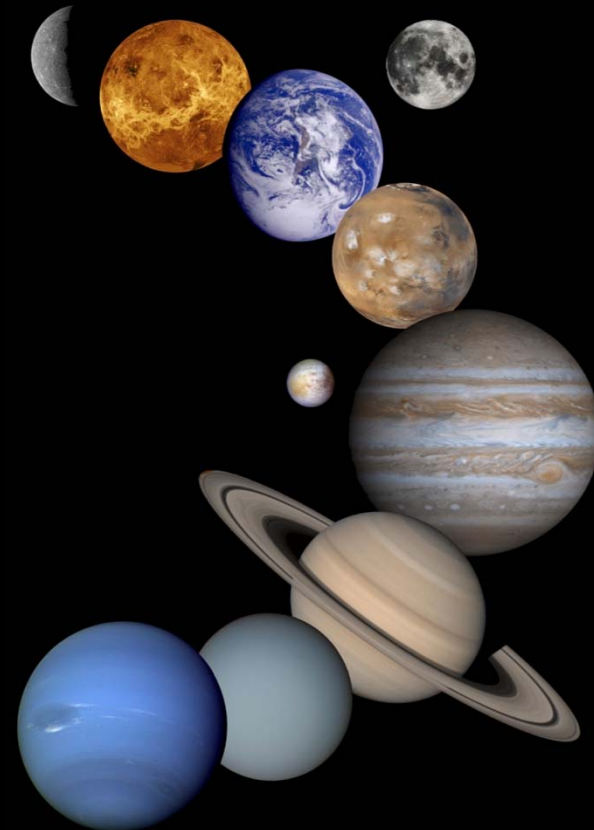
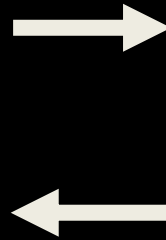


Some Ethical Considerations in Space Exploration:

With Illustrations from Environmental Ethics



John D. Rummel, SETI Institute, 4 November 2017

Philosophical Background

- **Ethics** is the branch of philosophy that studies morality (**right** and **wrong** behavior).



Branches of Ethics

1. **Meta-ethics** is concerned with the ultimate nature and justification of ethical claims: Are there objective moral facts and principles, and if so what is their source?
2. **Normative ethics** is concerned with investigating standards for right and wrong behavior in general (**moral theory**) and in practice (**applied ethics**).
3. **Descriptive ethics** tells us how the world is vs. how the world should be.

Normative Ethics

Concepts of Moral Status:

1. **Intrinsic value:** what qualifies something as a basic object of moral concern.

Possibilities: immortal soul, sentience, consciousness, subject of a life, an end in itself, aesthetic beauty?

2. **Instrumental value (derivative):** things lacking moral standing in themselves—whose moral standing is derivative upon their significance to moral subjects, e.g., pristine gulf waters, the Rosetta stone, the American flag, money.

Concepts of Moral Status: (continued)

3. Moral Agency: What sorts of entities have ethical obligations towards moral subjects?

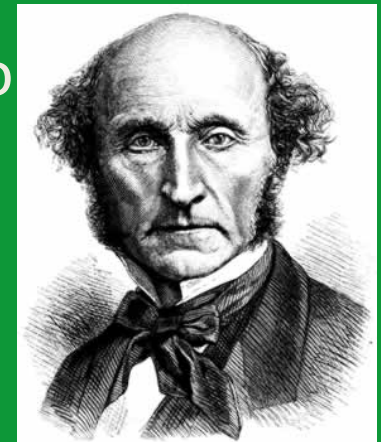
Necessary conditions: intelligence and self-consciousness. Only creatures that understand that they can make choices, and that their actions can benefit and harm others, may be held morally responsible for their behavior.

Three Moral Theories

Consequentialism

(Bentham, Mill, Singer):

- The rightness or wrongness of an action is determined its consequences.
 - Intrinsic value: “pleasure” (typically broadly construed to include interest satisfaction) and “pain” (broadly construed to include interest frustration).
 - Right actions produce the greatest balance of “pleasure” over “Pain.”
- Principal of Utility:
“Actions are right in proportion as they tend to promote happiness; wrong as they tend to produce the reverse of happiness.”



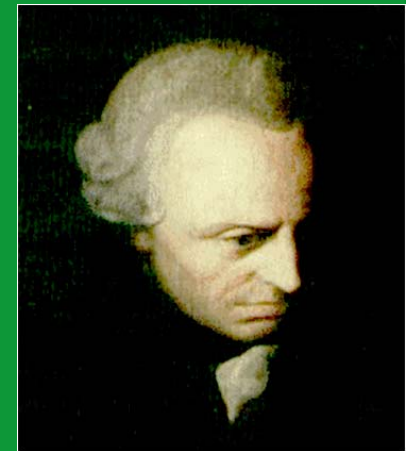
John Stuart
Mill

Deontology

Three Moral Theories (cont.)

(Kant, Regan):

- The rightness or wrongness of an action is determined by **moral duties** (vs. consequences of actions).
 - Intrinsic value: being a “*subject of a life*” (having representations, e.g., sense perceptions, and goals, e.g., rationality, beliefs, desires, and motives; sometimes interpreted more liberally as being an *end in itself*, or being a *teleological center of action*).
- Moral agents have a general duty to treat subjects of a life as ends in themselves (with respect) vs. mere instruments
- Categorical Imperative: FUL,
“Act only according to that maxim whereby you can, at the same time, will that it should become a universal law.”



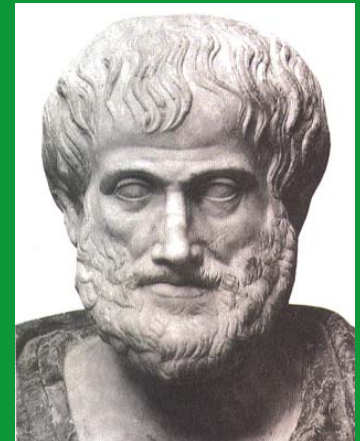
Immanuel
Kant

Virtue Ethics

(Plato, Aristotle, theology):

- The rightness or wrongness of an action is determined by the reasons (motives) one has for acting and these motives flow from one's **character**.
- The character of a moral agent (e.g., kindness, loyalty) is what determines whether an action is morally right or wrong, as opposed to the consequences of her actions or her duties.

“One swallow does not make a summer, neither does one fine day; similarly one day or brief time of happiness does not make a person entirely happy.”



Aristotle

Summary

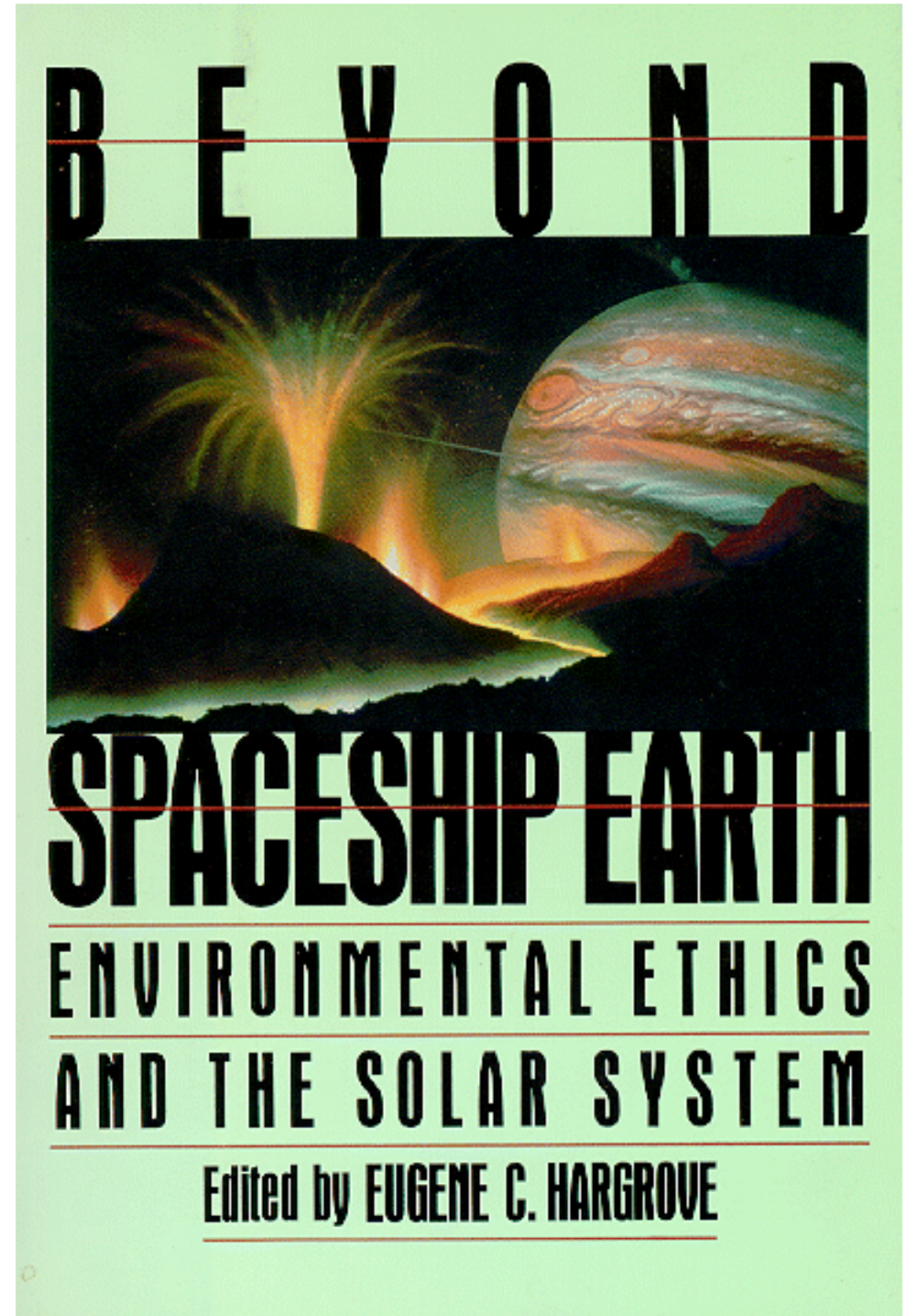
- These 3 moral theories frequently render the same conclusions about the rightness or wrongness of an action but for different reasons:

Example: All things considered, helping someone in need is the morally right thing to do.

1. **Utilitarianism:** because the **consequences** of doing so will maximize well-being
2. **Deontology:** because the agent will be acting in accord with a moral **duty**: Do unto others as one would have others do unto you.
3. **Virtue ethics:** helping people is being **virtuous** (charitable or benevolent).

Philosophical Environmental Ethics

- Concerned with the moral status of the environment and its nonhuman contents (individual organisms, species, communities, and ecosystems)
- Studies the moral relationship of humans to the environment and its non-human contents
- Focuses on applying traditional ethical theories to shed light on the above concerns: can all environmental ethics be fit within these theories?



The Gold Standard for Intrinsic Moral Status



- Membership in the species *Homo sapiens*
 - Humans are sentient
 - Humans are persons (Kantian subjects of a life)
 - Humans have motives and character (act for reasons)
 - Humans have a soul

What of non-biological “beings”?

- What of R2-D2?



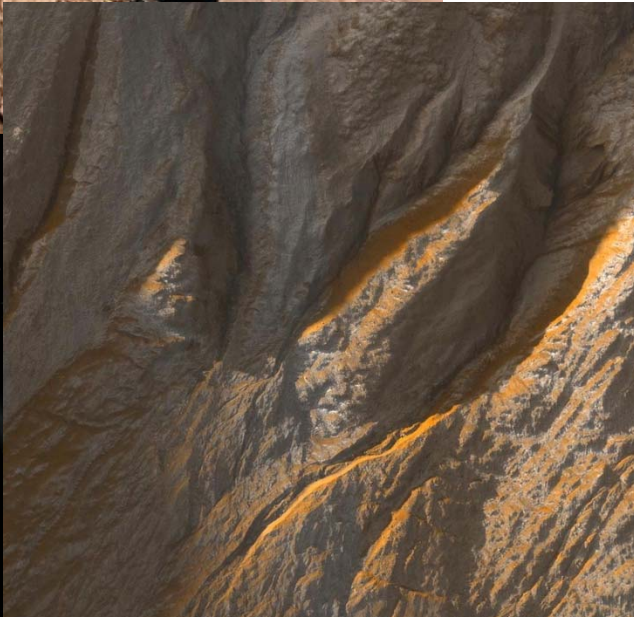
- What of the Horta?



- What of the Borg?



What of inanimate objects?



- Ecosystems?
- Rocks?
- Rivers?
- Special places?
- an entire natural world?
- every asteroid above the size of a dust particle?
- every dust particle?

The Battle of Hetch Hetchy

- Two sides of a classic environmental controversy that took place in 1913
- Should the Hetch Hetchy Valley within Yosemite National Park be dammed and flooded to provide water for the growing City of San Francisco?
- Key figures:
 - John Muir: Founder of the Sierra Club
 - Gifford Pinchot: Chief of the US Forest Service
 - James Phelan: Mayor of San Francisco

Hetch Hetchy

I am fully persuaded that . . .the injury . . .by substituting a lake for the present swampy floor of the valley is altogether unimportant compared with the benefits to be derived from its use as a reservoir.

– Gifford Pinchot

One may as well dam for water tanks the people's cathedrals and churches, for no holier temple has ever been consecrated by the heart of man.

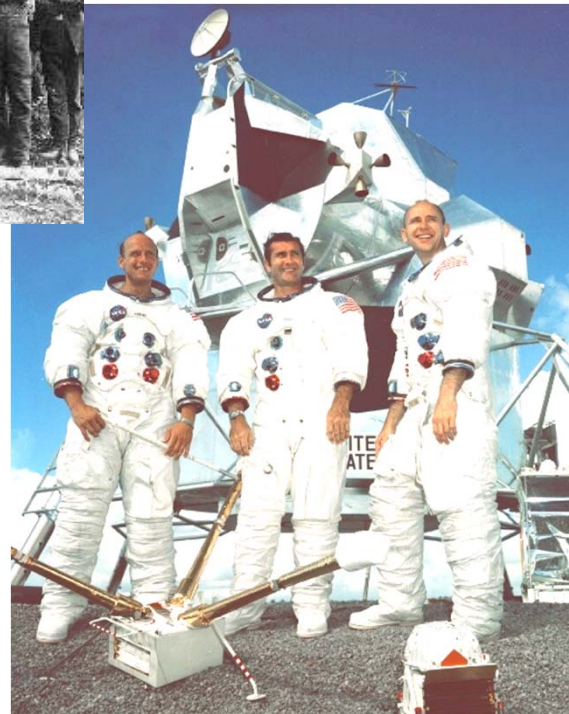
– John Muir

Hetch Hetchy Today



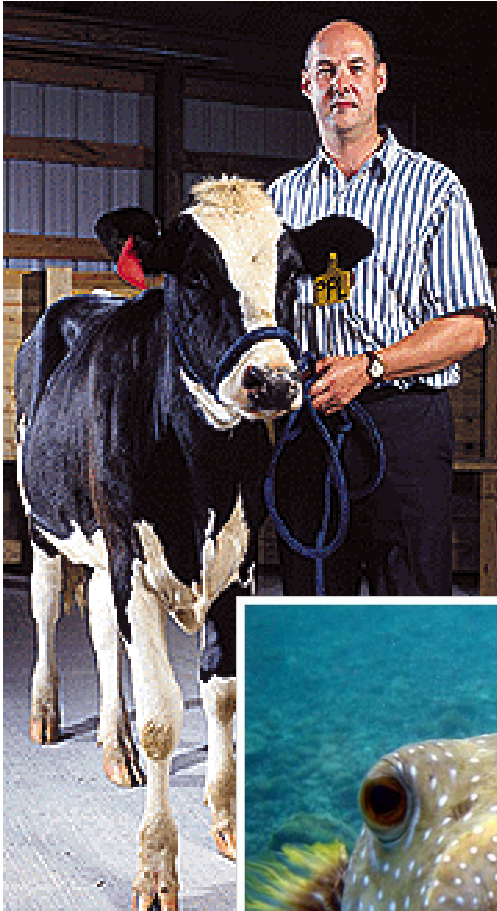
Approaches to “Environmental Ethics”

Environmental Ethical Positions



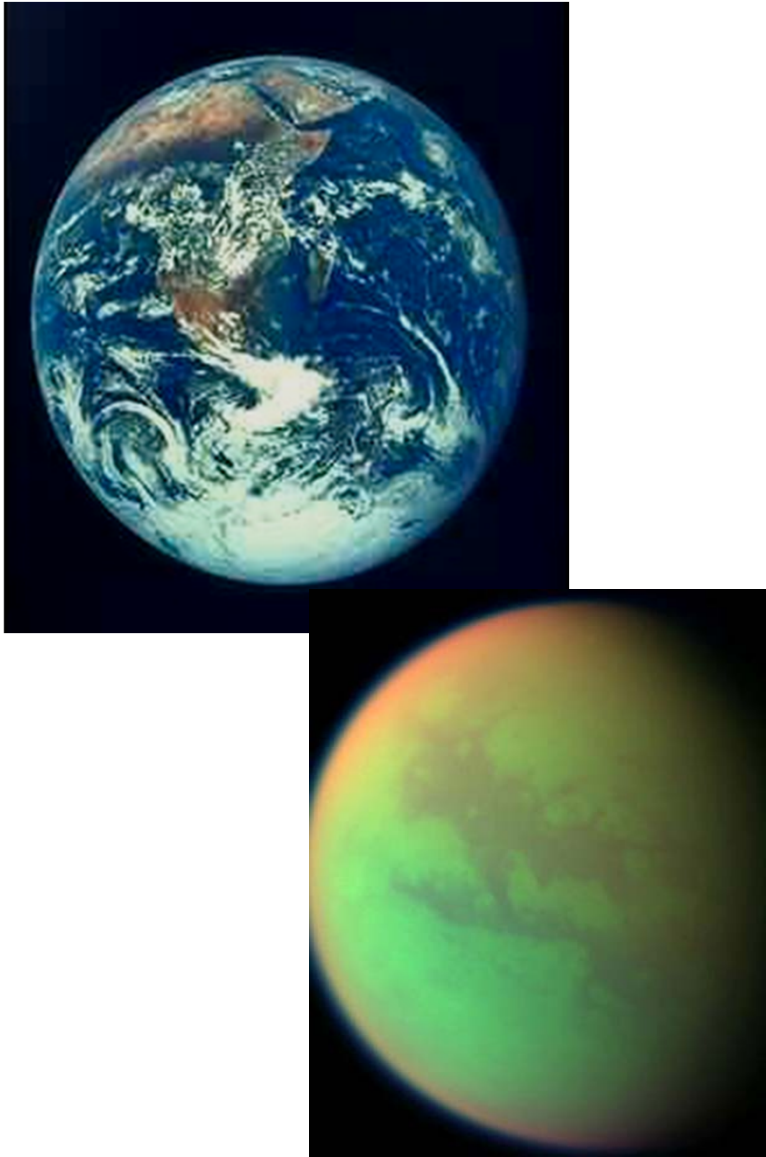
- **Anthropocentrism:**
Human centered morality
 - Only humans have intrinsic value and moral standing.
 - The rest of the natural world has *instrumental value* (use to humans).

Environmental Ethical Positions



- **Sentio-centrism:** Sentient-being centered morality
 - All and only sentient beings (animals that feel pain) have intrinsic value and moral standing.
 - The rest of the natural world has instrumental value.
 - Both humans and sentient animals have rights and/or interests that must be considered
 - Even if it is silicon-based?

Environmental Ethical Positions



Eco-centric Holism: ecosystem centered morality

- Non-individuals (the earth as an interconnected ecosystem, species, natural processes) have moral standing or intrinsic value and are deserving of respect.
- Individuals must be concerned about the whole community of life/nature,
- Humans should strive to preserve ecological balance and stability.
- Is there an extraterrestrial ecological balance to preserve?

Environmental Ethical Positions



Deep Ecology

- Humans are deeply connected with nature.
- If humans *identify with* nature, then taking care of the natural world will become part of taking care of one's self.
- But: Some environmentalists, argue that in Deep Ecology terms, eco-sabotage cannot be labeled terrorism, because
 - from this perspective it is
 - actually an act of self-defense.
 - For space exploration, this
 - level of environmental appreciation could all take a long time.



Ethics and Science, Redux

- Changes in science + same ethics => better success.
 - Anthropocentric: does not alter what we value; discovery of new, efficient ways to solve environmental problems for the benefit of humans.
- Changes in science => changes in the scope of ethics.
 - Non-anthropocentric: discovering that more than humanity falls under existing ethical criteria for moral consideration (sometimes called “extensionism” including animal rights).
- Changes in science => transformations in ethics.
 - Holistic and/or Ecocentric: we value ecological wholes and have duties toward preserving their integrity and stability, which represents a significant transformation of traditional ethical theories (Deep Ecology & Leopold’s Land Ethic).

Narrow Precautionary Principle

- If an action or policy has a suspected risk of causing harm to the public or to the environment, in the absence of scientific consensus that the action or policy is harmful, the burden of proof that it is not harmful falls on those taking the action.

Ethical Issues in Space Exploration

- Should we spend valuable resources that could be used on Earth to explore our solar system? (*Not the subject of this workshop – focus on ROI, here*)
- What sorts of non-human entities have intrinsic moral status?
- What obligations do we have to living systems that are not part of the Earth's ecosystem?
- Where does the human ecosystem begin and end?
- How much do we have to know before we let humans go beyond Earth orbit and be exposed to planetary environments
- How might ecocentrism apply to outer space?
- How wide should our precautionary principle be for space exploration: Should it extend to far future human beings? What about possible or future non-human moral subjects?



Available online at www.sciencedirect.com

SCIENCE @ DIRECT®

Space Policy 20 (2004) 291–295

Space Policy

www.elsevier.com/locate/spacepol

A Planetary Park system for Mars

Charles Cockell^{a,*}, Gerda Horneck^b

^a*British Antarctic Survey, High Cross, Madingley Road, Cambridge CB3 0ET, UK*

^b*German Aerospace Center, Institute of Aerospace Medicine, 51170 Cologne, Germany*

Abstract

The increasing robotic exploration of Mars and eventual human exploration and settlement of that planet threatens to have a significant environmental impact on scientifically important sites and sites of natural beauty in the form of contamination with micro-organisms and spacecraft parts. By definition, the sites that we might wish to preserve are likely to be those to which robots and humans will be sent. An interventionist step to protect pristine regions of Mars with the formation of a Planetary Park system is proposed. Possible locations for the first seven Planetary Parks are suggested. Landing of unmanned craft in these parks would be forbidden. Although global dust storms can carry microorganisms across the planetary surface, the regulations suggested for these parks will allow for the maximum level of preservation. We also suggest that the Planetary Park system could be applied to the Moon.

© 2004 Elsevier Ltd. All rights reserved.



Report

**COSPAR Workshop on Ethical Considerations for
Planetary Protection in Space Exploration**

Princeton University

Princeton, New Jersey

8-10 June 2010

Prepared for the COSPAR Panel on Planetary Protection

John D. Rummel

Margaret S. Race

Gerda Horneck

Editors

May 2012

Executive Summary

The goals of the workshop were to:

- Determine whether PP measures and other practices should be extended to protect other aspects of planetary environments going beyond “science protection,” and how?
- What other implications and responsibilities are engendered when exploring outer space, while avoiding harmful impacts on potential indigenous biospheres and other aspects of a planetary body?

Executive Summary (cont.)

Results:

1. An expanded framework for COSPAR is needed to address other forms of “harmful contamination” beyond biological and organic constituent contamination).
2. COSPAR should maintain the existing planetary protection policy while examining how to address issues related to life, non-life, environmental management and multiple uses.
3. COSPAR should add a separate and parallel policy to provide guidance on requirements/best practices for protection of non-living/non-life-related aspects of Outer Space and celestial bodies.

Executive Summary (cont.)

4. COSPAR should consider that the appropriate protection of potential indigenous extraterrestrial life shall include avoiding the harmful contamination of any habitable environment within the maximum potential time of viability of any terrestrial organisms that may be introduced into that environment by human or robotic activity.
5. The group recommended that specific wording be added to the COSPAR preamble and policy on planetary protection related to life and non-life, biological planetary protection, and environmental disturbances.

Executive Summary (cont.)

6. There should be continued study to identify useful management options and mechanisms for establishing a framework for environmental stewardship on celestial bodies that could incorporate scientific input on one end, and enforcement on the other, considering possible features such as:
- Environmental impact assessments for screening activities on celestial bodies
 - An intergovernmental mechanism for management of space exploration and use
 - Ensuring that COSPAR and other groups have input on management guidelines through a scientific committee providing advice to a Convention or appropriate process/structure
 - Possible designation, establishment and monitoring of planetary parks and areas for other uses, both protected and not-protected, and
 - Determine the appropriate jurisdiction over planetary ecosynthesis, where science and other uses might be threatened or in conflict

Executive Summary (cont.)

7. COSPAR should set up a group (or future workshop) to further explore the ethical values (e.g., intrinsic and instrumental) that apply to life, non-life, and environments as well as to the different classes of target objects in our solar system.

Additional details on what this workshop comprises will be developed at future COSPAR Assemblies. During this period when COSPAR is reanalyzing PP policy, a conservative approach to decisions regarding space exploration and activities is warranted.

Executive Summary (cont.)

8. COSPAR should elaborate on management guidelines in interaction with organizations such as IISL and others, to establish a framework for environmental stewardship on celestial bodies for submittal to the UN COPUOS for UN General Assembly consideration. This should apply additionally to the accepted regulations for preventing harmful planetary contamination, which currently only consider biological and organic chemical contamination. This could include the establishment of an intergovernmental mechanism and/or body to provide for regulation of space exploration and use.

Executive Summary (cont.)

9. COSPAR should encourage its members and the associated states to undertake public dialogue and engagement efforts at the national and/or regional level concerning ethics in space exploration, with the ultimate purpose of having public sentiment (including public perception) integrated appropriately into COSPAR policy deliberations. In addition, COSPAR should ask the PPP and PEX panels to hold a workshop on public engagement, consultation, and participation in policy-making in order to inform members about the premises, principles, and purposes of public engagement activities and best practices.

COSPAR's Planetary Protection Policy



COSPAR

(42 National Scientific Institutions & 13 International Scientific Unions)

- is responsible for organizing biennial Scientific Assemblies with strong contributions from most countries engaged in space research.
- provides the means for rapid publication of results in its journal *Advances in Space Research*,
- strives to promote the use of space science for the benefit of mankind and for its adoption by developing countries and new space-faring nations, in particular through a series of Capacity Building Workshops which teach very practical skills enabling researchers to participate in international space research programs,
- organizes, on a regional scale, scientific exchange and public outreach on specific research topics, in the framework of Colloquia and Symposia,
- **advises, as required, the UN and other intergovernmental organizations on space research matters or on the assessment of scientific issues in which space can play a role, for example the Group on Earth Observations (GEO), in which COSPAR is a Participating Organization,**
- **prepares scientific and technical standards related to space research,**
- promotes, on an international level, research in space, much of which has grown into large international collaborative programs in the mainstream of scientific research

Why a Planetary Protection Policy?

- Long before space travel was a reality, the implications of biological contamination control (i.e., planetary quarantine/protection) were appreciated and illustrated—most notably in H. G. Wells's (1898) *War of the Worlds*
 - The triumph of Earth microbes over the invading Martians saved the day for the earthlings, but provides a timely and instructive comment on one potential concern that might cause the human invasion of Mars to have a negative outcome
- By 1967, general agreement among spacefaring nations had been reached that interplanetary contamination should be avoided
 - Article IX of the United Nations Outer Space Treaty of 1967 reflected this agreement, placing obligations on spacefaring nations:

Article IX of the OST

“...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... “

Category-Specific Listing of Target Body/Mission Types

- Category I: Flyby, Orbiter, Lander: Undifferentiated, metamorphosed asteroids; Io; others to-be-defined (TBD) **Many asteroids**
- Category II: Flyby, Orbiter, Lander: Venus; Moon (with organic inventory); Comets; Carbonaceous Chondrite Asteroids; Jupiter; Saturn; Uranus; Neptune; Ganymede*; Callisto; Titan*; Triton*; Pluto/Charon*; Ceres; Kuiper-Belt Objects > 1/2 the size of Pluto*; Kuiper-Belt Objects < 1/2 the size of Pluto; others TBD **Most other asteroids**
- Category III: Flyby, Orbiters: Mars; Europa; Enceladus; others TBD
- Category IV: Lander Missions: Mars; Europa; Enceladus; others TBD
Cats III/IV concern only 3 solar system bodies; just 1 that humans wish to visit
- Category V: Any Earth-return mission
 - “Restricted Earth return”: Mars; Europa; others TBD
 - “Unrestricted Earth return”: Venus, Moon; others TBD **Most asteroids**

This is apparently more scary
than it should be....

Draft of the

“American Space Commerce Free Enterprise Act of 2017”:

§ 80103. Certification application and requirements

(c)2(D) “Guidelines promulgated by the Committee on Space Research may not be considered international obligations of the United States.”

Meanwhile, there is COPUOS Recognition

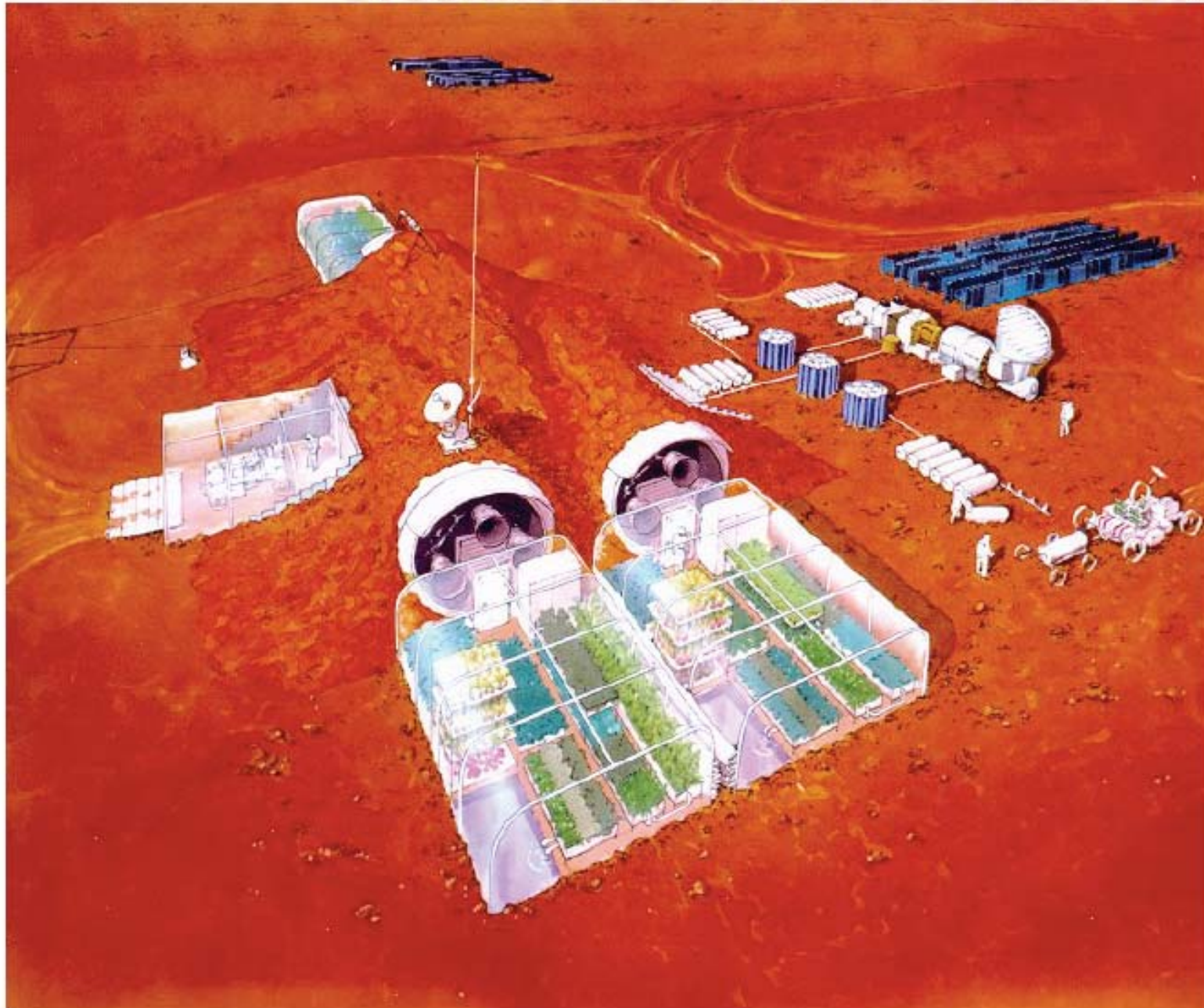
- In 2017, the UN Committee on the Peaceful Uses of Outer Space specifically recognized:

“the long-standing role of COSPAR in maintaining the planetary protection policy as a reference standard for spacefaring nations and in guiding compliance with Article IX of the Outer Space Treaty”

Consider Today's Policy

- Over the modern lifetime of COSPAR's Panel on Planetary Protection, beginning in 1999, the Panel has effectively pursued an international consensus standard to avoid organic and biologic contamination during solar system exploration missions.
 - It is now time to continue in that same way as the potential uses of the solar system grow beyond science and include other goals.
- The commercial use of outer space must comply with Article IX of the OST, including provisions associated with avoiding “harmful contamination”
 - It is anticipated that commercial entities will follow the international consensus standard for planetary protection maintained by COSPAR, as recognized by UN COPUOS.
 - **But that should be quite easy to do in most cases!**

Greenhouses at a Mars Base: 2025+



Three Possibilities for Life on Mars

- If there is no life on Mars — No worries, except for possible secondary effects from Earth pathogens, etc.
- If there is life related to Earth life, with common genetic systems — Low level of concern; understand past history of biotic exchanges and possible implications for astronaut exposure
- If life on Mars reflects a second genesis — major concern about Earth organisms destroying fundamental astrobiology science and operational medicine

Should Microbes Have Further Standing?

- No. Go brush your teeth and wash your hands
- Yes. If they are the only representatives of a second genesis

Why Preserve a Second Genesis

- Fundamental ethical principles related to the value of life and life's diversity
- Utilitarian benefit that comes from direct study of second genesis organisms and milieu
- Restoring life and a biosphere to a dead world is a worthy goal for a space-faring people

Implications of the Policy

- For most of the solar system, there are no obvious conflicts between adherence to the COSPAR Planetary Protection Policy and the needs of commercial entities
 - Missions to the asteroids and the Moon would not have operational requirements imposed on them—only record keeping would be required.
- For the foreseeable future, planetary protection conflicts would be limited to those generated by human activities on and around Mars, which has many conflicting usage issues (science, human exploration and colonization, commercial use).
 - Outside of national agencies, however, interest in Mars is limited to a few companies with the nascent capability of having their own missions.

Implications of the Policy

- For most of the solar system, there are no obvious conflicts between adherence to the COSPAR Planetary Protection Policy and the needs of commercial entities
 - Missions to the asteroids and the Moon would not have operational requirements imposed on them—only record keeping would be required.
- For the foreseeable future, planetary protection conflicts would be limited to those generated by human activities on and around Mars, which has many conflicting usage issues (science, human exploration and colonization, commercial use).
 - Outside of national agencies, however, interest in Mars is limited to a few companies with the nascent capability of having their own missions.

What are the “ethics” involved?

and

Do governments* need to impose environmental regulations on commercial space companies?

** at some level (which?)*

Most people think so...!

The Hague Space Resources Governance Working Group

The Working Group has agreed to circulate the building blocks as the preliminary result of its work and to invite comments to inform its further consideration of the building blocks. . . The Working Group hopes that its activities will complement efforts at the national, regional and global level.

Two of 19 Building Blocks

1. Objective of international framework

1.1 The international framework should create an enabling environment for space resource activities that takes into account all interests and benefits all countries and humankind.

1.2 To achieve this objective, the international framework should:

- a) Identify and define the relationship of space resource activities with existing international space law, including the provisions of the United Nations treaties on outer space;
- b) Propose recommendations for the consideration of States for the application or development of domestic frameworks;
- c) Propose recommendations for the consideration of intergovernmental organizations for the application or development of internal frameworks;
- d) Promote the identification of best practices by States, intergovernmental organizations and non-governmental entities.

The Hague Space Resources Governance Working Group

An “Environmental” Building Block

9. Avoidance of harmful impacts resulting from space resource activities

Taking into account the current state of technology, the international framework should provide that States and intergovernmental organizations authorizing space resource activities shall adopt a precautionary approach with the aim of avoiding harmful impacts, including:

- a) Risks to the safety of persons, the environment or property;
- b) Damage to persons, the environment or property;
- c) Adverse changes in the environment of the Earth, taking into account internationally agreed planetary protection policies;
- d) Harmful contamination of celestial bodies, taking into account internationally agreed planetary protection policies;
- e) Harmful contamination of outer space, including the creation of harmful persistent space debris;
- f) Harmful interference with the normal operations of other on-going space activities;
- g) Changes to designated and internationally endorsed outer space natural or cultural heritage sites;
- h) Adverse changes to designated and internationally endorsed sites of scientific interest.

What do Terrestrial Competitors
say about preserving the
environment,

Mining-Wise?



Protecting the environment

Environmental stewardship is essential to our relationships with host communities, regulators and others. We recognise that our environmental performance is important to our host communities and that we are responsible for managing impacts associated with our operations.

In planning and operating our assets, we seek to avoid, prevent, mitigate and remediate the environmental impacts of our activities. We work with our host communities and regulators to manage and monitor these and to comply with relevant regulations.

We work in accordance with the Rio Tinto management system standard as well as Group-wide and business-specific environmental standards and processes. We participate in industry reviews covering issues such as tailings management and water stewardship to share knowledge, learn from others and improve our management approaches.

RioTinto

Protecting the environment





FREEPORT-McMoRAN

Sustainability

The Freeport-McMoRan Environmental Policy is based on our objective to be compliant with laws and regulations and to minimize environmental impacts using risk management strategies based on valid data and sound science. It requires that we review and take account of the environmental effects of each activity, whether exploration, mining or processing; and that we plan and conduct the design, development, operation and closure of each facility in a manner that optimizes the economic use of resources while reducing adverse environmental effects.



FREEPORT-McMoRAN

Sustainability

ENVIRONMENT





PotashCorp

Helping Nature Provide

Environmental Stewardship

PotashCorp is committed to protecting our environment and minimizing our footprint. Guided by our Safety, Health and Environment (SHE) Committee and by the elements outlined in our core values and SHE Manual, our environmental strategy focuses on environmental leadership, serious environmental incident prevention, pre-job hazard assessments and focused work pausing.

We invest our time and capital in technology, research, stewardship initiatives and management systems that help us:

- Meet federal, state/provincial and local regulatory requirements
- Use natural resources and energy efficiently
- Minimize waste, air emissions, water discharges and unwanted byproducts
- Increase recycling
- Preserve habitats and promote natural biodiversity in areas affected by our operations

To ensure we are minimizing our environmental impact, we continue to identify and implement best practices at all our sites and our focus is increasingly on preventing serious incidents.



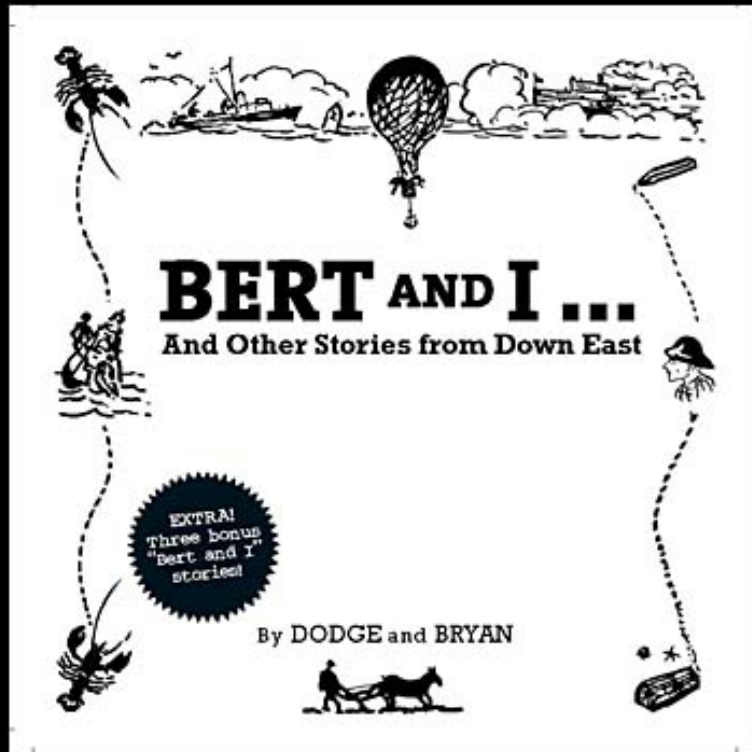
PotashCorp

Helping Nature Provide

Environmental Stewardship



Space Environmental Ethics should *not* be like this



Eban Robay goes to a lecture by socialist Norman Thomas, returns and starts preaching socialism, and sharing, throughout the small, Maine town.

One of his neighbors puts him to the Test...

Q. You mean to say, Eban, that if you had two fans you'd give me one of them?

A. Yup

Q. You mean to say, Eban, if you owned two hay rakes, you would give me one?

A. Yup

Q. Or, if you had two hogs, you would give me one?

A. Darn you Enoch, you know I got two hogs!

Questions?

