Book Review

The continuing puzzle of life on Mars

by Marsha Freeman

Mars: The Living Planet
by Barry E. DiGregorio
Berkeley, Calif.: Frog, Ltd., 1997
365 pages, hardbound, $25

On July 20, 1976, seven years to the day after the first astronauts landed on the Moon, the Viking I spacecraft landed on Mars. Its sister ship, Viking II, landed six weeks later.

Aboard both spacecraft were instruments given the task of trying to answer one of the most profound questions that had been posed to science: Did life develop on any planet in the solar system, beside the Earth?

Mars was the best candidate, because, like the Earth, it appeared to have had a warm and wet past. Also, like the Earth, the inclination of Mars's axis of rotation produces seasons, and it is neither too far from nor too close to the Sun to preclude the possibility of incipient life forms. It was also known that Mars, unlike the nearby Moon, has an atmosphere.

One of the three scientific instruments aboard the Viking landers had been developed by Dr. Gilbert Levin. His Labeled Release Experiment placed a drop of radioactive nutrient on a sample of Martian soil, and measured the gas coming out of it. Radioactive gas evolving from the soil sample suggested the presence of life. For 20 years, Dr. Levin has insisted that the results show that there is life on Mars. For most of those two decades, the overwhelming majority of the scientific community insisted that there was *no* life found by Viking, in large part because the conditions on Mars today could not support life.

No one has come up with a plausible explanation for the results Dr. Levin's experiment sent back to Earth. But more important than the skepticism with which his work has been treated, not many in the scientific community have been interested in developing *new* experiments on current Mars missions, which Dr. Levin has suggested, to continue the search for the truth.

This book is Dr. Levin's story.

The changing envelope for life

One thing scientists have recently learned, is that one should not be too hasty in making absolute statements about where life can and cannot exist. Author DiGregorio has done an excellent and exhaustive job of seeking out and summarizing the research that has been done in the past few years, which indicates that life can exist under many conditions that were previously thought to be prohibitive, including conditions one would find on Mars.

None of the experiments on the Viking landers indicated the presence of organic materials on or near the surface of Mars. There are varying, though not convincing, explanations for this finding. But could life exist that requires neither organic material, nor the ability to photosynthesize?

DiGregorio reports that in 1995, Drs. Todd Stevens and James McKinley, from the Pacific Northwest Laboratory in the state of Washington, discovered anaerobic bacteria living on nothing but basalt rock and oxygen-free water at a depth of 1,500 meters, in the groundwater in Columbia River basalt acquifers.

These rock-eating bacteria were subsequently named Subsurface Lithoautotrophic Microbial Systems, indicating an organism that manufactures organic nutrients from inorganic substances, such as volcanic basalt rock. According to DiGregorio, Dr. Stevens stated that the Viking life science experiments would not have been able to detect such life forms, if they exist, on Mars.

It is now broadly believed that there may be liquid water beneath the surface of Mars. While it is too cold and the atmosphere is too tenuous for liquid water to exist on the surface of Mars, there is no doubt that Mars was once, and may still be, a geologically active planet, with volcanoes and other attributes that could warm the frozen soil under the surface, to enable water to exist in a liquid form.

But, many have pointed out, there is little radiation shielding on Mars, due to its thin atmosphere and lack of an ozone layer, and the ultraviolet radiation would be lethal to life. In *Mars: The Living Planet,* DiGregorio points out that on Earth, organisms have developed a variety of methods of protecting themselves from UV radiation.

For example, there are organisms that encapsulate themselves in water for protection. Others use a process of biomineralization, where the incorporation of a small particle of iron, produced by the organism itself, protects it from ultraviolet light. It has also been observed that snow algae store dust and metals within their cell structure to use as nutrients, as well as for protection from solar UV.

In addition to the cosmic rays and UV that bombard the surface of Mars from space, there is also, most likely, the constant decay of radioactive materials intrinsic to the Martian soil, which, it has been argued, could be lethal to life.

DiGregorio reports that in 1989, a radiation-resistant microorganism was discovered living *inside the core* of the Three Mile Island nuclear reactor in Pennsylvania. These cells

apparently survive the extreme radiation environment by producing enzymes that repair their DNA, carrying on constant "damage control" as they are metabolizing.

Any scientist worth his salt would certainly now conclude that it is surely too early—that our information is too scant—to close the book on the possibility that there is, today, life on Mars.

How to look for life on Mars

Dr. Levin has not been discouraged by the lack of support and disagreement he has encountered from nearly the entire exobiology profession. He has continued to propose new experiments that could be placed on spacecraft to gather data on this crucial question of life on Mars.

He has focussed on one unique characteristic of living systems: the fact that they are chiral (left- or right-handed). The United States contributed the Mars Oxidant Experiment to the Mars '96 lander that was developed by the Russian Space Agency. Designed to identify and measure oxidants in the Martian soil, MOX included a fiber coated with two versions of an amino acid with opposite handedness, proposed by Dr. Levin. If the Martian soil reacted to the left-handed isomer of the amino acid, Levin proposed, it would indicate the presence of life.

Unfortunately, the Russian Mars '96 spacecraft did not make it to Mars, or even out of Earth orbit, but Dr. Levin has also proposed experiments that should be included in the Mars landing missions that NASA has planned over the next decade.

Levin proposed that the Thermal and Evolved Gas Analyzer, already slated to be flown on the NASA Mars Surveyor '98 lander, be modified to include a life detection experiment. That proposal was not accepted. Initially, Levin was told that searching for life on Mars was not part of that mission.

After the August 1996 announcement by scientists that they believed they saw evidence for past life on Mars in Mars meteorite ALH84001, Levin proposed his experiment again, but was told that the process required to sterilize the spacecraft, so that any positive indication of life would not come from Earth contamination, was too expensive.

But the excitement over the Mars meteorite, which led to renewed interest in future manned missions to Mars, has also renewed scientists' interest in life science experiments on upcoming unmanned Mars missions.

This excellent book is a fitting tribute to a man who has stubbornly insisted for more than 20 years, that scientists should be searching for the truth, and should be mobilized to find answers to puzzles that they cannot answer. If that kind of drive is applied to this puzzle of life on Mars, mankind may be able to begin to put some of the pieces together, even before we are on the way to Mars, to find out ourselves.