Planetary Protection and Article IX of the Outer Space Treaty

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Does life exist beyond Earth? This has been one of the recurring questions in natural philosophy throughout human existence. The advent of the Space Age, enabling direct exploration of other planets, has raised the possibility that we might obtain a scientific answer to this question. However, human exploration of the Earth has demonstrated that the thoughtless transportation of organisms from one location to another can cause significant and irreversible disruptions in the environments being explored—the introduction of rabbits to Australia and of smallpox to the New World are but two well-known examples of something that has happened, most often regrettably, many times through human action in the past.

In 1956 concerns were raised at a meeting of the International Astronautical Federation, about the potential for contamination of planetary targets by Earth microbes and the consequent possible interference with the ability of space missions to investigate the existence, origins, and evolution of life elsewhere in the solar system. In 1958, the International Council of Scientific Unions (ICSU, now the International Council for Science) took up these questions, which were included among the issues to be addressed by ICSU's new standing Committee on Space Research (COSPAR). The charter of COSPAR, when formed, stated that the primary purpose is to "provide the world scientific community with the means whereby it may exploit the possibilities of satellites and space probes of all kinds for scientific purposes, and exchange the resulting data on a cooperative basis"—research on the origin and evolution of life being one of those purposes. Since 1963, COSPAR, with input from its national and scientific-union members, has promulgated specific guidelines on how to explore the solar system while preventing biological contamination, both to protect future scientific research and to protect the Earth.

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The Formal Basis for the COSPAR Planetary Protection Policy

COSPAR's original policy on planetary protection predated the United Nations (UN) Space Treaty of 1967, and the consultative roles that COSPAR and ICSU play with the UN contributed to the eventual treaty language and subsequent elaboration. COSPAR, in the formal policy statement on the prevention of biological contamination that is maintained by the COSPAR Panel on Planetary Protection, now cites the Outer Space Treaty in the preamble of the consensus international policy on planetary protection (http://cosparhq.cnes.fr/Scistr/PPPolicy(20-July-08).pdf):

> *"Noting* that COSPAR has concerned itself with questions of biological contamination and spaceflight since its very inception, and
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> *noting* that Article IX of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (also known as the UN Space Treaty of 1967) states that:
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> > States Parties to the Treaty shall pursue studies of outer space, including the Moon and other celestial bodies, and conduct exploration of them so as to avoid their harmful contamination and also adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter, and where necessary, shall adopt appropriate measures for this purpose. (UN 1967)
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> *therefore*, COSPAR maintains and promulgates this planetary protection policy for the reference of spacefaring nations, both as an international standard on procedures to avoid organic-constituent and biological contamination in space exploration, and to provide accepted guidelines in this area to guide compliance with the wording of this UN Space Treaty and other relevant international agreements."

Policy Considerations

Given that biological planetary protection considers a subset of the “harmful contamination” and “adverse changes” that can result from space missions, and also only a subset of those missions, the COSPAR Policy’s requirements are tailored to the missions of direct concern, based on the target being visited and the type of mission being flown:

> “The conduct of scientific investigations of possible extraterrestrial life forms, precursors, and remnants must not be jeopardized. In addition, the Earth must be protected from the potential hazard posed by extraterrestrial matter carried by a spacecraft returning from an interplanetary mission. Therefore, for certain space mission/target planet combinations, controls on contamination shall be imposed, in accordance with issuances implementing this policy.”

The justification for controlling biological contamination on a spacecraft travelling to another planet is a determination, based on the best available scientific advice, regarding whether that location is of interest for understanding the origin and evolution of life and the possibility that the location might have conditions that could support the growth and propagation of Earth life:

- Locations not of interest for understanding the origin and evolution of life, such as rocky asteroids not likely to contain carbon-bearing material, are not considered to merit protection and missions travelling there are have no requirements for purposes of planetary protection.

- Locations that are of interest for understanding the origin and evolution of life but in which Earth life is unlikely to survive, which includes the Earth’s Moon and most other objects in the Solar System, are protected to a limited extent, such that missions travelling to those objects must generate documentation regarding mission operations and an identification of any material to be introduced into target environments, but do not require

controls on biological contamination.

- Locations that might host life or be hospitable for Earth life, such as Mars, Europa, or Enceladus, are protected by a requirement for strict limitations on the number of Earth organisms imported, constraints on unintentional impacts on such solar system bodies, and operational restrictions to ensure that even the limited number of organisms present aren't introduced into environments where they might grow and thrive.

Requirements are specified for each individual mission depending on the mission type and scientific investigations, on the basis of the best available advice and practices at the time. Normally such advice is requested from the lead agency's (in COSPAR usage, the agency that designs the mission) national scientific organization that is a member of ICSU/COSPAR, but the policy provides that COSPAR will provide expert advice and input on the policy and its implementation to a launching party upon request. Requirements may include additional restrictions beyond the general guidelines specified above, depending on the detailed objectives of the mission. Importantly, a mission targeting an object of low priority, e.g. Pluto, is given a more strict set of requirements if the spacecraft will encounter an object of higher priority *en route*, such as a Mars gravity assist.

Application of the Policy

In COSPAR policy, the lead agency on a mission has responsibility for ensuring planetary protection compliance and reporting to COSPAR on the outcome of the mission. Based on the reports received, it is understood that the COSPAR policy has been followed for all missions sent to date beyond low Earth orbit.

The more active a space agency, the more likely they are to have formal policies that accept and extend the guidelines offered by COSPAR. For example, the agency-level policy and requirements documents of both the U.S. National Aeronautics and Space Administration (NASA Policy Directive 8020.7 and NASA Procedural Requirements

Document NPR 8020.12) and the European Space Agency (ESA Planetary Protection Policy ESA/C(2007)112) specify that all missions launched by those agencies will follow COSPAR policy. In addition, both of those agency-level policies specify that agency support will only be provided to international missions if all mission participants agree to follow the COSPAR Planetary Protection Policy.

Note that the launching agency (in COSPAR usage, the agency that provides the launch) for a mission, if different from the lead agency, also must be responsive to national obligations under the Outer Space Treaty. This is simple in the case of a nation where only one agency is responsible for all such missions, e.g., the Russian Space Agency, Roskosmos, for Russia. However, when multiple national agencies or even commercial firms could be involved in launching a mission to another planetary body, things become more complicated. In the US, NASA procedures for launch approval of planetary missions require that such a mission document its compliance with planetary protection policy and requirements, but there is no current intra-governmental process to ensure that other US government agencies would do the same thing if they were to undertake such a mission without NASA support. For example, the Clementine mission flown by the Strategic Defense Initiative Office, in 1994, fully complied with then-extant COSPAR and NASA policies, but was not required by the US Government to document that compliance to NASA or report on its protection provisions to COSPAR.

Future Directions – Regulatory Considerations

Within the European Union, the purpose of ESA is “to provide for and to promote, for exclusively peaceful purposes, cooperation among European States in space research and technology and their space applications…” as stated in Article II of the ESA Convention. ESA acts for its member states when developing and implementing space activities and programs. In coordination with the national space agencies, ESA is currently the only agency in Europe that has the necessary expertise, resources, and structure in place to advise, support, review and certify the proper implementation of planetary protection requirements, pursuant to member states’ obligations under Article

IX of the 1967 Outer Space Treaty.

The European Commission has issued a mandate to the European Cooperation for Space Standardization (ECSS) to maintain a series of space industry standards, under ESA guidance and in consultation with industry and national space agencies. The six ECSS standards dedicated to planetary protection are readily accessible and used for spaceflight missions that may or may not include ESA contributions. The ESA Planetary Protection Policy, in combination with associated requirements, standards, and research/development programs, provides a consistent approach to meeting the obligations of member states and optimizing the use of resources.

An emerging question in planetary protection enforcement is the development of mechanisms to allow the application of these policies and requirements to the activities of non-national agencies. Two current scenarios are illustrative: the first is the provision of a biological experiment by a private organization based in the U.S to a Mars mission led and launched by Roskosmos, and the second is the announcement of a prize, to be awarded by organizations based in the U.S., for the successful completion of a privately-led mission to the Moon.

In the first example, the Planetary Society, an organization founded to promote the robotic and human exploration of space, has developed and constructed hardware to transport samples of a variety of dormant biological organisms beyond Earth orbit. This hardware has been provided to the Russian Phobos-Grunt project, a mission with a launch date 2011 that is intended to orbit Mars and return to Earth samples of the martian moon Phobos—along with The Planetary Society's biological experiment and a similar experiment provided by the Russian Institute for Biomedical Problems. In addition, the Phobos-Grunt mission also plans to carry a Chinese satellite to Mars, which will be operated by the Chinese Space Agency once it attains Mars orbit.

As the lead agency, Roskosmos would be responsible under COSPAR policy for ensuring that the mission as a whole complies with planetary protection requirements

for Mars, as well as requirements imposed on a mission returning samples to Earth. Planetary protection requirements for Mars can be met by demonstrating a sufficient probability of avoiding impact through an analysis of mission design and operations. However, the responsibility of the US Government under the treaty and the process to determine that responsibility have not been defined, regarding the implications of a private US entity having provided biological material to this mission. This question is also of academic interest: the 2011 International Institute for Space Law Moot Court problem has been framed around a related scenario.

A second example involves the Google Lunar X-Prize. The Lunar X-Prize competition was announced several years ago by the X-Prize Foundation and the internet company Google, and provides for the award of monetary prizes to organizations that demonstrate capabilities identified as milestones leading to the private exploration of the Earth's Moon. An article on the X-Prize website suggests that Google Lunar X-Prize competitors should comply with the COSPAR planetary protection policy (http://thelaunchpad.xprize.org/2009/02/good-solar-system-citizenship.html). Compliance with these requirements involves documentation only, without a need for biological contamination control or operational restrictions, and thus is not too burdensome for private operators.

Beyond the basic prizes, a bonus-prize is available to be awarded to competitors that successfully demonstrate a visit to a site of previous human activity on the Moon—particularly the Apollo landing sites. Rather than being solely a biological issue (and there are some biological interests in exploring the Apollo sites) this opens a number of questions in other areas of "harmful contamination" and science protection, especially those regarding access to potentially 'historic' sites in space exploration, and whatever consequences there might be if such sites are disrupted.

Within the U.S., a formal regulatory framework needs further development, although there are some legal threads already available to follow. For example, The National Aeronautics and Space Act of 1958 includes Section 203(c)8, that authorizes NASA

> “to establish within the Administration such offices and procedures as may be appropriate to provide for the greatest possible coordination of its activities under this Act with related scientific and other activities being carried on by other public and private agencies and organizations.”

Additionally, for launch licenses to be issued by the FAA under the US Code of Federal Regulations, Title 14, in section 415.23(b)3 (“Policy review”) it is stated that

> “the FAA consults with other federal agencies, including the National Aeronautics and Space Administration, authorized to address issues identified under paragraph (a) of this section, associated with an applicant's launch proposal,”

where paragraph (a) states,

> “the FAA reviews a license application to determine whether it presents any issues affecting U.S. national security or foreign policy interests, *or international obligations of the United States”* (italics added).

These threads are incomplete and perhaps too convoluted to be dependable, but this area of policy implementation and treaty adherence is certain to be more important in the future, as commercial players take part in the space enterprise and find themselves successful.