N89-18331

# THE LIFE ON MARS DILEMMA AND THE SAMPLE RETURN MISSION

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It has now been established (1-10) that: 1. the amount of water on Mars far exceeds initial estimates with liquid water detected within meters of the Mars surface, 2. for at least a billion years large quantities of water flowed on Mars, 3. Mars environmental conditions then were such that life might have developed as it did under similar conditions on Earth, and 4. a wide variety of life forms has been found in the most Mars-like environments on Earth. There is an emerging consensus from the NASA-oriented science community concerning the likelihood that life developed on early Mars. Many scientists, including some of the authors just cited, now propose to make the search for <u>fossils</u> an important part of the Mars Sample Return Mission. However, no one of them mentions the possibility of encountering <u>living</u> organisms. These scientists hypothesize that a catastrophic loss of much of the atmosphere on Mars with consequent cooling and loss of liquid water ended the red planet's experiment with life. They believe the changes exceeded life's ability to adapt, but that such events on Earth, while also drastic, did not. No basis for such a fine distinction currently exists. Indeed, scientific developments trend contrariwise. Life has been found within rocks, within permafrost, and on the dark floors of permanently ice-covered lakes in the Antarctic. Heretofore unknown life forms have been reported in other extreme environments thought uninhabitable. That extant terrestrial bionts many possess, if not in a single organism, all the characteristics necessary for survival on present-day Mars cautions against accepting this arbitrarily imposed limit on evolution with its far-reaching consequences. The dilemma thus created, that life on Earth evolved to survive, but that life on Mars did not argues against a long sought General Theory of Biology.

Furthermore, the Viking Mission legacy exacerbates the dilemma. None of the efforts made by the numerous investigators attempting to explain away the positive findings of the Viking Labeled Release (LR) life detection experiment on Mars has proven scientifically acceptable (11). The primary Viking Mission objective, to determine whether life exists on Mars, remains unresolved. The LR Mars data more than satisfied the pre-launch criteria (12) for a positive finding (13). However, the Viking gas chromatograph mass spectrometer (GCMS) reported (14) no organics in the Mars "soil". This finding was generally accepted by the scientific community as a bar to life on Mars. Later, however, it was revealed (15) that an Antarctic soil gave a positive LR response while the GCMS failed to detect any organic matter in the soil which, by wet chemical methods, was found to contain 0.3 percent organic carbon. These results make it possible to accomodate the Mars LR and GCMS data with the presence of living organisms.

Specific criteria (10) have now been proposed to detect fossils on Mars through imaging. A study of Viking Lander images (16) made to seek visual evidence to confirm the LR data, found colored patterns on rocks satisfing these criteria. Furthermore, lapse-time studies of these images over one and two-year periods indicate possible changes in the patterns.

The NASA Mars Sample Return Mission would be vitally affected by the presence of life on Mars. However, no experiments are presently planned to seek living organisms in the Mars "soil" or to protect humans exposed. The extensive studies (17, for example) of the problems of viable sample integrity and human safety have been set aside on the unwarranted assumption that Viking had demonstrated the sterility of Mars.

At a recent satellite workshop (18), in which US and USSR scientists compared objectives for exploring Mars, polarized views evolved. The US scientists discussed their plans to look only for fossil evidence of extinct life on Mars. The USSR scientists countered vigorously that they will look for living organisms on Mars.

A major objective of the Mars Sample Return Mission should be the resolution of the life problem. A method for doing this is proposed. It follows the time-tested scientific axiom of elaborating on productive investigations. Even if the active agent producing the LR response on Mars is nonbiological, the reactivity of the Mars surface material is of extraordinary interest. It's elucidation should be of high priority. The new Mars lander, therefore, should seek to verify the LR experiment, and then expand the technology to explain the reaction. A simple way that might determine whether the reaction is one of living organisms would be to supply the LR nutrients, including the L- and D-isomers, separately. A response from only isomer but not its enantiomer would essentially prove the presence of life. If life is found, important biochemical information could be obtained. Atmospheric composition, temperature, pH, water content and the like could be controlled and measured for this purpose.

The sample size required for all phases of this study would be aliquots of one cc for a total not exceeding 100 cc. A return to the Viking landing sites might be desirable for replication. However, should the response be attributable to living organisms, they are probably pervasive on Mars as on Earth and sites might be selected to accommodate other scientific objectives as well. In addition to testing surface samples, as was the case with Viking, attempts should be made to obtain deep-hole samples from environments possibly similar to those unexpectedly found to support life in the Antarctic.

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