# IAC-13-A4.2.01 Analyzing the Stephens Mystery Signal (2013 Billingham Cutting Edge Lecture)

by H. Paul Shuch Executive Director Emeritus, The SETI League, Inc. 121 Florence Drive, Cogan Station PA 17728 USA drseti@verizon.net

#### 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

#### THE BILLINGHAM CONNECTION

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. 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 to be selected by the Committee, with one Cutting-Edge Lecture to be delivered each year at the opening of the SETI II 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). Though no longer a compensated lecture, the BCEL now honors the memories of Tough (who passed away in 2012) and Billingham (who died this year).

The project described in this paper represents Prof. Tough's final SETI research effort, and elucidates an analysis in which he was actively involved at the time of his death. The author is 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.

### **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 highefficiency 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.

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).

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 conclusion 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. Α 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.

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 recogni-

tion – in fact, such a skill has remarkable survival value for predator and prey alike. The scientific record is replete with examples 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.

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."



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



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



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



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