Organic production on Mars

Current theories concerning the origin of life on earth are based primarily on classic experiments in 1953 by Drs. Stanley L. Miller and Harold C. Urey. Simulating in the laboratory conditions thought to be present on primordial earth, they exposed a mixture of methane, ammonia, water and hydrogen to ultraviolet radiation. The result was a high-yield production of amino acids, building blocks of proteins.

Now Drs. Norman H. Horowitz, Jerry S. Hubbard and James P. Hardy, using a similar method, have exposed a mixture of gases simulating conditions believed to exist on the surface of Mars to ultraviolet radiation. The reaction produced organic compounds. They conclude that the ultraviolet radiation bombarding the surface of Mars could be producing organic matter on that planet. The results of the laboratory simulation at the California Institute of Technology's Jet Propulsion Laboratory appear in the March PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES.

The fact that such organic compounds may be produced on the Martian surface increases the possibility of life on Mars from "very unlikely to unlikely," says Dr. Horowitz.

Using the most recent data from ground observations and from the 1969 Mariners 6 and 7 flybys of the planet, the scientists exposed sterilized soil or powdered vycor glass and mixtures of carbon monoxide, carbon dioxide and water vapor to ultraviolet radiation in wavelengths from 2,000 to 3,000 angstroms. The results showed that carbon monoxide was converted to carbon dioxide, recoverable from the gas phase, and to organic compounds, recoverable from the soil. Three organic compounds have been tentatively identified as formaldehyde, acetaldehyde and glycolic acid. Although relatively simple, formaldehyde and acetaldehyde are important starting materials for the synthesis of several more-complex organic compounds, such as sugar-like materials.

The relative yields of the organic compounds and carbon dioxide in the laboratory tests varied with the wavelengths and the amount of surface area and water vapor used. The researchers conclude that "the rates of production [of organic material] would be limited by the low partial pressures of carbon monoxide and water in the Martian atmosphere, but the amount of product formed could be considerable over geological time."

Such an accumulation could occur, they believe, only if the matter were protected from ultimate destruction by the ultraviolet radiation that helped form it. "This would require," they continue, "that the products be periodically buried." This could occur as a result of what some scientists believe to be dust storms occurring on Mars.

Dr. Cyril Ponnamperuma of National Aeronautics and Space Administration's Ames Research Center calls the results "very important." It is noteworthy that the JPL scientists "took the most recent Martian data and used these as a basis for their experiment."

The data from Mariners 6 and 7 two years ago had seemed to diminish the chances for the existence of living material on Mars. Chemical spectroscopy had revealed carbon dioxide to be the major constituent of the lower atmosphere. There was 0.1 to 0.3 percent of carbon monoxide and a very small, seasonally variable amount of water vapor. Considerable amounts of high-energy ultraviolet radiation down to wavelengths of approximately 1,950 angstroms were reflected back from the Martian surface. (No high-energy solar radiation of less than 3,000 angstroms penetrates the earth's atmosphere.)

These findings and the Miller-Urey experiment, which showed that early life on earth probably arose under extremely reducing conditions—in which reactions with hydrogen are the dominating influence—made it seem unlikely that the oxidized atmosphere of Mars would be favorable to life. Another limiting factor was the unavailability of water in sufficient amounts.

"Before this experiment," says Dr. Richard S. Young, head of the exobiology branch of NASA, "it was generally felt that synthesis of organic compounds required a reducing atmosphere." What this new experiment has shown, says Dr. Young, is that carbon monoxide reacts with the hydrogen in water and is protected and catalyzed by the soil.

"The experiment is as important as the original Miller experiment itself," says Dr. Wolf Vishniac of the University of Rochester, and a principal investigator for the Viking Mars landing craft. Previous experiments had shown that as long as carbon dioxide was in the gaseous state in the atmosphere, no organic compounds could be found. Dr. Horowitz's simulation provides a surface to which the compounds can cling.

The possibility of organic compounds being formed on Mars does not necessarily mean that forms of life would be there. But the compounds are life-related in that a similar process is thought to have occurred on earth. The compounds provide at least a starting point for the development of self-replicating, or living, material.

Dr. Horowitz said this week that research is continuing. "None of the compounds identified so far contain nitrogen," he says. "Until we find those, we do not know if we have the 'soup' for life."

The search for life on Mars will continue. In May two Mariner orbiters will be launched by NASA, reaching the vicinity of Mars in November (SN: 9/12/70, p. 227). They will orbit the planet for three months at distances as close as 1,000 miles. (The closest approach to Mars by the Mariners 6 and 7 spacecraft was about 2,100 miles.) Then in 1975, the Viking spacecraft will be launched to land on Mars in 1976. □

Another confirmation of Murchison amino acids

Since last December's report by a National Aeronautics and Space Administration scientific group of the detection of amino acids in the Murchison meteorite (SN: 12/5/70, p. 429), there has been widespread interest in the finding. The key question is whether the amino acids are the results of contamination after the meteorite reached the earth or whether they were synthesized chemically in space. The NASA group believed it had ruled out contamination, and earlier this month a University of Houston group reported that its own studies also tend to indicate that extraterrestrial nonbiological synthesis "seems the most likely" mode of synthesis (SN: 3/20/71, p. 195).

A second independent confirmation has now been made by Drs. John R. Cronin and Carleton B. Moore of the University of Arizona's Center for Meteorite Studies. Using material from the interior of another stone from the Murchison fall and somewhat different laboratory methods, they identified the same six protein amino acids found by the NASA group and four of the twelve nonprotein amino acids. Laboratory contamination has apparently been avoided, they believe. They also have confirmed the presence of the same amino acids in an intact piece of a similar meteorite, Murray, that fell in 1950. They conclude the amino acids are indigenous to both. The report has been submitted to SCIENCE.