

# THE NEED FOR OPERATING GUIDELINES AND A DECISION MAKING FRAMEWORK APPLICABLE TO THE DISCOVERY OF NON-INTELLIGENT EXTRATERRESTRIAL LIFE

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## ABSTRACT

While formal principles have been adopted for the eventuality of detecting intelligent life in our galaxy (SETI Principles), no such guidelines exist for the discovery of non-intelligent extraterrestrial life within the solar system. Current scientifically based planetary protection policies for solar system exploration address *how* to undertake exploration, but do not provide clear guidance on what to do *if and when* life is detected. Considering that martian life could be detected under several different robotic and human exploration scenarios in the coming decades, it is appropriate to anticipate how detection of non-intelligent, microbial life could impact future exploration missions and activities, especially on Mars. This paper discusses a proposed set of interim guidelines based loosely on the SETI Principles and addresses issues extending from the time of discovery through future handling and treatment of extraterrestrial life on Mars or elsewhere. Based on an analysis of both scientific and ethical considerations, there is a clear need for developing operating protocols applicable at the time of discovery and a decision making framework that anticipates future missions and activities, both robotic and human. There is growing scientific confidence that the discovery of extraterrestrial life in some form is nearly inevitable. If and when life is discovered beyond Earth, non-scientific dimensions may strongly influence decisions about the nature and scope of future missions and activities. It is appropriate to encourage international discussion and consideration of the issues prior to an event of such historical significance.

## INTRODUCTION

In the broadest sense, Astrobiology encompasses the search for extraterrestrial life anywhere in the universe. In practical terms, however, the search is currently comprised of two distinctly different efforts: 1) the search within our galaxy for signals from intelligent extraterrestrial life (referred to here as SETI—the search for extraterrestrial intelligence) and 2) the search within the solar system to detect evidence for the origin, evolution and existence of non-intelligent life (referred to here as exobiology). The discovery of any type of extraterrestrial life would have significant scientific, societal, practical and ethical implications.

The two search types -- SETI vs. exobiology-- differ in many important ways. In addition to searching vastly different locations and distances from Earth (within our galaxy vs. in the solar system), each presumes distinctly different types of extraterrestrial life (intelligent and complex vs. microbial and biologically simpler). In addition, both searches employ different equipment and methods (radio telescopes vs. spacecraft and scientific instruments), and involve distinctly different data (incoming electromagnetic signals vs. biological, chemical and/or geological evidence). Searches for extraterrestrial intelligence (ETI) use non-intrusive, indirect methods, with no environmental impacts or potential planetary cross contamination concerns, either on Earth or in space. In contrast, the exobiological searches for life employ spacecraft, scientific equipment and experiments within the solar system, and raise questions about environmental impacts and planetary cross contamination both on Earth and the celestial bodies visited. Taken together, all these differences have significant implications for activities during the period of exploration as well as for future actions if and when extraterrestrial life is discovered.

Already, the SETI detection scenario and its implications have been discussed in detail. Less attention has been paid to the implications of discovering non-intelligent, presumably microbial, life within the solar system. Considering that the discovery of non-intelligent extraterrestrial life may be at least as likely as the discovery of ETI in our lifetimes, it is appropriate to explore fully and formally the broad implications well in advance. Such an

analysis should consider the varied scenarios associated with exploration already underway or planned within the solar system, whether by robotic mission, sample return, human exploration, or eventually perhaps during colonization or even terraforming of extraterrestrial environments. For each scenario, it will be important to identify key issues, consider their implications, and develop guidelines for both short and long term responses.

## **SETI PRINCIPLES**

Within the SETI community, there have been serious discussions about the meaning and prospects of extraterrestrial intelligence (ETI) for a long time and from a variety of perspectives (e.g. Dick, 1998 and 2000; Peters, 1994; Billingham et al. 1994; Tough, 2000). More than a decade ago, recognition of the profound significance of discovering ETI prompted leaders in the SETI community to initiate discussions about how to respond *if* and *when* a signal is detected. Rather than presuming anything about the nature of the extraterrestrial intelligence itself, they focused instead on the human response anticipated in the face of a discovery scenario.

As a starting point, discussions acknowledged that any initial detection may be incomplete or ambiguous and thus will require careful re-examination and verification of the signal. They also recognized that because the search is a scientific endeavor, it will be critical to maintain the highest standards of scientific responsibility and credibility in all activities. Finally, all involved would need to observe specific steps and principles in the process of disseminating information about the detection as well as prior to attempting to communicate with ETI in return. Over a period of several years, the SETI Committee of the International Academy of Astronautics (IAA) developed a Declaration of Principles to serve as guidelines for individuals or organizations, national or international, engaged in carrying out radio searches for extraterrestrial intelligence. The Declaration, which is not legally binding and has no enforcement provisions, was approved by the Academy in 1989 and subsequently endorsed by numerous major organizations (complete text in Billingham et al. 1994 p 129-31). Key points of the Declaration of Principles are presented in a shortened form in Table 1.

**Table 1. Summary of Key Points of the Declaration of Principles Concerning Activities Following the Detection of Extraterrestrial Intelligence**

1. If an alleged signal is detected, the discoverer should seek to verify the source as extraterrestrial
2. Prior to public announcement, confirm the discovery by independent observations with research colleagues at other sites
3. If the signal is credible, inform UN and appropriate government and professional bodies, allowing the discoverer to inform observers throughout the world.
4. Confirmed detection should be announced promptly, openly and widely via scientific and public media channels, with the privilege of announcement reserved for discoverer.
5. All data necessary for confirmation of detection should be made available to the scientific community
6. Discovery should be confirmed and monitored and with data recorded and stored permanently
7. If detection is in the form of electromagnetic signals, protect the appropriate frequencies through international agreement
8. No response to the signal without consultation. Details of consultation to be developed.
9. Continue to review procedures and revise as appropriate

In practical terms, the SETI Principles provide step-by-step recommendations for what to do operationally and in the short term when a credible signal is received from a presumed intelligent civilization. It is interesting to note that the principles in their current form offer a set of operational guidelines for disseminating information about the detection of ETI upon initial discovery, but deliberately side-step any detailed recommendations for the long term. Instead they have adopted a policy of 'consultation' prior to sending a response to any signal. The intent of this consultation is to involve a range of governments, agencies and peoples in discussions and ensure broad consideration for all humankind. The principles are intended to be flexible and adaptable by including a provision for revision and refinement as more information becomes available. As might be expected with any attempt to formulate guidelines in advance of actual experience, there is already a recognized need to refine and revise the

principles. For example, Schenkel (1997) proposed the need to acknowledge and plan for a different kind of response if ETI actually visits Earth or makes direct contact, rather than simply sends signals. Tarter (1997) suggests that a higher level of organizational readiness may be needed to avoid chaotic conditions upon discovery due to a clash between the scientific goal of openness and governmental concerns about security. In addition, because of the vigilance of the mass media, it is likely that public announcements about alleged discoveries may occur far earlier in the verification process than The Principles have planned. Unofficial, premature, or widespread publicity based on uncertain signal findings could create a public frenzy of sorts, similar to those experienced following a SETI hoax, the announcement of fossil life in martian meteorites or predicted impacts by Earth crossing asteroids. (Shostak, 1997, Oliver et al., 1999)

## NO EXOBIOLOGY PRINCIPLES

While formal SETI principles have been adopted for the eventuality of detecting intelligent life in our galaxy, no such guidelines exist for the discovery of non-intelligent extraterrestrial life within the solar system. Moreover, there is no NASA policy or international protocol for the proper handling of non-intelligent extraterrestrial life *per se*, nor any deliberations currently underway to address the topic. To date, most discussions and planning have emphasized practical aspects of exploration, focusing on the science and technology needed to detect extraterrestrial microbial life and the planetary protection controls required to avoid harmful forward and back contamination during missions. [e.g., NRC (1992, 1997, 1999, 2002), MSHARP (1999), DeVincenzi et al. (1997)]. The approach used to date has provided scientifically justified recommendations on *how to undertake robotic searches* for evidence of life in a safe and appropriate manner, but no clear guidance on *what to do if and when life is detected*. While scientific guidelines will of course be critical, other dimensions must also be considered in the long run. As noted by LaMontagne (1999), actual discovery will prompt response at multiple levels, and the debate will be complicated by public attitudes, ethical considerations, national interests, and input from international institutions, and scientific and space community interests.

Despite a dramatic increase in solar system missions of all types during the past decade, discussions about the societal, ethical and practical implications of discovering non-intelligent, microbial life remain comparatively less mature than those in the ETI literature. The importance of including these other perspectives is clearly acknowledged in the Operating Principles elaborated as part of the NASA Astrobiology Roadmap (see Table 2).

**Table 2. Four Operating Principles Integral to the Astrobiology Program**

1. Astrobiology is ***multidisciplinary***, and achieving our goals will require the cooperation of different scientific disciplines and programs
2. Astrobiology ***encourages planetary stewardship***, through an emphasis on protection against biological contamination and recognition of the ethical issues surrounding the export of terrestrial life beyond Earth
3. Astrobiology ***recognizes a broad societal interest*** in our subject, especially in areas such as the search for extraterrestrial life and the potential to engineer new life forms adapted to live on other worlds.
4. In view of the intrinsic excitement and wide public interest in our subject, Astrobiology ***includes a strong element of education and public outreach***.

To be sure, there have been precious discussions on the possible existence of martian life accompanied by thoughtful questions about what its discovery might mean to future missions and human activities. In addition, there have been limited discussions about the ethical and societal contexts of such a discovery and suggestions about the need for advance planning (e.g. Sagan 1980; Lupisella 1997, 1998; Lupisella and Logsdon 1997; Logsdon et al. 1997; McKay 1990 & 2001; Zahnle 2001; Race et al. 2001). As noted by Randolph et al. (1997), a comprehensive exobiology exploration and discovery policy should be developed now, before any discoveries are made, and should be informed by an ethical analysis concerning our obligations as both space explorers and inhabitants of Earth.

## COMBINING SETI PRINCIPLES AND MARS EXPLORATION

Since a discovery of life in the solar system could occur in widely different locations and ways, it will be important to anticipate what kinds of operational and long term considerations might be appropriate for the various

scenarios. One way to focus the discussion about discovering non-intelligent ET life is to consider Mars exploration as a specific example and use the SETI Principles as a guiding format. By framing the analysis in such a way, it becomes apparent that there are issues related to both Earth and Mars that have implications for future decision making about mission hardware and activities, both robotic and human. These concerns extend from pre-launch through the time of discovery and include future search methods, handling and treatment of extraterrestrial life, whether on Mars or elsewhere.

Like the original SETI discussions, it is appropriate to begin by focusing on the nature of evidence anticipated upon detection. The SETI principles are built around a response to an incoming electromagnetic signal that may be ambiguous or incomplete. Searches for non-intelligent life could likewise discover ambiguous evidence, but in contrast to SETI, the 'signal' would be in real time (rather than tens to thousands of years old) and could be more varied in nature (alive, dormant, fossil, biomaterials, chemical evidence, or biomarkers). In addition, life could be discovered in one of several ways-- robotically on Mars, in a sample returned to Earth, or by humans on the planet sometime in the future. Each scenario would probably require a different set of guidelines.

### **Ethical Principles Underlying SETI vs. Exobiology**

In addition to focusing on the nature of evidence and possible discovery scenarios, it is also useful to analyze the SETI Principles from an ethical perspective. The nine steps for action in the SETI Principles appear to be based upon a foundation of just two ethical principles that stress the importance of:

- 1) *following proper scientific procedures* [confirmation and verification (step 1) ; making data available to other qualified scientists (steps 2 and 5) ; protecting the integrity of the data (steps 6 and 7); and giving credit to the original discoverers (steps 3 and 4)] , and
- 2) *communicating widely and seeking the participation of humankind as members of the Earthly community* [informing other parties, organizations and the Secretary of the United Nations (step 3) ; disseminating information promptly, openly and widely via scientific channels and the public media (step 4) ; and seeking international consultation prior to any response (step 8)].

Despite the obvious differences between the anticipated encounter with *intelligent* extraterrestrials and the discovery of *non-intelligent* extraterrestrial life, at the very least, the same two ethical principles—do good science, and communicate with humankind-- will be important in any proposed guidelines for searches within the solar system, as discussed below.

1. Observe “good” science procedures. "Good" science procedures include practices such as confirmation and verification; sharing scientific findings in the traditional ways; and giving due credit for scientific achievements. In the case of extraterrestrial ecosystems, it also means conducting scientific experiments and procedures in a manner that is responsible and non-harmful to extraterrestrial life, while also guarding against any back contamination that would harm life on planet Earth. Observing proper science procedures and undertaking credible, responsible science are already reflected in the Outer Space Treaty (U.N., 1967), in NASA's planetary protection policies and directives, and in recommendations of the Space Studies Board of the National Research Council (NRC, 1992, 1997, 1999, 2002). The current NASA sponsored international effort to develop a draft protocol for handling and testing returned samples (Race et al., 2001) is also consistent with this underlying ethical principle.

Thorough, proper scientific verification will be especially important in determining the nature of any life found.<sup>1</sup> If the extraterrestrial life form is shown to be similar to Earth life, but merely living in a distant, separated location, this may be explainable in terms of biological isolation, interplanetary dispersal and transfer processes, adaptation, and evolutionary divergence. Although scientifically quite exciting, some argue that there would be no fundamental difference between such an extraterrestrial life form and terrestrial extremophiles. On the other hand, if extraterrestrial life is distinctly different and unrelated to Earth life, it may represent an independent origin or 'second genesis.' In addition to being scientifically significant, this distinction may be ethically quite profound, with potentially serious implications for future space activities (e.g., McKay, 2001, Zubrin, 2000, Lupisella 1997).

2. Insure the participation of all humans in the discovery of extraterrestrial life. Just as the SETI guidelines acknowledge the importance of sharing the findings about extraterrestrial life with all humankind, and involving them in discussions about how to respond, so too should any guidelines for non-intelligent life. The discovery of ET life, whether intelligent or non-intelligent, will likely affect all humans by fundamentally changing our view of ourselves and our place in the universe. If we are truly no longer "alone in the universe," this represents such a

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<sup>1</sup> Verification is critically important for ETI as well (Boyce, 1990a and b) but it will not involve characterization of the life form.

profound and major discovery that everyone should be allowed to participate as members of the “human family.” NASA’s long-standing policy about communicating openly, combined with the vigilance of the mass media and the intense interest of the general public all but ensure that information will be shared widely and quickly. In addition to sharing information, there will be a need for ensuring broad participation in discussions about the implications for future space exploration and activities.

### **Additional Concerns Raised by the Necessity for Space Travel in Exobiology**

Beyond the two principles discussed above, analysis of exobiology discovery scenarios suggests that additional ethical concerns are involved. In fact, the underlying ethical principles for microbial ET life are actually more complex than for intelligent ET life. Perhaps the most significant difference between the search types is that virtually all the discovery scenarios for non-intelligent life involve space travel in some form or another, whereas SETI’s search for electromagnetic signals does not. The inclusion of space travel raises two critical concerns for solar system exploration that are not considered in the SETI Principles: (i) concerns about biohazardous back contamination of planet Earth when extraterrestrial samples or spacecraft are returned, and (ii) questions about obligations that earthly space travelers may have to preserve extraterrestrial life and ecosystems. Thus, in addition to the two ethical principles identified earlier—do good science and communicate widely—exploration via space travel raises the following other ethical principles:

3. Cause no harm to the biota and ecosystems of planet Earth. As with many ethical systems, perhaps the most fundamental principle is: “First, do no harm.” Because of the real-time transfer of materials associated with space missions, there is a need to be concerned with cross-contamination, especially from the return to Earth of materials that may harbor ET life forms or contaminants, whether in samples themselves or via ‘hitchhiker’ materials.<sup>2</sup> From the earliest days of space travel, scientists and policy makers acknowledged these concerns through provisions in the Outer Space Treaty, which urges the avoidance of harmful cross contamination during exploration (United Nations, 1967). Current Planetary Protection controls and policies promulgated by COSPAR and implemented by NASA through its regulatory directives formalize these cross-contamination concerns from a scientific perspective.

4. Respect and do not substantively (or perhaps irreparably) alter the extraterrestrial ecosystem. While the Outer Space Treaty addresses the question of forward contamination, it does so out of concern for protecting celestial bodies of biological interest for the sake of science. Even today, current terrestrial international space law recognizes no absolute protection for alien life-forms or alien environments *per se* (Cypser, 1993). NASA’s planetary protection controls during the Viking missions required that spacecraft orbits be designed to prevent impacting Mars for a period of “biological interest,” which extended decades into the future “in order to provide sufficient time for the study of Mars before it became contaminated by terrestrial spacecraft.” (DeVincenzi et al 1998). Likewise, all of the key NRC reports on Mars exploration and sample return are written from the perspective of ensuring the integrity of scientific experiments to detect and characterize possible extraterrestrial life, rather than any concern *for* that life. Part of the reason for this position is pragmatic: it is important to preserve life and the ecosystem in a manner that insures they will be available for research by future scientists of all nations.

While pragmatic concerns are important in maintaining the opportunity for future science study, a more fundamental and central rationale for a policy of non-interference or non-disturbance of an extraterrestrial ecosystem arises if ET life is found. Put simply, human space explorers may have a moral obligation to respect the integrity of extraterrestrial ecosystems just as they do those on Earth. It can be argued that extraterrestrial ecosystems should continue to function essentially the same as they did before their discovery by space explorers, following their natural evolutionary or development trajectory, whatever that might entail.<sup>3</sup>

This fourth ethical concern is perhaps the most unusual and far reaching when considering non-intelligent ET life. In essence, this argument is consistent with the Christian conception of the Golden Rule: “Do unto others as you would have them do unto you,” an axiom that has cognates in most other religious traditions, as well as many secular ethical systems. If planet Earth were visited by extraterrestrial beings with vastly superior intellectual capacities, we would want them to respect the Earth’s life, ecosystems and evolutionary trajectory, or at least not

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<sup>2</sup> It is assumed that detection of an electromagnetic signal for SETI would cause no direct harm; researchers have begun to explore the likely human responses and psychological impacts of ETI detection (e.g., Vakoch, and Lee, 2000). Presumably these impacts would be considered during discussions prior to any response to a signal.

<sup>3</sup> This position is one of continuing debate. For example Lupisella (personal communication, 2002) and Zubrin (2000) have suggested there may be no special obligation to non-intelligent life, especially if the consequences substantially or unduly interfere with human interests of science, exploration, rate of exploration, resource exploitation, terraforming, etc.

interfere in harmful ways. Similarly, we should follow the same ethical considerations when humans explorers play the role of the intellectually superior species vis-a- vis non-intelligent ET life.

Interestingly, this position in relation to non-intelligent life is an area of debate among scientists and space advocates, especially since it is by no means certain what martian microbes might 'want.' For example, Sagan (1980) asserted "If there is life on Mars, I believe we should do nothing with Mars. Mars then belongs to the Martians, even if they are only microbes." Taking the argument further, McKay (1990, 2001) suggests that the rights of Martian life 'confer upon us the obligation to assist it in obtaining global diversity and stability' by altering the planet "to promote the biota's emergence as a global biological system controlling the planet's biogeochemical cycles." Lupisella and Logsdon (1997) suggest consideration of "peaceful coexistence" as a practical compromise position. Zubrin and Wagner (1996), on the other hand, suggest that martian microbes should be viewed no differently than terrestrial microbes which 'we wouldn't hesitate to kill with an antibiotic pill.'

Ultimately, the various advocacy arguments for non-interference in the evolutionary trajectory of extraterrestrial ecosystems grow out of a commitment to freedom as a privileged intrinsic value for life. This commitment to freedom for all life to live and die freely is also mirrored in environmental ethics on Earth<sup>4</sup>. As applied to ET life, all species and ecosystems should be allowed to grow and develop freely; to flourish or become extinct without *undue* interference from more advanced, space-faring species.

It is important to note that this principle and commitment to freedom from undue influence does not exclude the taking of sample specimens or the conduct of scientific experiments within the extraterrestrial ecosystem -- so long as such scientifically legitimate enterprises do not cause irreparable harm or disruption to the ecosystem. Clearly, this would require careful study and observation of the ecosystem before proceeding further. Until we know more about ET life and how to mitigate potentially adverse ecological effects, it may be advisable to put a hold on projects such as ecopoiesis, terraforming,<sup>5</sup> and future private-sector entrepreneurial or commercial activities on celestial bodies with the potential for life.

### **Revisions Needed in Astrobiology Operating Principles?**

The foregoing analysis of underlying ethical principles for exobiology also uncovers an inherent contradiction in Astrobiology's Operating Principles. Principle 2 states: "Astrobiology encourages planetary stewardship, through an emphasis on protection against biological contamination and recognition of the ethical issues surrounding the export of terrestrial life beyond Earth." As previously noted, this principle implies that there are ethical considerations in the exploration of space and the possible discovery of non-intelligent extraterrestrial life. But, this principle also implicitly endorses the export of Earth life and assumes scientists mainly owe ethical obligations to Earth and its inhabitants. It clearly does not consider the possibility that human explorers may have ethical obligations toward extraterrestrial ecosystems and their inhabitants, regardless of their level of intelligence or biological complexity. It is appropriate to re-consider and perhaps modify the second Astrobiology Operating Principle in light of ethical arguments for respecting the freedom of all life and ecosystems to follow their own unique evolutionary trajectories. There is perhaps a need to introduce broader ethical perspectives, such as cosmocentric ethical perspectives, into discovery policies since all treaties, polices, laws and regulations regarding planetary protection and space exploration are written exclusively from an Earth-centric perspective. [Haynes (1990); McKay (1990); Randolph et al.,(1997); Cypser (1993); Fasan (1970); Lupisella and Logsdon (1997)]

### **SUGGESTED GUIDELINES FOR EXOBIOLOGY DISCOVERY**

In considering how these four ethical principles would apply to exobiological discoveries, they logically unfold in the following order:

1. Cause no harm to planet Earth, its life, and its diverse ecosystems
2. Respect and do not substantively or irreparably alter the extraterrestrial ecosystem.
3. Observe "good" science procedures.
4. Insure the participation of all humankind in the discovery of extraterrestrial life.

When listed in fuller detail like the SETI Principles, the following suggested steps are proposed as preliminary guidelines for further discussion. Looking ahead, these steps raise some interesting questions and concerns that

<sup>4</sup> This argument about freedom for life to flourish (whether applied to Earth- or extraterrestrial- microbial life) is admittedly a strong and debatable philosophical position, one that does not consider the more difficult challenges of weighing the value of other legitimate conflicting interests (e.g., human activities vs. preserving/protecting microbial life; helping life flourish, etc) .

<sup>5</sup> Ecopoiesis as defined by Haynes (1990) is the creation of a self-regulating anaerobic biosphere whereas terraforming refers to the creation of a human habitable climate via planetary engineering [as per Fogg (1995) in Hiscox (1996)]. It is not known whether the creation of such biosphere is possible.

will require clarification via scientific, technical and public deliberations. The proposed steps in the preliminary guidelines and the issues they raise are shown in Table 2.

**Table 2. Suggested Guidelines for Exobiology Discovery**

Guideline Steps	Questions and Concerns
1. If evidence of extraterrestrial life is detected, do no harm. Avoid intrusive action until full consultation can be made.	Need to develop operating guidelines for ‘no harm’ dependent upon the discovery scenario. a. if <i>in situ</i> robotic discovery: don't disturb or harm organism or habitat (consider observational or non-destructive methods only?) b. if discovered in returned samples: reassess containment adequacy, revisit questions about sterilization, culturing, and distribution of life forms to scientific community c. if <i>in-situ</i> human discovery-- implications for potential contamination of both martian environment and on-Mars habitat module, as well as concerns about eventual Earth-return of astronauts.
2. If presumed evidence of ET life is detected, seek to verify and confirm that the life form is truly extraterrestrial	(a scientific process)-- will require up-to-date life detection methods and expert consultation plan; especially important to distinguish whether ET life is related to Earth life or truly unique.
3. Prior to public announcement, confirm the discovery by independent observations with research colleagues and institution elsewhere	At what point do data become results for distribution to scientific community? Who gets credit for discovery when multidisciplinary teams of scientists are involved?
4. If the discovery is credible, inform UN and appropriate government agencies	Who should do the informing? Who will be informed, and in what order?
5. All data should be made available to the scientific community	Access to materials and samples may be constrained initially because of limited amounts of sample and concerns about containment —who has access? Who decides? International implications?
6. Protect and Preserve the ET life form	On Earth: Where? Under what ambient conditions? What about culturing and reproduction in the laboratory? What about the need for effective sterilization as part of the precautionary measures? On Mars: Implications for preserving and protecting martian habitats from undue alteration during activities
7. No further missions or activities prior to international consultation.	Will need both scientific and political discussions; Who should be involved in consultations and deliberations? Long term plans dependent on various scenarios (should additional robotic missions be allowed? additional sample returns? human missions, ecopoiesis or terraforming, private or commercial ventures, etc.?)
8. Continue to review and update procedures and policies	Update based on scientific methods, knowledge and advances; revision on of both pre- and post-discovery operational and long term plans as well as communications plans and public involvement, etc.

## CONCLUSIONS

In this paper, we have proposed a series of preliminary guidelines for actions immediately following the first discovery of non-intelligent extraterrestrial life, regardless of the discovery scenario. The proposed guidelines are based upon a foundation of four ethical principles that are important for space exploration involving spacecraft and actual travel to celestial bodies. Like the SETI Principles, the proposed guidelines are intended to provide “stop-guidance” at the point and moment of discovery, until longer-range plans for the handling and treatment of extraterrestrial life can be developed, presumably through careful discussion and deliberation involving relevant international experts, scientific and otherwise. While many of the mission scenarios discussed in this paper may not occur for a decade or more, ideally the recommended contingency planning and discussions should be done well in advance in order to reduce confusion and missteps at the time of detection.

Since many missions could discover ET life, these suggested guidelines are intended to prompt further discussion by specialists based on their expertise, as well as by non-specialists, who are interested in contributing to public discourse on responsible space exploration and the treatment of non-intelligent ET life. Ultimately, discussions may lead to a more comprehensive set of guidelines that are flexible and adaptable for use with multiple scenarios. Undoubtedly, discussions of these proposed guidelines will also reveal other interesting areas for investigation, including some beyond the scope of this paper (e.g., development of clearer search/pre-detection guidelines; the impact of mass media reporting on the public; the effect of a martian fossil discovery on continued NASA exploration programs, both robotic and human; impact of a SETI discovery prior to detecting life within the solar system; impact of non-scientific events or issues in selection of future missions and research, etc.)

Taking a lesson from the SETI principles, the proposed guidelines serve as a measure of foresight and may ultimately be a useful tool for providing oversight or regulation for an event of historical significance *whenever, wherever and if it occurs*. Already some preliminary discussions have been initiated about the scientific responses to various discovery scenarios (Race et al., 2001; Criswell et al., 2002). It is likewise appropriate to deliberate in advance about societal and non-scientific implications of an exobiology discovery. These issues are no less significant than those already encountered in genetic engineering, biomedical interventions, global warming debates or nuclear technology. Because bold endeavors involving science and technology can have profound effects upon the future of humankind, they deserve responsible, deliberate discussion by scientists and society alike. Let the discussions begin.

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## REFERENCES

- Billingham, J., R. Heyns, d. Milne, S.Doyle, M. Klein, J. Heilbron, M. Ashkenazi, M. Michaud, J. Lutz, and S.Shostak (eds.), Social Implications of the Detection of an Extraterrestrial Civilization. A Report of the Workshops on the Cultural Aspects of SETI . SETI Press, SETI Institute, Mountain View CA. March 1994.
- Boyce, P.B., The First Two Steps After the Signal Arrives: Verify and Tell the World, *Acta Astronautica* **21**(2), pp 85-88, 1990a.
- Boyce, P.B., Signal Verification in the Real World: When is a Signal not a Signal? *Acta Astronautica* **21**(2), pp 81-84, 1990b.
- Criswell, M.E. C.P. McKay, and M. Duke (eds.), When Ecologies Collide? Planetary Protection Issues in the Human Exploration of Mars. (workshop summer 2001, Pingree Park , CO. Report. in preparation), 2002.
- Cypser, D. A., International Law and Policy of Extraterrestrial Planetary Protection. *Jurimetrics. Journal of Law, Science and Technology*. **33**(2) PP 315-339. Winter 1993.
- De Vincenzi, D.L., Race, M.S., and H.P. Klein, Planetary Protection, Sample Return Missions and Mars Exploration: History, Status and Future Needs. *J. Geophysical Research*, **103**(E12) 28,577-28,585 1998.
- DeVincenzi, D., J. Bagby, M. Race, and J. Rummel (eds.), Proceedings: Mars Sample Quarantine Protocol Workshop, NASA/CP-1999-208772, April 1999. NASA Ames Res. Ctr., Moffett Field, CA, 1999.
- Dick, S.J., Life on Other Worlds. The 20<sup>th</sup>-Century Extraterrestrial Life Debate, Cambridge University Press, Cambridge, UK, 1998.
- Dick, S.J.(ed.), Many Worlds: The New Universe, Extraterrestrial Life, and the Theological Implications, Templeton Foundation Press, Philadelphia, 2000.

- Advances in Space Research 30(6), pp 1583-91, 2002
- Fasan, E., Relations with Alien Intelligences: The Scientific Basis of Metalaw, Berlin Verlag, Berlin, Germany, 1970.
- Hiscox, J.A., Biology and the Planetary Engineering of Mars, <http://spot.colorado.edu/~marscase/cfm/articles/biorev3.html>, 1996.
- LaMontagne, S., The Discovery of Extraterrestrial Life: Policy Implications for the Search for Origins. In The Search for Origins- Issue for Space Policy, A Report of the Policy Taskforce on Origins (C.B. Pilcher, WWS 402b Course Director), Woodrow Wilson School of Public and International Affairs, Princeton University, May, 1999.
- Logsdon, J.M., Ziegelaar, and A.M. Burns (eds.), Life on Mars: What Are the Implications? Proceedings of a Symposium "Life in the Universe: What Can the Martian Fossil Tell Us?" held on Nov. 22, 1996. Space Policy Institute, George Washington University, Washington, D.C., 1997.
- Lupisella M. and J.Logsdon, Do We Need a Cosmocentric Ethic? International Astronautical Congress (Turin, Italy), IAA-97-IAA.9.2.09, International Astronautical Federation, 3-5 Rue Mario-Nikis, 75015 Paris, France, 1997.
- Lupisella, M., Astrobiology and Cosmocentrism. *Bioastronomy News*, IAU Commission 51, **10**(1), pp1-2,8), (Published by The Planetary Society, Pasadena, CA), 1998.
- Lupisella, M., The Rights of Martians. *Space Policy*, **13**(2), 89-94, 1997.
- McKay, C.P., Let's Put Martian Life First. *Planetary Report*, July/August 2001. P 4-5, 2001.
- McKay,C.P., Does Mars Have Rights? An Approach to the Environmental Ethics of Planetary Engineering. In Moral Expertise, pages 184-97, ed. D. MacNiven, NY: Routledge, 1990.
- MSHARP, Mars Sample Handling and Requirements Panel, Final Report, NASA/TM-1999 – 209145, Jet Propulsion Laboratory (JPL), Pasadena, CA ,1999.
- NASA Astrobiology Roadmap, NASA Ames Research Center, Moffett Field, CA <http://astrobiology.arc.nasa.gov>
- NRC (National Research Council), Biological Contamination of Mars: Issues and Recommendations, Space Studies Board, National Research Council, National Academy Press, Washington, D.C., 1992.
- NRC, Mars Sample Return: Issues and Recommendations, National Academy Press, Washington, D.C., 1997.
- NRC, Evaluating the Biological Potential in Samples Returned from Planetary Satellites and Small Solar System Bodies: Framework for Decision Making, National Academy Press, Washington, D.C.,1998.
- NRC, The Quarantine and Certification of Martian Samples, National Academy Press, Washington, D.C., 2002.
- Oliver, C., H. Sim, and G.S. Shostak, The Case of EQ Peg: Challenge and Response, International Astronautical Congress 1999. International Astronautical Federation, 3-5 Rue Mario-Nikis, 75015 Paris, France, 1999.
- Peters, T., Exo-Theology: Speculations on Extraterrestrial Life. *CTNS Bulletin* **14** no. 3 (summer 1994) page 1-9, Center for Theology and Natural Sciences, Berkeley, CA, 1994.
- Race, M. S., K. Nealson, Rummel,J.D. and S. E. Acevedo (eds.), Mars Sample Handling Protocol Workshop Series, Workshop 3 Final Report, in press, NASA/CP-2001- 211388. Washington, D.C., 2001.
- Randolph, R., M.S. Race, and C. McKay, Reconsidering the Ethical and Theological Implications of Extraterrestrial Life., *CTNS Bulletin*, **17**(3), 1-8. Center for Theology and Natural Sciences, Berkeley, CA 1997.
- Sagan, C., Cosmos, Random House, NY, 1980.
- Schenkel, P., Legal Frameworks for Two Contact Scenarios. *J. British Interplanetary Soc.*, **50**, pp. 258-262. 1997.
- Shostak, S., Media Reaction to a SETI Success. International Astronautical Congress (Turin, Italy), International Astronautical Federation, 3-5 Rue Mario-Nikis, 75015 Paris, France, 1997.
- Shostak, S., Sharing the Universe, Perspectives on Extraterrestrial Life, Berkeley Hills Books. Berkeley, CA, 1998.
- Tarter, D.E., Security Consideration in Signal Detection. International Astronautical Congress, IAA-97-IAA.9.2.05 (Turin, Italy), International Astronautical Federation, 3-5 Rue Mario-Nikis, 75015 Paris, France, 1997.
- Tough, A. (ed.), When SETI Succeeds: The Impact of High-Information Contact. Foundation for the Future, 123 105<sup>th</sup> Avenue SE, Bellevue, WA 98004, 2000.
- United Nations Treaty on Principles governing the activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies. U.N. Doc. A/RES/2222(XXI); TIAS No. 6347, New York, USA, January 1967.
- Vakoch, D.A. and Y.-S. Lee., Reactions to Receipt of a Message from Extraterrestrial Intelligence: A Cross-Cultural Empirical Study. *Acta Astronautica*, **46**, No. 10-12, pp 737-744, 2000.
- Zahnle, K., Decline and Fall of the Empire. *Nature*, **412**, 209-13, 2001.