PROTECTION OF THE LIFELESS ENVIRONMENT IN THE SOLAR SYSTEM

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ABSTRACT

The main concern of planetary protection policy is how to protect the (hypothetical) extraterrestrial life against contamination and back-contamination. There is almost no interest in the preservation of the existing lifeless surfaces of extraterrestrial bodies, although some planetary transformation plans (in order to exploit hypothetical resources) were made public a long time ago. It should be remembered that planetary environments are practically unchanged since ages and damage caused by any human intervention would be irreversible. Our intention is not to prevent any commercial utilization of Solar System resources, but to make space exploration and exploitation of resources a controlled and well-planned endeavor. The three main issues connected with the protection of the lifeless space environment are the following:

1/ The scientific aspect: a limited, well-defined initiative to select by scientific investigation areas and objects of highest priority on different celestial bodies.

2/ The legal aspect: to start the drafting of a declaration of principles supporting the protection of selected areas and objects on celestial bodies with solid surface. It might evolve into an international legal instrument or treaty in order to limit the "free-for-all" intervention and use of Solar System resources.

3/ The societal aspect: to initiate a large-scale discussion on the possible "ethical values" of the lifeless environment.

INTRODUCTION

In a previous paper (Almár 2000) we emphasized the need for an environment protection policy within the Solar System for the sake of future generations. The task of planetary scientists would be to survey and evaluate all known planetary environments with regards to their scientific value. Based on such a survey a list of scientifically important planetary environments can be drawn up by an international panel. The result would be a limited list of sites and objects open to scientific investigation but closed to exploitation of natural resources. These international scientific preserves or "wilderness areas" should be legally protected within the frame of an international environment-protection treaty.

In the present paper our intention is to further elaborate this suggestion and separate its scientific, legal and societal aspects. Our intention is not to prevent any commercial or other utilization of Solar System resources, but to make space exploration and exploitation of resources a controlled and well-planned endeavor taking into account the interest of environmental protection for the sake of future generations.

What happened since 2000 in this respect? Some papers have been published in order to draw the attention of the space community to the issue (Williamson 2000, Spall 2002, Almár and Williamson 2002). The landing of the *NEAR-Shoemaker* space probe on asteroid Eros on 12 February 2001 and its functioning until 28 February on the surface demonstrated clearly the technical capacity of some nations to search and to exploit asteroidal resources. *Deep Impact,*a NASA Discovery Programme mission to fly by a comet and blow a large crater into it for analysis of its composition, was approved on 25 May 2001. The space probe is scheduled to be launched to Comet Tempel-1 in January 2004 and impact the comet on 4 July 2005. The crater will be produced by releasing a 350 kg projectile that will hit the comet at a speed over 35,000 km/hr. The resulting crater is expected to be about 100 m in diameter and 30 m deep. The experiment will demonstrate the capability of NASA to cause significant changes on the surface of a pristine celestial body in the Solar System. Environmental or ethical issues were not raised at all in this case. With the permission of NASA, NOAA and the State Department *TransOrbital* intends to launch its lunar probe *Trailblazer* in June 2003. This will be the first step by a private company in Solar System exploration – again without any international agreement on its rights and responsabilities.

Another event which should be mentioned in this respect is the visit of the first *space tourist*, Denis Tito on the International Space Station in April 2001. His spaceflight was neither legally nor politically well prepared in advance. The confusion – on the part of NASA in particular – was a consequence of the official skepticism that such an event may occur in the near future. Tito's flight proved that – in cases when a new kind of activity starts - an international agreement is absolutely needed well in advance in order to reduce the risks and misunderstanding.

Space tourism within near-Earth space is not an issue for planetary protection, but space tourism on the Moon or later on Mars would be a real danger for the conservation of these important planetary surfaces – as Mr. Nicholas Spall correctly points out. Space tourism will be without doubt an important industry in the 21st century and we ought to be prepared. With reference to the flight of the second space tourist, Mark Shuttleworth in 2002, we can conclude that regular space tourism started earlier than expected, and there is a chance that tourists will appear on the Moon also earlier than we are prepared with regulations. It is an international problem, closely related to the "protection of the planetary environment" issue, which is not properly discussed and regulated yet.

It is evident that there is almost no interest in the preservation of the existing *lifeless* surfaces of extraterrestrial bodies, the main concern of planetary protection policy is at the present time how to protect the (very hypothetical) extraterrestrial *life* against contamination.

THE SCIENTIFIC ASPECT

Classification of Planetary Bodies

In addition to the "classification of the problem" raised in our previous paper, one further important point is the age of the solid planetary surfaces. Io has the youngest surface in the Solar System, also Europa, Earth, and several cometary nuclei show relatively fast changes on their surface. Although in certain cases the interaction from humanity may be important for the future of the celestial body (e.g. the nucleus of a comet as the target of an impacting rocket may fall into pieces), nevertheless on fast changing surfaces there is generally less danger that human interaction would destroy something which otherwise would stay unaltered for billions of years.

On the other side very old, non-variable surfaces (Moon, Mercury, several satellites and asteroids) are absolutely vulnerable and their scientific value would be irrevocably damaged if a large-scale intervention occurs.

Mr. Mark *Lupisella* in his review of my previous COSPAR paper (Almár 2000) made several suggestions how my classification scheme should be improved. His remarks are worth further consideration and complement our previous classification scheme (Lupisella 2002). He emphasizes that when creating ecosystems (named *ecopoeisis)* the activity need not be constrained as to the type of ecosystem I was dealing with in the paper, but it could be done also to assist existing extraterrestrial biota. It may imply the creation of a planet-wide ecosystem, but also a regional or local one. Accordingly he is suggesting the following additional classification of this kind of activity:

Ecopoeisis – Creating Ecosystems

Terraforming – creating an earth-like ecosystem
Anthroterraforming – creating an ecosystem for humans
Non-anthroterraforming – creating an ecosystem for terrestrial life (e.g. microbes)
Planetary ecopoeisis – creating any kind of global ecosystem
Assistive (or indigenous) ecopoeisis – creating an ecosystem to assist
Indigenous biota, perhaps limited to locations or regions
Planetary assistive ecopoesis – planet-wide ecosystem development/creation to
assist indigenous biota on a global scale

According to his opinion there is a need to distinguish between colonization and terraforming: colonization can occur with or without terraforming and the environmental consequences could be quite different.

Different Kinds of Protection

He suggested also a classification, which can be applied to planetary surfaces:

Complete protection, which might imply remote sensing only,

Robotic exploration only, which might imply in-situ robotic exploration (perhaps with only a certain number of missions, and maybe sub-categories distinguishing between biological and non-biological experiments)

Controlled human exploration implying high levels of control over disturbance activities and contamination

Uncontrolled human exploration perhaps suggesting little or no control of activities and contamination required.

The first *objective* of the scientific part of such a project would certainly be to start a limited, well defined and organized initiative to select the highest scientific priority areas and objects on different kinds of planetary bodies (Moon, Mars, Mercury, satellites of outer planets, asteroids, comets, KBOs including Pluto), and then to give the position, the description (with a scientific definition) and the kind of protection it needs to each of the regions and objects in question.

Diagram of planetary surfaces as well as possible and permissible astronautical interventions on them

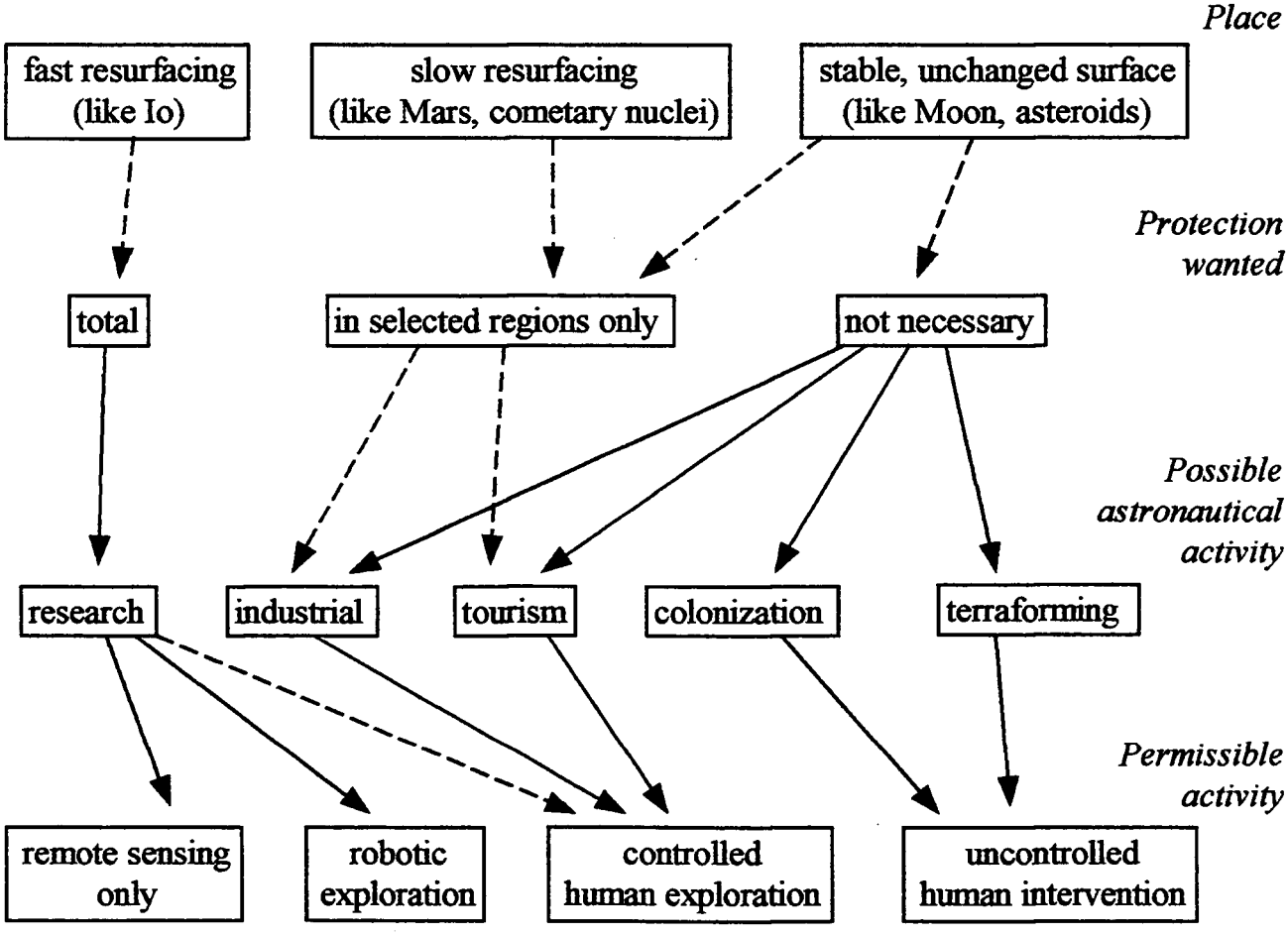

Fig.1 The diagram tries to summarize the different aspects of the planetary protection problem, without unnecessary details. It does not attempt to give definite answers. (Dotted lines mean uncertain connections.)

THE LEGAL ASPECT

It is not the task of the present paper to give a standpoint in the debate on the legal position of different celestial bodies or to elaborate on the legal side of the protection of the planetary environment. There is, however, one point, which is worth mentioning.

According to N. Spall (2002): *"Non of the UN Outer Space Treaties provide any legislation or protection policies to address this future problem."*

This is definitely true if only UN Treaties signed and ratified by the majority of nations are taken into consideration. But there is an *Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (MA79)* adopted by the UN General Assembly on 5 December 1979, which entered into force on 11 July 1984 (United Nations Treaties 1996). Only 9 governments, excluding most of the leading space powers have ratified it. It contains, however, several important paragraphs from our point of view, which are definitely suitable to lay the foundation of another international agreement on the preservation of planetary surfaces.

According its *Article 1* 1. The provisions of this Agreement relating to the moon shall also apply to other celestial bodies within the solar system, other than the earth...

Article 4 1. The exploration and use of the moon shall be the province of all mankind and shall be carried out for the benefit and in the interest of all countries ... Due regard shall be paid to the interest of present and future generations...

Article 7 1. In exploring and using the moon, State Parties shall take measures to prevent the disruption of the existing balance of its environment, whether by introducing adverse changes in that environment, by its harmful contamination through the introduction of extra-environmental matter or otherwise.

3. States Parties shall report to other States Parties and to the Secretary-General concerning areas of the moon having special scientific interest in order that, without prejudice to the rights of other States Parties, consideration may be given to the designation of such areas as international scientific preserves for which special protective arrangements are to be agreed upon in consultation with the competent bodies of the United Nations

Article 11 1. The moon and its natural resources are the common heritage of mankind, which finds its expression in the provisions of this Agreement...

3. Neither the surface nor the subsurface of the moon, nor any part thereof or natural resources in place, shall become property of any State, international, intergovernmental or non-governmental organization, national organization or non-governmental entity or of any natural person.

Although the *Moon Agreement* has been the subject of several serious critical remarks (see Reijnen, 1993, Williamson, 1997), we repeat that it has entered into force in 1984 and so is the last of the "space agreements". This Moon Agreement may be the fundament to start the drafting of a declaration of principles supporting the protection of selected areas and objects on celestial bodies with solid surfaces. It might evolve into a special international legal instrument or treaty in order to limit the "free-for-all" kind intervention and use of Solar System resources.

As mentioned in our previous paper (Almár, 2000) although the "Vienna Declaration" of UNISPACE III does not mention explicitly the planetary protection problem, its *Technical Forum on Space Activities in the Twenty-first Century* recommends the following: *"Defining roles for the protection and preservation of the planetary and space environment and establishing a framework for implementation."* (Par.9 point h). It corresponds exactly to the intention of the present paper; therefore our suggestions are following up directly the recommendation of this UN Forum.

THE SOCIETAL ASPECT

The most important societal or philosophical question connected with the protection of the non-living planetary environment is probably asked by Callicott (and quoted by M. Lupisella, 2000): *"In addition to human beings, does nature (or some of nature's parts) have intrinsic value?* That is the critical theoretical question in environmental ethics." Robert Hynes, Chris McKay and Don MacNiven conclude that existing ethical theories exclude the extraterrestrial environment because they are geocentric and cannot be applied to extraterrestrial environments, hence leaving a vacuum for *a cosmocentric ethic.*

Is there any way to assess and measure such values objectively? Several authors argue that if the Universe creates objects of formed integrity (e.g. objects worthy of a proper name) they might have intrinsic value, which should be respected. According to Rolston "If a thing has formed integrity, or is worthy of a proper name, it should

be respected." This is practically linked closely to the value measurement problem. IAU has given names to different parts of known surfaces of planetary bodies, but neither the hierarchy nor the exact boundaries of these features are defined exactly. Whether a feature has an official name or not is almost accidental, depending on the resolution of space probe images being at our disposal. There is plenty of work to be done before all celestial bodies in the Solar System will be mapped homogeneously.

We suggest initiating a profound professional discussion on the possible "ethical values" of the lifeless environment.

CONCLUSIONS

There is a general consensus that no NASA policy or international protocol exists for the proper handling of planetary bodies and their environment.

According to the general opinion, activities in space such as colonization will be unavoidable since it is consistent with the dominant practice of our civilization. Historically human exploration has seldom been concerned about its effect on the original biological or geological environment, even aboriginal population. Is this kind of attitude unavoidable? There is, however, another tendency: the formation of strong environmentalist and animal rights movements in the 20th century. It would be highly desirable to extend similar attitudes to *extraterrestrial environments* as well; we need to be proactive in this respect.

We emphasize again that only the dedicated effort of an international group or task force of experts can draft the necessary recommendations, serving as a basis of the legal discussion. (Sterns and Tennen, 1990) The societal or ethical background should be worked out as well. The whole effort should be initiated and coordinated by international space organizations (like COSPAR, IAF, IAA, IISL or UN COPUOS). This will definitely be an important task in the present decade in order to prevent confusion and irreparable damage in the future, when planetary surfaces will become places, where a large-scale astronautical activity might occur at any time.

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