SCIENCE NEWS OF THE WEEK

Six searches for extraterrestrial civilizations

One of the best-attended sessions at the sprawling annual meeting of the American Association for the Advancement of Science in Boston last week was a self-confessed ado about nothing—negative results. It is only because of the staggering significance of a "something," should it ever appear, that six research teams in three countries have been listening for signs of intelligent communication attempts from extraterrestrial civilizations: messages from the stars. Last week's session was the first meeting presenting results from a range of observational searches.

The quest began in 1959 when Frank Drake used the antenna of the National Radio Astronomy Observatory in Green Bank, W. Va., in a small but pioneering venture to listen to two stars, at a single frequency, for a period of a few weeks. He named the effort Project Ozma, after the princess of the idyllic but hard-to-reach kingdom of Oz. Now there is Ozma II, as well as a number of other searches on a larger scale capable of covering Ozma's original territory in as little as 0.01 second. But now, as then, the leading question is where to search, and how. And why.

The odds against success are ridiculous. Our galaxy has perhaps 250 billion stars. There are approximately 100 billion other galaxies. Every step in trying to conceive a manageable hunt requires fundamental decisions based on limited data, educated guesswork and sheer speculation. How many stars have planets? How many of those have life? How many of that number have suitably advanced technical civilizations? And even of that final, eligible bunch, how many happened to be around at just the right time to be sending messages so that earthlings would be receiving them today? Carl Sagan, director of the Laboratory for Planetary Studies at Cornell University, who has been playing with the numbers for as long as many and longer than most, guesstimates that all but 0.00001 percent of the stars would be weeded out by such an accounting, yet the remainder in our galaxy alone is still an imposing million. Other factors suggest that 100,000 stars must be examined for a statistical chance of finding even one.

Arecibo listening to distant galaxies.

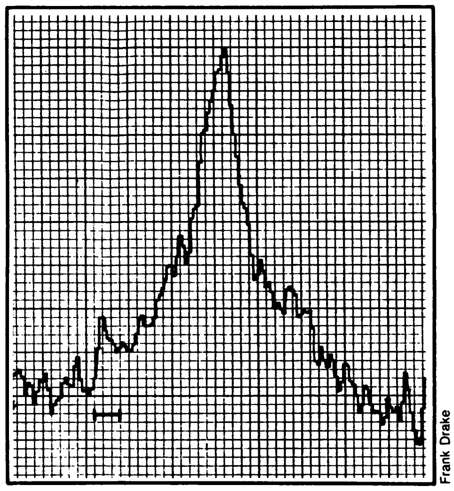
If the inhabitants could actually send messages, would they do so? What if no one is listening at the right time? Or at the right frequency?

This last point is a major question. Both Project Ozmas have concentrated on the 21-centimeter wavelength that results from the 1420-megahertz emission frequency of hydrogen, in hopes that an extraterrestrial civilization, knowing that hydrogen is the most abundant element in the universe, would pick it as a logical choice. But there are other logical choices. Between the hydrogen and hydroxyl (OH) bands, for example, lies the "water hole," the emission frequency of H_2O, which is not only a basic constituent of life as even most exobiologists can envision it, but also offers a frequency less drowned in deep-space static, or "sky noise."

Project Ozma II is largely the work of Patrick Palmer of the University of Chicago and Ben M. Zuckerman of the University of Maryland. Again at Green Bank they have the advantages over Ozma I of a much larger antenna (300 feet vs. 85), a more noise-free receiver and a filter system capable of breaking down the general 1420-MHz frequency into 384 separate parts to dig out possible messages that might otherwise be masked in the broader bandwidth. Before even beginning, they eliminated some stars as too old (or post-catastrophic) for life, others as too young for life to have yet developed, others as chemically deficient and still others whose planets would have to be so close for adequate warmth that they would be bathed in lethal radiation. Once started, they studied 659 star systems, laboriously checking their early results by hand ("I guess we were too old-fashioned to trust the computer," says Palmer) and ultimately examining nearly 20 million data points in some 51,700 individual radio spectra. Results: negative.

The reasons for deciding how and where to search are, of course, largely speculative. In the words of a previous searcher, who was in the AAAS session's audience and who gave up the idea years ago, "It's like looking for a needle in a haystack and then giving a scientific rationalization for which side of the haystack to start looking in." But the difficulties, Sagan points out, are only half of an equation that must also include the import of success—that man is not alone.

Sagan and Drake, in fact, are engaged



A message for Arecibo? Only a cloud.

in one of the largest of the searches, using the huge, 1,000-foot radio dish at Arecibo in Puerto Rico to study whole galaxies of stars. Drake estimates that such signals would have to be sent with a million times Arecibo's power to be detectable, but extraterrestrial transmitters could be far advanced over those of the earth, which are in only the earliest stages of stellar conversation attempts. Using four different frequencies—1420 MHz, 1667 MHz (hydroxyl), 1652 MHz (the water hole) and 2380 MHz (Arecibo's radar frequency)—the giant ear has monitored the galaxies Leo 1, Leo 2, Messier 33 and Messier 49. On one occasion, "phone lines crackled," says Drake, when a small peak appeared on the broader 1420-MHz signal from Leo 1, but diasppointment followed when the same peak showed up from a slightly different direction. This implied that the signal source was far too broad for a point-source transmitter, and was probably a cold gas cloud. So far, nary a message.

Two Canadian researchers, Alan H. Bridle of Queens University in Kingston, Ontario, and P. A. Feldman of the National Research Council, Downsview, Ontario, have auditioned the maser frequency of water for 28 stars, with another 250 in mind, using the 150-foot telescope of the Algonquin Park Radio Observatory. The results again have been negative, but such sky-watches often have unexpected payoffs. Other researchers at Algonquin, says Feldman, have just verified the detection of the heaviest interstellar molecule yet announced, cyanodiacetylene, HC_5N. Sagan points out the parallel with cyanoacetylene, one of the basic components in living systems—at least on earth.

A much broader survey, albeit a modest one, is being carried out by Robert S. Dixon and colleagues at Ohio State University. Using a variety of equipment cobbled from a variety of sources and running on a shoestring budget, often completely unattended, the hydrogen-line survey is nonetheless free to operate almost 24 hours a day, 365 days a year. The antenna system is the equivalent of a 175-foot-diameter dish, and although results are so far the same as everyone else's, the value of such a broad mapping effort is obvious. Two other wide-ranging experiments are being conducted in the Soviet Union, using arrays of radio telescopes spanning the country under the auspices of the Institute of Cosmological Research in Moscow and of Gorky University. Both, says Sagan, use a "coincidence-count" system, in which a signal must appear on at least two receivers to be registered.

With all this listening going on and more to come, Philip Morrison of Massachusetts Institute of Technology took advantage of the AAAS session to call for order. A journal, he suggested (with a broad hint at Sagan's ICARUS), or some central clearing house ought to keep track of who has looked where, when and at what frequencies. Looking for extraterrestrial civilizations, he says, is not so much science as exploration. Maybe man is alone in the universe, but earth's sun is part of a vast population of similar ones, and in an apparently unextraordinary part of its galaxy. "In spite of that blandness," he asks, "are we somehow singled out?" □

A computer under your hat

Most of our Science News of the Week section and the research notes on page 139 are devoted to coverage of the annual meeting of the American Association for the Advancement of Science in Boston. Further articles will appear in later issues.

"When the question is asked, 'What kind of relationship would you want to have with your computer?' the answer is simple: Whenever you think you want to know something, you will have the information right in your head, instantly." That sounds about three orders of magnitude easier said than done—but not to Adam Reed. Within 50 years, Reed says, scientists will have perfected the ultimate computer technology: the brain-computer hook-up.

Miniaturized computers, implanted under the scalp, will be programmed to "read" and "speak" the electrochemical language of the human brain, Reed says. And, without the cumbersome translation of input and output messages, the computer will function as an automatic brain booster that expands the memory and allows the processing of large amounts of information with the speed and accuracy of . . . well, a computer. Reed, a postdoctoral psychologist at Rockefeller University, presented this prediction to a skeptical but nevertheless fascinated crowd at the AAAS session on future man-computer relations.

Reed is currently working on a rudimentary step in the long-term project; the deciphering of the brain's internal language. Animal studies are beginning to yield neural coding and processing patterns that can be linked to specific physical activities. But the research is relatively new and the recording hardware—thin-wire electrodes inserted into individual neurons—must undergo a "qualitative improvement" if this internal language is to be learned. The total cross sectional area of 100,000 of these electrodes should not exceed one square millimeter, Reed says, but that's a 10-fold decrease from their current size.

And this technological advance, he says, is only one of five leviathan problems. Researchers will also have to learn 1) how to get computer information into the brain, 2) which are the relevant neurons (in other words, where to hook up the electrodes), 3) how to program the computer with the brain's internal language (whatever it may be) and 4) how the brain "stores the meaning of things" with its coding and processing. "I don't know how long this will take," Reed says, "but we can expect it within our lifetimes."

Developmental problems aside, potential abuse of the computer implants in terms of "memory-tapping" or thought control poses a second dimensional problem.

A scientist's participation would have to be conditional on governmental nonabuse of the technology, Reed says. "If there were abuses," he said, "those who work in the field would simply shut off the availability of that technology." The brain computer hook-up would be a "great thing to have," he says, "as long as it was under one's own personal control."

* * * *

Computer access of a different sort—command and input by the human voice rather than brain impulses—is another futuristic concern in computer research. William A. Woods, a senior scientist at Bolt Beranek and Newman, Inc., of Cambridge, Mass., described computer speech-recognition systems to the same AAAS session.

"Unlike 'Hal' in the movie '2001,' " Woods says, "current computers are far from being able to understand a wide range of spoken English." Some existing spoken-word computer systems can recognize about 50 words if the voice patterns are put in in advance by the one who will later give voice commands. Such systems are being used successfully for zip code sorting and numerical data input. But recognition of complete, spontaneous sentences can only be done with slow experimental systems—and then somewhat poorly.

The research is slow-moving, Woods says, because at a basic level there is little information in the acoustic signal the voice makes. The best error rate for word recognition by voice prints alone is about 25 to 30 percent. When a syntax program and semantic commands are added though, the accuracy can be as high as 96 percent. But, as the axiom goes, computers are essentially dumb. An experimental voice recognition computer used during analysis of the moon rocks, for example, "heard" this phrase: "Give me all lunar samples with magnetite," and interpreted it as this one: "Ten people are glass samples with magnetite."

Speech recognition is a desirable input mode, Woods explains. "First of all, speech is man's most natural output channel." It's four times faster than high-speed typing and ten times faster than average typing. Besides that, he says, speaking is spontaneous. It doesn't tie up hands, eyes, feet or ears. It can be used while in motion. And the computer's input terminals would be inexpensive—microphones or perhaps telephone receivers.

"The prospect looks good" for perfecting the system within 10 to 15 years, Woods says. "But a great deal more must be done before we can take a person off the street and have a computer understand his speaking voice." □

Day-care children: No ill effects

"But what will happen to the children if you go back to work?" This question is becoming increasingly important as more and more women decide (or are forced by economic pressures) to have a job as well as children. One solution to the problem has been day-care centers, but it has been suggested that such rearing can be psychologically harmful to a child. Separating a child from its mother every day, for instance, is thought to provoke anxiety and promote insecurity. While the long-term effects of day-care rearing are still unknown, one study has been completed which compares patterns of psychological development in day-care and home-reared children. No significant differences were found.

Research was done by Jerome Kagan of Harvard University and Richard B. Kearsley and Philip R. Zelazo of Tufts University Medical School in Boston. The results were presented last week at the AAAS meeting.

Chinese and Caucasian children from working- and middle-class families took part in the study. Beginning at three and one-half months of age they attended an