2000: *Microwave Update*, Trevose PA.
October 2 - 6, 2000: *International Astronautical Congress*, Rio de Janeiro, Brazil.
October 19, 2000: *Searching for Life Among the Stars*, Science North, Sudbury ON Canada.
October 26 - 30, 2000: *18th AMSAT Annual Meeting and Space Symposium*, Portland ME.
January 22 - 24, 2001: *OSETI III*, Third International Conference on Optical SETI, San Jose CA.
March 2 - 4, 2001: *Contact 2001*, Santa Clara CA.
April 21, 2001: Third annual SETI *League Ham Radio QSO Party*, 14.204 MHz.
April 29, 2001: SETI League *Annual Membership Meeting*, Little Ferry NJ.
May 18 - 20, 2001: *Dayton Hamvention*, Dayton OH.
May 25 - 28, 2001: *Balticon 35*, Baltimore MD.
August 30 - September 3, 2001: *Millennium Philcon* World Science Fiction Convention, Philadelphia PA.
October, 2001 (date TBA): *Microwave Update*, Arkansas.
May 17 - 19, 2002: *Dayton Hamvention*, Dayton OH.
August, 2002 (proposed): *Bioastronomy '02*, Hamilton Island (Great Barrier Reef) Australia.
October, 2002 (date TBA): *Microwave Update*, Washington DC.
May 16 - 18, 2003: *Dayton Hamvention*, Dayton OH.
October, 2003 (date TBA): *Microwave Update*, Dallas TX.
October, 2004 (date TBA): *Microwave Update*, Seattle WA.
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Guest Editorial:

Searching for Alien Beacons

by Gregory Benford

Project Phoenix, the SETI Institute's sensitive targeted SETI effort, regularly cycles among 1000 stars, those nearer than 155 light years. So far, no luck.

Not surprising, really, in a galaxy spanning 100,000 light years, when even the optimists estimate there might be only a million alien societies capable of sending waves our way right now. With those numbers (guesses, really) the nearest similar society would be more like a thousand light years away.

But maybe it's time to admit an obvious fact -- we live in the 'burbs. Our Sun circles the galactic core about four times in a billion years, two-thirds out from the compact center. There are not a lot of nearby stars (next door neighbor Alpha Centauri is 4.2 light years away) and many are small, dull, red suns probably incapable of ever warming an Earthlike world to life.

We eavesdrop on our neighbors that seem promising, sifting through a third of a million candidates, cupping an electromagnetic ear at the skies... It's lonely work, as the SETI teams have discovered.

Though SETI listeners can check on a suspiciously narrowband signal in real time, using the microwave telescope dishes at their command, much data processed is left for later inspection. The trouble is that there are many narrow signals, seemingly artificial, which turn out to be our own satellites or natural astronomical sources of subtle signatures.

Is there a different strategy? The SETI Institute targets single stars; how about looking for the glaring, wealthy societies sending beacons? That is the idea behind The SETI League's Project Argus all-sky survey.

This, too, is an old idea. New astronomical discoveries and the steady advance of radio astronomy have opened new reasons to look for beacons, following on ideas that go back 30 years and that have been updated by artist Jon Lomberg and others. Lomberg, a SETI League member, helped design the famous messages that fly now on Voyager, bound out of the solar system.

A bright beacon would, by definition, be so obvious, so powerful that it would light up the galaxy for a short while. The power would have to be a major fraction of the star's output. Beacons attract interest, then direct attention to a weaker signal that carries the larger message.

Where to look, though? Certainly, we should direct some of our radio ears into the plane of the spiral disk, where most stars dwell. In all that welter, one direction stands out: the center, the Times Square of the galaxy. Near it, a million stars lie within a single light year. Think of a sky with dozens of stars brighter than the full moon.

Of course, the dense center is a dangerous place for life like ours. Proton sleet slams onto worlds, and stars swoop near each other every 100,000 years or so, scrambling up planetary orbits and raining down comets upon them.

But, a bit further out, weather gets better. We now know that star formation started at the center, 10 billion years ago. That means that metals built up from the early supernovas there, so planets capable of sustaining interesting organic life like ours could have begun their slow, winding path upward toward life and intelligence within the first billion or so years.

Think of it--a world like ours that took 4.5 billion years to produce smart chimpanzees like us would have done so about four billion years ago!

In that much time, intelligence might have died out, arisen again, and gotten inconceivably rich. The beyond-all-reckoning wealthy aliens near the center could afford to lavish a pittance blaring their presence out to all those crouched out here in the 'burbs, just getting started in the interstellar game.

Whatever forms might dwell further in toward the center, they must know the basic symmetry of the spiral. This suggests the natural corridor for communication is along the spiral's radius, a simple direction known to everyone which maximizes the number of stars within a telescope's view. (A radius is better than aiming along a spiral arm, since the arm curves away from any straight line of view.) So, a beacon should broadcast outward in both directions from near the center, and we 'burbanites should look inward.

Presto! -- point your 'scope in a narrow angle (a few degrees) toward the constellation Saggitarius. Listen for the big spenders to shout at us.

But how often should we cup an ear? Here, I prefer to invoke a Principle of Mediocrity -- that we're mediocre, near the middle, in planetary properties. We follow a daily cycle atop an annual sway of climate.

If aliens are anything like us, they might then broadcast for a day, once a year. But which day?

No way to tell -- so listen every day, for maybe an hour. Watch for narrowband signals that stand out even against the bright glare of that Times Square glow.

Luckily, several radio telescopes could easily carry out a beacon-seeking strategy. Piggy-backing on existing observing agendas demands little time and effort. Looking inward, such a 'scope listens to a billion or more stars at once. Of course, the power demanded of a broadcaster is high, rising with the square of the distance away, because the signal spreads out over a larger area. But the number of stars listened to rises almost as fast as the cube of the distance (since it's proportional to the volume of a sphere).

We would be listening to the oldest stars. Here we can dream a little... Suppose ancient societies, feeling their energies ebb, yet treasuring their trove of accumulated art, wisdom and insight, wanted to pass this on? Not just by leaving it in a building somewhere, hoping some younger species comes calling someday. Instead, build a robotic "funeral pyre" that blares out your greatness:

> *My name is Ozymandias, King of Kings,*
> *Look on my works, ye Mighty, and despair!*

as the poet Shelley put it, witnessing the ruins of ancient Egypt.

We cannot know how often some civilization in the galaxy gets really rich, and lasts long enough to send its tidings across thousands of light years. The galactic center is about 25,000 light years away, and among its densely packed stars radio communication may be common. After all, they don't have to wait a long time to hear from neighbors that may lie quite near. We live in cities for similar reasons.

Finally, we should consider beacons because people here are already pondering it. It gets cheaper every year to call out to the stars electromagnetically. Already a firm promises to broadcast your very own Message to the Galaxy for a small fee. I'd rather that our society not send out personal messages, probably more like graffiti than the Psalm of Psalms. But there's no way to stop people from doing it. So far no radio telescope team has responded to questions about using their dishes to shout at the stars. But it will come.

A way of focusing on this issue is to listen first, establishing a calm, orderly way of thinking about this issue, for the discussions that will surely come -- as soon as somebody begins broadcasting.

The prospect of beacons might well bring a pulse-quickening sense back into the SETI search. We may look back on this era and remember the old joke about the guy searching for his keys under a street lamp. He had lost them elsewhere, but the light was so good for searching right here, near the lamp... ❖

Software Corner:

SETIFox for Win9x

By Dan Fox, KF9ET
SETI League Software Committee Chairman

SETIFox is a suite of four shareware programs for SETI data analysis and station control. The SETIFox programs operate in the Windows 95/98/NT/2000 environment, having the following capabilities:

Configuration Utility - for configuring the SETIFox programs with the local coordinates, dish elevation and azimuth. The utility is also used for setting serial port configuration, frequencies being scanned, and radio control strings for a wide range of radios.

Doppler Detection Program - is a program that looks for changes in the radio spectrum that are occurring at a linear rate (such as a narrowband carrier drifting through the beam of the antenna). Signals that are not drifting in frequency, or have a drift rate that falls outside the search parameters, will tend to be cancelled out in the detection and integration algorithm. When a signal is detected, information raw data is logged along with the doppler display to help determine the source of the detection.

Data Extraction Utility - is used to examine the logged files from the Data Detection Program and to convert the data to other formats.

Scanning Power Logging Program - is used to scan a range of frequencies and log the relative power at each frequency. The readings are logged to a text file which can then be imported into a spreadsheet such as Excel.

Status - At present all four programs are being downloaded regularly and apparently being used with very little problem. Radio control strings have been written and used for controlling several types of ICOM radios as well as an AOR AR5000. The Doppler Detection easily detects GPS satellites passing through the beam of the antenna. While this is not a narrow band signal, the frequency components do drift at a linear rate and trigger the detection algorithm. The Scanning Power Logging Program is being used by several amateur radio astronomers.

Availability - SETIFox is available for download from http://php.ucs.indiana.edu/~foxd/home-seti.html. ❖

Hardware Corner:

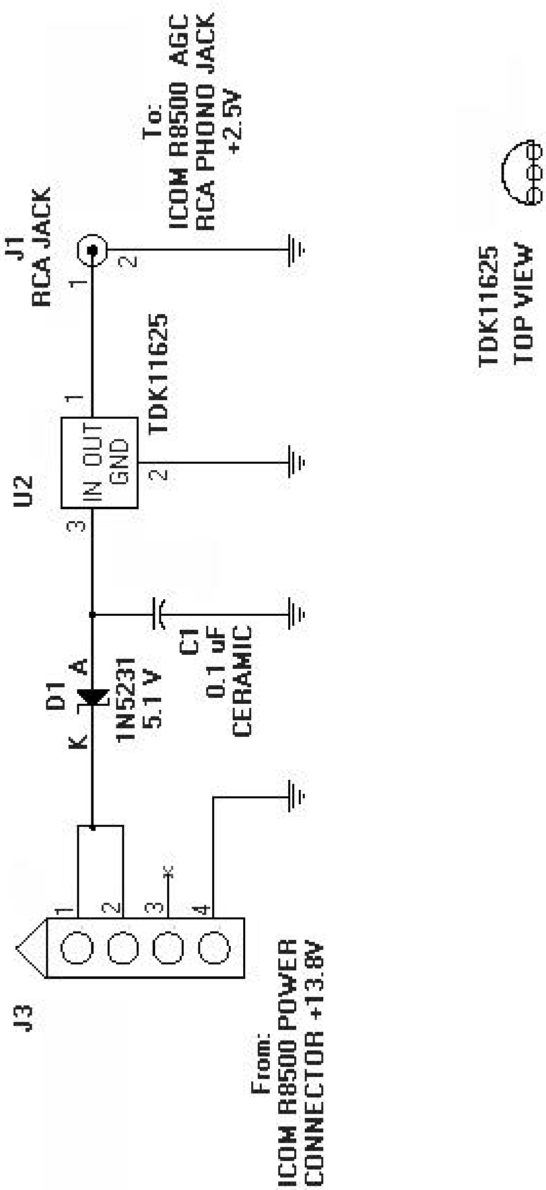
Another Icom R8500 AGC Mod

By Norm White (email NOREX@mcia.net)

Being somewhat lazy and not wanting to disassemble my new R8500, I have designed a new method to disable the AGC externally. The AGC driver Q27 is a weak voltage source of greater than 1K ohm impedance. This voltage source can very easily be overcome by a low power regulator. I have used a Toko TO92 regulator part # TK11625. This +2.5v regulator is available from Digikey for $1.30.

Maximum gain in the R8500 is at an AGC voltage of 2.4V. I have built this strong voltage driver in an RCA phono jack. I get the input power from the 13.8v DC connector on the back of the receiver. I can now disable the AGC by just plugging in the driver into the AGC RCA phono jack on the back of the R8500.

Here is a schematic diagram of this modification. ❖



This issue of *SearchLites* is dedicated to the memory of SETI pioneer Prof. Jean Heidmann

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