BIOLOGY

Space Biology Experiments

The discovery through space research that even a low form of life exists on other planets would have profound effect on man and his thinking, Ann Ewing reports.

➤ THE MOST PROFOUND and earth-shaking discovery resulting from space research would be that any kind of life exists on other planets.

Finding positive proof of life on Mars, not human life but plant life resembling earth's mosses and lichens, would be sensational. It would mean that life appears wherever conditions are right for it, and that life on earth is not unique.

If some form of plant life is confirmed for Mars, then chances are good that higher forms of life can be found on other planets revolving around other stars, or suns.

Many astronomers believe the seasonal color changes seen on the Martian surface are probably due to a form of Martian life, but this is now only a logical supposition. Confirmation will very likely have to wait until space research is sufficiently far advanced to include biology, as it is expected within a few years.

Present evidence for life on Mars is based on sunlight reflected from the planet as seen in the far infrared. The infrared spectrum indicates an accumulation of hydrocarbon-like materials in the dark areas.

This evidence is complemented by a report that the dark areas show the seasonal changes of granularity, indicating life forms.

Life on Mars Likeliest

In searching for life beyond the earth, Mars is usually considered the likeliest target. Microbiological analysis is believed the most promising method for detecting the presence of life and the microscope the most efficient sensing instrument.

Dr. Joshua Lederberg, professor of genetics at Stanford University Medical Center, Palo Alto, Calif., has urged microanalysis for the detection of extraterrestrial life. He pointed out, tongue in cheek, the difficulties of developing the automatic quipment that would be needed to catch a mouse or an elephant and then determine its nutritional requirements.

He believes a microscope-television combination would be a good way to obtain information from atmospheric dust or surface soil. The device would be landed on the surface of the planet, then a ribbon of transparent tape would be thrown out and, after collecting samples, rewound.

The ensuing inspection by microscope would be transmitted to earth by television. Detailed studies of such problems as how to process the samples for best obseravtion and how to focus the microscope are now under way.

Undoubtedly, the biological exploration of space will result in new insights into the origin and evolution of the physical universe, and of the chemical factors that constitute life. Even a sterile planet, one completely devoid of life, would be of extraordinary interest to scientists.

There are two dangers, however, in space exploration.

One is that man or his instruments, in landing on the moon or planets, might contaminate with microbes the very targets under study. An untouched planet with life forms presents "a rare opportunity to construct and test a theory of life that should not be dissipated," Dr. Lederberg said.

The second danger, exposure of humans to contamination by foreign organisms from other planets, is more remote in time. However, Dr. Lederberg has warned that even the slightest risk of epidemic disease, and the greater likelihood of weeds that could hurt earth's agriculture, makes the premature return of planetary samples or of craft that might inadvertently carry them impossible.

Dr. Lederberg's report to the Space Science Board of the National Academy of Sciences-National Research Council discounts the possibility of life on the moon because of the lack of atmosphere and water.

However, the moon does offer a chance to test the theory that spores may be the original space travelers. Natural or artificial transfer of spores has been proposed by some as an alternative theory to the evolutionary theory of life on the planets.

Because the moon is a gravitational trap for meteoric material, particles of earthly origin might be found there, saved from the deadly effects of solar radiation by the protection of lunar crevices.

Among others, Dr. Thomas Gold, director of the Cornell University Center for Radiophysics and Space Research in Ithaca, N. Y., has suggested that the beginning of biological evolution on a planet may result from contamination brought by space travelers. A billion years later inhabitants of such a planet might then be in a position to spread the contamination further.

There is little doubt that another century of productive science and technology, Dr. Lederberg believes, could give humans the ability to disseminate life.

Ideas Anticipated in Fiction

Many of the ideas Dr. Lederberg presented to the Space Science Board are not new. However, only occasionally have they been reported scientifically. Some are anticipated in the classic works of science fiction, such as "War of the Worlds."

But space biological research is no more fantastic than the realization of space travel itself.

For space research to uncover facts about the cosmic distribution of life, much thoughtful insight, meticulous planning and laboratory testing will be needed. Not only international cooperation, but mutual

POSSIBLE LIFE FORMS—Lichens or mosses, such as shown in this photograph, are the types of life forms most often suggested as those, if any, that exist on Mars. Within a few years, the search for life beyond the earth will be a reality.

understanding among scientific fields as different as biochemical genetics and planetary astronomy is a must.

The argument concerning whether or not there might be life on Venus is connected with its temperature, a highly controversial subject. Dr. Lederberg believes accurate measurements of its temperature must be made as soon as possible. Even should the surface be unbearably hot, as many astronomers believe, there may be a more temperate layer at another level.

Conditions on Mercury may be somewhat like those on the moon. However, since Mercury keeps one side always turned toward the sun and the other turned away, its dark side may furnish an even more reliable refuge for space traveling spores than the moon.

Mercury, Venus, the earth and Mars, in that order, are the planets closest to the sun, and are called by astronomers minor planets. The major planets include Jupiter, which is the largest in the solar system, more massive than all other planets combined.

Main Planets Difficult to Visit

In view of their distance, exploring the main planets may be very difficult. Because of Jupiter's large mass, slowing down a space vehicle to land on the outermost planets may be very hard to manage.

However, the fact that they have a high proportion of light elements, which have been bombarded by solar radiation at temperatures and in gravitational fields very different from the earth's, offers "the most exciting prospects for novel biochemical systems," Dr. Lederberg believes.

Since useful landings on other planets are difficult and hazardous, Dr. Lederberg urges that some attention be given to experiments done at a distance. Balloon and satellite-mounted telescopes can reveal much about planetary chemistry and, therefore, biology. Space probes to the vicinity of planets can furnish additional information prior to actual landings.

Earth Would Appear Different

To turn the tables, what could possible intelligent life on other planets discover about the earth with equipment such as is now available on earth?

From Venus, for example, the earth through the telescope would appear very different from any of the other planets. The most conspicuous feature would be its clouds, which on the average cover about half the earth's surface and reflect considerably more light than the surface.

When spotted through the clouds, the most conspicuous surface features would probably be the reflection of the sun from oceans, snow-covered areas and deserts, which would be yellowish or reddish in color if there were little vegetation. The darkest parts of the earth's surface would be the oceans, when not reflecting direct sunlight, and the great forest regions. Cultivated regions and grasslands would appear somewhat green, but only the most general features could be seen. To be seen individually, objects would have to be many miles in diameter, so the chances are against detection of the existence of mankind from Venus.

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BIOCHEMISTRY

Gives Scientists Tracer

➤ BECAUSE OF THE TESTING of nuclear weapons, scientists have in their possession a giant-scale tracer that can be used to study the mechanisms and rates of many natural processes that involve the element carbon.

Several examples of such tracer studies are suggested by Drs. Wallace S. Broecker and Edwin A. Olson of Columbia University's Lamont Geological Observatory at Palisades, N. Y., in a report to Science, 132:712, 1960. They also report estimates of the proportion of radioactive carbon available for such studies.

The ratio of carbon-14 (radioactive carbon) to carbon-12 in the atmosphere over the Northern Hemisphere will reach a maximum before 1963 at from 1.3 to 1.4 times the pre-bomb level, the scientists report.

The maximum for surface ocean water will be between 1.09 and 1.15 times the pre-bomb level and the maximum will occur between 1970 and 1975.

By 1980, the ratio for the atmosphere will have dropped halfway back to the pre-bomb level.

Early in the next century, the proportion of radioactive carbon in the atmosphere will be affected more by man's burning of coal and oil than it is by setting off of nuclear bombs. This is due to the fact that such combustion releases into the atmosphere carbon dioxide that is free from radioactive

Bomb-produced radioactive carbon can be used as a tracer in investigations in the fields of soil science, biochemistry and oceanography, the scientists suggested.

Radiocarbon measurements in simultaneously collected tree-leaf and atmospheric carbon dioxide samples, for example, show that the concentrations are often the same but that situations arise where tree leaves give a lower value. A possible explanation for this lack of agreement is that the leaves receive part of their carbon dioxide through the roots of the tree.

Bomb-produced radiocarbon also has effects on radiocarbon dating. Although archaeologists have long been complaining that the bomb-produced radiocarbon has been interfering with their dating tests, the bomb-produced radiocarbon can also have its advantages, the scientists indicated.

Due to "continuous spiking" of the atmosphere with bomb-produced radiocarbon, changes in the radiocarbon concentration throughout the carbon cycle are now occurring much faster than changes due solely to radioactive decay. Consequently, processes carried out in from one year to 100 years are now measurable or will be in a few years.

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