

The “Astrobiology” Fantasy of NASA

The term “astrobiology” is an oxymoron that has become a buzzword in the Age of Space Hype.

Howard Gest

Distinguished Professor Emeritus of Microbiology,
Departments of Biology and History & Philosophy
of Science, Indiana University, Bloomington, IN 47405
email: gest@indiana.edu

The possible existence of life beyond Earth has been a subject of speculation, debate, and science fiction for centuries. An interesting survey of the older literature has been provided by Norman Pirie, a pioneer in analysis of the basic properties of living organisms and theories on the origin of life on Earth (1,2). We now know three facts about “life elsewhere”: a) there are no living organisms on the Moon, and b) Mars does not contain living organisms greater than ca. 2 mm in diameter, and c) actual experimental tests for living microbes on the surface of Mars by the 1976 Viking Missions gave negative results. The ingenious Viking experiments were well designed to detect metabolic activity of a wide range of physiological types of terrestrial microorganisms. Norman Horowitz, Director of Biosciences for Viking, described and evaluated the detection experiments in his 1986 book *To Utopia and Back: the Search for Life in the Solar System* (3). He concluded that “Viking found no life on Mars, and, just as important, it found why there can be no life.” In brief: Mars is devoid of liquid water, is suffused with short wave length ultraviolet radiation, and has “a highly oxidizing surface environment that is incompatible with the existence of organic matter on the planet.”

In 1996, NASA scientists made the claim that they had found evidence for “*past*” life on Mars in the form of fossil microorganisms in a small meteorite, designated ALH84001, collected in Antarctica (4). Their claim created an unprecedented media extravaganza. It is remarkable that the gifted political cartoonist Kevin Kallaugher (KAL) of the *Baltimore Sun* quickly saw through the hype and ambiguities in the media announcement of the evidence offered by the NASA scientists...see his cartoon at the end of this article.

I was invited to attend a meeting in March 1997 of the “Martian Meteorite Working Group,” organized by the Lunar and Planetary Institute, to evaluate applications from independent scientists who requested small samples of ALD84001 for further study. The invitation was probably based on recognition of my membership (1967-1969) in a National Academy of Sciences-National Research Council committee on “Microbiological problems of man in extended space flight” and my long-term interests in the origin of life, biochemical evolution, and Precambrian paleobiology (5). By 1998, it became clear that the NASA claims could not be substantiated (6,7).

The so-called “microfossils” were simply bits of inorganic debris. As the Martian microbe story deflated, NASA established a virtual “Astrobiology Institute” to promote its foray into extraterrestrial life. This institute now awards grants to university consortia for study of Earth’s microbes that exist and grow under unusual physical and chemical conditions, i.e., so-called “extremophiles.” The existence of such bacteria is exploited by NASA to fuel the tacit hope that there may have been organisms that once lived under the hostile conditions on Mars (average temperature, minus 55C!). Publicity from the Astrobiology Institute strongly implies that terrestrial extremophiles were discovered only recently. In fact, many such bacteria were

isolated and characterized by microbiologists long before the Space Age. For example, Benjamin Volcani discovered extreme halophiles (e.g., *Halobacterium*) in the Dead Sea in the 1940s. During the 1970s, Thomas Brock and others isolated and described several kinds of extremophiles, including a variety of thermophilic microorganisms (8).

What is “astrobiology”?

NASA’s Astrobiology Roadmap (9) describes astrobiology as: “study of the origin, evolution, distribution and destiny of life in the universe. Astrobiology represents a synthesis of disciplines from astronomy to zoology, from ecology to molecular biology, and from geology to genomics.” Since there is no biology of any kind known other than on Earth, “astrobiology” is an oxymoron that does not represent a coherent scientific field. The word simply expresses a *hope* that life will be found beyond Earth. Philosopher-journalist A. C. Grayling (10) has said of *hope*: “The deceitfulness of hope gives it a bad name; for every ten thousand men there are a million hopes, but very few are realized. It offers lies as truth, and traps people in vain pursuits, which lead them on to greater disillusionments later...the fact that hope always applies to the future makes it a cheaply purchased, endlessly renewable commodity.”

In fact, the hope of astrobiology “is now trumpeted in a deluge of books, magazine and newspaper articles etc. aimed at the general public. One of the latest books (11) that describes “The NASA search for (and synthesis of) alien life” does not even cite Horowitz’s book on the Viking experimental attempts to detect life on Mars. In sum, “astrobiology” has become a buzzword. According to Partridge (12), a buzzword is “any resounding but hackneyed, and by misuse almost meaningless, word, borrowed from the jargons of the professions or technology”

The importance of scientific definitions

As a scientific phenomenon or entity becomes more well understood, its definition changes accordingly. An excellent example of how evolution of knowledge becomes encapsulated in scientific definitions is given by considering “dephlogisticated air” [other examples are given by Gest (13)]. In 1774, Joseph Priestley observed that heating a certain red powder yielded “dephlogisticated air.”

He later made the important discoveries that this kind of air was produced by plants and was required for the life of animals. A 1795 dictionary of chemistry defined “dephlogisticated air” as follows: “This aerial fluid being the grand instrument of combustion composes between one third and one fourth of the weight of the atmosphere, and is absorbed by various bodies, from which it may afterwards be extricated or expelled by heat assisted by the action of light.” Between 1787 and 1790, Antoine Lavoisier revolutionized chemistry, replacing the term “dephlogisticated air” with “oxygen,” which eventually could be defined as: a colorless, tasteless, odorless gaseous element that constitutes 21 percent of the atmosphere and is found in water, in most rocks and minerals, and in numerous organic compounds, that is active in physiological processes, and that is involved especially in combustion. Lavoisier clearly understood the importance of accurate definitions. In his words (14): “We cannot improve the language of any science without at the same time improving the science itself; nor can we, on the other hand, improve a science without improving the language or nomenclature.”

All things considered, I suggest that the term “astrobiology” should be discarded and replaced with the older word “exobiology,” with the provisional definition: “the search for extraterrestrial life.” If valid evidence for past life on Mars is ever found, the word “astrobiology” can be resurrected and redefined.

The very unlikely possibility of finding authentic microfossils on Mars is certainly not imminent. Steve Squyres, chief scientist for the current Mars mission is recently quoted (15) as saying: “If there’s life on Mars, its probably hundreds of meters below the surface, and it would be very hard to drill that deep without humans on the scene.”

Scotoma in science

Through detailed study of the early history of research in his field, neurologist Oliver Sacks observed that a number of early discoveries of significance are somehow “lost” or later forgotten (16). He informs us that “the term ‘scotoma’ (darkness, shadow)-as used by neurologists-denotes a disconnection or hiatus in perception, essentially a gap in consciousness produced by a neurological lesion.” Sacks further explains that “scotoma involves the *deletion* of what was originally perceived, a loss of knowledge, a loss of insight, a forgetting of insights that once seemed clearly established, a regression to less perceptive explanations. All these not only beset neurology but are surprisingly common in all fields of science. They raise the deepest questions about why such lapses occur.” Current “astrobiologists” have great zeal in promoting their research findings as novel additions to the scientific literature, but their writings frequently reveal a scotoma in respect to basic biochemical and microbiological knowledge.

Déjà vu

In 1958, I gave a lecture at Western Reserve University School of Medicine, where I was a faculty member, on theories of the origin of life and biochemical evolution. In this talk, I discussed the ideas of A. I. Oparin and Norman Horowitz in great detail and opened the lecture by quoting some remarks (17) of George Sarton, the eminent historian of science: “The chief requisite for the making of a good chicken pie is chicken; no amount of culinary legerdemain can make up for the lack of chicken. In the same way, the chief requisite for the history of science is intimate scientific knowledge; no amount of philosophic legerdemain can make up for its absence.” Forty-eight years later, evidence for extraterrestrial microbes has still not been found, and no amount of knowledge on terrestrial microbes can be used as evidence for the possibility of “life elsewhere.”

- (1) Pirie, N. W. *On making and recognizing life*. *New Biology* (Penguin Books Ltd.) **16**: 41-53 (1954)
- (2) Pirie, N. W. *Possible impact of cosmochemistry on terrestrial biology: historical introduction*. *Phil. Trans. R. Soc. Lond.* **A303**, 589-594 (1981).
- (3) Horowitz, N. H. *To Utopia and Back: the search for life in the solar system*. W.H. Freeman, San Francisco (1986).
- (4) McKay, D.S. *et al.* *Search for past life on Mars: possible relic biogenic activity in Martian meteorite ALH84001*. *Science* **273**, 924-930 (1996).
- (5) Gest, H. *Microbes in the search for extraterrestrial life*. *Amer. Soc. Microbiol. News*, December 2005, **vol. 71**, pp. 560-561.
- (6) Gest, H. *Microorganisms are ubiquitous on Earth-Did they also evolve on Mars?* *Amer. Soc. Microbiol. News* **63**, 296-297 (1997).

- (7) Kerr, R. A. *Requiem for life on Mars? Support for microbes fades.* *Science* **282**, 1398-1400 (1998).
- (8) Brock, T.D. *Thermophilic Microorganisms and Life at High Temperatures.* New York: Springer Verlag (1978).
- (9) Goldin, D. *Astrobiology Roadmap. Undated NASA (Ames Research Center) brochure* <http://astrobiology.arc.nasa.gov> See also <http://astrobiology.arc.nasa.gov/roadmap/index.html> (2003).
- (10) Grayling, A.C. *Meditations for the Humanist* Oxford University Press, Oxford (2002).
- (11) Ward, P.D. *Life as We Do Not Know It.* Viking Penguin, New York, 2005.
- (12) Partridge, E. *A Dictionary of Slang and Unconventional English*, ed. by P. Beale. Routledge & Kegan Paul, London, 8th ed. (1984).
- (13) Gest, H. *Evolution of knowledge encapsulated in scientific definitions.* *Persp. Biol. Med.* **44**, 556-564 (2001).
- (14) Lavoisier, A. *Elements of Chemistry.* Transl. by R. Kerr. Creech, Edinburgh (1790).
- (15) Tierney, J. *Your ticket to Mars.* *New York Times*, January 28, 2006, p. A 27.
- (16) Sacks, O. *Scotoma: Forgetting and neglect in science.* In: *Hidden Histories of Science*, ed. by R. B. Silvers, pp. 141-179. New York Review Book (1995).
- (17) Sarton, G. *The teaching of the history of science.* *Sci. Monthly* **7**, 193-211 (1918).



Depiction by Kevin KAL Kallaugher, Baltimore Sun, CartoonArts International, of the August 7, 1996 press conference in which NASA scientists announced evidence for "past" microbial life on Mars. The cartoon originally appeared in the Baltimore Sun on August 8, 1996; used with permission of the artist.