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UTILIZATION OF EXTRATERRESTRIAL RESOURCES: LAW, SCIENCE AND POLICY

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ABSTRACT

The utilization of extraterrestrial resources involves consideration of numerous scientific, jurisprudential and political issues. The space treaties presently in force recognize the rights of states to conduct a wide range of activities in space for peaceful purposes, without interference, on the basis of equality, and for the benefit of all mankind. Nevertheless, these rights are subject to certain restrictions and limitations, to ensure that activities in space are conducted with due regard for the corresponding rights of other entities in accordance with international law.

A primary principle of space law is the non-appropriation doctrine, pursuant to which states are prohibited from claims of national sovereignty in outer space, including the Moon and other celestial bodies, by means of use, occupation or any other means. In addition, international law recognizes that all states, irrespective of their present level of economic development, have the right to use and enjoy the natural resources of space. Toward this

end, states have agreed to undertake to establish an international régime, such that present and future generations may share and participate in the orderly development and management of natural space resources.

The nature and attributes of the international régime will be shaped by the interplay between scientific capabilities and political realities. The transformation of the global political environment in recent years will have a profound effect on the international régime to be created. This study identifies and analyzes the factors which will influence the establishment of the international régime, with particular emphasis on the interrelationship of technology and politics to the existing law of outer space.

INTRODUCTION

The development of the law of outer space has been related directly to, and frequently has preceded, scientific and technological capabilities. Telecommunications satellites, remote sensing,

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private launch services and other activities in space all would be impossible without effective and appropriate legal regulation. Following the launch of Sputnik I on October 4, 1957, the global community created the United Nations Committee on Peaceful Uses of Outer Space (COPUOS), for the purposes of studying, issuing reports, and making recommendations concerning the scientific, technical and legal aspects of man's activities in space. Through its legal subcommittee, COPUOS has been responsible for the formulation of the five extant space treaties.¹ The *corpus juris spatialis* not only must be adequate to effectively regulate current technological capacity, but also must be sufficiently flexible to provide meaningful guidance to direct future activities.

One area in which the law of outer space has sought to meet this challenge concerns the extraction and utilization of extraterrestrial materials. The Moon Treaty, in particular, directly has addressed the issues which will be presented therein, by declaring the natural resources of the Moon and other celestial bodies² to be the common heritage of mankind, and by providing for states to undertake to establish an international régime to govern and manage the orderly and rational exploitation of such resources.³ Created during the height of the cold war, the Moon Treaty reflects the political apprehensions of its time.⁴ The provisions concerning the international régime represent a compromise between competing interests sufficient to achieve the consensus of the members of COPUOS and the approval of the U.N. General Assembly.⁵ The radical transformation of geo-political relationships in recent years, together with the renewal of efforts to return to the Moon and travel to the planets, has created an appropriate environment to examine the factors which will influence the creation of the international régime.

UTILIZATION OF EXTRATERRESTRIAL RESOURCES AND THE *CORPUS JURIS SPATIALIS*

The law of outer space is intended to encourage the establishment of a multitude of extraterrestrial facilities for scientific and other purposes, including the extraction and utilization of celestial resources. The international régime of the Moon Treaty is not the only substantive article of the *corpus juris spatialis* relevant to such activities, and therefore it is appropriate to review briefly the

additional provisions of the law of outer space which will be applicable. Among the issues to be considered are: what entity will establish and operate the proposed mining facility; where will the facility be located; how large an area will the facility occupy; what are the purposes for which the extraterrestrial materials may be utilized; what will be the environmental consequences of the activities to be conducted; will any extraterrestrial materials be returned to Earth; and if so, will such materials pose a risk to the environment of, or life on, Earth. In general, these questions may be consolidated into issues of jurisdiction and liability, environmental consequences, and non-appropriation.

A. JURISDICTION AND LIABILITY

The issue of jurisdiction largely will be determined by the entity which establishes and operates an extraterrestrial mining facility. This entity could be public or private, as well as national or international, or a combination thereof. Where a single state conducts the entire activity, that nation would be the launching and registry state, subject to the direct benefits and obligations of the applicable treaties, including the exercise of jurisdiction and the assumption of liability.⁶ Similarly, a state authorizing and exercising continued supervision and control over its nationals in space would be internationally responsible and liable for the acts of its authorized entities.⁷

A more complicated situation would be present in the event the program were conducted by two or more states. In such an event, the participating states would designate one member to be the state of registry,⁸ and liability would be apportioned between them in some manner, most probably by the instrument creating the mission.⁹ Nevertheless, the participating states would need to reach agreement on basic questions, such as chain of command, and control over day to day operations of the facility.

The facility also could be established and operated by an international organization, or by a consortium of public or private entities subject to the authority of several nations. The Outer Space Treaty specifically provides that its provisions apply to the activities of states party to the treaty, whether conducted individually or within the framework of an inter-governmental organization.¹⁰ The Moon Treaty, on the other hand, provides that

inter-governmental organizations, under certain circumstances, may become parties to the Treaty, in which event the organizations are accorded the rights and obligations of a launching or registry state.¹¹ However, if a program were to be conducted by a group of nations, independent of an international organization, the participating states would need to designate which state would exercise primary jurisdiction, and bear primary responsibility and liability. The participants also would need to determine the manner and methods in which jurisdiction, control and responsibility would be apportioned between them. Similarly, an agreement between the appropriate authorizing states would be necessary where the project were to be conducted by an international private consortium.

B. ENVIRONMENTAL CONSIDERATIONS

The establishment of a facility and related structures to extract extraterrestrial resources, as well as the actual extraction thereof, permanently could alter the physical landscape of a celestial body, forever foreclosing other entities from the exploration and use of that pristine celestial environment. Such an activity must be conducted in conformity with the environmental protection provisions of space law. Article IX of the Outer Space Treaty obligates states to conduct exploration of celestial bodies so as to avoid their harmful contamination. The Moon Treaty, at Article 7, paragraph 1, affirmatively requires states to take measures to prevent the disruption of the existing balance of the natural celestial environment. Such disruption could occur through the introduction of adverse changes to or harmful contamination of the environment, as well as by other means. Consideration also must be given to the potential for disruption of the environment of the Earth by the introduction of products or other items containing extraterrestrial materials, and the potential for damage by injury or risks to health which may be caused thereby.¹²

At the present time, there is no consensus as to the precise interpretation of these treaty provisions. Nevertheless, it is clear that an open pit mine on the Moon, the total depletion of Phobos, or other similar modifications to the surface or subsurface of a celestial body, would constitute harmful contamination and/or disruption of the pristine environment. The questions in need of resolution relate to both the nature and degree of disruption to the celestial environs which may be

caused without violating the applicable treaties. These issues, in regard to the initial period of planetary exploration, have been addressed by the international scientific community in the form of planetary quarantine requirements.¹³ As missions progress from preliminary to more comprehensive explorations and examinations, environmental consequences must continue to be of primary concern, and programs should be designed to minimize the intrusion and other impacts of the activities to pristine celestial environments. It is probable that such issues would be addressed by the international régime as set forth in the Moon Treaty.

C. NON-APPROPRIATION

A fundamental principle of the *corpus juris spatialis* is expressed in Article II of the Outer Space Treaty, which provides:

Outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.

Issues regarding the non-appropriation doctrine relate to a number of considerations, including but not limited to the location and physical dimensions of a facility and related installations. A facility to extract extraterrestrial materials will not exist in isolation, but will be accompanied by various support structures, such as personnel habitats, construction sites, and fabrication and processing centers. These support structures may not be adjacent to the extraction facility, and the entire complex could occupy a substantial area of the surface and/or subsurface of a celestial body. Proposed programs must be examined carefully to determine whether they can be conducted consistent with the prohibitions against national appropriation of space and celestial bodies.

The law of outer space expressly authorizes a wide variety of activities which may be conducted consistent with the non-appropriation doctrine. States have the right to establish facilities on or below the surface of the Moon and other celestial bodies.¹⁴ This authority could extend a right of control for a limited distance beyond the perimeter of the physical structures. The occupation of a particular location precludes other entities from utilizing that same location, and it is possible that

such other entities might assert that appropriation could arise from the exclusive occupation of an area, particularly if the area possessed unique attributes.¹⁵ Such a claim, however, could be countered by demonstrating that the operating entity is acting in full compliance with the other provisions of the space treaties.

Included among the restrictions on facilities contained in the *corpus juris spatialis* is the limitation on the area to be occupied to that which is necessary for the support of the mission. Moreover, the establishment of an installation, whether for a mining facility or otherwise, must not interfere with the activities of other states on the particular celestial body.¹⁶ In addition, states are obligated to allow for visitation of the facility by other states.¹⁷ The adoption and utilization of appropriate procedures by the operating entity for these purposes strongly would militate against the assertion that the occupation of the celestial location is exclusive and violative of the non-appropriation doctrine.

The determination of whether an activity constitutes appropriation is not restricted to consideration of the physical area occupied by the installation, but also includes questions concerning the nature of the facility and the uses for which any extraterrestrial materials are intended. Missions conducted for scientific investigation specifically are authorized to utilize extraterrestrial minerals and other materials in reasonable quantities for the support of the mission. The phrase "*in support of the mission*" could be sufficiently expansive to include, for example, the use of lunar resources as a fuel source for a manned mission to Mars, or the extraction of hydrogen and oxygen from Martian materials for the life support systems of astronauts. Such utilization, by itself, would not give rise to national appropriation, nor would the extraction of materials necessarily give rise to appropriation of the surface or subsurface.¹⁸ However, it is arguable that this conclusion bears greater significance in the absence of the international régime envisioned by the Moon Treaty.¹⁹

THE INTERNATIONAL RÉGIME AND THE COMMON HERITAGE OF MANKIND

The legal issues concerning exploitation and use of extraterrestrial resources were among the most deeply divisive between the delegations to COPUOS

during consideration of a draft Moon treaty. The inability to achieve consensus on these matters greatly contributed to the lengthy delay in concluding an acceptable text, which consumed most of the decade of the 1970's.²⁰ The debate largely was driven by political concerns, and included both East-West and North-South divisions.²¹ The industrialized west sought to gain international sanction of the right to use extraterrestrial resources for commercial purposes, and to secure the role of the private sector in such activities. Eastern states, on the other hand, were opposed to the pursuit of private profit in space, and held that the exploration and use of the cosmos should be the exclusive domain of governments.²² Both East and West, however, were united in their resistance to the concept of internationalization of extraterrestrial resources, a position espoused by the developing countries in the tradition of the law of the sea negotiations.²³ In late 1979, consensus finally was reached on a compromise draft of the treaty, which subsequently was approved by the General Assembly, and formally opened for signature. Although the Moon Treaty entered into force in 1984, it has been ratified by only eight states as of January 1, 1992, none of which conduct independent launches of spacecraft.²⁴ Much of the reticence of states to sign or ratify the Moon Treaty directly is attributable to Article 11 of that instrument, and the implications of the concept of the common heritage of mankind.

The seven paragraphs of Article 11 of the Moon Treaty comprise a series of standards against which any use of extraterrestrial resources must be measured. Certain of these provisions, such as the prohibition of national appropriation contained in paragraph 2, and the right of states to explore and use celestial bodies set forth in paragraph 6, merely restate principles articulated in the Outer Space Treaty. Within the remaining paragraphs, however, are legal concepts which previously were not part of the positive international law of space, including the following:

1. The moon and its natural resources are the common heritage of mankind, which finds its expression in the provisions of this agreement, in particular in paragraph 5 of this article.

* * *

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.

* * *

5. States Parties to this Agreement hereby undertake to establish an international régime, including appropriate procedures, to govern the exploitation of the natural resources of the moon as such exploitation is about to become feasible.

* * *

7. The main purposes of the international régime to be established shall include:

(a) The orderly and safe development of the natural resources of the moon;

(b) The rational management of those resources;

(c) The expansion of opportunities in the use of those resources;

(d) An equitable sharing by all States Parties in the benefits derived from those resources, whereby the interests and needs of the developing countries, as well as the efforts of those countries which have contributed either directly or indirectly to the exploration of the moon, shall be given special consideration.

The substance of Article 11 strikes a compromise between the competing positions expressed during the COPUOS deliberations. The right of private entities to conduct activities in space, recognized in the Outer Space Treaty, is not diminished, and no blanket prohibition against commercial uses of extraterrestrial resources is expressed. However, the resources of the Moon and other celestial bodies are declared to be the common heritage of mankind, and subject to an international

régime which states undertake to establish in the future. In order to obtain the consensus of COPUOS on the Moon Treaty, the terminology utilized therein purposely was vague. As a result, the meaning and interplay of the various provisions of Article 11 are subject to widely differing interpretations. The precise meaning and details regarding both the substance as well as the procedures of the international régime must await further agreement by the community of nations. Nevertheless, while a wide range of activities may be conducted on or below the surface of celestial bodies, it is clear that private entities are not granted *carte blanche* to extract and exploit the natural resources of the celestial bodies for commercial purposes.

The most serious objections to the Moon Treaty in general, and Article 11 in particular, concern the interrelated questions regarding private ownership of extraterrestrial resources, whether a moratorium on commercial uses of such resources is imposed pending the establishment of the international régime, and the scope of the concept of the common heritage of mankind *vis-a-vis* the international régime. A strict interpretation of the Treaty holds that no entity, whether public or private, may claim ownership of extraterrestrial resources,²⁵ and that the international régime will apply to all use of such resources, which by definition are the common heritage of mankind. This interpretation would result in the conclusion that the Moon Treaty imposes a moratorium on all commercial uses of extraterrestrial materials pending the establishment of the international régime.²⁶

At the other end of the spectrum is the broader view that the Moon Treaty facilitates the role of the private sector in the use and exploration of celestial bodies. Proponents of this view stress that the right to exploit extraterrestrial resources was recognized in the Outer Space Treaty, and is firmly rooted in international law.²⁷ In addition, the concept of the common heritage of mankind is not defined in the Moon Treaty,²⁸ and is subject to limitations contained in the *corpus juris spatialis*. One such limitation is the applicability of the concept to extraterrestrial resources *in place*. It is argued that the negotiated history of the COPUOS Legal Subcommittee makes it clear that resources which have been extracted from the surface and/or subsurface can become the property of the entity which caused such extraction.²⁹ Moreover, proponents of this interpretation assert that pursuant

to paragraph 5 of Article 11, states merely agree to *undertake* to establish an international régime as exploitation of extraterrestrial resources *is about to become feasible*. Thus, the Moon Treaty does not obligate states to guarantee the success of that undertaking, nor does it expressly declare a moratorium on exploitation pending the establishment of the international régime.³⁰

The primary purposes and objectives of the international régime are set forth in Article 11, paragraph 7, of the Moon Treaty. The first three purposes expressed concern the orderly and safe development, rational management of, and expansion of opportunities in the use of extraterrestrial resources. In the abstract, these are admirable and appropriate goals. The crux of the debate over the international régime is set forth in subsection (d) of paragraph 7: the equitable sharing of benefits derived from the use of extraterrestrial resources. Questions may be raised concerning the meaning of each and every salient term of this provision. What is equitable; what must be shared, with whom, and on what terms; how are benefits to be determined; and what constitutes use? The Moon Treaty provides some guidance for resolving these questions. For example, paragraph 7, subsection (d) provides that it is states party to the treaty which are entitled to the equitable sharing of benefits. This same provision, however, identifies two other categories which are entitled to receive "*special consideration*:" the interests and needs of developing countries, and the efforts of countries which contributed to the exploration of the Moon. It appears that the Moon Treaty does not require states to be party to that instrument in order to qualify for this "*special consideration*," but also it appears that this phrase is not synonymous with "*equitable sharing*" of benefits.

The uncertainty regarding the meaning of Article 11 of the Moon Treaty reflects the interdependency of law and policies relating to activities in space, together with scientific and technological capability. The drafters of the Moon Treaty were not operating in a legal vacuum, but had to consider the extant *corpus juris spatialis*, and in particular, the provisions of the universally accepted Outer Space Treaty.³¹ However, the competing policies of states and geo-political alliances had to be accommodated in order to achieve consensus for the instrument. The result was an agreement by states to *attempt*, in the future, to *agree* on rules and

regulations based on broad and imprecise concepts. The timetable for such future attempt also is imprecise, as it is keyed to technological capability, *i.e.*, as the exploitation of extraterrestrial resources is about to become feasible. Thus, the viability of the international régime is tied to technological, economic and political factors.

The political decision to defer negotiations to establish the international régime, in order to finalize the Moon Treaty, has been partially vindicated by the recent and rapid transformation of the former Soviet bloc from communism to democratic systems and free market economies. That is, the philosophical chasm and institutional distrust separating East and West, which greatly contributed to the difficulty in concluding the Moon Treaty, have begun to subside. A more conducive geo-political climate for international relations and commercial activities is being created as the economic interests of former antagonists increasingly coincide. This positive evolution in the international environment can and should be applied to the issues regarding the commercial uses of extraterrestrial resources.³² The interests of the developing nations, however, must be given adequate consideration, and there is no certainty that agreement can be reached on these questions under prevailing international conditions. Clearly, future events may reduce the substantial differences which have divided the international policies of the industrialized and developing nations. Nevertheless, extant political circumstances and technological capabilities will have profound effects on the positions of states at such time as negotiations for the international régime are conducted.

It is significant to note that the Moon Treaty includes states which are not party to the treaty in the effort to undertake the establishment of the international régime. The Moon Treaty, however, cannot obligate states which are not party to that instrument to engage in this endeavor. Nevertheless, the Moon Treaty declares that Article 11, paragraph 5, is to be implemented in accordance with Article 18, which sets forth a procedure for the General Assembly of the United Nations to review the treaty, with particular reference to the creation of the international régime. Thus, all member states of the United Nations, irrespective of any individual country's status as a state party to the Moon Treaty, will have a role in formulating both the structure and substantive policies of the international régime.

The negotiations concerning the international régime will need to consider a multitude of issues, including what form the governing body will take, whether private entities and international organizations will be granted representation, and whether special preferences will be granted to states which are party to the Moon Treaty. This last area of inquiry will apply both in terms of a greater measure of governing authority in relation to activities which may be conducted on celestial bodies, as well as in regard to the sharing of benefits derived from the use of extraterrestrial resources. The resolution of these issues may be a slow and arduous process, as the establishment of an international régime necessarily will require states to reconsider and moderate traditional notions of sovereignty. Nevertheless, political reticence in this regard may be overtaken by technological capacity and economic reality. Missions to utilize extraterrestrial resources, albeit for scientific purposes such as a manned flight to Mars, presently are in the planning stage. The development of new technologies for such missions and activities undoubtedly will lead to novel and unforeseen commercial opportunities for the private sector. The expansion of technological ability will enhance the desire to ascertain and implement methods to profitably utilize extraterrestrial materials. Protracted and inconclusive discussions

over international regulation of the use of such resources may inhibit, but not prohibit, private enterprise from engaging in ventures utilizing the resources of the Moon and other celestial bodies

CONCLUSION

The provisions of the Moon Treaty concerning the common heritage of mankind and the establishment of an international régime reflect an effort by states to provide a mechanism to reconcile the conflicting political philosophies which have divided the world during the space age. International relations have undergone remarkable changes in the past few years, as democracy and free market economies have been introduced in the former Soviet bloc. Although the current geo-political climate is more favorable for considering the structure and substance of the international régime than that which existed at the time the Moon Treaty was drafted, significant divisions of interest, particularly between the industrialized and the developing nations, continue to present obstacles to achieving the goals expressed in the Moon Treaty. States must be encouraged to build upon the progress realized in the recent past, and strive to exclude conflicts over future activities, thereby securing the interests of the present as well as future generations.

NOTES

1. Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, *opened for signature* January 27, 1967, 18 U.S.T. 2410, T.I.A.S. No. 6347, 610 U.N.T.S. 205 [hereinafter referred to as the "Outer Space Treaty"]; Agreement on the Rescue of Astronauts, the Return of Astronauts, and the Return of Objects Launched Into Outer Space, *opened for signature* April 22, 1968, 19 U.S.T. 7570, T.I.A.S. No. 6599, 672 U.N.T.S. 119; Convention on International Liability for Damage Caused by Space Objects, *opened for signature* March 29, 1972, 24 U.S.T. 2389, T.I.A.S. No. 7762, 961 U.N.T.S. 187 [hereinafter referred to as the "Liability Convention"]; Convention on Registration of Objects Launched Into Outer Space, *opened for signature* January 14, 1975, 28 U.S.T. 695, T.I.A.S. No. 8480, 1023 U.N.T.S. 15; Agreement

Governing the Activities of States on the Moon and Other Celestial Bodies, *entered into force* July 11, 1984, *text reproduced in* Report, Committee on the Peaceful Uses of Outer Space, 34 U.N. GAOR Supp. (No. 20), U.N. Doc. A/AC.105/L.113 Add 4 (1979); UNITED NATIONS TREATIES ON OUTER SPACE 27 (1984); *and* 18 I.L.M. 1434 (1979) [hereinafter referred to as the "Moon Treaty"].

2. The Moon Treaty, *supra* note 1, states in Article 1, ¶ 1, that "[t]he provisions of this Agreement relating to the moon shall also apply to other celestial bodies within the solar system, other than the earth, except in so far as specific legal norms enter into force with respect to any of these celestial bodies." Thus, references in the text to the Moon shall include other celestial bodies unless otherwise specifically noted.

3. See Moon Treaty, *supra* note 1, at art. 11, ¶¶ 1, 5.
4. See Myers, *The Moon Treaty in Legal and Political Perspective*, in PROCEEDINGS OF THE 23RD COLLOQUIUM ON THE LAW OF OUTER SPACE 49 (1981).
5. For a historical perspective of the negotiations surrounding the Moon Treaty, see generally Committee on Commerce, Science and Transportation, AGREEMENT GOVERNING THE ACTIVITIES OF STATES ON THE MOON AND OTHER CELESTIAL BODIES (Committee Print 1980); see also Christol, *An International Regime, Including Appropriate Procedures, For the Moon: Article 11, Paragraph 5 of the 1979 Moon Treaty*, in PROCEEDINGS OF THE 23RD COLLOQUIUM ON THE LAW OF OUTER SPACE 139 (1981); de Saint Lager, *The Third World and Space Law*, in PROCEEDINGS OF THE 24TH COLLOQUIUM ON THE LAW OF OUTER SPACE 57 (1982); Menter, *Commercial Space Activities Under the Moon Treaty*, in PROCEEDINGS OF THE 23RD COLLOQUIUM ON THE LAW OF OUTER SPACE 35 (1981); Okolie, *Legal Interpretation of the 1979 United Nations Treaty Concerning the Activities of Sovereign States on the Moon and Other Celestial Bodies Within the Meaning of the Concept of Common Heritage of Mankind*, in PROCEEDINGS OF THE 23RD COLLOQUIUM ON THE LAW OF OUTER SPACE 61 (1981); Rosenfield, *A Moon Treaty? Yes, But Why Now?*, in PROCEEDINGS OF THE 23RD COLLOQUIUM ON THE LAW OF OUTER SPACE 69 (1981).
6. Outer Space Treaty, *supra* note 1, at arts. VI, VIII; see also Liability Convention, *supra* note 1, at art. I(c).
7. Outer Space Treaty, *supra* note 1, at art. VI.
8. *Id.*
9. See, e.g., Intergovernmental Agreement for a Permanently Manned Civil Space Station, September 28, 1988.
10. Outer Space Treaty, *supra* note 1, at art. XIII.
11. Moon Treaty, *supra* note 1, at art. 16.
12. For a detailed discussion of environmental considerations of man's activities in space, see Cocca, *Environment as a Common Heritage of Mankind*, in PROCEEDINGS OF THE 32ND COLLOQUIUM ON THE LAW OF OUTER SPACE 71 (1990); Hintz, *Environmental Aspects of Settlements on the Moon and Mars - Planetary Protection*, in PROCEEDINGS OF THE 34TH COLLOQUIUM ON THE LAW OF OUTER SPACE 59 (1992); Jasentuliyana, *Environmental Impact of Space Activities: An International Law Perspective*, in PROCEEDINGS OF THE 27TH COLLOQUIUM ON THE LAW OF OUTER SPACE 390 (1985); Miklody, *Some Remarks to the Legal Status of Celestial Bodies and Protection of Environment*, in PROCEEDINGS OF THE 25TH COLLOQUIUM ON THE LAW OF OUTER SPACE 13 (1983); Perek, *Protection of Environment and of Space Activities*, in PROCEEDINGS OF THE 27TH COLLOQUIUM ON THE LAW OF OUTER SPACE 376 (1985); Reijnen, *Pollution of Outer Space and International Law*, in PROCEEDINGS OF THE 32ND COLLOQUIUM ON THE LAW OF OUTER SPACE 130 (1990); Sterns & Tennen, *Principles of Protection of the Outer Space Environment in the Corpus Juris Spatialis*, in PROCEEDINGS OF THE 30TH COLLOQUIUM ON THE LAW OF OUTER SPACE 172 (1988); Sterns & Tennen, *Legal Aspects of Settlements on the Moon and Mars: International Legal Infrastructure and Environmental Considerations*, in PROCEEDINGS OF THE 34TH COLLOQUIUM ON THE LAW OF OUTER SPACE 95 (1992); van Traa-Engelman, *Environmental Hazards From Space Activities: Status and Prospects of International Control*, in PROCEEDINGS OF THE 25TH COLLOQUIUM ON THE LAW OF OUTER SPACE 55 (1983); Zhukova-Vasilevskaya, *The International Legal Protection of Space Environment: The Quest for Ways of Solving the Problem*, in PROCEEDINGS OF THE 30TH COLLOQUIUM ON THE LAW OF OUTER SPACE 186 (1988).
13. See generally COSPAR Res. 26, COSPAR INFO. BULL. at Annex 4 (1964); *Outbound Spacecraft: Basic Policy Relating to Lunar and Planetary Contamination Control*, NASA Pub. No. NPD 8020.7 (1957); *Outbound Planetary Biological and Organic Control: Policy and Responsibility*, NASA Pub. No. NPD 8020.10a (1972); *Quarantine Provisions for Unmanned Extra-Terrestrial Missions*, NASA Pub. No. NPD 8020.12a (1976); *Biological Contamination Control for Outbound and Inbound Planetary Spacecraft*, NASA Management Instruction 8020.7a (1988); see also DeVincenzi, *Planetary Protection Issues and the Future Exploration of Mars*, in 12 ADV. S. RES., No. 4, 121 (1992); Sterns & Tennen, *Recent Developments in the Planetary Protection Policy: Is the Outer Space Environment at Risk?*, in PROCEEDINGS OF THE 32ND COLLOQUIUM ON THE LAW OF OUTER SPACE 163 (1990).
14. Moon Treaty, *supra* note 1, at arts. 8, ¶ 2(b), 9.
15. Cf. *id.* art. 7, ¶ 3 (providing that areas which are discovered to be of unique scientific interest are to be reported to the Secretary General of the United

Nations, in order for such areas to be designated as international scientific preserves).

16. *Id.* arts. 8, 9; Outer Space Treaty, *supra* note 1, at arts. I, IV, XI, XII.

17. *See* Outer Space Treaty, *supra* note 1, at art. XII, which provides that facilities shall be open for visitation on a basis of reciprocity, and further provides a procedure for advance notice of a proposed visit, and appropriate consultations between the parties to assure safety and prevent the disruption of the normal operations of the facility. The right of visitation provided by the Moon Treaty, *supra* note 1, at art. 15, ¶ 1, is not conditioned on reciprocity.

18. Moon Treaty, *supra* note 1, at art. 6, ¶ 2.

19. *See* Williams, *The Common Heritage of Mankind and the Moon Agreement: Economic Implications and Institutional Arrangements*, in PROCEEDINGS OF THE 24TH COLLOQUIUM ON THE LAW OF OUTER SPACE 87 (1982).

20. *See* Okolie, *supra* note 5.

21. *See* Myers, *supra* note 4.

22. *See* Vereshchetin, *Space Activities of "Nongovernmental Entities:" Issues of International and Domestic Law*, in PROCEEDINGS OF THE 26TH COLLOQUIUM ON THE LAW OF OUTER SPACE 261 (1984). Dr. Vereshchetin argued that the governmental nature of activities in space is demonstrated by the requirement of authorization and supervision by states of their nationals' activities. He further stated that the Outer Space Treaty does not sanction the notion of freedom of private enterprise in space, and that the conduct of activities in space by private entities is an exceptional circumstance. It is interesting to note that Dr. Vereshchetin did not refer to the Moon Treaty in his study.

23. *See* Rosenfield, *supra* note 5; de Saint Lager, *supra* note 5; Williams, *supra* note 19.

24. Report, IISL Standing Comm. on the Status of Int'l Agreements Relating to Activities in Outer Space, in PROCEEDINGS OF THE 33RD COLLOQUIUM ON THE LAW OF OUTER SPACE 393 (1991). The states which have ratified the Moon Treaty are Australia, Austria, Chile, Mexico, The Netherlands, Pakistan, The Philippines and Uruguay.

25. *See* van Traa-Engelman, *The Moon Treaty - Legal Consequences and Practical Aspects*, in PROCEEDINGS OF THE 23RD COLLOQUIUM ON THE LAW OF OUTER SPACE 73 (1981).

26. *See* Dula, *Free Enterprise and the Proposed Moon Treaty*, 2 HOUS. J. INT'L L. 3 (1979); Rosenfield, *Article XI of the Draft Moon Agreement*, in PROCEEDINGS OF THE 22ND COLLOQUIUM ON THE LAW OF OUTER SPACE 209 (1980).

27. *See* Finch, *1979 United Nations Moon Treaty Encourages Lunar Mining & Space Development*, in PROCEEDINGS OF THE 22ND COLLOQUIUM ON THE LAW OF OUTER SPACE 123 (1980); Haanappel, *Article XI of the Moon Treaty*, in PROCEEDINGS OF THE 23RD COLLOQUIUM ON THE LAW OF OUTER SPACE 29 (1981); Menter, *supra* note 5; Okolie, *supra* note 5.

28. *See* Reijnen, *Future Legal Rules in Respect to Private Enterprise in Outer Space*, in PROCEEDINGS OF THE 24TH COLLOQUIUM ON THE LAW OF OUTER SPACE 63 (1982); *but see* Vasilevskaya, *What is New in the Legal Regulations of Activities in Outer Space*, in PROCEEDINGS OF THE 23RD COLLOQUIUM ON THE LAW OF OUTER SPACE 79 (1981)(asserting that the common heritage of mankind is defined by Article 4 of the Moon Treaty).

29. *See* Dekanozov, *Juridical Nature and Status of the Resources of the Moon and Other Celestial Bodies*, in PROCEEDINGS OF THE 23RD COLLOQUIUM ON THE LAW OF OUTER SPACE 5 (1981); Menter, *supra* note 5; Haanappel, *supra* note 27.

30. *See* Fasan, *Some Legal Problems Regarding the Moon*, in PROCEEDINGS OF THE 23RD COLLOQUIUM ON THE LAW OF OUTER SPACE 9 (1981).

31. The Outer Space Treaty has been signed, ratified, adopted or accepted by over 100 nations. *See* IISL Report, *supra* note 24.

32. *See* Vasilevskaya, *supra* note 28; Luton, *Consequences of the Changing Political Landscape for Future Space Projects*, in 70 ESA BULL. 10 (1992).