LISTENING FOR ET

What if the message comes?

By JONATHAN EBERHART

"Mr. Watson," said the voice, "come here. I want you." It was March 10, 1876, and the value of the first intelligible words transmitted by telephone lay not so much in their meaning as in their demonstration of the technology that made them possible. Of course, the hearer was already aware Alexander Graham Bell existed, so identifying the sender posed no problem.

A confirmed signal from life elsewhere in the universe, however, would be a fundamentally different matter. Its mere existence could dwarf the significance of whatever method brought it to Earthlings' attention. And any plan to conduct a deliberate search for extraterrestrial intelligence — an undertaking commonly abbreviated as SETI — raises subtler issues in the momentous central question of whether Earth harbors the universe's only life.

For two years, NASA has been developing sensitive receivers it will link with the dish-shaped antennas of its spacecraft-tracking Deep Space Network and other, larger radiotelescopes. Their purpose: to listen for possible signals produced by extraterrestrial life forms. From 1992 through 1998, NASA plans to examine all of the nearly 800 known stars somewhat similar to our sun (spectral types F, G and K, luminosity class V) within a distance of 25 parsecs (82 light-years), as well as other candidate targets researchers may perceive as promising. In addition, the plan calls for a less sensitive survey of the entire sky, taking advantage of the opportunity to catalog all known and new radio sources. Besides widening the SETI search, the survey — formally called the SETI Microwave Observing Project — will offer a valuable resource for studying naturally produced emissions from those sources.

The radiotelescope receivers are designed to listen selectively to 14 million separate frequency bands, each only 1 hertz wide. The developers of the receivers expect them to weed out signals from natural sources (such as pulsars), artificial ones produced on Earth (radio-frequency interference, hoaxes) and any other "false alarms" that filters or computer algorithms can remove.

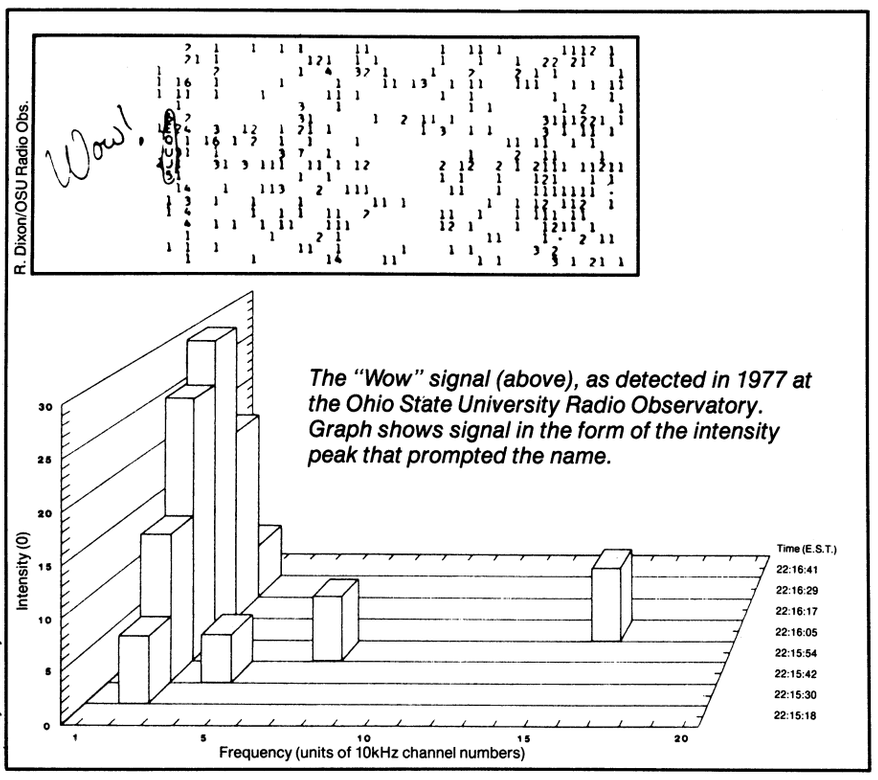
But what if the search turns up what might be a message? Who gets told, and when?

Preparing for that possibility — which lies somewhere between intriguing and astounding — has challenged a working group of several dozen scientists and lawyers as well as representatives from NASA, the State Department, universities and diverse other organizations in the United States, Europe, the Soviet Union and elsewhere. In addressing what may be the most significant question any of its members will ever face, the group has prepared what it calls a "Declaration of Principles Concerning Activities Following the Detection of Extraterrestrial Intelligence."

In part, it's a manual on what to do when the extraterrestrials call. But the bulk of the document focuses on the best ways to pursue a possible but uncertain line of evidence of extraterrestrial contact. This is not only a potentially momentous issue, but one in which, as the declaration acknowledges, "any initial detection may be incomplete or ambiguous and thus require careful examination as well as confirmation." Anticipating that possibility, the document notes "that it is essential to maintain the highest standards of scientific responsibility and credibility."

The Declaration of Principles is not just to guide NASA's own scientists. It is meant for any astronomers, spacecraft engineers, policymakers, diplomats or others who may find themselves with a role in the drama of a possible SETI success.

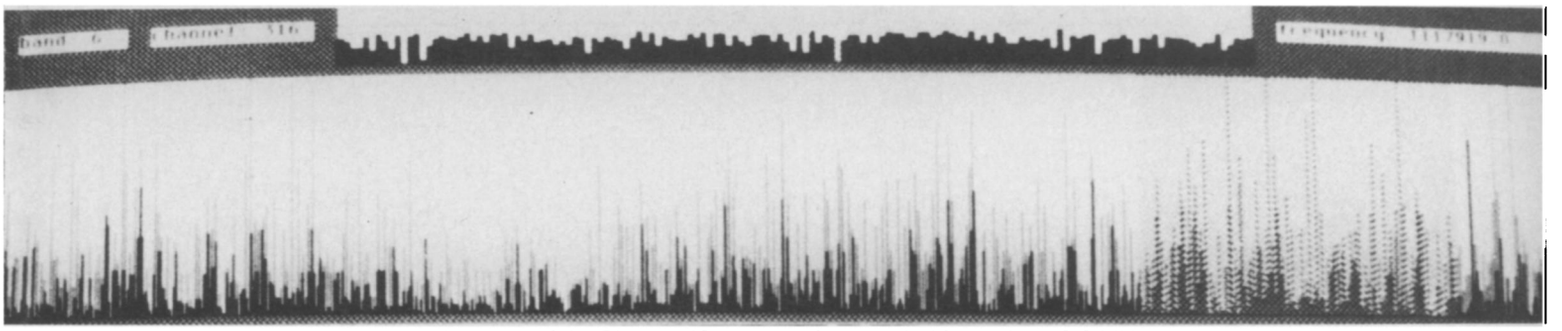
What do you do, in other words, if the chart recorder printing out data from your radiotelescope suddenly starts spewing forth a pattern the likes of which you have never seen before and cannot explain?



The "Wow" signal (above), as detected in 1977 at the Ohio State University Radio Observatory. Graph shows signal in the form of the intensity peak that prompted the name.

One of the best-known such events was the 1967 discovery at Cambridge University's Mullard Radio Observatory in England of signals whose pulsations were far more regular than those of any natural source familiar at the time. The emissions, detected by Anthony Hewish, Jocelyn Bell and their colleagues, came from what is now known as a pulsar. But their provocative regularity gave rise at the time to what the observers promptly dubbed the LGM ("Little Green Men") hypothesis — that the signals came from a civilization outside the solar system.

In their original pulsar paper, according to astronomer Frank Drake of the University of California, Santa Cruz, the researchers said they also knew of three



A test from space shows the carrier wave of the Pioneer 10 spacecraft, recorded from about 3.3 billion miles away by a prototype version of NASA's SETI receiver attached to one of the NASA Deep Space Network antennas. (Photo: NASA)

other regularly pulsating objects but provided no other data. When asked about the matter at a press conference, project director Martin Ryle still declined to offer additional information about the other finds, such as their position coordinates and pulsation frequencies. Even though pulsars offered a more reasoned if less spectacular interpretation than Little Green Men, Drake calls Ryle's limited response both "unethical" and "counterproductive" for such a potentially weighty issue.

A decade earlier, while a graduate student at Harvard University, Drake had experienced his own arresting adventure with the possibilities of detecting extraterrestrial life. In the spring of 1957 he was observing the constellation known as the Pleiades at a wavelength of 21 centimeters. "The radiation associated with them is very distinctive," notes Drake. "There is a hump in the spectrum due to their Doppler shift. As I'm observing, a peak appeared that seemed to be associated with the peak that goes with the Pleiades." It was a narrow peak, looking like "a rounded hill with a pylon" on the chart recorder. "I looked at it and I was shocked, because I'd never seen that before."

"It just hit me that this looked like an intelligent signal from the Pleiades," Drake adds. "You feel a very special emotion — enlightenment, rapture, eye-opening."

What did he do, faced with such a possibility? "I moved the telescope, and [the emissions] didn't disappear. That's the signature of terrestrial interference."

Three years later, Drake led a deliberate SETI effort called Project Ozma at the Green Bank radio observatory in West Virginia. Ozma ran only two months, but it started off with a bang on its very first day. When the telescope homed on a star known as Epsilon Eridani, it picked up emissions that promptly knocked the chart recorder's pen off-scale, accompanied by noise bursts from a monitor loudspeaker. "It was a real shock," Drake says.

The emissions lasted for only a couple of minutes, but the astronomers kept the instrument on that frequency for a week while they set up a second receiver to monitor possibly misleading radio-frequency interference. When the signal was detected a second time with the big dish, it also appeared on the monitor. No aliens from other worlds — just interfering radar from Earth.

Some emissions recorded in 1977 by the radiotelescope at Ohio State University near Columbus were so dramatic that astronomers dubbed them the "Wow" signal, after a comment by one of the observers. The signal was narrower in frequency than most natural sources, covering a band less than 10 kilohertz wide. But Robert H. Gray of Gray Data in Chicago notes that "extended observations ... found no evidence of strong *ultra*narrowband [0.05-hertz] signals. Weak evidence suggesting periodic and drifting features was found, however, suggesting that additional observations may be warranted."

Astronomers never identified the source, reported Gray at a SETI meeting held last year by the Planetary Society, and the pattern did not recur.

The Planetary Society has also funded a SETI project, known as META, with full-time use of an 84-foot radiotelescope operated by Paul Horowitz of Harvard University and belonging to Harvard and the Smithsonian Astrophysical Observatory. "We typically go for two or three weeks without seeing anything," Horowitz says, and when emissions are detected they are usually spread over too wide a band of frequencies to excite SETI investigators. "About twice a year we see a feature that looks like the right kind of signal. It's narrow and it's strong. We go back and we look at these things. We've had about six since we started in '83." None, however, has stimulated Horowitz to call a news conference.

The subject of SETI is loaded with the potential for misunderstanding. A scientist who publicly reads too much into such an observation, for instance, could be perceived as guilty of what one participant at a SETI conference called "a case of terminal 'Wolf! Wolf!' "

The SETI guidelines seek to minimize that possibility, from the standpoint of scientific results and of potentially panicky public reaction to the first evidence that humankind is not alone in the universe. Accordingly, the declaration's first item warns: "Any individual, public or private research institution, or governmental agency that believes it has detected a signal from or other evidence of extraterrestrial intelligence . . . should seek to verify that the most plausible explanation for the evidence is the existence of ETI rather than some other natural phenomenon or an anthropogenic phenomenon before making any public announcement."

Executive Officer Peter Boyce of the American Astronomical Society in Washington, D.C., who helped draw up the document, observes that scientists could conceivably pick up another civilization's leakage radiation without ever knowing whether it was a deliberate attempt at communication. On the other hand, he points out, in some circumstances "you don't have to understand the message when you see a lighthouse."

Such data may be far less obvious than a lighthouse. Even without "proof," the declaration says, "the discoverer should inform his/her or its relevant national authorities. If the evidence cannot be confirmed as indicating the existence of ETI, the discoverer may disseminate the information as appropriate to the discovery of any unknown phenomenon."

Item 2 addresses the possibility of a declaration signatory deciding there is something worth telling. "Prior to making a public announcement that evidence of ETI has been detected, the discoverer should promptly inform all other observers or research organizations that are parties to this declaration. . . . Parties to this declaration should not make any public announcement of this information until it is determined whether this information is or is not credible evidence of the existence of ETI."

"It's not a matter of being able to define what identifies intelligence," says Jill Tarter of NASA's Ames Research Center at Moffett Field, Calif., the agency's SETI project scientist. "What constitutes 'credible evidence' is being unable to explain a signal — which you also can't make go away — by any known astrophysics or technology."

When document signatories learn of such a signal, even if its validity has not yet been confirmed, the telephones of everyone even remotely associated with the matter will probably start ringing. Says Boyce, "I don't think it can last more than a day without the word getting out.... If you find a signal, the emotions are going to be so high that you aren't going to have much time to figure out what you're going to do about it." The pressure from press, public and politicians could continue to build for scientists trying to analyze the data, whether the additional analysis is for decoding a message or "merely" establishing to their own satisfaction that the signal is of intelligent origin.

The declaration aims to see that accurate information gets around at least as promptly as rumors. Item 3 says that once the discovery appears to be credible evidence of ETI and other signatories are informed, "the discoverer should inform observers throughout the world through the Central Bureau for Astronomical Telegrams of the International Astronomical Union (IAU)." IAU circulars go to most astronomers and a number of journalists, providing prompt alerts of supernovas, newly discovered comets and other objects in space. Says Boyce, "We need the IAU telegram network so that we can get every scientist in the world to work on this signal." In addition, the declaration calls for informing the Secretary General of the United Nations.

It also pointedly acknowledges concern that someone involved in such a discovery might attempt to keep it secret from other agencies, governments or the public. And conscious censorship by discoverers isn't the only such problem. Armies of lawyers and policy analysts deal with the pluralistic aspects of human activities in space, ranging from safety to proprietary ownership rights to liability.

"It's clear that the spacelaw community has no concept of the uncertainty we're going to be facing," Boyce says. "What the SETI scientists are concerned about is that something will be done by the lawyers without any scientific understanding." At one SETI conference, in fact, "one of the suggestions would have prohibited publishing information about the signal in the ASTROPHYSICAL JOURNAL," a respected outlet for research results.

To forestall such fears, Item 3 states the matter flatly: "A confirmed detection of ETI should be disseminated promptly, openly and widely through scientific channels and public media.... The discoverer should have the privilege of making the first public announcement."

In Boyce's words, "The protocol was written to avoid government censorship *and* the *appearance* of censorship, as well as to ensure that scientists will be able to exchange the data freely." In short, it aims "to foreclose the option of keeping something that's so important secret."

Two items deal with scientists' concern that key data may be lost, degraded or otherwise damaged. Says Item 5: "All data necessary for confirmation of detection should be made available to the international scientific community through publications, meetings, conferences and other appropriate means."

Item 6 states: "The discovery should be confirmed and monitored, and any data bearing on the evidence of ETI should be recorded and stored permanently to the greatest extent feasible and practicable, in a form that will make it available for further analysis and interpretation."

Item 7 covers the possibility of more than a single message. "If the evidence of detection is in the form of electromagnetic signals, the parties to this declaration should seek international agreement to protect the appropriate frequencies by exercising the extraordinary procedures [a legal term allowing for meetings to be called to deal with specific subjects] established within the World Administrative Radio Council of the International Telecommunications Union." Such sanctions have been invoked in the past to protect certain frequency bands important to radioastronomers. Says Boyce, "Suppose [the ETI signal] comes in in the middle of a taxicab band? Although a military band might be more likely."

One concern is a growing series of Soviet navigation satellites called GLONAS, similar to the U.S. Global Positioning System. Both the Soviet and U.S. systems emit precise timing signals whose frequencies are essentially rendered useless for SETI, Tarter says. The signals from the U.S. satellites occupy a single frequency band centered at 1,575 megahertz, covering only about 500 of the 14 million extremely narrow channels planned for NASA's SETI receivers. But GLONAS covers numerous frequencies between about 1,604 and 1,612 megahertz, with new ones being added as more satellites join the network.

A particularly touchy matter is whether to answer a message. Item 8 simply finesses the issue: "No response to a signal or other evidence of ETI should be sent until appropriate international consultations have taken place. The procedures for such consultations will be the subject of a separate agreement." Comments Boyce: "That's where we duck the issue of who decides when to send things back. It's a very sensitive issue."

Finally, the declaration states that after a message is validated, the SETI Committee of the International Academy of Astronautics (IAA), in cooperation with the IAU's Bioastronomy Commission, will conduct a continuing review of the ETI detection procedures and the handling of data. "Should credible evidence of ETI be discovered," says the declaration's last item, "an international committee of scientists and other experts should be established to serve as a focal point for continuing analysis of all observational evidence collected in the aftermath of the discovery."

Moreover, the IAA and IAU are to "provide advice on the release of information to the public." James Cornell of the Smithsonian Astrophysical Observatory in Cambridge, Mass., proposes that ETI searchers might find it wise to prepare for a level of public interest that could escalate within hours from a vague awareness of SETI to a demanding deluge. "At the Toronto meeting," Cornell says, "I was recommending that we have a sort of P.R. SWAT team."

The document's authors feel that the most appropriate way to encourage the astronomical community to participate is by seeking endorsement of the declaration from major international scientific organizations concerned with space research. In part, this is to cope with disagreements that have been raised by some scientists over potentially thorny items like having to discuss data with other researchers before announcing possible confirmation of ETI. A number of the document's phrases, for example, have been altered from statements of what the signatories "will" do to what they "should" do. Several participating lawyers had argued that without such changes, the document might never be widely accepted.

The International Academy of Astronautics endorsed it last month — a major step for the credibility of the overall effort. The International Astronautical Federation will consider the declaration at an October meeting in Beijing, China; in 1990, the document will go before the Committee on Space Research of the International Council of Scientific Unions in the Hague and before the IAU Bioastronomy Commission in France. If the Bioastronomy Commission approves, the declaration will go before IAU's general assembly for endorsement in 1991.

A more material concern, of course, is whether NASA will gain the funds in its 1990 budget to actually start building the fully developed version of its SETI receivers.

And there remains the question of whether SETI itself will succeed. The consequences of an actual message from an intelligence in outer space could beggar the significance of many of the key findings, scientific or otherwise, in the history of our civilization. The elaborate legal and semantic gymnastics needed to produce the Declaration of Principles represents an attempt to deal in advance with an absolutely unprecedented situation.

Summing up SETI's status today, Horowitz says: "The good news is we don't have many false alarms; the bad news is we don't have any signals." □