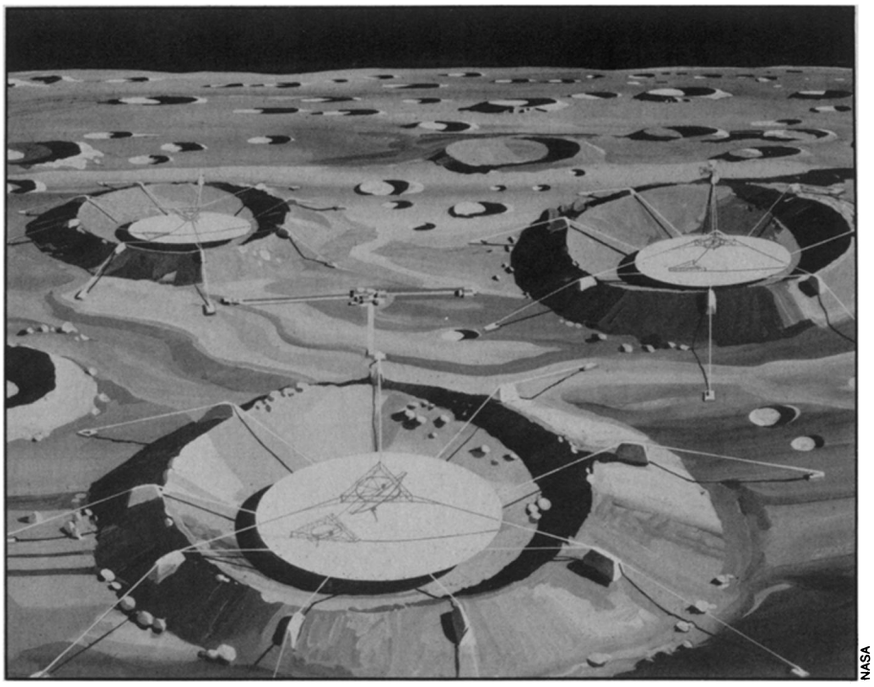
Looking for LGM's

Intelligent aliens may be neither little, green, nor men, but if any are there, NASA wants to look for them

BY DIETRICK E. THOMSEN



NASA

Lunar craters seem one natural place to put future antennas for SETI applications.

Suppose you have won the race to the moon, not once but several times. (Let's not worry whether the other party was ever in the race.) Suppose you have sent automated probes to every planet you can think of, landed twice on Mars and obtained encyclopedias of information and atlases full of stunning photographs. How do you follow two successful acts like that?

Well, if you're the National Aeronautics and Space Administration, or at least some of the people in its Ames Research Center, from which planetary work is being transferred for concentration at a single center, you propose a search for intelligent life elsewhere in the universe. As John Wolfe of Ames put it at a press conference, if those beings exist, they're out there in space, and space is NASA's bailiwick. So who better to operate, or at least coordinate, a national effort to Search for Extraterrestrial Intelligence (SETI)?

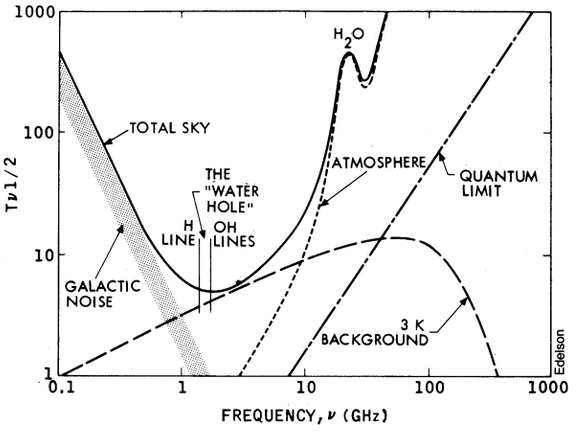
This, too, would not be the only program of its kind in the world. As a couple of international conferences have shown, there is multinational and multidisciplinary interest in Communication with Extraterrestrial Intelligence (CETI), as others have preferred to call it. (Who will win the battle of acronyms remains to be seen; NASA people stress the semantic difference between "search," meaning "seek evidence of the existence of" and "communication," which implies a two-way conversation.)

Like the moon, Venus and Mars, C/SETI (luckily or unluckily, both acronyms have the same pronunciation) is also of interest to the Soviet Union. The Soviet Academy of Sciences has made public plans for a 10-year effort using both existing and specially built equipment (SN: 11/15/75, p. 316). It would be wrong to call this a race, exactly. Camelot has been buried in peanut shells, and the image of Parsifal after a lunar Holy Grail was never a very sophisticated one anyhow, but evidence of Soviet interest is likely to be a talking point with Congress and the public.

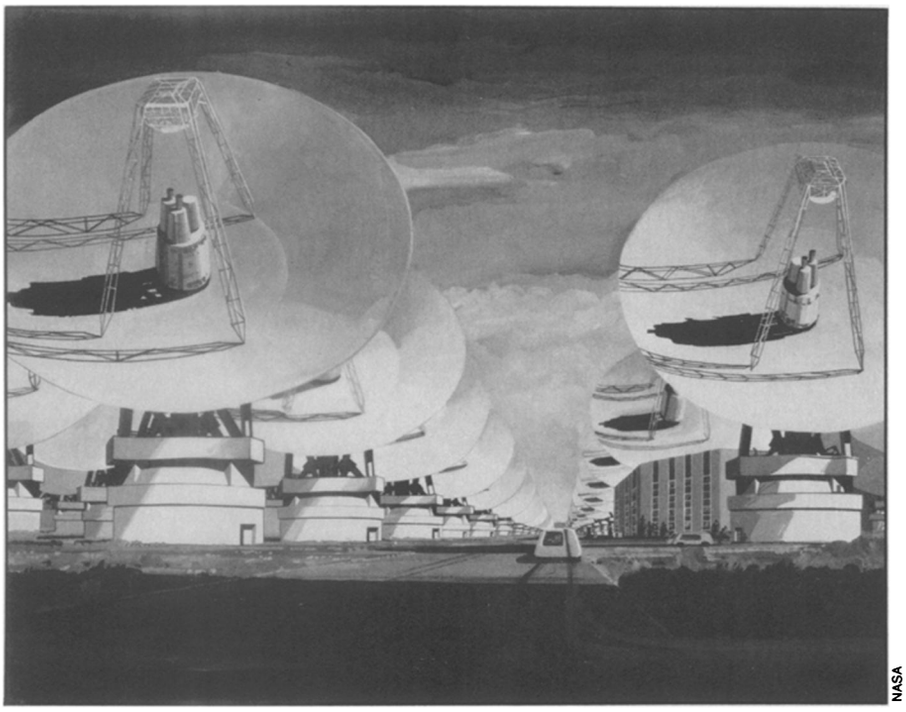
Such a search is assumed to be a radioastronomical specialty. It is assumed that a civilization as advanced as ours would communicate by radio. For messages over interstellar distances radio is really quite slow, and several scientists have suggested that well advanced civilizations will have developed something better. If they have, there is, however, now no way that we can reach them unless they are also broadcasting in radio in hopes of contacting backward civilizations like ours. It is supposed that they might do that for didactic or altruistic purposes.

So for now, until we discover more advanced technology, radio is all we can use, and over the last two decades or so such searches as have been made have used it. The latest, called Ozma II, and done by Patrick Palmer of the University of Chicago and Benjamin Zuckerman of the University of Maryland is typical though perhaps more ambitious than most. Using equipment of the National Radio Astronomy Observatory they looked at 640 sun-like stars within 80 light-years of us. They were looking for possible signals at 21-centimeters wavelength that showed glitches or something strange. They found a couple dozen that warranted a second look, and there are about a dozen that they intend to go back and follow up sometime in December.

But so far, the searches that have been done have yielded negative or at least inconclusive results. For half a decade or more, the received wisdom has been that this was because telescopes with greater signal-collecting power and greater freedom from manmade terrestrial interference were necessary. The fruit of international conferences, summer workshops at Ames since 1971 and Soviet planning is to look to three types of new



Different kinds of interference combine to make the water hole the easiest frequency band in which interstellar signals can get through to a groundbased antenna.



NASA

The granddaddy of all radiotelescope arrays is an option for groundbased SETI.

equipment: a large groundbased array of radiotelescopes with mammoth signal-collecting power (often called Project Cyclops) and one or more radiotelescopes in orbit around the earth or on the moon (especially good for avoiding manmade interference).

Such projects remain in NASA's plans, but they would be very expensive, and for the moment, it seems a start will be made with existing radiotelescopes, but somewhat different observing methods. If nothing is found this way, says John Billingham of Ames, chief of the Interstellar Communication Study Group, the new-equipment options will be pressed.

How the start ought to be made is described by R. E. Edelson of the Jet Propulsion Laboratory in a paper delivered at the International Astronautical Federation's 27th congress at Anaheim Calif., in October. One of the things Edelson reminds us of is that if we think of beamed transmissions, "the great telescope at Arecibo, Puerto Rico, equipped with only a few hundred of kilowatts transmitting power, could communicate with an equal aperture half-way across the galaxy." One of the problems has been that radioastronomical signal processing has actually discriminated against the type of modulated signals that might carry interstellar messages (because most of the terrestrial interference that it wants to get rid of is signals of this kind).

Edelson proposes new signal-processing techniques. He argues that interstellar communicators would be likely to use sophisticated codes involving many simultaneous frequency channels, FM signals to beat all FM signals. Multichannel signal analyzers coupled to existing telescopes will increase signal detection possibilities by a factor of 100. A million-channel analyzer should be ready in about two years' time, using state-of-the-art electronics, and Edelson believes that, in the future, receivers with a billion channels or more can be made at costs of about one cent a channel.

These developments are described as encouraging by Frank Drake of Cornell University, director of the National Astronomy and Ionosphere Center, which operates the Arecibo telescope. Drake was one of the first into the SETI business with the first Project Ozma in 1959, and he has maintained a high interest in the subject ever since. The million-channel analyzer, he says, represents a very important step because it is the first time money has been committed to a piece of equipment specifically for SETI. Drake's opinion is that ultimately a billion channels and 10 years' search time will be necessary, but he sees the SETI trend as upwards.

Another serious problem is what frequency band to observe. In principle signals might come in any part of the electromagnetic spectrum from longwave radio to X-rays, including modulated laser beams or induced modulation of the natural masers, but the thinking of most interested scientists can be described as out of the water hole and back into it.

The water hole is not a place where zebras slake their thirst while nervously sniffing for the scent of lion. It is a band of microwave radio frequencies dominated by the natural emissions of the hydrogen atom and the hydroxyl radical, the constituents of the water molecule. The emission of atomic hydrogen at 21 centimeters was the only emission line of interstellar gas known when interest in SETI began. It was assumed that any civilization with radio astronomy would have discovered that emission and have equipment tuned to that line. It seemed a natural beacon for interstellar signals.

Since then, more than three dozen different molecules have been discovered in the interstellar matter, each with its characteristic frequencies of radio emission. The whole microwave region began to look altogether too noisy, and SETI searchers were advised to look elsewhere. Now, however, in the work of Edelson and others, considerations of signal efficiency, especially for groundbased observations, lead back to the water hole. It is the part of the spectrum that suffers least from interference by natural galactic and universal background and atmospheric absorption. So it seems new observations are likely to start in the water hole.

Of course all of this can be severely criticized, and it was at the same IAF meeting by Gerrit L. Verschuur, a professor of astronomy at the University of Colorado. Although astronomers now believe that there are unnumbered planets circling unnumbered stars, even the first man to claim evidence of planets associated with other stars (Barnard's star and Epsilon Eridani) is cautious about any belief in widespread life. He is Peter van de Kamp of Swarthmore College, and he remarks, "If stars have planets, there doesn't need to be life or life at this moment." And somewhat philosophically, "The universe is very wasteful."

Verschuur's thesis is that the universe is so wasteful that there is likely only one source of life in it, and we are likely to be that. This is a minority view among scientists, but Verschuur shows how to build a case for it. He rehearses events necessary to the rise of life on earth that seem very improbable: the sequence of formation of light molecules and then the formation of heavier ones by reactions that required heat from oceanic volcanoes and mixing by being sloshed in tidal pools. Tidal pools happen because the earth has a large moon that is very close. Verschuur points out that this situation is unique in the solar system and is likely to be extremely improbable anywhere else. By these and similar arguments he takes the Drake equation, by which SETI enthusiasts calculate the probability of finding something, and drives its result way down. In his opinion, when we finally achieve interstellar communication, it is likely to be with our own colonies, and then to go, not by radio, but by something like ESP.

So maybe Starship Enterprise will come sooner than a SETI success. But that "sooner" is a long way off. The kind of SETI that Edelson proposes can be done right now, and as soon as NASA gets enough experience with the space shuttle, telescopes in orbit and telescopes on the moon can be built if desired. So SETI is likely to be tried, however high or low the probabilities of finding something. □