A PARTIALLY PREGNANT IDEA

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Paul Voosen reports (Science, DOI:10.1126/science.357.6351.535, 2017) that NASA has put "… off limits to all but its most sterile (*sic*) of spacecraft" areas of Mars that may contain extant life. He then compounds this oxymoron with discussions of various degrees of sterility, such as "the rover was not fully sterilized." He says Alberto Fairen, Cornell University, has an op-ed article in press (Alberto Fairen, *et al*., *Astrobiology*), which Voosen describes as arguing that "NASA should slightly lower its sterilization standards."

Voosen, and Fairen (in several earlier publications), go on to contend that NASA's sterility requirements have prohibited Curiosity from seeking life in promising areas for fear of contaminating Mars with hitch-hiking Earth organisms. He neglects to say that Curiosity has no experiment with which to seek life, all life detection proposals having been rejected by NASA for the 41 years since Viking.

In support of lowering sterility requirements, Voosen cites the forthcoming article by Fairen *et al.* as stating that the harsh Mars environment "would kill Earth's microbes quickly." Voosen and Fairen seem unaware of the many experiments that have found terrestrial life to survive those harsh conditions. They ignore the recent news (It's Alive! "Algae Survive 16 Months Exposure To Space," CBC News, *Tech. and Science*, Bob McDonald, Feb. 10, 2017) supporting the earlier findings (S. Onofri *et al.,* "Survival of Rock-Colonizing Organisms After 1.5 Years in Outer Space," *Astrobiology*, 12, 5, 2012) that terrestrial microorganisms survived one and one-half years exposed to the naked space environment outside the International Space Station.

The problem seems to be whether or not the designated special regions of Mars should be examined by spacecraft not meeting sterility requirements, thereby risking contamination with terrestrial microorganisms. The possibility exists that these regions may be contaminated from the many

spacecraft that have already landed on Mars, with hitch- hikers growing and reproducing, and possibly being widely distributed by Martian winds. Or, if not contaminated now, the longer we wait to study such regions, the more likely they will become contaminated by future landers. Rather than add to the possibility of contamination by exploring these regions with unsterilized spacecraft, it would seem to make more sense to explore them as quickly as possible with sterilized instruments carefully deployed (as per G. V. Levin, *et al*., Proc. IEEE Aerospace Conf.,1, 2007) to establish whether or not life exists there. It is important to have answers prior to returning potentially lethal samples to Earth, or sending humans to Mars who would further contaminate the planet and/or be subject to health issues caused by alien microbes.

While mentioning Viking as an example of the high cost of spacecraft sterilization, Voosen fails to mention that Viking's Labeled Release life detection experiment (G.V. Levin and P.A. Straat, *Astrobiology*, 16 (10), 798-810, 2016) obtained strong evidence for extant life. These results have never been duplicated non-biologically. Nor does he mention that Levin and Straat have published (*ibid*) their conclusion that the LR detected life in the topsoil of Mars. Even with its high bar to acceptance of life on Mars, NASA concedes that the LR life detection results remain "ambiguous." So, there is a chance that life exists on Mars. Even if small, this chance must be taken seriously, because of the huge adverse impact on terrestrial life and environment should that risk materialize and be pathogenic.

The life conclusion is supported by Curiosity's finding of organics on Mars using wet extraction of complex organics. The heat extraction method used in all prior organic analyses of Martian materials, including those by the analytical instrument, SAM, on Curiosity, can transform or destroy some organics. Even so, organics up to 300 molecular weight have been reported by this limited method. However, the wet method can extract more highly complex organics unharmed, including molecules possibly of biological complexity, that can then be identified by SAM. Using the wet extraction method, SAM has found long-chain carboxylic acids, long-chain alcohols and functionalized aromatic compounds. These groups could include compounds found in microbial membranes. Though tantalizing, pending identification of the specific molecules, this information has not been published in a scientific journal. It has been informally disclosed by PI Carol Freissinet (to G.V. Levin, 7/7/2016, GSFC). Freissinet also said her team would perform the detailed, specific analyses "in several months." However, as of this writing, no such results have been published.

The best way to resolve this scientific and political issue of life on Mars would be to follow the classical dictate of science: *when an experiment produces a new result, repeat that experiment to check its validity, and, if it proves true,*

expand the experiment to gain new facts. **The way to do that would be to go back to one or both Viking sites with an updated version of the LR experiment that would confirm or deny the Viking results, and, if confirmed, expand them as proposed (G. V. Levin, *et al*., *International Journal of Astrobiology*, 6, 2, 95-108, 2007), including examination of special regions. Meanwhile, let's not put our health and environment at risk, no matter how small that risk might be. We could have a partial epidemic.**

Disclosure: Both Drs. Levin and Straat are Science Advisors for the International Committee Against Mars Sample Return (ICAMSR), but have no financial interest in it.

***Dr. Straat performed on the Viking Labeled Release experiment while employed at Biospherics Inc.**