



SearchLites

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The Quarterly Newsletter of The SETI League, Inc.

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We're All Volunteers Now

by H. Paul Shuch, Executive Director

When the nonprofit SETI League was founded, I was happily employed as a tenured college professor, enjoying both my teaching duties and the security of a lifetime job contract, backed by the taxing authority of the state. So when your Board of Trustees offered me the opportunity of a lifetime, to do fringe science on soft money, of course I jumped at the opportunity! For their part, the wise and generous founders of The SETI League offered me a five-year contract, guaranteed to match my teaching salary and benefits, thus allowing my family to continue to eat. It has been a good deal for me, and I hope for all of you, in that we've managed to stretch that five-year contract farther than anyone expected. I am now in my tenth year with The SETI League, and I wouldn't want to be doing anything else.

Unfortunately, however, the economy has other plans for me. As you know from reading our Annual Reports and past issues of *SearchLites*, we have been struggling to keep our organization's collective head above water in the face of global recession, international conflict, and a general downturn in private support for nonprofit endeavors in general, and SETI science in particular. So I was not particularly surprised to learn some months ago that the Board of Trustees would be unable to extend my present contract beyond its August 15 expiration date.

I remain as committed as ever to The SETI League and its educational and scientific mission. Unfortunately, since my family has not yet learned how to survive without food, clothing, shelter, and health care, I find it necessary to seek gainful employment elsewhere. A few months ago I resurrected Microcomm, a business I founded in California thirty years ago, and have once more hung out my engineering shingle. You may wish to browse to the resulting website, <<http://microcomm.net>>. I've already had a few consulting jobs (and been able to contribute some of the proceeds to The SETI League), so I can expect to remain gainfully employed for the foreseeable future.

Does this mean, as has been recently rumored, that The SETI League is going out of business? **ABSOLUTELY NOT!** Although our League can no longer afford the luxury of a full-time Executive Director, we are a dynamic and vital organization of dedicated and committed volunteers. Like SETI science itself in the wake of Congress pulling the plug on NASA funding some thirteen years ago, The SETI League refuses to die. And I refuse to turn my back on the most exciting venture of my lifetime (and possibly of yours).

So, where does this leave me? As a SETI League volunteer, just like the rest of you. As long as it pleases our Board, I will continue to serve as Executive Director, on a volunteer basis. Like the rest of you, I will pursue my profession, support my family, and serve The SETI League on weekends, and in the evenings, and in whatever spare time I can muster. I will continue as editor of *SearchLites*, and webmaster to our extensive website. I will write articles, and grant interviews, and attend conferences, as my work schedule permits. And I too will continue to strive toward the day of Contact.

So, we're all volunteers now. Your continued support becomes more important than ever, as we make the transition to life without fulltime leadership. And yes, I will continue to be an active SETIzen. I just won't be able to answer your emails instantly anymore. But then, if nothing else, the search for extraterrestrial intelligence has taught us patience.



Book Review:

Lonely Planets

by David Grinspoon

Reviewed by Athena Andreadis

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Its detractors have called astrobiology “the science without a subject”. Astrophysicists, astrochemists and astrogeologists are drowning in data from the planetary missions and the Hubble. At this point, they can all reasonably state that processes which occur in our X (for X substitute galaxy, solar system, planet, depending on your field) also occur elsewhere and therefore can be used to deduce general principles. Paradigm-shifting surprises come often enough but the mode is highly successful until we hit the cement wall of biology. No Martians, Jovians, Titanese or Europeans have yet waved appendages at our crafts, and the SETI search has so far collected only the hiss of inanimate events (the Wow! signal notwithstanding).

So astrobiologists, unlike their luckier equivalents, can only philosophize – or extrapolate from extreme terrestrial environments which harbor very exotic organisms, indeed, but share one common denominator: life in such niches is often remarkably complex but it does not qualify as intelligent by our definition. And let’s face it; bacteria and fungi do not fire the imagination. It is really companions and playmates that we are seeking when we extend the SETI antennae. After all, we sent a recording of Chuck Berry into space in hopes of locating creatures that would share our enthusiasm for this heroic, now intergalactic, guitar slinger.

Since astrobiologists lack a truly independent second life sample, they still cannot determine what is universal and what is parochial. Is carbon the universal scaffolding? Is water the universal solvent? Is DNA (or a nucleic acid double helix) the universal genetic transmitter? Is manual dexterity or language the universal prerequisite for intelligence? Can a civilization live forever? You can see at a glance that such questions do not position a scientist favorably for getting either grants or tenure, which is why they have been a domain traditionally reserved as a playground for famous (that is, tenured, fully salaried and grant-flush) scientists.

So what is a young and eager astrobiologist to do? If she is of the applied persuasion, she explores sulfur-based ecosystems in caves or tries to join NASA planetary mission groups. If, on the other hand, he is of the theoretical persuasion, he writes a book. Books about astrobiology have been appearing at a brisk clip the last few years, though only one was brave enough to openly flaunt the word itself in its title (David Darling’s *Life Everywhere: The Maverick Science of Astrobiology*). All others hedge their bets by purporting to deal with something else (Fermi’s paradox, the uniqueness of earth, the big picture) and attempt to bolster sales by using “Alien/s” in their titles. To this category belongs David Grinspoon’s *Lonely Planets: The Natural Philosophy of Alien Life*.

David Grinspoon is officially a planetary scientist and has written a book on Venus to prove his legitimacy to the academic guild, which tends to be as punitive as Yahweh about romps of its members outside the fold. With the more mainstream book under his belt, he can afford to show that he is clearly excited and well informed about his true subject –

namely, what we know and can deduce about the requirements for extraterrestrial life. His interest in the field is not surprising: he mentions repeatedly that his parents and grandparents were friends with Asimov and Sagan, who served as his intellectual mentors. In fact, the tone of his book owes much to Sagan’s writing style: it is folksy and accessible, both a meditation and a commentary. It is also occasionally clunky and grating, especially the wan jokey footnotes and the studied humility.

Lonely Planets has three sections. “History” deals with the ebb and flow of opinions about life beyond earth since science became more (or less) than natural philosophy, from the Epicureans to the Sojourner rover, with the usual honorable mentions of such pioneers as Galileo, Immanuel Kant and Percival Lowell. “Science” broadly sums up our current stage of knowledge about the universe, the solar system, earth, the other solar planets and the rapidly expanding roster of exoplanets. “Belief” goes into the question of alien visitations, with the obligatory stops at the Drake Equation and the Fermi paradox, as well as detours which include Orson Welles’ *War of the Worlds* broadcast and John Mack’s alien abduction theories. So this book combines several aspects that usually appear on separate (and very different) books. Interwoven throughout the narrative are the author’s personal experiences and opinions. The breeziness and anecdotal style recall Joel Achenbach’s *Captured by Aliens* whereas the biocentric emphasis recalls Jack Cohen’s and Ian Stewart’s *What Does a Martian Look Like?*

The science in the book is excellent and up to date, though there are very few completely new items in it for those who have been following the field. The novel and refreshing aspects of Grinspoon’s book are some of his less orthodox suggestions and opinions: he shows why astrobiology is in fact a very old discipline, which needs interaction between scientific fields that once were philosophically considered a unit, but are now kept in airtight compartments; he gives persuasive reasons why we should consider Venus (or at least its atmosphere) as a possible harbor for life despite its seemingly very hostile conditions; and he describes life as instrumental in shaping planets, thereby elevating it from a passive outcome to an active partner.

Grinspoon presents all the exciting knowledge gleaned from the robotic missions and powerful telescopes -- the tantalizing results of the Viking experiments, the possible microfossils in Mars meteorites, the ocean which almost certainly lurks beneath Europa’s ice and may harbor life fuelled by geothermal energy, the hot Jupiters and the new insights they gave to models of planetary system formation. Some of his anecdotes shed illumination on thinking outside the box, and how thin the line is between brilliant and kooky-- for example, the paper he reviewed and Sagan (as editor) published in the ICARUS journal, which suggested that viral genomes might harbor an extraterrestrial message organized on a grid of two primes.

In fact, viral genomes are tightly organized and have overlapping genes because they literally must squeeze their DNA into a confined space; our chances of finding such a message would be higher if we looked into higher organisms, with their profligate expanses of redundant DNA.

There are some omissions and minor errors. Most glaring to a biologist is the lack of explanation of what RNA is and does, given that it is currently our leading candidate for the

first protobiotic molecule. There is also the usual sidestepping of the definition of both life and intelligence, with the routine excuse that "We'll know it when we see it" – when all we know is our present single sample. Grinspoon also performs the Procrustean fits that physicists often resort to when they try to reduce biology to first principles, including the unquestioning presentation of such untested and unproved offshoots as Stuart Kaufmann's "complexity theory".

The book also suffers, in my eyes at least, from too much political correctness, and some of its views may inadvertently hurt the scientific mindset that Grinspoon represents. For example, we have come to realize that earth is an integrated system (the "weak" version of the Gaia hypothesis); however, positing humanity as the entity's brain is bad metaphor and worse science, unless you think Gaia is a very disturbed personality, indeed. Taking science to task for being hostile to bold ideas and for avoiding responsibility for the consequences of their actions plays right into the hands of Proxmire clones. True, science has its vicious politics and rigid hierarchies, but peer review works well for quality control – and death of old fogies clears the way for new concepts. Also, scientists have always wielded negligible political and cultural influence, especially so in today's USA (quick, name one active scientist outside your field; now name one whom you last saw on prime time TV).

Grinspoon argues for sensitive, socially conscious application of technology, which puts him squarely on the side of the angels. Yet he bypasses the inconvenient fact that such sensitivity can only come into play when technology and its underlying knowledge advance past the point of raw survival. At the same time, he unquestioningly accepts – indeed, hopes – that advanced alien civilizations will possess and wield world-altering technology, the way humans in the past assigned such powers to god(s). Finally, his discussions about science versus religion are oddly conventional and unenlightening (there are shades of Gould's Nonoverlapping Magisteria in his arguments, a fence-sitting position *par excellence*). Particularly distressing is his lumping of both SETI and UFOlogy under the category of strictly-on-faith items.

Grinspoon has done a very good overall job, which is why I am complaining about the imperfections of the book. *Lonely Planets* is an informative, enjoyable book – but with a bit more care and discernment, it could have been an outstanding one.

Editor's Note: Athena Andreadis, PhD is Associate Professor in Cell Biology at the University of Massachusetts Medical School. Her first book, *To Seek Out New Life: The Biology of Star Trek*, appeared in the spring of '98 and she is now at work on her second, *Distant Campfires*. ❖

SETI League Presents Annual Awards

Ewing, NJ., 7 August 2004 -- At its annual Awards Reception this evening at The College of New Jersey, the nonprofit SETI League, leaders in a global search for extraterrestrial intelligence, along with the editors of the scholarly journal *Contact In Context*, recognized five individuals for major contributions to the art and science of SETI. Honored this year were microwave engineer Ed Cole, artist Jon Lomborg, webmaster H. Paul Shuch, industrialist Richard Factor, and author James Gardner.

Lomborg, a respected space artist living in Hawaii, was the recipient of a Best Ideas Award sponsored by the peer-reviewed periodical *Contact In Context*. Over the years, he contributed the illustrations and artistic designs to several of Carl Sagan's books, his TV series *Cosmos*, and the film adaptation of his novel *Contact*. Lomborg was design director for NASA's Voyager record, as well as the Portrait of Humanity, a photograph which had initially been scheduled to fly aboard the Cassini spacecraft, but which sadly was deleted from the flight manifest prior to launch. His recent *Contact In Context* article "Portrait of Humanity," which this award honors, tells the story of that abortive attempt at announcing humankind's place in the cosmos.

This year, in addition to the award to Jon Lomborg, the editors of *Contact in Context* decided to recognize an entire website instead of a particular publication. A second Best Ideas Award goes to the SETI League website for providing a wide-ranging forum for creative, innovative, and controversial ideas. Such a forum, free from ultraconservative prejudice and subtle censorship, is especially important in the SETI field -- a field that clearly needs fresh ideas and voices. As the SETI League executive director and webmaster, Dr. H. Paul Shuch receives a Best Ideas Award for creating and nurturing such a forum.

Without the vision, enthusiasm, energy, and funding of Mr. Richard Factor over the past decade, the SETI League would likely not exist today. Factor runs Eventide, Inc., a high-tech electronics company in New Jersey. Founder of the nonprofit SETI League, and its President since its inception in 1994, he is an important leader in the privatization of SETI. Factor established The SETI League in response to the US Congress having canceled the NASA SETI program in 1993. Without Richard Factor there would be no SETI League website to provide a home for unusual ideas from outside of mainstream thinking. Consequently, the editors of *Contact in Context* declare Richard Factor a winner of a Best Ideas Award for making this website possible.

Honorable Mention goes to James N. Gardner for his book called *BIOCOSM, The New Scientific Theory of Evolution: Intelligent Life is the Architect of the Universe*.

Ed Cole, a prominent amateur radio operator, was honored with The SETI League's annual Orville Greene Service Award. He has been an active contributor to SETI League technical activities for a number of years. He serves as The SETI League's volunteer Regional Coordinator for Alaska, participates actively on the organization's various technical email discussion lists, has given papers at previous SETICon Technical Symposia, has contributed articles and software to the group's website, and last year conducted the first SETICon Hardware Workshop.

Earlier this year, The SETI League recognized Italian engineer Stelio Montebugnoli with its annual Giordano Bruno Memorial Award, for his significant technical contributions to SETI science. Montebugnoli, who heads the SETI Italia program at the Institute for Radio Astronomy, National Council of Research, near Bologna, Italy, received his award at the EuroSETI04 meeting in Heppenheim, Germany, this past April.

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In Memoriam:

Dr. John D. Kraus, W8JK

by H. Paul Shuch

I am saddened to report the death on 18 July 2004, just three weeks after his 94th birthday, of Dr. John D. Kraus, W8JK, a true renaissance man. John was Professor Emeritus at Ohio State University, where he had taught engineering, physics, and radio astronomy for nearly half a century. Long after his retirement, he was still going to campus daily, to meet with students. Ever the optimist, John had renewed his ham radio license a few days before his death -- for a period of ten years.

Prof. Kraus distinguished himself as a prominent physicist, educator, antenna designer, engineer, writer, publisher, radio amateur, and philosopher. His textbooks *Radio Astronomy*, *Antennas*, *Electromagnetics*, and *Our Cosmic Universe* guided a whole generation of astronomers and engineers, including me. His two volumes of memoirs (*Big Ear* and *Big Ear Too*) inspired a whole generation of radio amateurs (again, including me). His short-lived periodical, *Cosmic Search*, was the world's first SETI magazine, its thirteen issues still cherished by those of us involved in the SETI enterprise. And his designs (including the legendary Big Ear radio telescope) have expanded humanity's knowledge of the cosmos.

It was at Big Ear that the most tantalizing, elusive and enigmatic evidence yet of extraterrestrial intelligence was collected. The legendary 'Wow!' signal received there on 15 August 1977 remained the greatest mystery of John Kraus' life, a detection that fit exactly the expected profile of intercepted radiation from another intelligent civilization in the cosmos. That the anomaly was observed right around the time of his retirement must have been frustrating to John, who would have liked to direct the hundreds of repeat observations that followed. Instead, Kraus turned the effort over to a most able lieutenant. Bob Dixon, W8ERD, had come to Ohio State as a grad student, specifically to study under the best antenna engineer of his day. He was studying there when Big Ear was being commissioned, stayed on as a faculty member, became John Kraus' deputy director, and ran the observatory during its final years.

Those final years of Big Ear came too soon, both for Dixon and for Kraus (who remained actively involved in radio astronomy and SETI well beyond his retirement). The land under the antenna's beautiful 3.5 acre ground plane had become just too valuable, and ultimately the University sold it to the developers. Big Ear, John Kraus' brainchild and one of the greatest radio telescopes of all time, was ploughed under in early 1998 to make way for a commercial golf course. Such is progress.

On a personal level, it was John Kraus who ordained me as a radio astronomer. That particular episode occurred a number of years ago at the Ohio State University, when Kraus was already a Professor Emeritus. I had just given a SETI paper to a room full of astrophysicists, and I was justifiably nervous. "After all," I told him afterward, "I'm just an electrical engineer."

"Don't ever say that!" roared Kraus, with a forcefulness which belied his then eight decades. "You are a radio astronomer!"

Right there, I realized I had offended my mentor. (After all, he himself was, first and foremost, an electrical engineer.) "But John..." I started.

"But nothing!" he retorted. "As an engineer, you can very easily learn (and, in fact, have already learned) all the astronomy you need to call yourself a radio astronomer. The converse cannot be said of the physicists."

Over the years, John Kraus remained quick with his wit, frank in his criticism, generous with his praise, and ever supportive of the young upstart with his head in the clouds. I am proud to have been able to call him my friend.

The last time I saw Kraus in person was on 5 November 2000. John and fifty friends gathered on the green at the former Big Ear site, to dedicate an historical marker. That ceremony was not only a memorial to Big Ear, but a tribute to Kraus and his many accomplishments. I know that when Big Ear died, so did a part of John Kraus. That he remained among us, warm, compassionate, and mentally alert for an additional four years, was a gift to all who knew him. ❖

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.

All events listed below are subject to change by the event organizers. Please double-check The SETI League website for latest details.

September 2 - 6, 2004: *Noreascon 4* World Science Fiction Convention, Boston MA.

October 4 - 8, 2004: *55th International Astronautical Congress*, Vancouver BC Canada.

October 9 - 10, 2004: *2004 Mid-Atlantic States VHF Conference* and *Hamarama*, Trevoise PA.

October 14 - 16, 2004: *Microwave Update*, Dallas TX.

December 10 - 12, 2004: *Philcon '04*, Philadelphia PA.

April 17, 2005, 0000 UTC - 2359 UTC: Seventh annual SETI League Ham Radio QSO Party, 14.204, 21.306, and 28.408 MHz.

July, 2005 (dates TBA): Central States VHF Conference, Colorado Springs CO

August 4 - 8, 2005: *Interaction* World Science Fiction Convention, Glasgow, Scotland UK.

October 17 - 21, 2005: *56th International Astronautical Congress*, Fukuoka, Japan.

April 22, 2006, 0000 UTC - 2359 UTC: Eighth annual SETI League Ham Radio QSO Party, 14.204, 21.306, and 28.408 MHz.

July 2006 (dates TBA): Central States VHF Conference, Minneapolis MN.

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

September 8 - 10, 2006: SETICon06, in conjunction with the Fourth International Congress for Radio Astronomy, Heppenheim Germany.

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

July 2007 (dates TBA): Central States VHF Conference, San Antonio TX. ❖

Guest Editorial:

Moon Yes, Mars No!

by Ron Sirull, Delray Beach, FL

Fellow SETI enthusiasts: We are missing the boat on President Bush's new "Moon, Mars and Beyond" program! This editorial is nothing less than a call to arms, metaphorically speaking.

Instead of using the Moon as just a "stepping stone to Mars", as the US President's proposal has outlined, a lunar farside SETI facility (radio astronomy dishes linked like the Allen-array network, and an optical cluster there as well for the Laser SETI Searchers) offers as its reward the possible detection of a Galactic Internet, not merely the frozen/fossilized microbes likely to be found on Mars.

Even if those microbes exist, they are, from Earth, one hundred times the travel time and a thousand times the distance of the Moon. Real-time telerobotic operations, and a near-constant -50F temperature at the lunar South Pole (rather like Earth's Antarctic Stations) are additional advantages Moon missions have over Mars. Solar panels work better on the Moon than they do here on Earth, (no atmosphere to blunt the rays), but Mars, at twice Earth's distance from the Sun, get it's solar energy much less efficiently.

I don't know what percentage of Earth's general population consists of microbiologists, but it must be rather small. I suspect that few people really care all that much about microbes, yet many people would be fascinated by First (and subsequent?) Contact with an alien civilization, as evidenced by that theme's popularity in all human cultures.

How have the Microbe Searchers managed to get so much attention from the White House, and so much of the funding at NASA? Where are the Moon Advocates? It's time for us to speak up.

I wish we could have helped convince someone (Commission members, the White House Science Advisor, whoever can make a difference) about the advantages of lunar SETI research. I feel responsible, and maybe you should too, for allowing NASA's limited funding to be spent primarily on microbe-hunting mania, at the expense of developing a lunar farside SETI base. The irony is that sustainability of funding has continually been cited by the President's own Commission as the *Moon, Mars, etc.* plan's greatest threat. That concern is the very reason a lunar SETI base is a better idea. If a series of robotically placed radio dishes could be positioned to form an ever-widening spiral on the lunar farside, it could continue to grow until such time as (inevitably) funding was curtailed at some point. Whatever facility was in place at that point would continue to operate on that powerful and abundant solar energy.

I hope I won't lose credibility here by acknowledging that some of the blame for our current fascination with Mars must surely go to Orson Welles! His "War of the Worlds" radio scare in 1938 solidified a curiosity about Mars that I too shared, until the Viking mission brought two GCMS (Gas Chromatograph Mass Spectrometers) labs to the Martian surface, and that pretty much answered for me all of the mystery about life on Mars.

Now that a new space initiative presents us with the opportunity for a return to the Moon, we must do whatever we

can to maximize the Moon part of *Moon, Mars and Beyond*. Our deepest understanding of the cosmos will come from telescopes, not microscopes. Though the Mars rovers Spirit and Opportunity have done so much in their semi-autonomous manner, the real-time telerobotic operations between Earth and the Moon would make their meanderings childlike by comparison.

For these, and other reasons, I say now: Moon yes, Mars no! ❖

2003 Annual Report Available for Download

The 2003 Annual Report of The SETI League Inc. is now available for download from our website, in Portable Document Format (PDF). This year's Report runs 18 pages. It features a description of our major educational and scientific projects; discusses last year's program service accomplishments in the areas of science, technology, media and outreach, and public education; lists and acknowledges our newest members, Life Members, Sustaining Life Members and major donors; and includes highlights and photos of major SETI League events, as well as the usual annual budget and audited financial statements. Also in the Report are The SETI League's Vision Statement, Mission Statement, and Case for Support, as well as a listing of our Trustees and Officers for 2004.

You will need the free Adobe Acrobat PDF Reader to view or print this Report on your computer. A link to download that Reader appears on our main web page. The report itself can be found at this location on the Internet:

<http://www.setileague.org/admin/report03.pdf> ❖

SearchLites Goes All Electronic

As announced elsewhere in this issue of *SearchLites*, The SETI League is going through a period of transition from full-time paid leadership to an all-volunteer organization. One of the casualties of this transition is the printed, posted quarterly newsletter which our members have enjoyed receiving for the past ten years. Because the costs of paper and postage have continued to increase during times our revenues have been shrinking drastically, your Trustees made the difficult decision at our August Board meeting to suspend printing and mailing of our newsletter.

This does not mean that *SearchLites* is going out of existence. Rather, we will be embracing for our internal League communications the same telecommunications technology that we hope will one day lead to interstellar contact. Thus, this fortieth issue of *SearchLites* is the last one you will be receiving in paper form. Beginning with the Volume 11, Number 1 (Winter 2005) issue, due out in December 2004, *SearchLites* is scheduled to become an all-electronic publication.

SETI League members in good standing will be able to continue downloading the current issue of our newsletter from our Members Only section at www.setileague.org/members. You will need to log in there, using the User Name and Password provided annually with your membership renewal letter. It will of course be necessary for you to pay your renewal dues in a timely manner each December, so you don't miss a single issue. Back issues of *SearchLites* will continue to be available to the general public and members alike, from the open sections of our website. Thanks for supporting this change. ❖

Astronaut Explains Danger of Asteroids

by Larry Klaes (lj4 @ msn.com)

Hundreds of Cornell University alumni, visiting the campus for their Reunion Weekend, made a special stop on Friday afternoon at the Newman Arena in Bartels Hall. They came to listen to one of their fellow alumni, astronaut Ed Lu, deliver the 2004 Spencer T. and Ann W. Olin lecture.

Lu, a 1984 graduate of Cornell with a bachelor's degree in electrical engineering, was introduced to the large audience by University President Jeffrey S. Lehman. The two had talked before by ham radio last October when Lu was spending six months in Earth's orbit aboard the International Space Station (ISS).

Lehman had asked Lu if he could take a photograph of Cornell when the space station passed over the university, but Lu replied that every time he did, the place was clouded out. Lu has flown on three space missions in four different space vehicles since 1995. Lu used his astronaut experiences and images from the ISS to highlight his talk, titled "Rocketships, Dinosaurs, Asteroids, and Immortality."

Using a large screen at the front of the arena, Lu displayed photographs of giant impact craters taken by him from Earth's orbit. The astronaut described the various types of natural space debris that have and could affect our blue planet. While most meteors that hit Earth every day are dust particles that quickly burn up in the atmosphere, some pose an actual threat to life on this world. On the lower end of the scale, space rocks averaging 60 meters across tend to strike about once per century and explode in the air before reaching the ground. A prime example of this type is the one that hit the Tunguska region of Russia in 1908.

It destroyed 200,000 square miles of Siberian forest in the process. Thankfully the remote area was sparsely populated. At the high end of the scale, asteroids five miles wide or more do not cross Earth's path around the Sun more than once in millions of years, but when they do, whole species can be wiped out.

Just ask the dinosaurs who lived on our world until 65 million years ago.

Lu compared this devastation and loss at the end of the Cretaceous Period to "turning off your computer without saving your work."

Should such an object strike Earth today, civilization as we know it would be gone. To drive the point home as to what could be lost, Lu displayed images of some major cities and human constructions that he saw from 240 miles above Earth's surface. This included Ithaca and Cornell, which Lu eventually got to photograph during his ISS mission.

Fortunately for everyone, scientists, engineers, and astronauts such as Lu have been thinking of ways to prevent this disaster from happening. Though recent films on the subject show astronauts blowing up threatening space rocks, Lu states that nudging these asteroids into a new solar orbit is the safer way to go.

Lu helped to found the [B612 Foundation](#), named after an asteroid in the famous story The Little Prince by Antoine de Saint Exupry.

Their goal is to use an electric-powered space tug that would push an offending asteroid just enough - perhaps as little as one centimeter per second (0.03 miles per hour) - to divert the object into an orbit that would miss Earth for ages to come. The technology could also be funded by and used for commercial purposes in the development of a space infrastructure for industry, exploration, and colonization.

Note: This article first appeared in the *Ithaca Times* for 16 June 2004. Copyright © 2004 Ithaca Times, used by permission. ❖

Ask Dr. SETI

Why Use the Rate of Stellar Formation?

Dear Dr. SETI:

In his famous Equation, Dr. Drake uses as the first variable R^* , the rate of star formation in the Galaxy. In helping to film a SETI documentary recently, I was asked why we use the rate of star formation, since it seems more logical to simply use the total number of stars in our Galaxy. I had no answer. Do you?

Lee, Arizona

The Doctor Responds:

The answer, Lee, lies in our desire to achieve dimensional consistency. Remember that the purported objective of the Drake Equation is to determine the number N of communicative civilizations in the Milky Way Galaxy. To get a pure number as the answer to the Equation, all the units in all seven of its Factors need to cancel. Describing R^* in terms of the rate of stellar formation, rather than as simply the number of stars in the Galaxy, accomplishes this for us. Here's why:

Consider the Units in which each of the seven Drake Factors are expressed:

Variable	Drake Factor	Units
N	Number of Communicative Civilizations	unitless
R^*	Rate of Stellar Formation	1/years
f_p	Fraction of Stars with Planets	ratio
n_e	Average number of Earth-like Planets	unitless
f_l	Fraction with Life	ratio
f_i	Fraction achieving Intelligence	ratio
f_c	Fraction developing Communications	ratio
R^*	Longevity in the Communicative Phase	years

Performing a dimensional analysis, you can see that: (1/years) * (ratio) * (unitless number) * (ratio) * (ratio) * (ratio) * (years) = a unitless number.

Notice that Years in the denominator of R^* cancels Years in the numerator of L . So the answer for N is a pure number, and we have achieved dimensional consistency. If instead of R^* we were to use R , the number of stars in the Milky Way Galaxy, then N would come out as the number of *civilization* years, which means something else entirely. ❖

A 96 kHz Project Argus Station

By Harry Kimball, N0TOU, Argus Station EM29je

The backend of a typical Project Argus radio telescope used in the search for extraterrestrial intelligence (SETI) consists of a microwave communications receiver with its audio output fed through a computer soundcard to a program that detects and logs candidate signals. The instantaneous bandwidth observed is usually about 3 kHz. Recent efforts at EM29je have increased the instantaneous bandwidth at that station to 96 kHz. This increase was accomplished by adding Time Machine hardware and SpectraVue software - commercially available products costing less than \$200 - to the existing station equipment.

In its original configuration, EM29je consisted of a 3-meter parabolic dish with a cylindrical waveguide feed and feed-mounted low-noise preamplifier (LNA). The signal from the LNA was delivered through low-loss coaxial cable to a line amplifier and then to an Icom R8500 receiver. The audio output of the receiver was fed through an attenuating cable to the microphone input of a soundcard on a personal computer where it was Fourier transformed to the frequency domain and inspected for potential signals with SETIFox software. With the receiver operated in upper sideband mode, the output bandwidth was just under 3 kHz.

In the new configuration, instead of the audio from the receiver being fed to the soundcard microphone input, the receiver's 10.7 MHz IF (intermediate frequency) output is connected to the RF input of a Time Machine with coaxial cable. The audio outputs of the Time Machine are connected to the stereo line input of a soundcard capable of sampling at 96,000 samples per second. SpectraVue software is used to Fourier transform the in-phase and quadrature (I and Q) baseband audio outputs of the Time Machine to the frequency domain and monitor the spectra for candidate signals. Qualifying signals are written to disk for later reprocessing and evaluation. With a sample rate of 96,000 samples per second, sampling 2 channels simultaneously produces a total of 192,000 measured values per second yielding an output bandwidth of 96 kHz after processing.

The Time Machine is a commercial product (<http://www.expandedspectrumsystems.com/>) available from Expanded Spectrum Systems for \$135 in kit form or \$170 assembled. In essence, it consists of two circuits on one circuit board. The first is a direct conversion receiver designed to take a section of an RF band and convert it to baseband I and Q channels for recording on a high bandwidth stereo audio recorder, such as a VCR. The other circuit (which is not used in this application) reconstructs the segment of RF spectrum from the recorded I and Q channels when they are played back at a future time of the users choosing - hence the name Time Machine. At EM29je, the Time Machine is configured with a 30-meter band pass filter board and 10.7 MHz crystal.

SpectraVue is a commercial product that can be downloaded free from the MoeTronix web site (<http://www.moetronix.com/index.htm>) for evaluation, but requires a \$50 license key before it will accept data from the PC soundcard. SpectraVue can accept real or complex (I and Q) samples from the PC soundcard at the rates supported by the soundcard. An FFT can be done on sets of samples ranging in size from 2048 to 262144 samples, yielding bin widths of 47 to 0.37 Hz for complex data collected at 96,000 samples

per second. The FFTs can be averaged or smoothed before display. Types of displays include: raw data, 2D FFT, 3D FFT, vertical waterfall, horizontal waterfall, continuum, and phase. The axis scales are adjustable for most displays. RF data can be saved to an RIFF wave file (.wav) continuously (at a rate of 31 GB per day) or when the signal breaks the squelch setting. Saved RF data files can be used as the input source to SpectraVue and reprocessed with different bin widths, FFT averaging, display type, etc.

While these items were not designed specifically for use in the search for extraterrestrial intelligence, they have features that make them amenable to that application. Plus, they are reasonably priced commercially available products that do not require extraordinary skill to install or use. The cost of the equipment for the original configuration of EM29je is estimated at \$3000 (\$1400 for the receiver, \$1000 for the PC, and about \$600 for miscellaneous other items). This is a cost of roughly \$1000 per kHz of instantaneous bandwidth. With the addition of \$200 worth of hardware and software, this cost was reduced to about \$33 per kHz; a significant improvement in cost effectiveness in the search for extraterrestrial intelligence.

Additional details can be found in the proceedings of SETICon 04, available on CD for a modest contribution (see the back page of this issue of *SearchLites* for ordering details).



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