Case Study on Mars Exploration

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An international team will launch robotic, unmanned missions to Mars sometime within the next decade to gather soil and rock specimens from the surface and near-surface and return them to Earth for scientific study. While the expectation that life can exist on Mars is small, it cannot be ruled out. Thus, the Mars Sample Return mission has had to grapple with the question of whether such life could pose a threat to life on Earth. Equally vexing is the concern that Earth exploration could inadvertently cause damage to life on other worlds.

A National Research Council (NRC) Space Studies Board advising NASA recommended in 1997 [1] that samples returned from Mars should "… be contained and treated as potentially hazardous until proven otherwise …" NASA and its partners have discussed the facility that will need to be constructed to ensure that such life forms can be contained successfully. They have concluded [2] that the required Sample Receiving Facility [SRF] will need to integrate the technologies found in maximum containment microbiological laboratories with clean-room technology used to preserve rare samples. A NASA workgroup studying the containment required has found that an integrated facility of the type needed does not now exist and has suggested that the containment and cleanliness conditions of the SRF be described by various Planetary Protection Levels [PPL]. The PPL-α level, for example, is described [2]:

> PPL-α designates containment for incoming samples and archived samples that will combine maximum biocontainment and maximum cleanliness while keeping samples in near 'pristine' conditions under martian-like cold temperatures in a non-contaminating, inert gas environment.

The nations of the world have considered the risks associated with exploration of space in the Outer Space Treaty of 1967. Article IX of that treaty states, in part [3]:

> "… 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…"

Despite the best efforts of NASA and other national organizations involved in space exploration, it is impossible to ensure that other worlds will not suffer contamination by Earth life forms during exploration. In fact, such contamination may have already occurred on Mars from previous space missions that crashed vehicles on the surface of the planet. It is also extremely difficult to design facilities to contain life in forms currently unknown. For example, the minimum size of a living organism is unknown, so how can one guarantee that the filters used to treat gases released by the PPL-α facility will not contaminate the Earth? Furthermore, protocols that specify "sterilization" to prevent the release of a life form must qualify the sterilization techniques against life forms with unknown life processes. We expect certain chemicals and high levels of radiation to kill life forms we have studied. Is it certain that these will work against all life forms?

It is clear that the unmanned exploration of Mars will provide unique specimens for scientific study and, it is hoped, that much will be learned that will be useful to the scientific disciplines engaged in the studies. However, one can ask whether the risk to life on Mars and Earth posed by these studies is justified by the benefits the studies can provide. It also isn't clear that the parties who suffer the risk will reap the benefits.

We ask the questions:

A. Given the uncertainties, the risks, and the potential benefits, is it morally permissible to send the unmanned mission to Mars and bring back soil samples for study?
B. On the assumption that life does exist on Mars, is it morally permissible to contaminate it by introducing Earth organisms?
C. On the assumption that life does exist on Mars, is it morally permissible to risk contaminating Earth by bringing samples back for study?

Case Study Response Form Name: _____

Assume that you are a member of the board governing the actions of the Mars Exploration Team. Answer the following questions.

1. What are your initial reactions about the specific ethical issues involved in the three questions A, B, and C?

A)

_____
_____
__
_____
_

B)

_____
_____
__
_____
_

C)

_____
_____
__
_____
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2. List risks and benefits arising from obtaining Mars samples and bringing them back to earth.

Risks

_____
_____
_____
__

Benefits

_____
_____
_____
__

3. Is there anything in human experience that provides guidance in analyzing the three ethical questions?

A)

_____
_____
__
_____
_

B)

C)

4. Meet briefly with your board (team) and make recommendations on how (whether) to proceed with the project. If there is not consensus, provide dissenting opinions as well.

Recommendations:

Dissenting opinions:

[Answer the questions on the following page after your recommendations are completed]

5. Are there any features of past explorations on earth that bear on the issues presented in B or C?

B) _____
_____
_____

C) _____
_____
_____

6. Are there any features of questions B and/or C for which our experience with animal rights/welfare issues might be useful?

B) _____
_____
_____

C) _____
_____
_____

7. Are there any features of questions B and/or C for which our experience with genetically modified organisms or other biotechnology issues might be useful?

B) _____
_____
_____

C) _____
_____
_____

References

1. "Mars Sample Handling Protocol Workshop Series," NASA/CP-2000-209624, October 2000. SSB recommendations quoted on Pg. 7, Introduction.

2. "Mars Sample Handling Protocol Workshop Series," NASA/CP-2001-(in press), May 2001. Interim Report of the Workshop Series; Workshop 2 Final Report; Bethesda, Maryland; October 25-27, 2000; pg. 45.

3. "Mars Sample Handling Protocol Workshop Series," NASA/CP-2000-209624, October 2000. Quoted by John D. Rummel in his presentation, "Planetary Protection Overview," 3/20/00. Pg. 93.

Additional Readings

Diamond, J. 1999. Guns, Germs, and Steel: The Fates of Human Societies. W.W. Norton & Co., NY.