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The SEnTInel (SETI News)

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Detection of Planets near Distant Stars

Current optical telescopes and photographic techniques probably are not powerful enough to definitely establish the existence of planets outside our own solar system, according to Professor George Gatewood of the University of Pittsburgh.* (* Congress of the International Astronautical Federation, Dubrovnik, Yugoslavia, October 1978) He specializes in astrometry (the measurement of star positions to extreme accuracy) and has been searching for tiny back-and-forth motions of stars that would reveal the existence of orbiting planets. The planets themselves are too dim to be visible directly, but since planets and their parent star revolve around their common center of mass (rather than around the center of the star as is commonly believed), planetary existence can be detected by the rhythmic motion of the star during each planetary revolution. Since stars are much larger than planets, their common center of mass is much closer to the star then to the planet, typically lying somewhere near the surface of the star. This means that the back-and-forth motion is only about twice as big as the star itself.

The fundamental limitation thus far in finding these tiny motions has been the irregularities in the Earth's atmosphere. Since the atmosphere is not perfectly uniform and stationary, stars appear to jiggle around a little bit (the same effect also causes twinkling). This makes it difficult to measure their positions accurately. Gatewood is now developing a new technique that will overcome a large part of this problem. He has discovered that all the stars in any small area of sky jiggle together, like synchronized dancers. By continuously tracking the positions of several other nearby stars in addition to the one he suspects of having planets, Gatewood is able to measure the relative position of the suspect star with respect to the others, almost independently of their common jiggling. This technique increases the accuracy of the measured position to the point that planets the size of Saturn could be detected up to 15 light years away.

The next limitation is the imprecision of existing optical telescopes. Gatewood points out that telescopes have never needed to be any better than they are now, since the atmosphere always limited their ultimate accuracy. Using Gatewood's technique, however, the telescope becomes the limiting factor. Gatewood proposes to overcome this limitation by building a telescope specifically designed for this purpose. The telescope itself would be completely stationary, with starlight being reflected into it by a moveable flat mirror. This would eliminate the slight elastic bending that occurs in the large glass lenses of other telescopes as they tilt to look at various angles in the sky. The telescope would also be in a vacuum, to eliminate the refractive effects of air between the lenses. Such a telescope would double the range at which planets could be detected, enabling Saturn-size planets to be found at 30 light years.

The ultimate solution proposed by Gatewood is to put the entire telescope in space. This would eliminate the effects of the atmosphere and gravity completely, and allow planets as small as the Earth itself to be found at 30 light years. There are about 200 stars within this range, and investigation of all of them would provide a clear indication of how common planets (and by inference, life forms) are in the universe.

Mars Life Search Inconclusive

A conference about the planet Mars was held recently at the California Institute of Technology in Pasadena, California. About 500 scientists from a dozen different countries participated and presented the results of their research programs. It seems clear that water is present on Mars in the form of permafrost and snow, but the Viking lander data about life forms is still inconclusive. Dr. Harold Klein of the NASA Ames Research Center at Mountainview, California, said that the most likely meaning of the Viking data is that no life forms were found, but that their absence is not yet proven.

Chemotons – The Fundamental Particles of Life

The random evolution of highly complex organic molecules does not lead directly to life forms. The missing ingredient is the overall organization of the molecular complex in such a way as to produce life-like characteristics such as individuality, self-regulation and control, growth, proliferation, heredity, adaptivity, and the ability to evolve into more complex systems. So says T. Ganti, of the University of Eotvos Lorand in Budapest, Hungary.* (*Congress of the International Astronautical Federation, Dubrovnik, Yugoslavia, October 1978) He has named the smallest particle of life having these characteristics to be the Chemoton. This is analogous to the way that an atom is the smallest particle having the properties of an element, and a molecule is the smallest particle having the properties of a compound.

Ganti states that a Chemoton consists of three components, each of which is itself a complex organic system, each of which is capable of reproducing itself, and each of which is believed to already exist in nature, and be capable of spontaneous formation by random chemical evolution.

The first component of a Chemoton is a chemical system which reacts with adjacent raw materials to produce additional quantities of itself.

The second component is a chemical system which reacts with adjacent raw materials to produce higher and higher polymers (more complex versions) of itself. The third component is a chemical system whose physical characteristics are such that it always exists as a thin membrane. Chemical membranes of this type generally exist as spheres, and Ganti says they have been observed to spontaneously divide into two identical spheres.

The mechanism by which these three components could be fused to form a Chemoton is not yet known, but putting that problem aside for the moment, Ganti has analyzed the behavior of the Chemoton itself. He has used a computer to solve the system of nonlinear differential equations that describes the behavior of a Chemoton, and finds that it does in fact possess all the characteristics of life described above.

Ganti is continuing his research into the formation of the three necessary components and into their fusion. He states that his research, if successful, will demonstrate that the spontaneous formation of living systems is neither accidental nor miraculous, but is inevitable wherever and whenever suitable conditions exist.

Ionizing Radiation May Have Started Life

The role of ionizing radiation (gamma rays, electron or proton bombardment) in the formation of elementary life may have been underestimated, say the husband and wife team of Ivan and Zorica Draganic, from the Boris Kidric Institute of Nuclear Sciences in Vinca, Yugoslavia.* (*Congress of the International Astronautical Federation, Dubrovnik, Yugoslavia, October 1978) Most investigators consider ultraviolet light to be the source of energy that gradually created more and more complex organic molecules from the elementary molecules present on primordial Earth.

The Draganics point out that ionizing radiation was more intense and widespread in the past than it is today. Examples of this are the radiation from supernovae that have probably occurred near the Earth several times during its history, and the occurrence of natural nuclear reactors. Uranium 235 (the kind used in reactors) was much more abundant in the early history of the Earth than it is now, and natural sedimentation processes are known to concentrate uranium into deposits. A natural deposit containing only a 5% concentration of uranium need only be 3 1/2 meters in diameter to be a critical mass. This would start a chain reaction producing heat and ionizing radiation, in exactly the same way that man-made atomic reactors produce energy and radiation. Such naturally-occurring nuclear reactors are known to have occurred, since the remnant of one was recently found in Gabon, Africa.

The Draganics believe that natural reactors were probably widespread in the early history of Earth. Since the energy available for the synthesis of organic molecules was much larger in the vicinity of these reactors than that generally available from ultraviolet light and other sources, the reactors may have been the parents of the first life-like molecules.

Computer Program Exhibits Life-Like Behavior

It is possible to create computer programs that exhibit life-like characteristics such as self-reproduction, random evolution (mutation) and purposeful evolution (self-modification toward a desired capability). Michael Zeidler, a computer consultant from Milwaukee, Wisconsin, has developed a method of creating such a program.* (*"Digital Design," August 1978) His purpose in doing so was to reduce the amount of work required to program complicated problems on computers.

Zeidler starts out with two separate programs in the same computer, each of each is capable of calculating only a crude approximation of the required answer. Each program can also modify the other program. In actual operation, one program starts out, obtains a crude result, and modifies the other program in such a way as to improve it. Then the second (now improved) program runs, obtains a better solution, and modifies the first program. The two programs continue to take turns solving the problem and modifying each other in a constructive way, so that ultimately the exact answer is obtained.

The important thing is not the answer, but the final program that calculates the answer. That program can then be saved and used to solve similar problems elsewhere. Zeidler points out that the evolution and cooperation among his programs is similar to that of life forms. It is an easy matter for a computer program to make one or more copies of itself, analogously to the reproductive process of life. Mutation can occur if the copies are not exactly the same as the originals, which might occur either accidentally or purposefully.

Zeidler speculates that unconstrained programs capable of self-evolution and mutation might ultimately exhibit unpredictable and perhaps intelligent (or even dangerous) behavior. Since computers are so fast, evolution could occur faster than human observers could keep track of it. These are interesting notions, telling us that the line dividing artificial from natural intelligence is getting thinner, and that if we ever find intelligence elsewhere in the universe, it may not be obvious which kind it is.

Large SpaceAntenna Planned

The U.S. Air Force is making plans to launch a 183 meter diameter antenna into Earth orbit by 1985.* (*"Electronic Warfare/Defense Electronics," October, 1978) The collapsible antenna structure would be carried aloft by the Space Shuttle in two pieces. Each piece would be expanded to full size while in space, and the two would then be joined to create the full 183 meter structure. The Air Force plans to use the antenna as a radar to track ships, aircraft, missles and other vehicles down on the Earth. The radar will use a 50 kilowatt transmitter and operate at a frequency of about 1.2 gigahertz. The antenna is not the conventional parabolic dish type, but consists of thousands of small wire antennas (called dipoles) fastened onto a flat, light-weight grid structure. This type of antenna (known as a phased array) is capable of steering its beam around very rapidly, without actually moving the entire structure at all.

A second purpose of the antenna is to provide experience in constructing and operating large structures in space. Even larger structures are planned for the future, such as a huge solar power satellite. The implication of this project for SETI is that the technology will soon be at hand to construct large antennas in space, suitable for all purposes, including SETI.

Signal-seeking System to be Designed

Each summer, a number of special research and design projects are carried out at many American universities, in cooperation with various military and civilian research organizations. Each project is on a different topic, and about 20 university scientists from all across the country are chosen to participate in each project. The purpose of these projects is to provide experience and training for the participants, and to provide useful results to the host universities and cooperating research organizations. Project Cyclops, held in 1971 by Stanford University and the NASA Ames Research Center is perhaps the most well-known example of these projects to readers of **COSMIC SEARCH**.

This summer, the University of Santa Clara, in cooperation with the NASA-Ames Research Center, is sponsoring a project to design a system capable of finding the few meaningful data points that may exist within the millions of data points that will be gathered every second by the SETI receivers now being planned. The project will be directed by Professor Timothy Healy, of the Department of Electrical Engineering and Computer Science at the University of Santa Clara, California. If the design team is successful, their system will also find wide usefulness in other areas such as earthquake prediction, location of earth resources from satellite data, and medical diagnosis.

The problem is very difficult, since the system has no way of knowing exactly what to look for. An analogy is to imagine yourself searching for an unknown man-made object that might or might not be present somewhere in a large jungle, and you have only one second to complete the entire search. If you could see the object, you would probably instinctively recognize it as being man-made, but you don't have enough time to search the whole jungle for it. Thus you are forced to construct a high speed machine (a computer) to do it for you. The only problem is, how does the machine distinguish between a man-made object and a tree or an elephant or a rock? This is the central problem to be solved by the design team. **COSMIC SEARCH** wishes them success.

SETI Hearings in Washington

The first Congressional Hearings ever held on the subject of the Search for Extraterrestrial Intelligence took place in Washington September 19-20, 1978. Seven scientists and engineers presented their views to the Subcommittee on Space Science and Applications of the House Science and Technology Committee.

Subcommittee Chairman Don Fuqua (D-Fla.) introduced the hearings by noting that the House and Senate authorization committees that deal with space science and technology had both approved NASA's request for $2 million to begin an initial SETI program, but that the Appropriations Committees of both Houses had cut this to zero in conference. Fuqua said that, while the prospects for successful search may be remote, either a positive or negative outcome could have significant implications for our society.

All witnesses agreed that the search was a legitimate activity, though most believed the likelihood of success was small, and that the level of effort and funding devoted to it should be modest. Several argued that SETI should not be seen as a separate project, but as part of a broader research effort aimed at understanding the evolution and frequency of life in the universe. Some suggested that detection, if it occurred, was likely to be a serendipitous spin-off from normal scientific research. None of the witnesses speculated extensively about the consequences of detection and contact.

The leadoff witness was Dr. Richard Berendzen, Provost of the American University. His remarks were presented in the March 1979 **COSMIC SEARCH**.

Berendzen at hearings

Berendzen was followed by Professor Philip Morrison of the Massachusetts Institute of Technology, who titled his presentation "Twenty Years After." His remarks are the same as appeared in the January 1979 issue of **COSMIC SEARCH**.

Hinners at hearings

The third witness was Dr. Noel Hinners, NASA's Associate administrator for Space Science. He described NASA's proposed SETI program as an imaginative, relatively low-cost gamble that could provide immense rewards if successful, and an excellent return of science data and technological development regardless of the SETI aspect. We can not judge whether or not a SETI search will be successful; we have not yet made a meaningful try. The transmitters necessary to be detected require little or no advance from our relatively young technology. (Hinners made clear that he was not proposing that we broadcast). There may be civilizations in our galaxy that reached our state of development billions of years ago. By looking for other civilizations, we are in effect trying to look into our own future.

Hinners described NASA's two-tier strategy: the JPL all-sky survey, and the NASA Ames targeted search. NASA considers it better to make a broad radio survey first on account of increasing pollution of the airwaves. The microprocessor revolution makes possible the million-channel analyzers that are at the heart of both programs. Hinners emphasized that the radio SETI search is only one approach to the broader question of understanding the origin of life in the universe.

The afternoon session opened with the testimony of Dr. George Pimentel, Deputy Director of the National Science Foundation, who said he was speaking as an individual. In Pimentel's view, the relatively small-scale SETI experiments being conducted today are proper efforts. They consume only a minute portion of the time and resources available for scientific research, and have a rightful place in scientific inquiry.

Pimentel was followed by Dr. A. G. W. Cameron, Chairman of the Space Sciences Board of the National Academy of Sciences.

Cameron said SETI is one important component of a larger and extremely fundamental question: What is the role of biology in the universe? To the degree that we ask about intelligence, we also involve the social sciences. Whether a search shows that we have lots of neighbors or that we are alone, the answer will be very important to the human race and its ultimate development. If humans prove to be a long-lived species, their ultimate destiny will be quite different in these two cases, but it would be premature to judge that one destiny would be better than another.

Cameron concluded his remarks by stating that SETI activities should have a place among NASA scientific programs.

The first witness on the second day was Dr. David Heeschen, former Director of the National Radio Astronomy Observatory (NRAO), where several SETI searches have been conducted. Heeschen described the development of ideas about intelligent life beyond the Earth as one of the major intellectual and philosophical events of this century. The searches rank among the most important developments of recent times; Heeschen was proud that NRAO has been involved in them. At NRAO, he noted, such searches have never taken more than 1 percent of total observing time in a given year. In conclusion Heeschen said that we should support as much as we can afford and as the most able people are willing to undertake.

The last witness was Bernard Oliver, Vice-President for Research and Development of the Hewlett-Packard Corporation, and Co-Director of the NASA sponsored Project Cyclops study in 1971. Oliver's comments are presented in full elsewhere in this issue of **COSMIC SEARCH**. An editorial by Oliver on SETI-funding appeared in the March 1979 issue of **COSMIC SEARCH**.

Questions and Answers

Congressman Lloyd (D-Calif.), apparently referring to the Golden Fleece Award Sen. Proxmire gave to NASA's proposed SETI program, asked how SETI could avoid political cheap shots. Berendzen said that the answer is education; Morrison that SETI would be well received by the public; Hinners that SETI needs more exposure in the appropriations committees. Lloyd commented that supporters of SETI must bring it into the public arena so that politicians can help them.

Congressman Winn (R-Kan.) asked why the Space Science Board has not taken a position on SETI. Cameron replied that NASA has not asked the Board for an opinion. Oliver noted that the 1958 Space Act included the search for life as part of NASA's charter.

The Subcommittee staff deliberately avoided publicizing the hearings in advance out of fear of an influx of "fringe types." As a result, public attendance was sparse, and although only a few media representatives came to the opening session, there was some press coverage (see, for example, the WASHINGTON POST editorial reprinted elsewhere in this issue of **COSMIC SEARCH**). The absence of such well-known SETI personalities as Carl Sagan and Frank Drake, and the lack of witnesses from the social sciences and the humanities was noteworthy. Congressional attendance was thin, partly because the hearings were concurrent with the signing of treaties by President Sadat and Prime Minister Begin.

(An 89 page report on the hearings entitled "Extraterrestrial Intelligence Research" (No. 97) is available from the U.S. Government Printing Office.)

SETI Puzzle (A Cryptographic Exercise)

Suppose that the message below were received at one of our radio observatories.* (*Contributed by Timothy Healy. See page 41 for hint.) This small portion might be a "signature page". Can you decide who sent the message, when it was sent and where it came from?

1	1	1	0	1	0	0	1	0	0
0	0	1	0	1	1	1	0	0	0
1	0	0	0	0	0	0	0	1	1
1	0	0	0	0	1	0	1	0	0
0	0	1	1	1	0	1	1	1	1
0	0	0	1	0	1	1	0	0	0
1	1	1	0	0	0	0	0	0	0
1	0	0	1	1	0	1			

[From page 41: SETI Puzzle (page 30) Hint: If you can't think of how to start, you might look at Chapter 30 of I.S. Shklovsky and C. Sagan, **Intelligent Life in the Universe**, Holden Day, Inc., 1966.

Miscellaneous

Heaven and earth are large, yet in the whole of space they are but as a small grain of rice. It is as if the whole of empty space were a tree, and heaven and earth were one of its fruits. Empty space is like a kingdom, and heaven and earth no more than a single individual person in that kingdom. Upon one tree there are many fruits, and in one kingdom many people. How unreasonable it would be to suppose that besides the heaven and earth which we can see, there are no other heavens and no other earths?

Teng Mu, 13th century philosopher (translated by Joseph Needham)

"Success in any venture is just the intelligent application of previous failure."
Maxie Anderson of the Double Eagle II, the first balloon to float from the United States to Europe.

"It ain't so much the things we don't know that get us in trouble. It's the things we know that ain't so."
Artemus Ward (1834-1867)* (*Contributed by Robert Morton)

The soul of man was made to walk the skies; Delightful outlet of her prison here! There, disencumbered from her chains, the ties of toys terrestrial, she can rove at large...
Edward Young
"Night Thought"
1745

"For thousands of years, people have sought their future in the starry sky. Now this old superstition has at last come true, for our destinies do indeed depend on celestial bodies — those that we have created ourselves."
Arthur C. Clarke.

HOME

Designed by Jerry Ehman.
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