THE BIOLOGY OF BARSOOM MARTIANS ACCORDING TO VIKING. S. A. Benner1
[1]Foundation for Applied Molecular Evolution, 13709 Progress Blvd. Alachua FL 32615, sbenner{at]ffame.org

Introduction: Discussions of planetary protection for Mars has been confused by a persistent misunderstanding of the results of the Viking 1976 mission. That mission observed:
• Fixation of ^{14}C from $^{14}CO_2$ and ^{14}CO.
• Emergence of $^{14}CO_2$ from ^{14}C-food fed to the soil
• Release of O_2 from the soil when moistened.
Under standard models for science process, theories should have then emerged to analyze these results under two models, one premising the of life, the other denying that premise.

Unfortunately, development of this dialectic was cut short when gas chromatography-mass spectrometry data were misinterpreted as showing that the Viking soils lacked organic molecules, this despite the delivery of organics to the Martian surface continuously. The need to find a slow soil oxidant to explain the absence of meteoritic organics expanded (unnecessarily) to a need for that oxidant to also explain the rapid release of O_2 from the soil when moistened, and the release of $^{14}CO_2$ from radiolabeled food. Viking Project scientist Gerald Soffen said: "That's the ball game. No organics, no life".

The conclusion that the Martian soil lacks organics has been known to be incorrect for a quarter century. In 1999, Benner *et al*. noted that the GC-MS could not have detected the primary organic molecules expected from meteorites even if they were abundant [1]. In 2010 [2], Navarro-Gonzales *et al*. explained all of the GC-MS results under a model that presumed a presence of organics and perchlorate. Rovers have found many organics in the Martian soil.

In a fascinating study of sociology in science, these developments since Viking were slow to move the community that made decisions about NASA missions. The 2013 Decadal Survey limited Martian astrobiology to activities to seek evidence for long-extinct life [3]. Despite a report from a 2019 Carlsbad conference where astrobiologists laid out the case for an extant biosphere on Mars [4], a report hoping to define community standards against which to judge claims for life-evidence repeated the 1976 misinterpretation of the Viking results as fact [5][6].

Thus, only in the past two years has progress been made to establish the dialectic necessary for a healthy science. A pro-life model has asked what lifestyle might make a bacterial photosynthetic autotroph fit to survive in the Viking soil given the scarcity of atmospheric O_2. On Earth, photosynthetic microbes release into the atmosphere O_2 that they generate in daytime as they fix organic carbon, confident that they can recover O_2 from the atmosphere when they respire some of that fixed carbon at night. On Mars, low atmosphere O_2 makes similar confidence unwarranted. Thus, to be fit for survival on the surface, photosynthetic autotrophs must store O_2 generated in the day for respiration at night [7].

This BARSOOM model (bacterial autotrophs respiring with stored oxygen for overnight metabolism) accounts for the three Viking results thus:
• Fixation of $^{14}CO_2$ is the key autotrophic process
• Emergence of $^{14}CO_2$ from ^{14}C-food fed to the soil is the key respiratory process during the night.
• The O_2 released when the Viking soil when moistened was the O_2 stored for overnight metabolism.

From a Terran biology perspective, BARSOOM faces these further challenges:
(a) The scarcity of liquid water, distant from frozen water below by a few meters.
(b) A need to block destructive UV light while accessing light needed for photosynthesis.
While non-life dialectical models have attributes, and while other bio-metabolisms must be considered as alternatives to the BARSOOM lifestyle, the fact that one can easily build a plausible biology at the Viking sites that is consistent with all available data suggest the following to the planetary protection team:
(c) Life is quite conceivably in many locales on the Martian surface, not just in special regions.
(d) The long community delay in seeking extant life robotically was misguided, especially since the Polyelectrolyte Theory of the Gene [8] provides a universal way to concentrate it for detection.
(e) With human visits likely in the next ~3 launch windows, life detection missions are urgent.

References
[1] Benner et al. (2000). The missing organic molecules on Mars. *PNAS* **97**, 2425.
[2] Navarro-González et al. (2010). Reanalysis of Viking results suggests perchlorate and organics at mid-latitudes on Mars. *J Geo Res: Planets*, **115** (E12).
[3] Rummel & Conley (2017) Four fallacies and an oversight. *Astrobiol* **17**, 971
[4] Carrier, et al. (2020) Mars extant life. *Astrobiol*. **20**, 785
[5] Meadows et al. (2022). Community Report from the Biosignatures Standards of Evidence Workshop. arXiv preprint arXiv:2210.14293.
[6] Benner (2023) "Why does the NASA culture still get Viking 1976 wrong?". *Primordial Scoop*, e20231113. doi.org/10.52400/OMNN6244
[7] Benner (2023) The BARSOOM model for life on Mars. *Primordial Scoop*, e20231118. doi.org/10.52400/USVX5880
[8] Benner (2017) Detecting Darwinism from molecules in the Enceladus plumes, Jupiter's moons, and other planetary water lagoons. *Astrobiol.* **17**, 840