DO INDIGENOUS MARTIAN BACTERIA HAVE PRECEDENCE OVER HUMAN EXPLORATION?

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ABSTRACT

This paper is a summary of a debate between the authors on the question: “Is it ethical for humans to terraform Mars, even in the event that microbial life is found to exist there?” Zubrin takes a “yes” position and McKay takes the “no” position. The evening debate at the 2000 Mars Society Convention was an historical event pitting the extremes of the broad spectrum of Mars exploration views. It first appeared in On to Mars, Apogee Books, 2002
Studies of life on Earth have long indicated that all life on this planet is biochemically similar. Obviously finding life based on a different biochemical pattern would indicate a separate and independent origin of life. Furthermore, recent work has extended our knowledge of life on Earth to show that all life on this planet is genetically, as well as biochemically, related and therefore descendent from a common ancestor. It is possible to imagine a life form that is biochemically identical to Earth life but is genetically different. This would also indicate a separate origin. (Incidentally, genetically different but biochemically identical life would support suggestions of the universality of the biochemistry in Earth life.) Methods for genetic analysis are sophisticated enough that it would be straightforward to determine if a Martian organism was genetically related to Earth life and could therefore be mapped on the known tree of life. It is interesting to note, however, that to do this analysis requires access to Martian organisms, be they either dead or alive. Fossils cannot provide an answer to this question. Frozen microorganisms in the permafrost can be used to address this question even if they are long dead from radiation.

A more interesting case arises if the life forms found on Mars are not part of the Earthly tree of life. They would then represent a second genesis – an independent origin of life.

If there is indigenous life on Mars, then it is not doing well. We can quantify what it means for a planetary biosphere to do well by looking at the Earth. On Earth, biology dominates the cycles of most of the biogenic elements (C,H,N,O,P,S). On Mars this is clearly not the case. There is not a global scale biosphere on Mars or it would have obvious and planet-wide effects on the atmosphere of Mars – and such effects are not observed. Indeed some have argued, based on the Gaia hypothesis, that life on a planet is either present globally or not at all, and since Mars obviously lacks a global biosphere it lacks any life whatever. Nonetheless we cannot exclude the possibility that there are limited subsurface refugia that still harbor the remnants of an indigenous Martian biota.

We can consider three possible responses to the discovery of indigenous life on Mars. First we could leave it alone. Secondly we could alter Mars to enhance the chances of that biota to become a global scale biology. A third possibility is to collect samples of this life for laboratory preservation, and then replace or augment it with terrestrial life forms. Each of these three options has distinct ethical and scientific aspects that are important to consider in full.

It has been argued that our primary ethical obligation to life on Mars is to leave it alone. In this case we would quarantine that life so as to prevent any unnatural changes to the Martian environment by the introduction of Earth life and to prevent the contamination of the Earth’s biosphere by Martian life. However, I believe this approach is too limited and not consistent with the clear biological potential of Mars. If we do nothing to either assist or harm indigenous Martian life we deprive that life and ourselves of the opportunity given by a global scale biological system on Mars. Our experience on Earth strongly suggests that the maximum richness and diversity of life is achieved when life has become fully global and dominates the biogeochemical cycles of a planet. Absent this, Mars cannot be said to be a living planet. It may be, and perhaps would remain, a planet with life, but it would not be a living planet. Furthermore, we deprive ourselves of the scientific and aesthetic value that we could obtain from observations of a second biosphere populated by life forms of a distinctly different origin.

I suggest that if we found a limited Martian biota it would be advantageous to us, and to that biota, to alter the planet Mars in a way that allows that biota to become a global biological system that controls the biogeochemical cycles on that planet. Given the similarities in the early history of Earth and Mars, it is likely that any indigenous Martian life would have had ecological requirements similar to life on Earth: sunlight would be the primary energy source, liquid water the reaction medium, and carbon the key building block. Thus enhancing the habitability of Mars for its indigenous life is likely to be the same task that we envision in making Mars habitable for aerobic Earth life.

It is very unlikely that we would drive to extinction any native Martian microorganisms in the process of extending the habitability of Mars. As we know from Earth, specialized microorganisms are able to live in small localized environments within a global biosphere. The greatest environmental change in the history of the Earth – the rise of oxygen – did not destroy the anaerobic microbial life that preceded it. In a newly habitable Mars some species of the indigenous Martian life may dominate the expanded biosphere, but it is likely that all the previous environments would still be represented at some scale in the new world. Biologically speaking, Mars would grow without loss and begin a new and separate evolutionary trajectory. It would be of enormous scientific interest to us to be able to observe this process: a second life form creating a second biosphere.

I argue strongly against the third alternative, namely preserving the indigenous Martian life in captivity and establishing a biosphere on Mars based on Earth life. I believe that, first and foremost, this approach is inconsistent with ethical standards. Further, I believe it does not optimize the knowledge we can gain from Mars in biology and ecology. And finally, I believe that supplanting an indigenous Martian biota is not critical to the progress of human expansion beyond Earth. With some difficulty, human expansion can continue without Mars. Human intelligence and drive are large enough and robust enough to move ahead even if Mars is already taken.
The ethical issues arise not because of any necessary respect for microbes per se. It is a respect for a second type of life, a second genesis. Clearly when we take medicinal antibiotics we try our best to exterminate microorganisms by the millions. However, in doing so, we are not exterminating an entire type of life or depriving that system of life of a chance to express its biological and evolutionary potential. It is the difference between killing a single deer and killing all deer. It is the difference between putting one deer in a zoo and putting all deer in zoos. And the difference is amplified by the fact that this is not just another species but another type of life. I see no ethical basis for assuming that indigenous Martian life is of less value and deserving of less consideration than life forms on Earth, especially given that the introduction of Earth life on Mars is not a compelling need but just a discretionary step in the expansion of life beyond the Earth. The incremental gain to humans and life from Earth in displacing indigenous Martian life is small in proportion to the loss of a second type of life and a second independent biosphere.

We do not know if we could inhabit Mars and still leave ecological room for an indigenous Martian biota. Cohabitation is unsupported by our experience on Earth. Earth microorganisms have expanded into every possible niche and would be expected to do so on Mars. Thus Earth microorganisms would probably compete ecologically if not biochemically with the Martian microbes. Ecological principles suggest that one or the other system would eventually displace the other, the two life forms could not both occupy the same ecological space for long. However, this can only be resolved by careful study and experimentation, and it could be that we are able to determine that Earth life on Mars is not inconsistent with allowing an independent indigenous Martian life to thrive.

It has been argued that human actions are as much a part of nature as the origin of life and its inexorable drive to expand. In this view, human actions need not be subject to ethical constraint. Our introduction of life is not any more unnatural than a meteorite carrying a microorganism from Earth to Mars. My personal view is that this is not a valid argument. Humans have accepted that our unique (as far as we know) capabilities include a responsibility to judge and control even our purely biological impulses. Purposeful actions by humans, for example causing the death of other humans, are ethically restricted even if the same actions occur naturally.

Clearly, I am presenting a personal view; there are no absolute criteria for assigning value to life and diversity or for comparing the value of a human outpost against the removal of an indigenous Martian biota. In actuality we may not have to face the dilemma of how to treat indigenous Martian life. Nonetheless, we should be intellectually prepared to face this issue and to defer to indigenous Martians—however microscopic—and even assist them in regaining biological control of their planet. We will be the better for this in both ethical and scientific terms.