

MAGAZINE SECONDS

SECONDS #32, 1995 • interview by George Petros

S E T I



They're out there — Extraterrestrials, Aliens, Little Green Men, Creatures From Outer Space — and SETI is going to find them.

SETI is an acronym for "Search for Extraterrestrial Intelligence" — a big science project born of Space Age optimism and killed by the pragmatism of the Welfare Age. THE SEARCH FOR EXTRATERRESTRIAL INTELLIGENCE is a radio astronomy project that predicts life on other worlds and systematically looks for radio signals that might reveal intelligent life out there somewhere among the stars. SETI anticipated alien contact as far back as the 1950s, when forward-looking scientists like Frank Drake extrapolated that we were not alone in the universe.

Once upon a time, NASA sponsored the SETI project. But the idea of Life In Outer Space distressed the selfish religious rabble who anticipate divine rescue; therefore the idea of Life In Outer Space distressed politicians, who convinced themselves that in fact we are alone. They were able to get SETI's budget redirected to more pressing things — like fielding an occupation army in Europe, destroying the hemp plant so it can't threaten the liquor industry, et cetera — and so the Search For Extraterrestrial Intelligence project went private.

In order to explain the project and its history we contacted BOB ARNOLD, director of publicity for the SETI Institute. Bob is passionate about SETI's search and is well-versed in the science — and the fiction — that propels it.

“Life is a normal, natural phenomenon likely to develop on planets with suitable environmental conditions.”

SECONDS: *What is the likelihood of life on other places in the universe?*

ARNOLD: The likelihood of existence of life elsewhere in the universe is extremely high. Over the last half century, scientists have developed a theory of cosmic evolution and this predicts that life is a normal, natural phenomenon likely to develop on planets that have suitable environmental conditions. I'd like to point out that scientific evidence shows that life arose on the planet Earth relatively quickly in its history and this suggests that life will occur on similar planets orbiting sun-like stars. With the vast numbers in the observable universe, we are up to four hundred billion of them in our galaxy alone. When you also add to that the probable number of Earth-like habitable planets orbiting other stars, it's considered likely that advanced technological civilizations are widely distributed in the galaxy. SETI is testing this hypothesis by searching for the specific technological manifestations of intelligent organisms in technological civilizations. As of now, it's important to keep in mind that the only life we know of for sure in the universe is what we have on the planet Earth.

SECONDS: *In the cosmic scheme, what purpose does life serve?*

ARNOLD: Those of us in biology do not discuss purpose when it comes to life. We describe what life is, reproducing systems that arise out of matter and the phenomena that's exhibited there, but to ascribe purpose to it is really outside the realm of science. That's the realm of philosophy and religion. All we can do in science is describe what organisms are, how they behave, how they evolve, and the phenomena pertaining to that. When you get in the realm of “What is the purpose of them?” we would say we can't ascribe a purpose to them. It's just something the universe does.

SECONDS: *Beyond the philosophical and religious connotations of it, isn't it possible that there is some physical purpose to it? Isn't it sort of an anti-entropic force that will —*

ARNOLD: A localized decrease in entropy — that's what living systems are. You could say it's the genetic material's way of making more genetic material. These ambulatory genetic systems, if there's any purpose ascribed to it, it's in a Darwinian

sense — they exist at the expense of their environment long enough to make copies of themselves. In the process, living systems evolve. They develop greater complexity over time, this is a real phenomenon. That's as far as I go as far as the discussion of purpose. It's DNA's way of making more DNA.

SECONDS: *Is that what's going on in physical matter too when we see a nucleus shattered or atoms split?*

ARNOLD: Well, yeah. This is the picture of cosmic evolution where energy evolves into matter, matter evolves into life. There are what appear to be — you have to be careful here because this can be a testy subject among scientists — forced processes in nature, there are definitely laws operating — it's not random. There are fundamental principles underlying the behavior of atoms and molecules and then getting into more complex aggregations of molecules.

SECONDS: *But the basic laws remain the same all the way up the spectrum.*

ARNOLD: As far as we can tell, these basic laws pervade the universe. What we see happening on Earth happens in other places. Different roots to complexity, but the basic drift towards complex systems seems to be operating because of the nature of matter. This is based on many years of observations.

SECONDS: *So there's possibly lots and lots of life out there.*

ARNOLD: That is the expectation overall. Change is the only constant in the universe and you ask about the behaviors of other civilizations, all we can say is what we've observed on the Earth. Organisms have developed a technological civilization and engaged in the use of the radio spectrum for entertainment and communications purposes. This phenomenon has happened on Earth and Earth seems to be a normal, run-of-the-mill astronomical object and so if it's happened here — due to the basic laws of physics and chemistry — and these are perfectly normal processes that can give rise to a primate that uses radio transmitters — then this can happen in other places because there can be a thing called convergent evolution where solutions are hit upon in different places because they work. All we can do is extrapolate and say “If it's happened here, it could have happened in other places.” Some subset of these other ecosystems could have developed species that

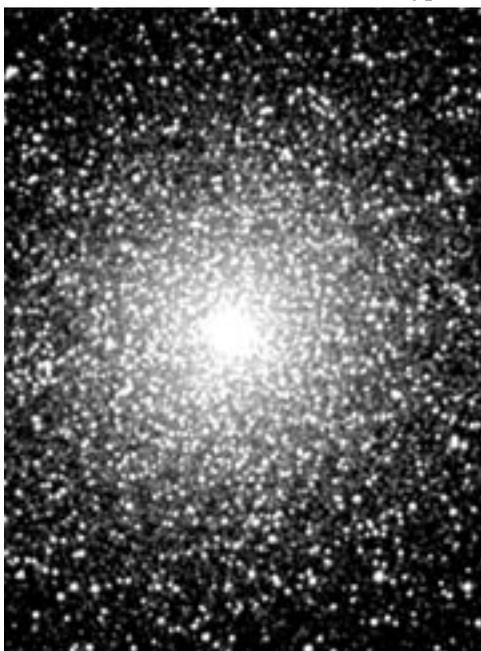
match us in certain behaviors, even though they have completely different evolutionary histories. There could be a convergence of certain behavior characteristics i.e. curiosity, and understanding of the radio spectrum and how to exploit it. You take that and then you go back and say “What are the best technologies we have to detect those sorts of manifestations?”

It turns out it’s radio astronomy and that’s where SETI comes in. So we’re applying the tools that maximize our sensitivity to the kinds of technological signals we generate and try and determine if other sites of biology have developed technological species that also engage in similar behaviors.

SECONDS: *What are the origins of SETI?*

ARNOLD: Radio astronomy is the study of radio wavelength emissions from the galaxy and the universe

to increase our understanding of the physical processes that give rise to stars, planets, and life in the universe. SETI is a subset of this field of endeavor that is specialized to attempt to detect artificial radio emissions from the galaxy. Standard radio astronomy studies natural radio emissions. Mother nature has been in the broadcasting business for billions of years at wide-band wavelength. SETI tries to detect narrow-band emissions from the sky that may indicate the presence of a technological intelligence on planets orbiting other stars like the sun. Over the last half century, scientists have developed a theory of cosmic evolution, which predicts that life is a normal, natural phenomenon likely to develop on planets with suitable environmental conditions. Scientific evidence indicates that life arose on the Earth relatively quick and it suggests that life will occur on similar planets orbiting other sun-like stars. When you consider the vast number of stars in the observable universe — four hundred billion stars in our galaxy alone — and then on top of that you



consider the probable number of Earth-like planets orbiting other stars, it is likely that advanced technological civilizations have in fact evolved elsewhere in the galaxy and the universe and did so long before the Earth even formed. SETI comes in in an attempt to test this hypothesis of cosmic evolution to

determine whether or not technology has in fact appeared on planets orbiting other stars.

SECONDS: *When did the program begin and at who’s instigation?*

ARNOLD: SETI, as a field of scientific inquiry, began in the spring of 1960 when Frank Drake listened to two nearby sun-like stars, and he listened for a several-week period in the spring of that year. That showed it was possible to mount a systematic search for evidence of extraterrestrial intelligent life. He used very primitive equipment, a

single-channel receiver, and since that time things have evolved considerably to the state where we can turn on receivers that have millions of channels simultaneously — this is not scanning one channel after another, this is listening to millions of channels all at once — and with this sort of capability, thanks to the evolution of computer technology and the microchip, we have entered an era where SETI can be conducted on a much more large scale and has a greater chance of success. Indeed, we can have equipment that is specifically engineered for this sort of thing. Back in Drake’s day, he had to clump together gear that was designed for other purposes. Now, things have evolved to the point where SETI has become a fairly mature exploratory scientific endeavor.

SECONDS: *For people who aren’t familiar with the technology, what it really is is no different from when they turn on their radio at home. It’s just you guys use more sophisticated and sensitive receivers.*

ARNOLD: The principles are the same, the technology is the same, it’s just on a larger

“We have to get off the planet because of the danger of living on a planet due to the asteroid problem.”

scale. Instead of listening to one radio station at a time, we can listen to twenty-eight million potential interstellar radio stations at a time. In order to do that, you need fairly sophisticated electronic equipment, which is very expensive.

SECONDS: *So SETI went along very happily from 1960, the optimistic Space Age, but what happened?*

ARNOLD: SETI was sporadic. Investigators here and there on shoestring budgets would string together equipment as Drake did and attempt to listen, but it wasn't done a systematic basic, it was done when there was free time and when equipment was available.

SECONDS: *Was it a NASA project all along?*

ARNOLD: No, it was a project driven by the curiosity of private researchers. It wasn't until the early 1970s that NASA became interested in the interstellar communications problem and devoted some of its resources to studying the feasibility of detecting evidence of extraterrestrial intelligent life. From that point onward, NASA began a slow road of looking into the question. Study groups were assembled, reports were issued, recommendations were made to proceed slowly but proceed nonetheless in this field of investigation.

SECONDS: *Who was the champion of the project in those earlier days?*

ARNOLD: A gentleman by the name of John Billingham, a British-born medical doctor who is now here with the SETI Institute helping us with fundraising. He's also the person who developed the liquid cooling garment that made moon walks possible. He, having an interest in biology, read a book in 1966 called *Intelligent Life In The Universe* by Shklovskii and Sagan.

SECONDS: *That was quite heretical in those days, wasn't it, for an American to work with a Soviet astrophysicist?*

ARNOLD: Actually, the book was written through the mail. They hadn't actually met at the time the book was put together. It

was not heretical for scientists to cooperate because science crosses political boundaries and it was the logical thing for these two gentlemen to work on the subject because it's a subject of interest to scientists regardless

of the political strife of the tribe to which they belong. It was a prototype for continued international cooperation in spite of the political goings-on in the home countries. This particular book really electrified the scientific community, including people like John Billingham, who is largely responsible for pulling together the right people in NASA and getting them interested so over the time after he read that book — from 1968 on — there was steady evolution of interest within NASA

in this question, which finally resulted in the initiation of a full-blown NASA project to search for evidence of extraterrestrial intelligent life. So, the US government had put their stamp of approval on it, it had passed all the peer review twists and turns to get to that stage and then in October of 1992, after years of study and research and development, the NASA SETI project was formally launched with the turn-on of listening devices at two large radio telescopes, one in Puerto Rico and one in the state of California. That lasted for a period of year when the project was terminated by Congress.

SECONDS: *Who lead the crusade against it?*

ARNOLD: At the time, a Freshman senator from the state of Nevada, Sen. Richard Bryan. He arose to cancel the project as an example of wasteful federal spending. SETI had been through this years before in the late Seventies. Sen. Proxmeyer did the same thing. It received a Golden Fleece award, I believe it was in 1978. It was verbal abuse on the floor of the US Senate.

SECONDS: *Is that an example of human chauvinism?*

ARNOLD: It's hard to get inside their minds. Our reading of it is that they want



Bob Arnold

to generate publicity for themselves and show that they're out to save the taxpayer money.

SECONDS: *So they can divert it to their cattle-ranching constituents.*

ARNOLD: Well, you know, it's been said we have the best Congress money can buy. It could also be said, in fairness, that these gentlemen have no

other motive than to make some inroads in wasteful federal spending and they truly believe this is a waste of money and that it's an example of things that need to be cut. One has to be fair and back off and not get too biased here. If it was really an honest attempt to make some cuts in the budget, then you have to respect that, even if it was an uninformed attempt.

SECONDS: *Did he go after anything else?*

ARNOLD: That's a good question. I'm unable to answer it because I don't follow their careers.

SECONDS: *At least Proxmeyer spent his whole career ferreting out waste and many times he was on target. Is Bryan still in the Senate?*

ARNOLD: Yes he is. That would be a good job for somebody doing an article, to go and see if he's successfully gone after any other programs. In any event, that's what happened and that's what brought down the NASA SETI project.

SECONDS: *How was it resurrected as a private concern?*

ARNOLD: The NASA SETI project was not resurrected in its entirety, only part of it was resurrected, the part called the targeted search. There were two parts of the NASA effort. One was called the sky survey and one was called the targeted search. They differ in their approaches and they're complimentary. The sky survey went away and the equipment that was used for the targeted search was redeployed with private funds. That's what's going on now in Australia.

SECONDS: *You inherited some of the staff from the original project?*

ARNOLD: Yeah, the group was essentially composed of scientists from the SETI Institute, so we're dealing with very few NASA people.

SECONDS: *Are they happier to be working privately?*

ARNOLD: Yes, there is a feeling of relief that this endeavor is no longer tied to the political ups and downs in Washington. On the other hand, there's always a feeling of regret that the country is no longer behind the effort as it was when it was a NASA project.

SECONDS: *But the country's no longer behind any science project.*

ARNOLD: Well said.

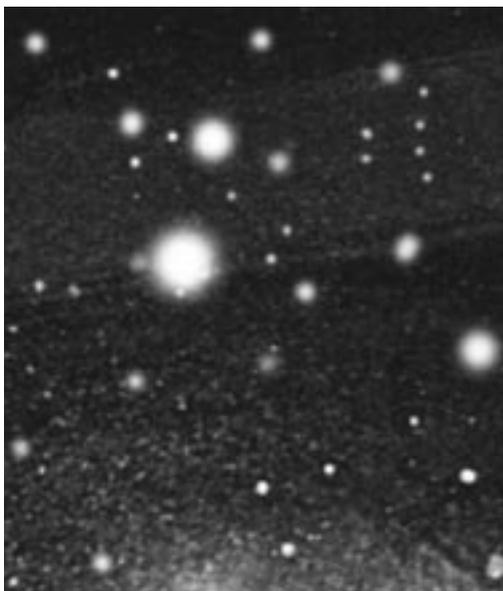
SECONDS: *They canceled the supercollider and I have a feeling that the*

space station is going to be whittled down until it's just a couple of coffee cans.

ARNOLD: The new budget proposal by the Republicans would eliminate the space station altogether.

SECONDS: *It could be a thousand years before somebody's on the moon again.*

ARNOLD: I try to be more optimistic than that, but these things do go in cycles and it could be that SETI is ahead of its time. The idea is right. It's like right idea, wrong century. People aren't quite ready to grasp all the implications. Another problem we have is that our culture is immersed with all sorts of science fiction and tales of abduction, which diverts attention from the real story. The media eats up all the UFO stories and people get deflected from the real issues involved and it dilutes the impact of the realization that there are a large number of scientists that take the possibility of life elsewhere very seriously. That tends to get lost in the noise. You see it in Congress, you see it in the media, you see it in Bryan's press release, a lack of critical insight into what's really going on. Informed decisions are not being made



“There is a feeling of relief that this endeavor is no longer tied to the political ups and downs in Washington.”

and that means these sorts of things are to be expected. You have to take the historical perspective and not be bitter about things. Just realize there’s a lot of ignorance out there and it’s going to take time — hopefully there will be time — for people to get a more informed grasp of the real issues involved.

SECONDS: *What about the idea that we might be broadcasting to creatures who see Earth as a place to plunder? Are you giving your position away to the pirates?*

ARNOLD: Yeah, but first of all, we are not giving ourselves away. SETI does no sending, SETI listens only. If we detect the technology of another species, there’s no way for them to know we’ve detected them. This is all a passive exercise.

The broadcasting is going on, but that’s been going on since the 1920s. There’s this spherical wavefront, sort of a broadcast bubble, surrounding the Earth seventy light years in diameter, which is saying there’s a technological situation here. There’s nothing we can do about that, it’s already out there. So if there are these non-benevolent species you’re speculating about, it’s too late, they already know of our existence.

SECONDS: *So anybody who lives around Alpha Centauri has known about us for the last sixty-five years.*

ARNOLD: If they had radio technology, they could easily know about us because the Earth is bright compared to the sun at radio frequencies.

SECONDS: *Do you think that a civilization being old and established is synonymous with it being peaceful?*

ARNOLD: That is the theory, that a civilization that’s been around a long time has gotten through the crisis we’re at of inter-group conflict. If they didn’t survive,

they wouldn’t be around long enough to explore space. That’s of course a theory. There’s no way to predict what’s going to happen in another civilization. It seems reasonable to speculate — and it’s all speculation — that a sufficiently mature

civilization is not going to go around eating people, it’s going to be interested in learning, not destruction. Besides, there seems to be a pretty good quarantine given the distance between stars. We do not anticipate interstellar travel. We don’t think there’s much danger of them ever getting here or ever wanting to come here when you can exchange information much more efficiently than you can move matter. You can move photons much more cheaply and safely and you can get the same amount of information transfer than physically

trying to go there. Our whole approach is stay home and listen to the radio. You take a look at Sagan’s latest book and it opens up the whole debate anew. He says that it’s our destiny to evolve into the universe and the galaxy and Star Trek got it right and that’s what we’re going to be doing if we don’t kill ourselves off. One of the founding fathers of the field of SETI is himself saying interstellar travel is not going to be a fantasy forever. It will happen if we survive because we will not survive if we don’t do it. We have to get off the planet because of the danger of living on a planet due to the asteroid problem. That ups the ante on the question of do other civilizations engage in this activity. You don’t have to be a rocket scientist to read between the lines and see that what he’s basically saying is the answer is a resounding yes because they have to. This opens up the whole field to wider possibilities then just sitting home and listening to the radio. But we’re not there yet, we have yet to see whether we can even survive the trip to



FRANK DRAKE

Mars. Still, we have to keep in mind there's a difference between our dreams and what we really know. We're making a stab in the dark here with SETI. This is not to say this is the final word on the question, but it's an honest attempt and it's the most comprehensive attempt that's ever been made to find life on other planets.

SECONDS: *Beyond the normal evolution of computer technology and the improvement in signal processing, what would be the most helpful things to the project?*

ARNOLD: Eventually, I think humans will return to the moon and set up permanent settlements there. That means there will be observatories on the moon. The best place to have an observatory for SETI purposes is on the far side of the moon where the moon acts as a shield against all the radio racket generated by humans. When you have that sort of a situation, you have less of a false alarm problem. Our ultimate scenario is setting up an observatory on the far side of the moon.

SECONDS: *You said something about a false alarm. In waiting for these signals, have you had false alarms and what is the reaction?*

ARNOLD: I can say that many of the SETI searches have in fact found unexpected signals, but you have to keep in mind that the data collected in these searches were often processed sometimes months after the observations. That means that the candidate signals could not be immediately checked.

SECONDS: *Was there ever a day where everyone at the SETI institute skipped lunch and stared intensely at the screen?*

ARNOLD: Yes, there was one night where I skipped dinner because that was happening. It turned out it was a glitch in the software and we were tracking a star for about five hours. When the star finally set, the signal was still there, which means it was not associated with the star. Refinements were still being conducted on the software.

SECONDS: *That must have been quite*

disappointing.

ARNOLD: Yes and no. You first of all tell yourself it's something mundane because that's the most probable explanation but also in the back of your mind there's the thought, "Gee, this time it really could be it." Yeah, there's a bit of a letdown, but you don't let yourself get set up for too much of a fall because you always realize there are many things that can go wrong in terms of interference and other problems. For me,

it was probably the most exciting couple of hours at SETI, but it was resolved in the way I expected it would be resolved.

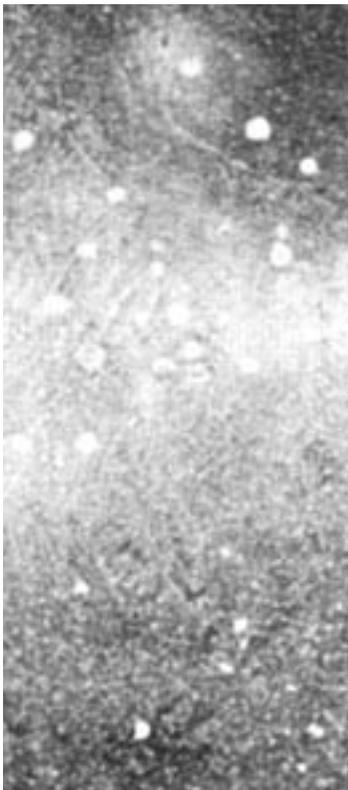
SECONDS: *When do you expect to find a signal?*

ARNOLD: It's impossible to say when we'll find a signal or if we'll ever find a signal. Our chances of success are difficult to estimate as Ciccone and Morrison pointed out in the first SETI paper in 1959 but if we never search, our chances are zero. We have to make the effort if we take the question seriously — and most scientists do. The act of conducting a search and increasing the sophistication of the search increases my optimism that some day the signals will be detected. When that happens, it'll be the first day of school, it'll be like an isolated farm family getting a glimpse of the big city for

the first time. We'll be getting a glimpse of the big city, other styles of life, other ways of doing things and learning that we are not the only kids on the block and we have a great deal to learn, perhaps a little bit to teach, and it would be a very interesting time to be around.

SECONDS: *What if we're the big city and we find a farm family?*

ARNOLD: In our search, that's not going to happen and the reason that's not going to happen is that we've had technology for so short a time that any civilization we become aware of will have to be older than us. If they're younger than us, they're not going to know about radio.



***“There’s a difference between our dreams
and what we really know.”***

SECONDS: *What if we find someone on a nearby stellar system who is not quite as advanced as us, but who has radio and is able to utilize electromagnetic waves?*

ARNOLD: We’ve had radio for such a short time. We’re still in the same century where radio was first utilized. There’s zero expectation that would happen. Any civilization we detect, we can confidently say is most likely going to be millions of years older than us, possibly hundreds of millions of years older than us and in that sense will maybe have very little in common with us and maybe will not do the same things that we would hope it would do. The essential concept as far as SETI goes is that we can only become aware of civilizations that are more advanced than us because they’ve

been in the radio broadcasting business longer than we have. Given the likely distributions of civilizations, the nearest civilizations are hundreds of light years away. If we detect their radio transmissions, they were in the radio business long before we even knew what the word meant. That means they’re older. They’ve had a head start in evolutionary terms over us. We’re the students and they’d be the teachers. It’s just the natural way it would go in a SETI setup. If the contact came through another means, it could be a completely different scenario. From the SETI standpoint, that’s the outlook we have on this question. This is not necessarily the final answer, but it’s our most hopefully and scientific approach so far to the problem. ●●●

<p>SETI’s search for intelligent life ... everywhere ...</p> <p>SECONDS: <i>What kind of equipment do you use?</i></p> <p>ARNOLD: A spectrum analyzer with unique capabilities. The MCSA divides a 20 MHz band of the radio spectrum (equivalent to an FM radio dial) into 28.74 million simultaneous channels, each only 1 Hz wide and separated by 0.67 Hz. The channels overlap each other slightly, providing near-optimum response to signals whether they remain in a channel or drift in frequency by as much as one channel per second. In order to accommodate pulsed signals, the MCSA simultaneously divides the band into channels with two other programmable widths from 2 Hz to 28 Hz. This gives nearly uniform sensitivity to pulses with durations (“on” time) from 0.02 to 1.5 seconds. In effect, the MCSA takes a snapshot of the power received in all of the millions of channels during a 1.4 second interval. Since pulses are unlikely to be synchronous with Earth-based clocks, successive spectra are overlapped in time by 50% to reduce the dilution of a pulse split between spectra. The final stage of the MCSA scales and formats the data for processing in the special-purpose hardware pattern detectors for continuous and pulsed signals.</p> <p><i>SETI Institute, 2035 Landings Drive, Mountain View, CA 94043</i></p>	
---	---

**Statement To The Press By The Office Of Senator
Richard Bryan. Sept 22, 1993.**

Washington, D.C. — The United States Senate agreed with Senator Richard Bryan (D-Nevada) today by voting by more than two to one to eliminate an expensive program to find intelligent life in outer space. The Senate supported Bryan’s position by a vote of 77 to 23.

“The Great Martian Chase may finally come to an end,” Bryan said. “As of today, millions have been spent and we have yet to bag a single little green fellow. Not a single martian has said ‘take me to your leader,’ and not a single flying saucer has applied for FAA approval. It may be funny to some, except the punchline includes a \$12.3 million price tag to the taxpayer.”