

PROPERTY RIGHTS AND FUTURE SPACE COMMERCIALIZATION

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ABSTRACT

With the trend toward commercialization and privatization of many space activities, a deeper understanding is needed regarding which activities in outer space will be allowed and which will be challenged. Entrepreneurs need to have confidence that they will be able to receive a payback for their investments. In an attempt to identify potential problems and clarify the legal status of activities seeking to use outer space, this paper discusses relevant issues in space law and analogous provisions in terrestrial law. In conclusion, some areas of space law that may require further clarification are identified.

INTRODUCTION

Questions regarding ownership of property in outer space pertain primarily to the use of celestial bodies for natural resources (to be used either in place or returned to the Earth); for exploration; for tourism and habitation; and to gain strategic advantage.¹ The last is prohibited in the Outer Space Treaty of 1967 (OST)² and will not be discussed here. (Also excluded is consideration of the radio spectrum and orbital slots

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as property.) The Moon, in addition to the above purposes, is also valuable because of its potential use as a launch site for travel deeper within the Solar System³ and as a base for astronomy, other scientific research, and potentially even for solar power to be beamed to Earth.

The trend toward commercialization and privatization of many space activities necessitates the development of a deeper understanding of which activities in outer space will be allowed and which will be challenged.⁴ For example, some asteroids contain significant amounts of various metals and minerals,⁵ and at this time somewhat tenuous plans are being made to mine near Earth asteroids.⁶ Entrepreneurs of the future will need assurance that they will be able to receive a payback for their investments and, at the same time, the developing countries want assurance that the Moon and other celestial bodies will benefit all of humanity, if, indeed, there is economic benefit to be gained.⁷

Thus, there is a need to clarify the legal status of activities seeking to use the resources of terrestrial bodies, whether for mining, tourism, or other purposes. As Carl Christol observes, "Legal stability can engender practical activity."⁸ However, some space analysts claim, "there is a legal vacuum on the topic of property rights in space," or "...international agreements affecting space property rights are clearly hostile

to commercial space activities.”⁹ Many believe the provisions of the Moon Treaty¹⁰ should be revisited and even that the 1967 Law of Outer Space should be amended.¹¹

EXISTING OUTER SPACE LAW

For the purposes of this discussion, the most relevant instruments are the Outer Space Treaty, the Moon Treaty, and the Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries.^{12,13} The most pertinent articles are discussed below individually:

The Outer Space Treaty of 1967

Article I declares that the “exploration and use of outer space, including the moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries...and shall be free for exploration and use by all States...”¹⁴ However, questions have arisen whether the activities mentioned should be regulated by States and whether there are activities that are not covered by “exploration and use.”¹⁵

Article II of the Outer Space Treaty provides that outer space, including the Moon and other celestial bodies, “...is not subject to national appropriation by claims of sovereignty, by means of use or occupation, or by any other means.”¹⁶ Some space commercialization enthusiasts contend that while States are subject to the non-appropriation doctrine, private entities are not. Also, property rights, short of sovereignty, may include ownership of minerals once they are mined.

Article III states that activities in the exploration and use of outer space shall be conducted, “in accordance with inter-

national law, including the Charter of the United Nations.” Steve Doyle correctly calls this article an “unambiguous declaration of the applicability of international law...to all that is done in space...” He also states, “There is no reason why cooperation could not be accomplished in the use of celestial bodies for activities such as propellant production, scientific exploration, establishment of settlements or other ventures...”¹⁷ There are no provisions of the OST, nor are there provisions in any other generally subscribed treaty relating to outer space that preclude uses of resources in outer space.

Article VI of the Outer Space Treaty recognizes that the private sector has the right to conduct activities in space, subject to authorization and continuing supervision by the appropriate responsible state. The drafters of the Treaty could not have foreseen the extent to which private enterprise would develop space capabilities that are sometimes comparable to those of States in launch vehicles and other technologies. But, like the authors of the United States Constitution, they were wise in the ways of human nature and made certain encompassing provisions such as here in Article VI, “States...shall bear international responsibility for national activities in outer space...whether such activities are carried on by governmental agencies or by non-governmental entities...” Carl Christol rightly distinguishes between national sovereignty and national jurisdiction.¹⁸ While the Outer Space Treaty prohibits the exercise of national sovereignty in the space environment, the exercise of national jurisdiction can and should occur and “[T]hrough the extra-territorial exercise of this national power the State is able to impose restrictions

and limitations on national exploitative activities.”¹⁹

Article IX requires consultation regarding environmental issues. Even before 1967, scientists at the National Aeronautics and Space Administration were aware of the possibility of contaminating the Moon and were taking steps to avoid that. Thought was being given to eventual back contamination from the Moon and Mars as well. Article IX, however, lacks enforcement mechanisms. As Christol points out, “[O]ther than for Article IX the Principles Treaty contains few specific limitations on the exploitation of the natural resources of the space environment. It does not make provision for a formal management system having the power to regulate such exploitative activities.... This constitutes a decentralized management system...” which contrasts with the centralized management system of Article 11, 5 of the Moon Treaty.²⁰

Article XII provides that “All stations, installations, equipment and space vehicles on the moon and other celestial bodies shall be open to representatives of other States parties to the Treaty.” Clearly, the authors assumed that stations and installations that would be the property of States or other entities would eventually exist legally on celestial bodies. From the articles above, it is equally clear that no claims of sovereignty can be made, but that “use” cannot be unduly inhibited.

Mining is the activity beyond Earth’s orbit with the most likely near term commercial payback, and the 1967 Treaty allows public and private entities to appropriate minerals in outer space. Wayne White²¹ summarizes some significant interpretations as follows: a) Space objects occupy locations on a

first-come, first-served basis,²² b) nations have jurisdiction over space facilities and all personnel in or near the facility, irrespective of nationality,²³ c) personnel have the right to conduct their activities without the harmful interference of other states, d) although entities may not claim ownership of mineral resources “in place,” once they have been removed, i.e., mined, then they are subject to ownership,²⁴ and e) jurisdiction and any rights with respect to a given area cease when a facility is returned to Earth, destroyed, or abandoned or when activity is halted outside a facility.²⁵ But Nathan Goldman raises the specter of mining consuming an entire near-Earth asteroid. He asks whether in such a case has “use” become an “appropriation” of the celestial body.²⁶

The Moon Treaty

The Moon Treaty was opened for signature Dec. 18, 1979, and in 19 years it has been ratified by only nine nations. No spacefaring State has adopted it, and it is in force only for those States that have ratified it.²⁷ The Treaty largely expounds upon the Outer Space Treaty, and many provisions state the obvious or are contradictory or redundant with other existing space law.²⁸

Article 4, however, goes beyond existing precedents in international law and calls for special consideration for developing nations. Restating provisions of the OST, it continues, “Due regard shall be paid to the interests of present and future generations as well as to the need to promote higher standards of living and conditions of economic and social progress and development...”²⁹

In Article 11, 1, the Moon Treaty advocates the controversial “common heritage of mankind” (CHM) principle.³⁰

CHM accounts for the fact that only nine States have ratified the Treaty.³¹

Francis Lyall summarizes the elements of the common heritage concept: certain regions should not be subject to national appropriation in any way, that there will be a management system for such an area, that the managers, be they state or international organization, will act as representative of mankind, that any benefits from such areas will be shared internationally, and that the area will be used for peaceful purposes only.³²

Although few States have ratified it, the provisions of the Moon Treaty cannot be completely disregarded just because it has received limited acceptance. Some commentators believe the absence of ratification by a State does not equate to authority for its citizens to engage in activities prohibited by the Moon Treaty.^{33,34} Christol believes that, where property rights are concerned, two regimes are in effect, i.e., one for those who adhere to the Moon Treaty and its provisions, and one for those who adhere only to the provisions of the OST and other existing space law. States not adhering to the Moon Treaty can exert jurisdiction over their nationals regarding their conduct on the Moon and celestial bodies, while making no claim of sovereignty.³⁵ Art Dula and others see the Moon Treaty as imposing a moratorium on exploitation for those nations that have ratified it.³⁶ Because returns from extraterrestrial resources have not yet promised to be lucrative enough to lure investors, conflicts have not yet arisen, and intense pressure has not been exerted to clarify the legal regime.

Article 11, 5 provides that States Parties to the agreement undertake to establish an "international regime, including appropriate procedures, to

govern the exploitation of the natural resources of the moon." The purposes of that international regime as stated in Article 11, 7 (d) include, "[A]n 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." In contrast, the province of mankind principle in the Outer Space Treaty imposes no treaty requirement on how benefits are to be shared.³⁷ The Moon Treaty does not provide details regarding how the proposed regime will be made operational, e.g., the institutional organization, rules and standards.³⁸

Harry Almond points out that "[A] literal reading of the provisions that set up the international regime indicate clearly that the drafters of the provisions expected to establish collective enterprise, ousting the market control and market forces." Like many others, he believes, "...this regime with trends bent toward collective exploitation of resources from space will necessarily promote cartels among nations and their productive or industrial entities, and these cartels will control prices, the amount of goods produced, and even the use of the goods. They would reduce, or even eliminate, competition as a major market factor."³⁹

Eilene Galloway clarifies that "those who explore, use or exploit resources that are located on or below the surface of the moon may remove them from where they are located and have property rights over them. Samples and minerals can be removed....Exploiters cannot have property rights over the surface or subsurface or natural resources in place,

but when substances are removed, they may have property rights.”⁴⁰

The Moon Treaty is flawed, as Doyle observes, because, “it proposes to establish new international law inconsistent with existing and widely accepted principles of law.”⁴¹

Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries

This 1996 Resolution attempts an important compromise regarding the “common heritage” provision offering a means to share benefits while recognizing market principles. It states that, “States are free to determine all aspects of their participation in international cooperation on an equitable and mutually acceptable basis. Contractual terms in such cooperative ventures should be fair and reasonable and they should be in full compliance with the legitimate rights and interests of the parties concerned, as, for example, with intellectual property rights.”

**RELEVANT TERRESTRIAL LAW
Real Property**

In the Western world, wealth has frequently been synonymous with ownership of property.⁴² However, this view has not been held universally, for example, in the Islamic world,⁴³ in the early Christian world with its precepts forbidding the charging of interest and practicing central authority ownership (often papal) of land, and among American Indian tribes and other communal societies who had no concept of personal land ownership.⁴⁴ Private property rights have been considered by some to be incompatible with justice.⁴⁵

Others have questioned the role of property rights in the framework of protection for nature.⁴⁶ However, even in the most acquisitive societies, unrestricted ownership doesn’t exist; ownership of real property is subject to a host of rules and regulations. Larry Stern points out a distinction between physical real estate assets and ownership rights in real property. Many parties can have different ownership rights in a given parcel of real estate. A person may have ownership rights to a property for his or her lifetime (a life estate), after which the ownership rights will be transferred to a different person (as a reversion or remainder). A company may have the rights to minerals under the land, and another person may have ownership rights to space above ground, e.g., ownership of a condominium unit on the upper floor of a building. Easements represent nonpossessory interest in land. Even the exercise of exclusive ownership rights for intellectual property, which is wholly created by the author or inventor, are limited in time.^{47,48} It is clear that ownership of property can occur in many forms and is not necessarily a simple matter.

The General Mining Law of 1872⁴⁹

Under this law and subsequent case-law doctrine of “pedis possessio,” (actual possession) in the United States miners’ activities are protected on public lands of the United States.⁵⁰ Miners do not need a license or other permission to prospect.⁵¹ To obtain a patent to the land in which minerals are located, the miner must discover a valuable mineral deposit (water is not considered a valuable mineral), locate the claim, record the claim, do at least \$100 in improvements or annual assessment work, file annual affidavits of assessment work with the

Bureau of Land Management, and apply for the patent. Because some valuable minerals cannot be discovered without substantial investment, prospectors for such minerals as uranium have been allowed by the courts and regulatory agencies to base discovery on radiometric detection and geological analysis.⁵² Such mining is similar to the situation in outer space in requirements for substantial capital investment and specialized equipment and engineering.⁵³

Wayne White notes that The General Mining Law provides that valuable mineral deposits "shall be free and open to exploration and purchase...under regulations prescribed by law...so far as the same are applicable and not inconsistent with the laws of the United States." Thus, mining activities are indeed constrained with respect to pollution control and environmental impact, zoning, land use planning, reclamation, administration of the public trust, and sometimes competing recreational and wildlife protection.⁵⁴

The only space "mining" experiences to date pertain to samples gathered on the Moon. During the *Apollo* missions, astronauts collected and transported to Earth many kilograms of Moon samples. The Soviet *Luna* space probes from 1970 also returned samples from the Moon's surface. These objects have been available to many nations for study, but their ownership has never been questioned. A special bill in the United States' Congress pertaining to implanting the American flag on the Moon⁵⁵ stated, "[T]his act is intended as symbolic gesture of national pride in achievement and is not to be construed as a declaration of national appropriation by claim of sovereignty."⁵⁶

Real property and mining rights provide some insight into how we regard

property in outer space. More analogous situations to outer space, perhaps, concern the Antarctic and the deep seabed. All three regions can be regarded as global commons. However, both the Antarctic Treaty Regime and the Law of the Sea provide management structures far different from that existing for outer space.

The Law of the Sea⁵⁷

The Law of the Sea also expounds the *common heritage of mankind* doctrine, and goes further to mandate an International Seabed Authority. Because of objections to the restrictions on commercial development, in 1994 an amendment was adopted to encourage market forces by making influence commensurate with investment.⁵⁸ The governing Council of the Seabed Authority is composed of representatives of the major consumers of minerals, the largest investors in deep seabed mining, the major land-based producers of minerals, the developing countries, and an overall equitable geographic distribution of states. Consensus is required for decisions regarding revenues, or "sharing the benefits." However, some commentators believe, "...the exploitation of vast mineral wealth on Earth's ocean floor was rendered impossible by absurdly restrictive treaties that essentially stripped any successful entrepreneur of half of his discoveries, half of his profits, and all of his proprietary technology."⁵⁹

In attempting to avoid a similar dilemma in outer space, approaches have been suggested whereby property might be held in common (e.g., between nations and aerospace companies) as incentive for exploration and development.⁶⁰ Regarding the extent to which the Law of the Sea may serve as a model

for outer space, Christol believes, "No practical experience with the Seabed Authority can act as reference or comparison since there has been only a limited mining of these resources."⁶¹

The Antarctic Treaty⁶²

Antarctica and outer space are similar in that they are inhospitable environments to humans and difficult to survive; lack permanent populations; and are isolated and not easily accessible.⁶³ The 1959 Treaty for Antarctica addresses some of the same problems associated with living and working in outer space.

Major interest in Antarctica began in the late 1950s as part of the International Geophysical Year, a time when scientists learned more in a few months than all the knowledge previously acquired about the polar area. This explosion of scientific experimentation and knowledge was followed almost immediately by the Treaty, at the height of the Cold War, and involved the United States and the Soviet Union in an unprecedented agreement.

The treaty provides for demilitarization of the Antarctic, full unilateral rights of inspection, the promotion of scientific investigation and cooperation, a freeze in the status of territorial claims, a ban on nuclear explosives and dumping of radioactive wastes, peaceful settlement of disputes concerning the Treaty, accession by other States, and a conference mechanism for consultation between adhering parties. What it does not specifically provide is government for the area or arrangements for joint operation of scientific, exploitative, or other development activities, although other facets of the Treaty System have accommodated some of these activities. To protect Earth's environment, in 1991, the Treaty nations drafted a Protocol to

the Treaty prohibiting mineral exploitation for at least 50 years. The ban can only be lifted by a vote of three fourths of the members. The ban was unopposed by mining interests because of lack of interest at the time.

Thus, in Antarctica, there has evolved a unique system of governance without an executive or bureaucracy. Lay and Taubenfeld quip that the Antarctic Treaty system may be viewed as "the last stand of colonialism, an association of the world's largest real estate operators, a political anachronism whose days are numbered, or an astonishingly successful experiment in international cooperation among antagonistic nations, depending on one's perspective."⁶⁴ Nevertheless, questions still exist about whether Antarctica belongs to the signatories to the treaty, to no one, or whether it is the "common heritage of mankind."

The Antarctic Treaty contains provision for future changes; Philip Quigg⁶⁵ notes that something like a consensus exists regarding several points for future revision:

- 1) A minerals regime must be in place before the technical capacity exists for oil extraction in Antarctic conditions; otherwise, the possibility of precipitous unilateral action may put the environment and the treaty at risk. A regime to cover extraction of hard minerals should be covered as well.⁶⁶
- 2) Development must proceed by degrees, with assurances at each step that the environment will not be seriously endangered by advancing too rapidly to the next step. Thus, for example, a green light to explore will not necessarily ensure a license to produce.

- 3) Claimant States must derive some tangible benefit from any mineral extraction on the territory that they claim over and above what others may gain.
- 4) Revenue sharing with developing nations is unavoidable.

The Antarctic Treaty procedures under which consultative meetings of the signatories are held in private has allowed delegates to exchange views without instructions and without commitment. It is unlikely some of the most difficult settlements could have been worked out or that, in some instances, parties could have reversed earlier stands, had sessions been open. Closed meetings, out of the view of the media, might offer a good approach to working out controversial space property rights issues.

Francis Lyall notes that the Antarctic system has the merit of "having been developed slowly and in response to practical needs, for precisely the sort of scientific enterprise that is likely at first at least to be seen on the Moon."⁶⁷ While he allows for eventual replacement of this flexible system with the Sea Bed Authority model, he believes there is no need to hurry to that, that we should learn by experience

There are clearly problems and stresses within the existing Antarctic Treaty Regime. The Antarctic Treaty came into being too late in the association of various States with that area for States to be willing to relinquish potential rights to territory or resources. The OST has forestalled premature property claims in space, and there is still time to address the question of property rights more fully before enticements of profit entangle the prospects and prevent compromise.

CONCLUSIONS

As seen above, current space law does not forbid the exploration and utilization of the Moon, comets, asteroids and other celestial bodies, but a whole host of unanswered questions remain that provide fodder for future space law. In examining relevant terrestrial law such as mining laws, the Law of the Sea, and the Antarctic Treaty, it seems clear that there are no perfect terrestrial antecedents, certainly none that can provide an optimal legal environment to open space for exploitation. The needs are for clarification of existing law and possibly new treaties or laws, regulations, or mechanisms that will protect those who invest in space while also protecting the rights of all humankind to accessible outer space environments in the future. The OST and the body of existing space law provide a solid foundation upon which to build. However, it is urgent that the question of property rights be approached in a timely fashion. With reference to the use of extraterrestrial resources, Doyle suggests, "[W]aiting for clarification of international legal rules relating to use of resources beyond the Earth may be self-defeating. The prevailing legal regime is permissive and clearly influencable by future action. The longer one waits, the more likely it is that constraints will emerge. The sooner action is taken to demonstrate what can be used and how it can be used, the sooner the international community is likely to move forward to establish appropriate rules to regulate the use and exploitation of extraterrestrial resources."⁶⁸ Christol wisely notes that: "It is entirely possible that as the value of these anticipated resources increases...the inclination to engage in voluntary sharing will decrease."⁶⁹ And, also, "...it can be argued that the

existence of a functioning international legal regime dealing with the exploitation and sharing of Moon resources would be beneficial or encouraging. It would provide, in an optimum situation, for the identification of principles, standards, and rules required to induce or facilitate engagement by affected legal entities in exploitative activities... Without the establishment of an international intergovernmental structure to govern these matters, it is not likely that States or private investors will be inclined to engage in exploitative activities.”⁷⁰ Thoughtful discussions with input from a wide variety of sources can contribute to defining and narrowing the differences among those with strong interests in the question.

Any list of areas for discussion and clarification would include the problem of definitions, for example of “use,” “peaceful use,”⁷¹ “equitable sharing of benefits,” and “for the benefit of all mankind.” However, these definitions may not be critical to reaching agreement on how development of outer space is to be permitted.

An agenda is needed of the areas that *are* critical to reaching fair and equitable agreements that will enable space development. Some areas that might be included are suggested below:

--The permissible extent of use or occupation of celestial bodies,⁷² as well as inclusion in space law of private activities

--Rights and obligations of individuals and other entities in addition to those of States in outer space

--Any perceived necessary limitations on space development

--Functional property rights and conditions for exclusion of others from a site that is occupied or being used by a specific entity. For example, should facility operators have a right to a safety zone surrounding their facility?

--The validity of telepresence, including robotics and remote sensing, in lieu of human presence, as a valid method of discovery and occupation

--A mechanism, rules, and guidelines for settlement of claims

--The notion of a register for mineral claims similar to the registry of launches of space vehicles, whether with the United Nations, World Court, or other. Some activists have suggested a claims registry with different classes of claims based on effort, human-visited claims being the strongest.⁷³

--Environmental restrictions

--Penalties for violation of environmental restrictions⁷⁴

--Regulation of land use. Mining, astronomy, geology, solar power, manufacturing and landing facilities are not necessarily compatible.⁷⁵

--Determination of mining rights. It seems almost inevitable that at some point in the future national governments or private companies will clash over the rights to exploit a given mineral deposit.⁷⁶

--Dispute resolution mechanisms

--Mechanisms for non-spacefaring States to participate in consortia or other activities in outer space

--Human rights as extended to outer space

--Administration of a regulatory regime for outer space. This is perhaps the most challenging to contemplate: Is there need for an international agency as a forum for administering a regime for outer space? What kind of voting structure would an administrative structure use, corporate, democratic, consensus, etc.? What kind of operating authority would be needed? For example, were it seen as desirable to issue an entity or entities a 99 year (or other) lease, who would issue and oversee such a lease? At the present time, the United Nations provides a focal point for registration of launch and other space activities.⁷⁷ But the United Nations is composed predominately of non-spacefaring nations, whereas nations and other entities with heavy investments in activities in space would require some guarantee of fairness from their point of view. Examples from terrestrial practices pertaining to other global commons might be contemplated in early discussions of administration and management of space activities.

Almond states, "A major problem that we face in participating in the law making processes and in seeking our legal precedents and experience for effective and economical future regulation, is to give law its operational basis"⁷⁸ Now is the time to explore and discuss in international fora what conduct will be permissible in the development and exploitation of outer space, i.e., the regulations that govern how States and other entities may operate in the space environment in the interest of safety, fairness, and preservation of the

environment. There is some urgency in identifying areas in need of regulation lest the current uncertainties regarding some of the issues listed above prove to be disincentives to commercial and entrepreneurial undertakings and before preemptive claims begin to stress the system!

The real question is not whether there will be property rights in space, but when and what kind of property rights.⁷⁹

The Outer Space Treaty was formulated and ratified at a time when States could afford to be objective about the future, i.e., before the issues became reality, but it did not provide the legal and management guidelines that will be needed for space commercialization to go forth.⁸⁰ It would be wise to identify and address the issues concerning property rights in space and the guidelines and constraints to which entities may be subjected in a timely fashion before problems arise.⁸¹ The goals of a legal regime for outer space should be to continue to preserve outer space for peaceful purposes and for the benefit of all human kind while at the same time not discouraging private enterprise.

Notes:

1. See Lewis, John S., *Asteroid Resource Exploitation: Property and Mineral Rights and Legal and Regulatory Regimes*, Presented to the National Space Society, 12 November 1998. Lewis enumerates some of the resources that might be exploited: "1) solar energy [solar power satellites], 2) the isotope helium₃, a constituent of the atmospheres of Uranus and the other giant planets, and a very minor constituent of lunar regolith, for use as clean fusion fuel on Earth, 3) oxygen extracted from lunar or asteroidal rocks and minerals for use in life-support systems and as the oxidizer for rocket engines departing from the Moon, and 4) water from Near-Earth asteroids, Martian permafrost, or lunar polar ice

- deposits for use in life support and rocket propellants.”
2. 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, 619 U.N.T.S 205. See Article IV.
 3. Some scientists, e.g., geologist, former astronaut and U.S. Senator, Harrison Schmitt have long conceived of the Moon as a source of fuel for space travel further into the Solar System. Because launching fuel and other raw materials from Earth is prohibitively expensive, the concept is to mine Helium₃ for fusion and as propulsion fuel to carry humans and cargo to Mars.
 4. The presumption that any entity will invest heavily in mining or other activities other than exploration is contingent upon the cost of space launches becoming significantly lower. If that doesn't happen, the arguments in this paper are moot. If the pace of launch technology development were to accelerate, the need for clarification of space property rights would become a high priority.
 5. Lewis, observes that asteroids are rich in “cheap” materials, such as water or iron, that are of great value and utility in space but prohibitively expensive to launch in large quantities from Earth. “Further, the large majority of near-Earth asteroids contain high concentrations of extremely valuable precious and strategic metals, such as platinum, osmium, iridium, rhenium, and palladium, and semiconductor components such as germanium, gallium, arsenic, antimony, tellurium, and indium.” He notes that asteroids have “feeble” gravity, making departure to return to Earth easier than, say, from the Moon. What remains to be done is to find simple, effective means to extract and separate these resources.
 6. Benson, James William, “Space Resources First Come First Served,” *Proceedings of the Forth First Colloquium on the Law of Outer Space*, 1999. Benson states “Private property rights in space are essential to the rapid and orderly development of space.” His company plans a commercial exploration mission, the Near Earth Asteroid Prospector, which will land instruments on an asteroid, NEA 4660 Nereus, and claim ownership of the asteroid on behalf of its public shareholders. He argues that it is “the responsibility and duty of those commercial interests operating in deep space to define private property rights in space, while legislators back on earth attempt to create a system of incentives and rewards for the commercial exploration and development of space.”
 7. Hertzfeld, Henry R., “Measuring Returns to Space Research and Development,” *Space Economics*, American Institute of Aeronautics and Astronautics, 1992, at 151-160. This survey of numerous economic and cost benefit space studies notes: “The Space Shuttle as well as future space-based facilities are similar to existing government laboratories. We tend to justify them with projections of economic benefits. But that is not the real reason to build and operate such laboratories. The main reason is political and cultural. We must preserve our technological leadership in order to be among the industrial and military leaders of the world. As a society, we have a cultural need to devote resources to exploring the unknown. The short-term benefits may or may not outweigh the longer-term economic returns. We do not and cannot know what those economic returns will be.”
 8. Christol, Carl, “The Moon Treaty and the Allocation of Resources,” *Annals of Air and Space Law*, Vol XXII-II, 1997, at 45
 9. Pace, Scott, *Policy Options for Recognizing Non-Terrestrial Property Rights*, Speech before the National Space Society Special Conference on Space Property Rights and Commercial Space Development, 2 December 1998
 10. Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, entered into force July 11, 1984, 1363 U.N.T.S. 3
 11. The United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS) has undertaken a Review of the Status of the Five International Treaties Governing Outer Space with the purpose of enabling the COPUUOS Legal Subcommittee to propose mechanisms to help achieve adherence to the five outer space treaties. Report of the Legal Subcommittee on the Work of its Thirty Sixth Session, 1-8 April 1997, UN doc. A/AC.105/674, 14 April 1997, at 10 and 22-23
 12. G.A. Res. 51/122, 13 December 1996
 13. For a comprehensive discussion of property rights and all existing treaties, see Almond,

- Harry H., Jr., "The Legal Status of Property on the Moon and Other Celestial Bodies," *Proceedings of the Fortieth Colloquium on the Law of Outer Space*, 1998.
14. Manfred Lachs pointed out that while "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, the term use does not belong to the catalogue of traditional titles to territory known in international law." Lachs, Manfred, *The Law of Outer Space; An Experience in Contemporary Law-Making*, Sijthoff Leiden, 1972
 15. Almond, Harry H., Jr., "The Legal Status of Property on the Moon and Other Celestial Bodies," *Proceedings of the Thirty-Ninth Colloquium on The Law of Outer Space*, 1997 at 22
 16. Galloway, Jonathan, "Limits to Sovereignty: Antarctica, Outer Space and the Seabed," *Proceedings of the Forty First Colloquium on the Law of Outer Space*, 1999. Interestingly, Galloway argues that sovereignty has become a point on a continuum that ranges from complete independence and autonomy to complete interdependence and community and asks what difference it would make if there were no sovereignty in terms of commercial and military activities?"
 17. Doyle, Stephen H., "Using Extraterrestrial Resources Under the Moon Agreement of 1979," *Journal of Space Law*, Vol. 26, N. 2, 1998.
 18. Christol, Carl Q., "The Natural Resources of the Moon: The Management Issue," *Proceedings of the Forty First Colloquium on the Law of Outer Space*, 1999
 19. Christol, *ibid* at 2
 20. Christol, *ibid* at 3
 21. White, Wayne, "Mining Law for Outer Space," *Proceedings of the 10th Annual Space Studies Institute/Princeton Conference on Space Manufacturing*, Fall 1991
 22. Gorove, Stephen, "Sovereignty and the Law of Outer Space Re-examined," 2 *ANNALS AIR & SPACE LAW*. 311, 1977
 23. Cheng, Bin, "The 1967 Space Treaty," 95 *Journal du Droit International* 532, 1968
 24. Cepelka & Gilmore, "Application of General International Law in Outer Space," 36 *Journal of Air Law & Com* 58, 1970
 25. Csabafi, I., *The Concept of State Jurisdiction in International Space Law*, 130-131, 1971
 26. Goldman, Nathan C., "Space Law and Space Resources," *American Space Law*, Iowa State Univ. Press, 1986. Goldman asserts that the "near-Earth asteroids raise a trickier legal issue. Although a nation cannot appropriate a celestial body, it can use the resources. If space mining basically consumes an entire, small near-Earth asteroid, has the "use," become an "appropriation" of the celestial body? "This situation appears to be another example in which the technologies have rendered the treaties obsolete." He suggests amending the treaties to redefine these smaller asteroids as a different class of celestial bodies.
 27. Galloway, Eilene, "Status of the Moon Treaty," *Space News*, August 3-9, 1998, at 21
 28. For an excellent analysis of the Moon Treaty, paragraph by paragraph, see Doyle, *supra*, note 22
 29. Doyle regards this sentence as "...a provision reflecting the interests of States that believe they are not sufficiently represented among the space faring nations of the world, fearing that they may be left out or ignored in the process of possible future exploitation of lunar resources." He continues, "A far more reliable guarantee of participation by such countries would be obtained by their development of national competence in selected or specialized space technology areas, such as we see being done in India, Brazil and selected other developing countries..." *Supra*, note 22 at 118
 30. The Moon Treaty provided for renegotiation after 10 years, but when it was revisited by the UN General Assembly on 9 December 1994, upon the recommendation of the Committee on the Peaceful Uses of Outer Space and its Legal Subcommittee, no action was taken. In its Resolution of 5 February 1996, however, the U.N. General Assembly invited "...States that have not yet become parties to the international treaties governing the uses of outer space to give consideration to ratifying or acceding to those treaties;" mentioning specifically the Moon Treaty. U.N. Doc. A/RES/50/27
 31. Gorove, S., "Space Law in the Global Community," *Journal of Space Law*, at 201

32. Lyall, Francis, "On the Moon," *Journal of Space Law*, Vol 26, No. 2, 1998 at 133
33. See Sterns, Patricia M. and Leslie I. Tennen, "Institutional Approaches to Managing Space Resources," *Proceedings of the Forty First Colloquium on the Law of Outer Space*, 1999
34. See also Cocca, Aldo Armando, Property Rights on the Moon and Celestial Bodies, *Proceedings of the Thirty Ninth Colloquium on the Law of Outer Space*, 1997, which argues that even in the absence of the common heritage of mankind provision of the Moon Treaty, the interests and needs of developing countries, and the rights of those conducting commercial activities using space resources, are to be taken into account, consistent with article 55(a) of the United Nations Charter, at 10-11.
35. Christol, AASL supra, note 13, at 44-45
36. See also Dula, Art, "Free Enterprise and the Proposed Moon Treaty, AIAA-80-0367, 1980.
37. E. Galloway, supra)
38. Christol, supra, note 13 at 40
39. Almond, supra, at 25
40. E. Galloway, supra
41. Doyle, supra, note 22 at 118
42. Stern, Lawrence H., Property Rights in Space--From the Caves to the Stars; The Evolution of Humanity, 1994, unpublished. Stern examines the history of various terrestrial approaches to property rights.
43. Bethell, Tom, "The Mother of All Rights; Without Secure Property, The Islamic World Can't Escape Tyranny and Stagnation," *Reason*, Vol. 25, April 1994, at 41
44. Sterns and Tennen, supra
45. Sterns and Tennen, supra at 4
46. Ackroyd, Peter, "Greek Lessons for Property Right Arrangements: Justice and Nature Protection," *American Journal of Economics and Sociology*, Vol.51, Issue 1, January 1992 at 19-26
47. Sterns and Tennen, supra, note 33
48. See Ellickson, Robert C., "Property in Land," *The Yale Law Journal*, Vol. 102, 1993, 1317-1400 for an exploration of issues surrounding ownership of land
49. USCA, 22 et seq
50. One of the most relevant cases from the point of view of space law is Columbus-America Discovery Group, Inc. v. The Unidentified, Wrecked and Abandoned Sailing Vessel, S.S. Central America, In Rem, 1989 AMC 1955. The S.S. Central America sank in 1857 carrying \$1 billion in gold. The Columbus America discovered the ship using advanced scientific means. Other expeditions began searching, and to prove their discovery Columbus America used a telerobotic probe to retrieve a piece of coal from the wreck. The court then issued a Temporary Restraining Order prohibiting other ships from entering the area. This case established two precedents: it protected the rights of individuals to exclude other entities from a specified area in international waters, and it recognized telepresence as a valid method of discovery. For additional discussion of this case, see White, supra note 21, at 88-89
51. G.C. Coggins and C.F. Wilkinson, Federal Public Land and Resources Law 335, 1981; See 30 U.S.C.A. Sec. 22
52. Dallas v. Fitzsimmons, 137 Colo. 196, 323 P. 2nd 274, 1958
53. Fiske, Pedis Possession: Modern Use of an Old Concept, 15 *Rocky Mountain Mining L. Inst.* 181, 215-16, 1969
54. White, supra, at 88. White cites, e.g., the Forest Service regulations, Bureau of Land Management regulations; the Federal Land Policy and Management Act of 1976, the Surface Resources Act of 1955, the Multiple Mineral Development Act, and the Surface Mining Control and Reclamation Act of 1977.
55. Sec 8 of the US Law on the Implantation of the United States Flag
56. See Oosterlinck, Rene, Tangible and Intangible Property in Outer Space, *Proceedings of the Thirty-Ninth Colloquium on the Law of Outer Space*, 1996, for a thorough discussion of property under Roman Law and the concepts that relate to space law, e.g., res nullius and res communis omnium.
57. Convention on the Law of the Sea, opened for signature Dec. 10, 1982, U.N. Doc. A/CONF.62/122 (1982)
58. Kopal relates that "...the ratifications of the 1982 Sea Law Convention, in which a detailed implementation of the common heritage principle, including a complex system of prospecting, exploration and exploitation with a central role of the International Sea-Bed Authority and its Enterprise, has been incorporated, also proceeded very slowly for years. But the main obstacles that hindered this process were removed in 1994 by an Agreement

- Relating to the Implementation of Part XI of the convention in which the ways and means of how to carry the controversial part of the Sea Law Convention into effect were found." Kopal, Valdimir, "Outer Space as a Global Common," *Proceedings of the Fourtieth Colloquium on the Law of Outer Space*, 1998.
59. Lewis, John S., *Asteroid Resource Exploitation: Property and Mineral Rights and Legal and Regulatory Regimes*, Speech before the National Space Society Meeting on Space Property Rights, 12 December 1998, at 6
 60. Sterns and Tennen suggest that The Law of the Sea "pioneer investor" proposal in Resolution II Governing Preparatory Investment in Pioneer Activities Relating to Polymetallic Nodules could serve as a model for an agreement on mining in space. It provides, among other things for the assignment of a specific area large enough to permit two mining operations. It requires reversion of 50 percent of the area to the "Preparatory Commission for the International Sea-Bed Authority and for the International Tribunal for the law of the Sea" by the eighth year. This type of concept can provide a compromise between those who believe property rights are essential if there is to be private investment and those who believe there should be a wide sharing of the benefits of space among the nations of the Earth.
 61. Chistol, *supra*, note 40 at 42
 62. Antarctic Treaty; 402 U.N.T.S. 71, T.I.A.S. 4780
 63. Clayton, JoAnn C., "International Cooperative Missions to Mars—Some Legal Considerations," *Proceedings of the Thirty-First Colloquium on the Law of Outer Space*, 1989, at 243-249
 64. Lay, S. Houston, and Howard J. Taubenfeld, *The Law Relating to Activities of Man in Space*, 1970, at 61
 65. Quigg, Philip W., *A Pole Apart, The Emerging Issue of Antarctica*, 1983, at 60, 71.
 66. This was written before the 1991 Protocol banning mineral exploitation for at least 50 years.
 67. Lyall, Francis, *supra* at 135
 68. Doyle, *supra*, note 22 at 127-128
 69. Christol, *supra*, note 13 at 44
 70. Christol, *ibid* at 45
 71. For a discussion of "peaceful," "non-military," and "non-aggressive" as well as insights into approaching new space law, see Galloway, Eilene, "Guidelines for the Review and Formulation of Outer Space Treaties," *Proceedings of the Forty-First Colloquium on the Law of Outer Space*, 1999.
 72. See, for example, Lachs, *supra*, note 14
 73. Reynolds, Glenn H., "Space Property Rights: An Activist's Approach," *Ad Astra*, September/October 1998 at 20
 74. For a comprehensive discussion of environmental issues, see Quizhi, He, "Space Law and the Environment," *Space Law Development and Scope*, ed: N. Jasentuliyana, Praeger Press, 1992.
 75. See, for example, Cramer, Karen, "The Lunar Users Union – An Organization to Grant Land Use Rights on the Moon in Accordance with The Outer Space Treaty," *Proceedings of the Fourtieth Colloquium on the Law of Outer Space*, 1998, at 352
 76. White, Wayne N., "Real Property Rights in Outer Space," *Proceedings of the Fortieth Colloquium on the Law of Outer Space*, 1998, at 371
 77. See Terekhov, Andrei D., "UN General Assembly Resolutions and Outer Space Law," *Proceedings of the Fourtieth Colloquium on the Law of Outer Space*, 1998, for an informed discussion of the United Nations process and the effectiveness of its Declarations.
 78. Almond, *supra*
 79. Doyle in considering possible exploitation of Moon resources under the Moon Treaty states, "It is difficult to see how the resources necessary to permit exploitation of lunar resources would ever be amassed, organized and brought to bear on the problem, if exploitation is to be under an international administration, on behalf of "mankind," the first premise of which is "there are no property rights." *Supra* at 127
 80. Many models have been proposed, including a proposal for a non-governmental space governance regime to assume jurisdiction in space, as Trustee for all nations and all humankind entitled The Metanation. O'Donnell, D.J., "A New Institution is Proposed to Manage Space Resources: The Metanation in Space," *Proceedings of the Forty First Colloquium on the Law of Space*, 1999

81. Almond in discussing the Moon Treaty notes the array of provisions “suggest that through the details states are gradually telling each other what is property, what

they can or cannot do with it, and who makes the decisions about these matters.”
Supra, at 24