

# Searching the heavens for intelligent life

by Marsha Freeman

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## Is Anyone Out There?

by Frank Drake and Dava Sobel  
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On Oct. 12 the most systematic and sophisticated search for extraterrestrial intelligence began on the world's largest radio telescope, buttressed by smaller radio antennas including those of the Deep Space Network, used to communicate with our space probes throughout the Solar System. The effort, called the High Resolution Microwave Search (HRMS), is funded by NASA, and involves more than 100 scientists and engineers around the world.

Over the past 50 years, looking for intelligent life in the universe has generally been ridiculed, since the life imagined often was made up of hideous aliens, "Martians" of all possible stripes and dispositions, and "wars of the worlds." Reported sightings of UFOs added to the fantastic store of science fiction material, especially in the U.S., which meant that any scientist proposing to engage in a search for extraterrestrial intelligence (SETI) was not taken very seriously. But, as Frank Drake eloquently recounts, the philosophical question of whether we humans on Earth are the only intelligent life in the expanse of the universe has interested the man over millennia.

The scientific revolutions which placed the Earth among a group of planets—rather than at the center of the universe—and which revealed that the Sun is only one of a vast number of similar stars that may have planets, encouraged the empirical inquiry into whether life on Earth is unique.

## Gauss's proposal

Drake reports that in 1820 renowned scientist Carl Gauss proposed that there be fields of wheat planted in isolated Siberia in huge geometric shapes, to be visible to other creatures in our Solar System. If the figures included a large right triangle, he reasoned, it would indicate not only our intelligence, but our understanding of the Pythagorean theorem.

At the beginning of this century, there were attempts to use the new technology of radio to listen for signals beamed to Earth from other civilizations. During tries by Nicola Tesla and Guglielmo Marconi, however, only natural, Earth-based radiofrequency emissions were detected. But in 1960 Frank Drake calculated that the 85-foot antenna at the National Radio Astronomy Observatory in Green Bank, West Virginia would have the sensitivity to detect a signal similar to what it could transmit, from up to 12 light-years' distance. Two nearby Sun-like stars were the targets, but after 200 hours of observation, no artificial signals were detected.

Frank Drake has been involved in SETI research ever since. With other accomplishments in radio astronomy behind him—such as the discovery of the radiation belts around Jupiter, and that the hellish temperature on Venus is caused by the atmosphere and not temporal changes—he has helped bring SETI into the world of accepted scientific inquiry. He has played a major role in laying the basis for what this search for other intelligent life should be.

## Criteria for searching

Scientists involved in SETI research assume that the laws of physics and chemistry are coherent throughout the universe. The processes of galaxy and star formation, the accretion of planets from material around stars, and the development of planetary atmospheres and geophysical dynamics are assumed to be similar throughout the universe to what we see in the Milky Way and the Solar System. The more difficult and controversial assumptions regard the evolution of life, and the development of intelligence once some form of life has evolved.

In 1961 Drake developed a conceptual framework, in the form of what is now known as the Drake equation, for the assumptions SETI research would make in determining the number of advanced, communicative civilizations that exist in the universe. The equation makes the most optimistic assumptions about the number of Sun-like stars, the percentage that have planetary systems, and the habitable planets that would develop in each solar system. Even most critics are willing to assume that these numbers would be very large. The equation also makes the assumption, however, that life will develop wherever there are habitable planets, "through the sheer force of physics and chemistry," according to Dr. Drake. Further, the assumption is made that, given enough time, intelligence will evolve everywhere life has evolved, and that 10-20% of these civilizations would try to locate and then communicate with other civilizations.

So far, in terms of empirical science, the only place we know that life has evolved is where we are. If we find that life did exist at a time when Mars was habitable, which in this author's view is quite possible, this will certainly dispatch the view that life is unique to this planet. Though it is unlikely that the vestiges of an advanced civilization will be found on Mars, nevertheless, the question of whether intelligent life

exists elsewhere remains a matter of optimistic or pessimistic speculation.

Is it worth the time of the scientists and the astronomical facilities to do SETI research? In itself, the answer depends upon the assumptions made regarding scientific questions, from the rate of star formation in the universe, to the probability that life will appear if all of the conditions are ripe.

### Other discoveries

But it is the case with SETI, as with all research, that applying advanced scientific tools to answer a question may well leave the intended query unanswered, and solve a different question altogether, or, better, raise new ones. Observations undertaken to search for radio signals from alien civilizations have discovered other natural, but previously unknown, sources of radio emissions in the expanse of space.

Will we find intelligent life? As Dr. Drake explains, SETI is not directly the search for intelligent life, but for the artifacts of a civilization that transmits radio signals! SETI searches try to detect non-natural transmissions in the part of the radiofrequency spectrum that makes it through Earth's atmosphere. For all of the previous history of SETI research, the only signals an antenna on Earth would have been able to detect would have been beacons sent by intelligent beings for the sole purpose of communicating. HRMS will have the collecting area using the 1,000-foot-diameter Arecibo

telescope to broadly survey the sky visible from Puerto Rico. The smaller telescopes used for a Targeted Search have the sensitivity, in terms of resolution, to detect signals another radio telescope might be transmitting, for example, to carrying out the same kinds of radar soundings of nearby planets that scientists conduct at Arecibo. The requirement that an advanced civilization has to *want* to communicate with us is removed.

For the purposes of SETI, intelligent life is defined as activity in the radio-wave part of the electromagnetic spectrum. It is possible that there is intelligent life elsewhere in the universe that does not use radio waves for communication. It is also possible that there are civilizations that possess intelligence, but may not have yet advanced to our level of technology.

But "failure" only makes SETI a project without an end. Even if nothing that can be verified as a transmission from an intelligent civilization is found, scientists will propose continuing the search at higher resolution, longer distances, and perhaps at different wavelengths than the HRMS. New tools would be called for to continue the search. Dr. Drake admits that none of the scientists would want to call it quits without being convinced that everything has been done to detect extraterrestrial intelligence.

*Marsha Freeman is associate editor of 21st Century Science & Technology.*

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