



SearchLites

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Allen Tough and the Billingham Connection

by H. Paul Shuch, Executive Director Emeritus

At its 2005 meeting in Fukuoka, Japan, the SETI Permanent Study Group (now known as the SETI Permanent Committee) of the International Academy of Astronautics (IAA) voted to establish an annual *Billingham Cutting-Edge Lecture* (BCEL), as a forum to showcase breakthrough thinking in advancing the Search for Extra-Terrestrial Intelligence. A number of SETI League volunteers serve on the IAA's SETI Committee, which I am privileged to co-chair along with Dr. Claudio Maccone, one of The SETI League's most active members. The lecture honors longtime SPSG member and former chairman Dr. John Billingham, a major force for forty years in promoting innovation within the SETI field. Speakers are selected by the Committee, with one Cutting-Edge Lecture delivered each year at the opening of the SETI II (SETI and Society) sessions of the IAA Symposium on SETI, at the annual International Astronautical Congress.

The BCEL was first proposed by, and initially endowed by, longtime Committee member Dr. Allen Tough (Professor Emeritus, University of Toronto; Chief Scientist, Invitation to ETI). Allen was a SETI League stalwart, an early Life Member who served us in several leadership positions, ranging from Regional Coordinator to Chairman of our Strategic Planning Committee. Though it is no longer a compensated lecture, the BCEL continues, now honoring the memories of Tough, who passed away in 2012, and Billingham, who died this year. Thus, I was honored by being scheduled to present the 2013 Billingham Cutting Edge Lecture, in Beijing, China in late September.

The project to be described in my 2013 Billingham Cutting Edge Lecture forms the bulk of this Special Issue of *SearchLites*. It details Prof. Allen Tough's final SETI research effort, and elucidates an analysis in which he was actively involved at the time of his death on 27 April, 2012. I am indebted to Prof. Tough for his tutelage and collaboration on this, and many other, SETI projects over the years, and would like Tough to be recognized as the rightful co-author of the present work. ♦



2013 Billingham Cutting Edge Lecture:

Analyzing the Stephens Mystery Signal

by H. Paul Shuch
Executive Director Emeritus,
The SETI League, Inc.

ABSTRACT

In April, 2012, longtime Canadian SETI researcher Robert Stephens informed The SETI League, Inc. of his reception of an unknown signal suggestive of extraterrestrial intelligence. Because of Mr. Stephens' reputation and extensive experience, the author opted to drive up to Stephens' Area 31 Radio Observatory personally, to participate in signal verification activities. He observed the signal in question, found it to exhibit a temporal persistence inconsistent with sidereal motion, and devised an experiment to test (and invalidate) the hypothesis that the signal was entering the receiver through the facility's antenna. This test was thus unable to confirm the Stephens Mystery Signal as a valid SETI candidate. Neither was it able to disprove Mr. Stephens' hypothesis that the signal observed was a manifestation of extraterrestrial communications sent by a mechanism heretofore unknown to humankind.

KEYWORDS

SETI, radio astronomy, radio telescope, signal verification, Stephens Mystery Signal

APRIL FOOL

If the email had come from anyone else, I might well have disregarded it out of hand. After all, as Executive Director Emeritus of the nonprofit SETI League, I am constantly bombarded with (generally unsupportable) claims of extraterrestrial contact. The date of this latest claim, 1 April 2012, was in itself suspicious, and I am no fool.

But then, neither is Robert Stephens. A highly respected Canadian radio astronomy enthusiast, Stephens had studied under the legendary John Kraus at the Ohio State University, had built his first radio telescope in the early 1980s, and had performed credible SETI research at both the Algonquin Observatory and much farther North, at a decommissioned DEW Line station. He was, to my knowledge, not one to make unsupportable claims. So, after consulting with Prof. Allen Tough (with whom Stephens had already spoken), I drove a day up to Rob's Area 31 Radio Observatory in Ontario Province, to see for myself what Stephens had uncovered.

THE AREA 31 RADIO OBSERVATORY

The detection in question occurred at Rob Stephens' personal radio observatory north of Toronto. The facility consists of a number of radio telescopes operating over a wide range of microwave frequencies. In the case of the subject detection, the instrument in use is a repurposed Telesat Canada Anik communications satellite uplink/downlink station, consisting of a 4.5 metre diameter Cassegrain parabolic reflector, illuminated by a 3.7 to 4.2 GHz high-efficiency feedhorn driving a broadband, low-noise GaAs FET preamplifier (Fig. 1).

Rather than applying the output of the preamplifier to a stable downconverter as initially implemented, Stephens had modified the receiver to crystal-video configuration, with the preamplifier's output signal further amplified before applying it to a bandpass filter, square-law detector, and baseband amplifier (Fig. 2). The baseband signal is then digitized in the sound card of a personal computer, which then performs a fast fourier transform, the results of which are seen as a waterfall display on a computer monitor. The result is a highly sensitive

direct-power radio telescope responding to the amplitude changes of any C-band signal falling within its capture area.



FIGURE 1: THE 4 GHz, 4.5 METRE RADIO TELESCOPE AT ROBERT STEPHENS' AREA 31 RADIO OBSERVATORY IN CANADA

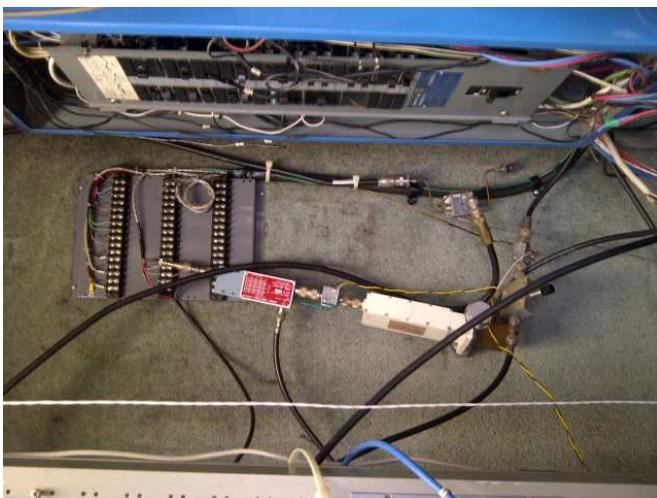


FIGURE 2: PRECISION SQUARE LAW DETECTOR USED AT THE AREA 31 RADIO OBSERVATORY

Stephens related to me that, beginning on 1 April and continuing for some weeks thereafter, the waterfall display revealed glyphs of apparently intelligent origin, emerging from out of a visual background of random noise with varying signal-to-noise ratio. The patterns he observed were described as containing both an apparent alphabetic or numeric symbology, and morphologies suggestive of alien faces (Fig. 3).



FIGURE 3: ROBERT STEPHENS ANALYZING THE STEPHENS MYSTERY SIGNAL ON AN FFT-DSP WATERFALL DISPLAY

From the earliest days of SETI science, it has been suggested that interstellar communications between diverse species might well be facilitated by the transmission of pictograms. It was my desire to see these pictograms for myself that motivated my visit to Stephens' facility.

THE DRIFT-SCAN DILEMMA

The Anik terminal being used by Stephens operates in meridian transit, or drift-scan, mode. That is, the declination being observed is set by an elevation rotor, the antenna is aligned with a meridian of longitude, and it is the rotation of the Earth itself that provides right ascension aiming, so that a full 360 degree scan is made over 23 hours and 56 minutes of time (one sidereal day).

In order to time my visit to coincide with a period of detectability, I asked Stephens for the right ascension and declination from which the signals appeared to be emanating. His rather startling response was: "Come up any time. The signals are continuously present."

This statement was reminiscent of the serendipitous 1964 discovery of the cosmic microwave background radiation, by Arno Penzias and Robert W. Wilson at Holmdel NJ. They stumbled across a signal which was always present, seeming to come from all directions as their antenna completed its drift-scan of the heavens. Their reluctant conclu-

sion was that the signal was coming from *everywhere*. Could the Stephens Mystery Signal be somehow associated with the cosmic microwave background?

Penzias' and Wilson's historic detection was, after all, made at 4 GHz, the same frequency band which Stephens was monitoring. Rob and I speculated about the ability of a truly advanced extraterrestrial civilization to modulate the cosmic microwave background. This was an intriguing hypothesis that just might be testable.

THE EXPERIMENT

In early May of 2012, I traveled to Stephens' Area 31 Radio Observatory north of Toronto, to observe for myself the phenomenon in question. Stephens was quite hospitable, and I found his facility to be well equipped and professionally operated and maintained. The pictograms which he had described were not immediately visible to me on his waterfall display, appearing to my untrained eye to be nothing more than random thermal noise. Rob insisted that, buried in that noise, could be detected alphabetical, numerical, and mathematical symbols indicative of extraterrestrial intelligence, in a language and symbology unknown to him. I could see how one might so interpret such apparent patterns in the noise.

To determine whether the artifacts in question were actually coming through the antenna, I devised an experiment to isolate the receiver from its antenna-mounted front end. The coaxial cable connecting the antenna-mounted low-noise preamplifier to the balance of the receiver system was removed. An identical high-performance preamplifier inside the shielded equipment trailer was connected to the square-law detector via a precision variable attenuator. To that amplifier's input waveguide connector I attached a waveguide directional coupler terminated in a precision matched dummy load. A solid-state diode noise source was connected to the coupled port of the directional coupler through another precision variable attenuator, and the noise diode was reverse-biased into breakdown with a 24 volt DC power supply (Fig. 4). This arrangement enabled duplication of the gain and noise profile of the

complete radio telescope, while preventing any input signals other than random thermal noise from entering the signal path.



FIGURE 4: STEPHENS WITH THE APPARATUS USED IN THIS EXPERIMENT TO ISOLATE THE ANTENNA INPUT FROM THE RECEIVER CIRCUITRY

Having totally isolated the receiver circuit from any possible signal artifacts entering via the antenna, I activated the calibrated noise source and asked Mr. Stephens to observe the waterfall display on his signal analysis computer. When asked if his mystery signal were still visible, he answered in the affirmative (Fig. 5). Thus, I concluded that the observed phenomenon was not a microwave SETI candidate signal being received in the conventional manner.

ANALYSIS OF EXPERIMENTAL RESULT

It is widely documented and well established that the human eye-brain combination is especially well adapted to pattern recognition – in fact, such a skill has remarkable survival value for predator and prey alike. The scientific record is replete with ex-

amples abundant of observers seeing patterns where in fact none exist. A familiar case is the appearance of a human face on the surface of Mars, detected by the Viking spacecraft in 1976. Subsequent high-resolution analysis by the Mars Global Surveyor space probe some decades later proved the “Face on Mars” to be nothing more than a trick of light and shadow playing down on a pile of rocks, but those who were enamored of alternative explanations continue to this day to “see” a human face, and to concoct conspiracy theories to refute the widely held scientific explanation.

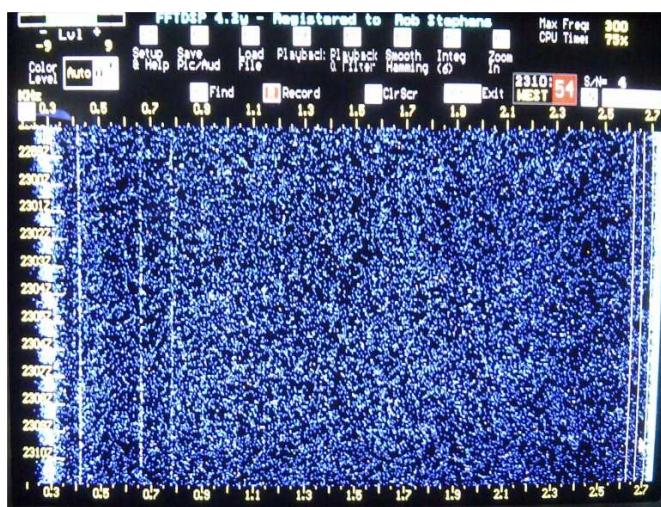


FIGURE 5: FFT-DSP WATERFALL DISPLAY WITH THE RECEIVER INPUT ISOLATED FROM THE ANTENNA

In the present case, I must give serious consideration to the hypothesis that Mr. Stephens is seeing glyphs and patterns in random noise, precisely because that is what he fervently wishes to see. In fact, in addition to alphanumeric and mathematical symbols, he told me he could detect faces, which he said resembled “monsters” and “gargoyles.” I am no psychologist, but I have to wonder whether a noise pattern on the screen might in fact be a very effective Rorschach test illuminating a combination of the observer’s hopes, dreams, and fears. Rather than an example of extraterrestrial intelligence, one might consider this experimental result as possible evidence of intelligence that resides within the observer. In any case, it clearly isn’t RF coming in from photons captured by the antenna.

THE RESEARCHER’S HYPOTHESIS

Confronted with clear evidence that the phenomenon being observed was not a conventional radio astronomy detection, Mr. Stephens hypothesized that he was observing communications from an extraterrestrial civilization beamed somehow directly into his computer, through a mechanism unknown to humankind. Though there is no way I can dispute this hypothesis, neither is there any way that I can test it, since the mechanism of communications is unknown to us. Since I can neither confirm nor invalidate the observation as being extraterrestrial in nature, we are left with an enigma. Mr. Stephens firmly believes in the existence of intelligent extraterrestrial beings (as, in fact, do I). He also fervently hopes to establish their existence through scientific evidence (as, in fact, do many in the SETI community), and hopes to personally establish contact (as, in fact, do most thinking humans). Whether his hopes inform his observation, perhaps to the detriment of objectivity, is not a judgment I am prepared to make. Yet, the possibility must be considered.

For now, the Stephens Mystery Signal remains yet another example of an inconclusive result from an otherwise well designed and executed SETI experiment.

CONCLUSION

Prof. Allen Tough once said that SETI research required the patience, intellect, perseverance, and objectivity of a Sherlock Holmes. In literature, Holmes is said to have stated: “Once you have eliminated the impossible, whatever is left, no matter how unlikely, must be the truth.” However, in SETI science (and, in fact, in science altogether), truth requires rigorous scrutiny, and independent verification. The Stephens Mystery Signal has been subjected to such scrutiny, and (at least to date) has defied independent verification. Thus, it seems appropriate in the present case to paraphrase Sir Arthur Conan Doyle: “Once you have eliminated the testable, whatever is left, no matter how tantalizing, must remain a mystery.”



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 29 - September 2, 2013: *Lonestarcon 3*, 71st World Science Fiction Convention, San Antonio TX.

September 23 - 27, 2013: *64th International Astronautical Congress*, Beijing, China.

October 18 - 19, 2013: *Microwave Update 2013*, Morehead, KY.

November 8 - 10, 2013: *Philcon 2013*, Cherry Hill, NJ.

March 17 - 21, 2014: *Search for Life Beyond the Solar System*, Tucson, AZ.

April 19, 2014, 0000 UTC - 2359 UTC: Fifteenth annual SETI League *Ham Radio OSO Party*: 3.551, 7.0309, 7.2039, 14.084, 14.204, 21.306, and 28.408 MHz.

April 20, 2014: Twentieth SETI League *Annual Membership Meeting*, Little Ferry NJ.

April 25 - 26, 2014: *Southeastern VHF Conference*, Atlanta, GA.

April 26, 2014: Northern Lights Radio Society *Aurora Conference*, White Bear Lake, MN.

May 23 - 28, 2014: *Balticon 48*, Hunt Valley, MD.

June 29 - July 2, 2014: *Society of Amateur Radio Astronomers Conference*, National Radio Astronomy Observatory, Green Bank WV.

August 14 - 18 August, 2014: *Loncon3*, 72nd World Science Fiction Convention, London, England.

September 29 - October 3, 2014: *65th International Astronautical Congress*, Toronto, Canada.

April 18, 2015, 0000 UTC - 2359 UTC: Sixteenth annual SETI League *Ham Radio OSO Party*: 3.551, 7.0309, 7.2039, 14.084, 14.204, 21.306, and 28.408 MHz.

April 19, 2015: Twenty First SETI League *Annual Membership Meeting*, Little Ferry NJ.

April 24 - 25, 2015: *Southeastern VHF Conference*, Morehead, KY.

October 2015 (dates to be announced): *66th International Astronautical Congress*, Jerusalem, Israel. ♦

Extraterrestrial Visitors? No Way!

by Dr. John Boardman

There are persistent rumors that extraterrestrials have contacted Americans, including members of the armed forces and other government officials, but that the government is keeping all such contacts secret. Now, six former members of Congress are claiming that such secret contacts were made, and are demanding that they be made public. (Andrew Siddons, *New York Times*, 4 May 2013). Ex-Senator Mike Gravel (D-AK) actually delivered himself of the remark: "Something is monitoring the planet, and they are monitoring it very cautiously, because we are a very warlike planet." This remark merely indicates that Senator Gravel has given up all hopes of being returned to public life by the electorate, even in a state which has elected Sarah Palin. Other ex-legislators in this group are Roscoe G. Bartlett (R-MD), Carolyn Kilpatrick (D-MI), and Merrill Cook (R-UT). Representative Bartlett once represented the district where I live, but was booted out last November by voters who objected to his numerous statements bearing little relation to reality.

Believers in frequent visits to Earth by extraterrestrials blithely ignore numerous scientific facts. For one thing, it's a *very* big universe. Distances from our Sun to other stars have to be measured in light-years, the distance light travels in one year. One light-year is just under 9.5 trillion kilometers or, in medieval measurement, about 5.9 trillion miles. And the star nearest to the Sun is a triple star system with at least one known planet, Alpha Centauri, 4.4 light years away. Going there would not be Columbus spending three months crossing the Atlantic, but a staggering engineering operation.

As for travel faster than light, this is not a scientific reality, or even a reasonably based speculation, but a creation of science fiction writers who want travel times to fit into their plot lines. More than a century ago, Albert Einstein showed in the special theory of relativity that nothing could travel faster than light. Since then, no scientific fact or reasonably based theoretical argument has found anything wrong with this concept. I can speak with some authority here, since I was a student of Peter G. Bergmann, himself an associate of Einstein at Princeton.

So, unless their lifetimes are fantastically long compared with ours, no extraterrestrials are likely to be landing their spaceships on Earth and confounding yokels with strange stories, or even (as some "reports" have it) by sexual intercourse with them. There is a reason why such reports come from remote deserts or isolated rural communities, rather than from an alien spaceship landing at Harvard's Department of Astronomy or India's Tata Institute. ♦

Guest Editorial: Will Extraterrestrials Understand a Message We Send?

by Michael Chorost

One day a message is received from the sky. It consists of a long string of bits - 400,000 of them, in fact. After some puzzlement, scientists figure out that it consists of 22 pages. Can we even begin to understand a message like that? Is it the product of minds that we couldn't comprehend?

Actually, this isn't a message from aliens. But it is a message from humans. It was transmitted from the Evapatoria Deep Space Antenna in Evapatoria, Ukraine to four target stars between May and July 1999. It's called the Cosmic Call.

Can we assume that this message will be understood by any intelligent alien mind? What hidden assumptions of ours might not be shared?

The actual message is just a long string of bits. It starts like this:

This is clearly not random. There is that suspiciously long string of 1's at the beginning, 128 of them in fact - and 128 is a suspiciously important number, two to the seventh power. It's followed by 125 zeros, and the rest of it looks patterned too, with plenty of 000 triplets. This does not look like noise. It looks like a message.

Let's skip over the complexities of figuring out that this is a message and reconstructing it properly. Our alien recipient has 22 pages of cryptic glyphs. What could stop them from understanding it?

We have to assume several things: that the recipients understand the idea of sequentially numbered pages, that they understand left-to-right, top-to-bottom reading, and that they understand the concept of information stored in a two-dimensional format. And, they have to understand the idea of writing itself. How reasonable are these assumptions?

Sequentially numbered pages are relatively new in the history of humankind. The Gutenberg Bible, printed in 1455, had no page numbers. Page numbers emerged gradually as writers and readers learned their value in clarifying and organizing content. Indeed, bound pages themselves are relatively new, developed by the Romans to replace scrolls in the first few centuries A.D. (The problem with the scroll is that it doesn't permit random access or easy use of both sides of the paper; bound pages do.)

I think pages are inevitable, and once developed, numbering them for information retrieval seems inevitable too. I think that just about any smart alien will understand pages. And once you have pages, you have the concept of information storage on a two-dimensional surface.

The idea of writing is trickier, as human writing is an encoding of speech. Speech is based on muscular vibrations in our throats, which we combine with lung exhalations and tongue and lip motion to convert into a flow of distinctive sound vibrations. Is there something about sound that is more attractive than any other option, such as gestural language

(used by deaf people), pheromonal signaling (used by ants), or visual signaling (which might be used by octopi by manipulating chromatophores in the skin)?

Sound certainly seems to be ubiquitous: it's used by phyla that diverged from each other many millions of years ago, including birds, primates, dolphins, and whales. Perhaps sound is the most metabolically efficient mode of communication, requiring the least expenditure of energy, and it doesn't require close proximity or eye contact. It may also be the easiest for intelligent minds to segment into representational units (e.g. phonemes) and code in a written form. There is a direct and easily memorizable connection between a phoneme and the letters that represent it. (For this editorial, I'm setting aside ideographic languages like Chinese, which present a whole different set of issues.)

It's worth noting that American Sign Language has no widely accepted written form. Why this is, I don't know. One reason is certainly that ASL users can use English for writing, though that's not easy, since it requires translating as well as transcribing. (ASL has a completely different syntax than English.) It's also probably harder to break gestures down into a limited repertoire of handwritten shapes. English has about 40 phonemes and 26 letters, and once you master that you can write any spoken word. I don't see how one could do that for a signed language except by using an ideographic language - and perhaps that's too much work. However, signed languages are also much younger than spoken ones, so it may simply be that their users haven't had the time nor the motivation to develop written forms.

Anyway, my point is that sound may simply meet more of an intelligent mind's needs than other modalities. If this is so, then writing may follow more or less inevitably - and writing on some kind of mashed-cellulose product, along with page numbers and all.

Left-to-right, top-to-bottom writing is hardly guaranteed. Humans may write left-to-right because most of us are right-handed. (Writing in the other direction smears the ink.) I know, this doesn't explain Hebrew or Arabic, and some ideo-graphic languages are written top to bottom, like Japanese. (At least it's written that way in the Japanese translation of my first book, REBUILT.) But in any case, it doesn't matter. The convention is easy to explain. In the first page of Cosmic Call 1999, the primes are written left to right, top to bottom. Simple. Done. The recipients can easily translate it into any other format they like.

In any case, it'll only make sense if they read it left-right, top-bottom. It won't make sense any other way.

As I write this I wonder if I am telling just-so stories, accounts in which our way of doing things is justified as the only possible way. But SETI fascinates me because it's an attempt at peeling back the surface of our own assumptions. What is accidental? What is fundamental? Since we have only ourselves and a handful of moderately intelligent co-dwellers on Earth to go by, we can't really answer this question. Yet. But it is fun to try.

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