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EFFICIENT ALLOCATION OF REAL PROPERTY RIGHTS ON THE PLANET MARS

by David Collins*

I INTRODUCTION

In August 2007 NASA successfully launched the \$90.5 million Phoenix Spacecraft which is scheduled to land on the surface of the planet Mars in the spring of 2008. The planned Mars Science Laboratory, another robotic spacecraft that should land on Mars in 2010, will cost an estimated \$347 million in 2007, with further operating expenses each year.¹ Should these new missions be completed as envisioned, they will be the sixth and seventh devices to land on the surface of Mars sent by the United States,² yet despite these significant achievements in space exploration and their enormous cost, the existing regime of space law tells us that Mars belongs to “common heritage of mankind”³. Common ownership of Mars (and the other planets as well as the Moon) and the resulting sharing of benefits derived from its exploration and developments disregards the unequal

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¹ NASA FY Budget Request Summary <www.nasa.gov> (September 2007)

² The others were Opportunity Rover (arrived 2004); Spirit Rover (arrived 2004); Mars Pathfinder (arrived 1997); Viking 2 (arrived 1976) and Viking 1 (arrived 1976).

³ The Moon Treaty Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, opened for signature Dec 18, 1979, 1363 U.N.T.S. 2L (entered into force July 11, 1984) [hereinafter The Moon Treaty].

burden of costs, and associated risks discouraging investment and productive use. As a number of authors have argued, the opportunity for private profit, in one form or another, is an essential incentive for the advancement of space exploration⁴, especially as the expected gains are of high uncertainty. This article will further develop this view by challenging the idea of common property with respect to real property on the planet Mars, viz. land rather than moveable goods such as minerals, and by evaluating specific ways in which such property rights can be allocated on the basis of efficiency. Accordingly the currently hypothetical, although not improbable, human exploration and colonization of Mars will be considered from the perspective of cost-benefit analysis. The article concludes that a present and definite legal regime that recognizes geographically limited, privately controlled claims to land on Mars will ensure timely and productive development of our neighboring world.

II THE FUTURE OF MARS EXPLORATION

Although numerous spacecraft have landed successfully on the planet or achieved orbit around it, a manned mission to the planet Mars is several decades away, colonization perhaps centuries, but there is little doubt that it will eventually occur because humans cannot expect to remain on Earth indefinitely, be it the result of our obviously degrading climate and depleted resources, or more dubious dangers such as global nuclear war or an

⁴ Eg: Brian Hoffstadt *Moving the Heavens: Lunar Mining and the Common Heritage of Mankind in the Moon Treaty* 42 UCLA L R 575 (1994-95), James J Trimble *International Law of Outer Space and Its Effect on Commercial Space Activity* 11 PEPPERDINE L R 521 (1983-84); Andrew H Pontious *A Proposed Regime and Its Ramifications on the Commercialization of Outer Space* 7 SANTA CLARA COMPUTER & HIGH TECH L J 157 (1991); Jeremy Zell, *Putting a Mine on the Moon: Creating an International Authority to Regulate Mining Rights in Outer Space* 15 MINNESOTA J OF INTERNATIONAL L 489 (2006)

asteroid collision, or radiation from the demise of our sun in far future⁵. President Bush indicated in his 2004 “Vision for Space Exploration” that robotic and manned missions to Mars were an important aspect of the American space exploration initiative. Accordingly NASA plans to send a manned mission to Earth’s Moon before 2020 as a prelude to a manned Mars mission, which should take place within the next 20 years.⁶ Roskosmos, the Russian space agency similarly announced in August 2007 that it anticipated sending cosmonauts to Mars after the completion of a Lunar base in 2035.⁷ The European Space Agency (ESA)’s Aurora program included a manned mission to Mars by 2024.⁸

Serious interest in Mars will continue to intensify for two important reasons. First, it is far more readily capable of sustaining human life than any other planetary body in the Solar System. Roughly half the size of Earth (and with about the same amount of dry land) Mars’ gravity and temperature are within the range of human tolerance. It is already known that Mars possesses vast resources of frozen carbon dioxide from which the important fuels of oxygen, deuterium, and helium-3, can be derived. Liquid water is now thought to exist not far beneath the planet’s surface, which could be used both for its oxygen and for irrigation in agriculture.⁹ The presence of water also raises the potential that isolated ecosystems may exist on Mars that could provide genetic material used to

⁵ Corey S Powell, *Twenty Ways the World Could End Suddenly* DISCOVER (Oct 2000), GERRIL L VERSCHUUR, *IMPACT: THE THREAT OF COMETS AND ASTEROIDS* (Oxford University Press, 1996) 156, 166 and generally MARTIN SCHRAM, *AVOIDING ARMAGEDDON* (Basic Books, 2003). Other potential sources for the extinction or near extinction of humanity include the reversal of the Earth’s magnetic field and flood-basalt volcanism,

⁶ E Baard and J Winters, *First Stop: Mars* in *SPACE 2100: TO MARS AND BEYOND IN THE CENTURY TO COME 58* (Popular Science, 2003)

⁷ W Atkins *Manned Mission to Moon in Russia’s Future* IT WIRE <<http://www.itwire.com/content/view/14267/1066/>> (September 2007)

⁸ Science and Space: European Scientists Plan Mars Missions, *SCIENCE AND SPACE*, <<http://www.cnn.com/2004/TECH/space/02/04/europe.mars.mission.ap/index.html>> (September 2007). It is noteworthy that no such date is given on the ESA’s official website

⁹ Arden L. Albee, *The Unearthly Landscape of Mars*, *SCIENTIFIC AMERICAN* vol 13 no. 3 (2003) at 34

treat illnesses.¹⁰ Mars' atmosphere, temperature and air pressure could be made to sustain human life through a complex process called terraforming, rendering the planet a potential refuge for humans should Earth become uninhabitable.¹¹ Mars has a 24 hour day which could allow greenhouses to be used, the only such celestial body in the solar system. Many useful ores may exist there that could be used on Mars to facilitate habitation.¹² Secondly, land claims on Mars will become more significant precisely because of its isolation from Earth. While Mars is close by astronomical standards; it is as little as 56 million kilometers away, with our current technology a mission to it would last at minimum two years and regular "return trips" to Earth are consequently unrealistic. It is therefore much more probable that Mars will eventually host a permanent, autonomous colony than, for example, the Moon. This much greater time frame necessitates a commitment to reliable, independent systems and infrastructure.¹³ Associated claims staked on land, such as mining, agricultural and settlement rights, could last for whole life spans of colonists or beyond.

III THE CURRENT LEGAL REGIME FOR PROPERTY IN OUTER SPACE

In order to frame properly a discussion of future real property claims on Mars, existing law on property in space will be considered briefly. There are currently two relevant

¹⁰ LAURENCE BERGEN, *VOYAGE TO MARS: NASA'S SEARCH FOR LIFE BEYOND EARTH* (New York: 2000) at 208.

¹¹ An greenhouse effect would be created by producing CFC's on a massive scale or through orbital mirrors which will release native greenhouse gases, mostly from Mars' polar icecaps. Genetically modified vegetation will be planted later to produce oxygen. It is estimated that Mars could be rendered fully Earth-like in 500 years. Robert M Zubrin, *Terraforming Mars* in *ISLANDS IN THE SKY: BOLD NEW IDEAS FOR COLONIZING SPACE*, Stanley Schmidt and Robert M Zubrin eds. (New York: 1996) at 125-126.

¹² Robert M. Zubrin and David A Baker, *Mars Direct: A Proposal for the Rapid Exploration and Colonization of the Red Planet*, in *ISLANDS IN THE SKY*, *id* at 64-67.

international treaties: The Outer Space Treaty and the Moon Treaty, both of which establish that Mars (and the other planets) are *res communis*: common property owned by the people of Earth. The former agreement, signed in 1967 as the result of efforts of the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS), establishes that space is “the province of all mankind” and “free for exploration and use by all states without discrimination of any kind on a basis of equality” and also that there should be “free access to all areas of celestial bodies”¹⁴ clearly precluding the exclusivity of possession that is a foundation of ownership. Celestial bodies, among them Mars, cannot be the subject of national appropriation by claims of sovereignty.¹⁵ The Outer Space treaty was signed by the United States, the USSR and 89 other nations and as such it can be viewed as a legally binding commitment in international law. The later Moon Treaty, ratified by only seven countries, establishes that all resources outside the earth are the “common heritage of mankind” and that no entity, either public or private can exclusively own any space resource¹⁶ and that there must be “equitable sharing” by all state parties in the benefits derived from space resources, taking into consideration the needs of developing countries.¹⁷ This language of public ownership mirrors The Law of the Sea convention, which establishes that no nation can own the world’s oceans.¹⁸ Significantly the Moon Treaty permits the retention of “samples” taken from planetary bodies,

¹³ BERGEN *supra* note 10 at 315. It would take six months to reach Mars and the crew would have to remain for 450 days to take advantage of Mars orbital position relative to Earth.

¹⁴ Treaty on the Principles Governing the Activity of States in the Exploration and Use of Outer Space Including the Moon and Other Celestial Bodies 610 U.N.T.S. 207-208 [hereinafter the Outer Space Treaty].

¹⁵ *Id.* Art II

¹⁶ *Id.* Art II par. 3.

¹⁷ *Id.* Art XI par. 2.

¹⁸ *United Nations Convention on the Law of the Sea*, opened for signature Dec. 10, 1982, 1833 U.N.T.S. 397. This treaty met with opposition from American mining interests, Carl Christol, *The Moon Treaty and the Allocation of Resources*, 22 ANNALS OF AIR AND SPACE LAW 31 (1997) at 42.

although it encourages that such materials be made available to other nations for the purposes of scientific experiment.¹⁹ The concept of personal property is thus recognized by the laws of space which has been interpreted by some to allow for commercial mining at some point.²⁰ Although under the Moon Treaty ownership in equipment, vehicles and installations is retained by the party who placed them there²¹ this is not true ownership in the common law sense, as there is no right to exclude because Article XV requires that all vehicles, installation and equipment shall be open to use by all other parties. This partial acknowledgement of private personalty may hold the potential for “quasi-sovereignty” involving ownership of objects on the surface of planets by individuals or corporations.²² The simple delineation between equipment and land may be difficult to draw on Mars, however, because the planet’s atmosphere necessitates artificial construction, such as a greenhouse, in order to render the surface agriculturally productive or habitable. According to the common law, a chattel (in which ownership is retained in space) loses its status as a chattel and becomes a fixture when it is so affixed to land that it becomes part of the land²³, and evidently according to treaty at that point ownership is lost. In this way a base built upon the soil or rock of Mars for the purpose of habitation or as a greenhouse, even if it is resting upon the planet’s surface under its own weight without attachment, as long as it is intended to permanently improve the land will become a fixture²⁴ and is therefore common property. Thus there is a strong risk that an investment such as a base costing possibly in the billions of dollars in preparation and

¹⁹ Art VI.2

²⁰ Christol, *The Moon Treaty and the Allocation of Resources*, *supra* note 18 at 40.

²¹ Art XII

²² Kurt Anderson Baca, *Property Rights In Outer Space* 58 JOURNAL OF AIR LAW AND COMMERCE 1041 (1992-93) at 1065.

transportation would become public property once it was placed upon the planet's surface.

Together the space treaties embody the now widely-criticized notion²⁵ that every human, as represented by the states in which they are members, has an effective “right” to Mars. Under this regime the allocation of Martian resources, possibly including land itself, will be determined by the “administrative model” in which each nation decides the distribution based on each country having an equal vote, much like the current United Nations regime.²⁶ Not surprisingly, the United States and the Soviet Union rejected the limitations on the use of space resources, refusing to sign the Moon Treaty. Indeed none of the signatories of the Moon Treaty has space travel capability, suggesting that it does not reflect any practical concerns in space exploration and development. Rather, the Moon Treaty illustrates resistance to the idea of private advancement through the acquisition or use of space resources as expressed through the voting dominance of less-developed nations in intergovernmental organizations.²⁷ Still, as many legal commentators have noted, the benefit sharing doctrines enunciated in the treaties are fortuitously vague and as such have little force in international law. At best they are loose policy guidelines not concrete obligations.²⁸ Interestingly, the treaties also present

²³ 5 Am.L.Prop., § 19.1

²⁴ *Snedeker v. Warring*, 12 NY 170, 175 (1854)

²⁵ See eg David Tan, *Towards a New Regime for the Protection of Outer Space as the Province of All Mankind* 25 YALE J OF INTERNATIONAL L 145 (2000), Kelly M. Zullo *The Need to Clarify the Status of Property Rights In International Space Law*, 90 GEORGETOWN L J 2413 (2001-02), and Brandon Gruner *New Hope for International Space Law: Incorporating Nineteenth Century First Possession Principles into the 1967 Space Treaty for Colonization of Outer Space in the Twenty First Century* 35 SETON HALL L R 299 (2004-05)

²⁶ Carl Christol, *The Moon and Mars Missions: Can International Law Meet The Challenge* 19 J OF SPACE L 123 (1999) at 133

²⁷ Christol, *The Moon Treaty and the Allocation of Resources*, *supra* note 18 at 32-33.

²⁸ See eg Tan, *Towards a New Regime*, *supra* note 25 and Zullo *The Need to Clarify the Status of Property Rights*, *supra* note 25

inconsistent principles: the Moon Treaty's common ownership concept contradicts the prohibition against national appropriation found in the Outer Space Treaty,²⁹ although this is little more than a semantic distinction; appropriation implying the taking of something from someone else. The ambiguity of these treaties and the fact that the Moon Treaty has not been ratified by space-faring nations suggests that property law in space remains, hopefully for the purpose of incentivization, clouded. Many commentators, notably Carl W. Christol, further assert the need to clarify and formalize the law of space exploration generally.³⁰ An internationally recognized legal regime for property rights on Mars is essential, or else uncertainty (if not the fear of expropriation in the name of mankind) will endanger financial investment both in reaching and then colonizing the planet.

IV OWNERSHIP AS AN INCENTIVE FOR PRODUCTIVE USE

In order to clarify the best regime for property on Mars it is first necessary to clarify how real property is treated on Earth, at least in Common Law jurisdictions. The Common Law views property as a bundle of rights: the right to use, to exclude others from use and to transfer those rights to others.³¹ As such, owning the planetary body of Mars in the legal sense would include the right to mine or build upon the planet's surface, to deny permission to land upon it from space, possibly to put something in orbit around it, and to sell or otherwise transfer those rights to someone else. Property law also recognizes the distinction between public and private property but this crucial distinction is problematic

²⁹ Zullo, *supra* note 25 at 2425

³⁰ See Christol, *The Moon and Mars Missions*, *supra* note 26

when applied to such a vast area as an entire planet because such rights cannot be readily categorized as either public or private goods. Mars is a private good in that it may (and likely does) contain valuable mineral resources and by definition these are private goods because they can only be consumed by one person to the exclusion of others³². It has already been suggested that the existing treaties may acknowledge mining rights on the planets as such resources can be extracted and removed from the planet. On the other hand the land itself, the vast terrain of the planet's surface, could be viewed as a public resource, like a National Park, or the Atlantic Ocean because it can be used in a non-rivalrous way³³. However the land on Mars is naturally inhospitable to humans and agriculture as we know it, so the land must be altered through the establishment of infrastructure like environmentally controlled bases or artificially irrigated greenhouses, before it can be useful in any practical sense. Because of the enormous technological commitment involved, land uses of this nature will be relatively restrictive (at least at first) and probably of small dimension compared to the entire surface of the globe. Such uses are therefore exclusive and rivalrous because there is limited room to live in a constructed base, limited soil under a greenhouse roof and no person can breathe the same artificially liberated oxygen (from the carbon dioxide atmosphere) or drink the same melted water. In that sense the land of Mars should also be viewed as a private good.

The incentive to make these productive uses of the land of Mars necessitates non-communal ownership because private property rights encourage the maximization of a resources potential because of the prospect of higher individual gains. The cost of

³¹ For a discussion of the historic origin of these rights see Richard Epstein, *Property and Necessity* 13 HARVARD J OF L AND PUBLIC POLICY 2 (1990).

³² ROBERT COOTER AND THOMAS ULEN, *LAW AND ECONOMICS* (4th Edition, Pearson, 2004) at 107

monitoring property is also negated through a regime where private entitlements are enforced by law.³⁴ Similarly, it has now been widely and effectively argued³⁵ that the recognition of property rights will be a strong incentive for space exploration because the expectation of future profit such as derived from property claims, legitimizes the enormous expense from a rational cost-benefit perspective. Missions to Mars are particularly needful of such clear incentivization because of the high cost and uncertain benefits. Recent estimates suggest that a manned mission to Mars would cost \$55 billion US.³⁶ The establishment of bases or other such infrastructure could cost infinitely more, and the value of such improved land is at best uncertain, especially as its expected utility may depend on some as yet unknowable future eventuality on Earth. In contrast, equal distribution of Martian land in line with the Common Heritage principle would lead yield no profit in the economic sense, and moreover inevitably result in the “tragedy of the commons”; the risk of self-interested over-exploitation or under-exploitation of shared resources if there is no enforcement mechanism that ensures each user pulls their own weight.³⁷ If each nation or person has equal claim to Mars as a matter of right and not as a function of contribution, then non-space faring nations and their taxpayers will avoid contributing in the efforts to reach and develop Mars. No country is likely to undertake the enormous risks, economic and otherwise, associated with Mars colonization without

³³ *Id.*

³⁴ CEN TO VELJANOVSKI, *ECONOMIC PRINCIPLES OF LAW* (Cambridge, London, 2007) at 61 and COOTER AND ULEN, *id* at 107.

³⁵ See eg Tan, Zullo, Gruner, *supra* note 25 and John Adolph, *Recent Boom in Private Space Development and the Necessity of an International Framework Embracing Private Property Rights to Encourage Investment* 40 *INTERNATIONAL LAWYER* 961 (2006)

³⁶ BERGEN, *supra* note 10 at 325. A Mars mission involving the construction of a large spacecraft in conjunction with a series of smaller landers was estimated to cost \$600 billion. Baard & Winters *supra* note 6 at 58.

the legal certainty that their rewards will not be distributed to others.³⁸ The private property right to exclude others from specific developed areas of the Mars, as well as to transfer those rights to others in a market, as well as obviously to use the land in a productive manner, are crucial incentives.

A key advantage of recognizing private ownership of real property on Mars is that non-state bodies could become committed in the productive use of land on the planet. Financing a Mars mission as a business venture could be an efficient way reach the planet and establish human habitation there.³⁹ Individuals or organizations could buy shares in the Mars mission to be compensated by land claims on the planet which would rise in value in proportion to the extent of colonization. Optimal investment would be undermined by the uncertain legal framework of the existing treaty regime – there would be fear of uncompensated expropriation under the auspices of the UN or some other international organization favoring absolute common ownership of all extra-planetary resources. Thus, as Hoffstadt has noted, a stable legal regime is required in order for investment in space exploration to be viable.⁴⁰ A clear and consistent legal regime will induce productive private capitalization of Mars missions in the future and would be advantageous in the development of Mars.⁴¹ While the negotiation of a legal framework fostering investment in extra planetary land has the potential itself to be costly, it is

³⁷ Garrett Hardin, *The Tragedy of the Commons* 162 SCIENCE 1243 (1968) and VELJANOVSKI *supra* note 34 at 66-68.

³⁸ Baca, *supra* note 22 at 1045.

³⁹ The corporate model of space exploration has been proposed by Christol, *The Moon and Mars Missions*, *supra* note 26 at 133.

⁴⁰ Hoffstadt *supra* note 4 at 580.

⁴¹ A stable legal regime involving the recognition of property rights and the enforcement of contracts is seen as a prerequisite to economically productive investment generally. DOUGLAS ARNER, *FINANCIAL STABILITY, ECONOMIC GROWTH AND THE ROLE OF LAW* (Cambridge University Press, Cambridge, UK, 2007) at 91.

expected that the relative costs will only increase over time as more nations and corporations become involved, suggesting that earlier settling of legal entitlements is favorable. Although at present it seems unlikely that interplanetary travel, let alone planetary colonization, could be achieved by a corporation or other private body because of insufficient resource consolidation, the growing relevance of private space exploration is evidenced by the numerous non-market initiatives to encourage a non-state role in space exploration, such as the Ansari X prize for suborbital spaceflight and Google's recent To the Moon prize to be awarded to the first individual to successfully place an object on the Moon.⁴² Recent successful advancements in private space flight, such as SpaceShipOne and the voyage of tourist Dennis Tito to the International Space Station may be indicative of future trends for involvement of private enterprise in this field.⁴³ Non-state space exploration has the economic advantage of capitalization from sources that would be unavailable to a publicly funded agency like NASA, such as selling the broadcast rights to video and audio images of the mission. The Mars Rover and Mars Explorer photographs were among the most popular images on the Internet for some time.⁴⁴ It is unlikely that private space exploration initiatives, such as ones involving the development of land on Mars, would occur without the prospect of economic recovery if not surplus profit.

Single state or private enterprise ownership of land on Mars is more efficient than an international regime of common ownership as envisioned by the Outer Space treaty because the transaction costs of international public action are much higher than those of

⁴² See generally the XPrize initiatives at <<http://www.xprize.org>> (September 2007)

⁴³ Adolph *supra* note 35

⁴⁴ This idea was suggested by BERGEN *supra* note 10 at 325

private entities, or even single state governments. Epstein termed this “negativism”: without unanimous agreement from all members of society on how to exploit a common resource, it may remain unused.⁴⁵ Indeed, space exploration is a notorious example of the difficulty in achieving collective international action.⁴⁶ Common ownership of Mars demands international regulatory unanimity that would be both prohibitively expensive and potentially impossible to implement. In contrast, private, or single sovereign ownership of a resource tends to result in the most efficient administration of that resource, for example when organizing colonization or a terraforming project on Mars, because bargaining among smaller groups tends to result in cooperation.⁴⁷ In this way the first expeditions to Mars will be undertaken by the party that can do so at least cost, and the costs should be lower for single states or private entities because less resources will be expended on decision-making than in an international initiative, even one coordinated by a centralized body such as the United Nations.

A Mars expedition will be undertaken when the expected benefit exceeds the cost, however the fact that NASA and other agencies have already expended resources in Mars exploration without economic gain illustrates that most, if not all, of the benefits derived from space exploration so far are non-market, such as the advancement of scientific knowledge and the satisfaction of curiosity. Similarly, a significant component of the cost of manned space exploration is the risk of human safety, which also cannot be readily

⁴⁵ Richard Epstein, *Possession as the Root of Title*, 13 GEORGIA L R 1221 (1978-79) at 1237

⁴⁶ Consider for example the difficulties involved in the Hubble Space Telescope and the International Space Station. Other practical problems, such as having an international crew may raise costs because of additional stresses cultural and language differences would place on a small Mars mission team, who would spend several years together.

⁴⁷ See eg, COOTER AND ULEN, *supra* note 32 at 141 and Harold Demsetz, *Toward a Theory of Property Rights II: The Competitiveness Between Private and Collective Ownership* 31 J OF LEGAL STUDIES S653-S672 (2002)

quantified for the purposes of cost-benefit assessment. While the expense of a manned Mars mission would be much higher than the robotic missions to date, one might expect that such costs and human risks will decline over time because of corresponding increases in technology. The expected gains from a Mars expedition should also increase over time because technology should augment the extent and quality of knowledge that can be gained from such missions as well as the degree to which the planet can be developed profitably, for example with improved technology of transforming deuterium ice into an ready energy supply. Thus the initial missions emerge as the least efficient from a cost-benefit perspective. Yet property law suggests that the initial missions are the most important for the purpose of establishing a claim, although this may depend upon what activities count as possessory ones.

V LAND CLAIMS ON MARS VIA FIRST POSSESSION

As intimated in the introduction to this article, there may be economic, and indeed moral, justification to assert that real property claims to terrain on Mars should already exist in favor of those nations that have sent probes that have landed on the surface. Such an argument is in keeping with a classic interpretation from Locke, who claimed that possession is determined by the act of mixing one's labor with the property.⁴⁸ Unfortunately this doctrine does not lend itself readily to celestial bodies because much of the early yet important "labors" of astronomy involved mere observation which pre-date recorded history. It is further unreasonable to assert that, for example, Galileo could have claimed ownership of Jupiter's three largest moons because he built a telescope to

⁴⁸ JOHN LOCKE, THE TWO TREATISES ON CIVIL GOVERNMENT BOOK II §27 (3rd ed. 1966)

observe them although the effort and ingenuity involved in so doing could be described as labor. Similarly, imaginative private citizen Dennis Hope claimed ownership of Mars in a declaration delivered to the United Nations in 1980.⁴⁹ However the issuance of a written statement alone is a legally insufficient act to connote possession under the Common Law and his assertion is accordingly meaningless. Locke's conception of possession likely had in mind some kind of physical interaction, such as building or repairing equipment or cultivating land. This is largely reflected in the Anglo-American tradition of property law and its characterization of the concepts of use and possession. In a very real sense, then, the five American probes which physically landed on Mars to take photographs and make charts mixed human labor with the planet such that America should own Mars. This cannot be the correct conclusion, however, because it seems more justifiable, practically as well as morally, to require a putative owner herself to have a physical presence on the planet's surface, at least at some point.

One of the complaints of the international community against sovereign claims on Antarctica was that there was no effective occupation by human settlers.⁵⁰ This is because international law requires that "acts of discovery" must be perfected by a form administrative control, which is difficult in vast areas with harsh conditions, such as Antarctica or Mars.⁵¹ If human occupation is to become a requirement for recognition of property rights under international law, one might be tempted to conclude that Mars belonged to Russia while the Russian space crew is there, only to become a *res nullius*

⁴⁹ Hope has authorized an Internet-based agency to sell plots of Mars at a cost of £14.25 per acre. www.moonestates.com/cat_Mars.asp [September 2007].

⁵⁰ Jennifer Frakes, *The Common Heritage of Mankind Principle and the Deep Seabed, Outer Space and Antarctica: Will Developed and Developing Nations Reach a Compromise* 21 WISCONSIN INTERNATIONAL L J 409 (2003) at 429.

once they departed. Indeed, under the Common Law, acts of possession such as presence can establish or maintain *de facto* ownership of land. The extent of the acts depends on the nature of the land itself and how it can be used.⁵² In this way, perhaps the numerous probes sent by Earth-based claimants could perpetuate ownership of barren Martian terrain if it had once been visited by humans. It is important to recognize that Locke's idea of "mixing labor" hinged on the addition of value to that property. Therefore if a robotic spacecraft can map the land, analyze the soil or deposit useful goods on the planet's surface that would benefit subsequent visitors, then the value of the land has increased. The many small landers that were sent to Mars in recent years were intended to facilitate future manned missions, in part by mapping the land features.⁵³ Rendering a planet more capable to sustain human visitors is an increase in its value. However such claims are tenuous because of the limited physical terrain, in terms of a percentage of the planet's entire surface, photographed and explored by the landing probes and also by the fact that their data transmissions are not permanent; the first Viking probes which landed on Mars in the 1970s are no longer operational, which could constitute a kind of common law abandonment that would negate a once existing property entitlement.

As a more readily comprehensible as well as morally defensible system of property claims in space, Baca has argued that the 19th Century principle of first possession as in first physical presence by humans should govern the initial claims for

⁵¹ DONALD P ROTHWELL, *THE POLAR REGIONS AND THE DEVELOPMENT OF INTERNATIONAL LAW* (Cambridge: 1996) at 59 and 6-7

⁵² For example, the mere shooting of rifle bullets over land during the winter months was sufficient to constitute *de facto* possession of the land: *Harper v. Charlesworth*, 1825, 4 B & C 574 at 584.

⁵³ BERGEN, *supra* note 10 at 64-65 and 206.

space-based resources.⁵⁴ This theory was recently re-iterated by Gruner in relation to the Moon and the planets of the Solar System.⁵⁵ Rooted in natural law, “first possession” is compatible with the Locke’s principle of adding value to an object by investing labor in it, and is the historic equivalent of a legal rule, as seen in the early settlement of the American frontier.⁵⁶ First possession of unclaimed land as in 18th century America can be readily analogized to a planet as both consist of undeveloped, uninhabited physical space.⁵⁷ Other than the scientific information we have gained from probes, Mars currently offers nothing other than esthetic value to humanity as a curiosity in the night sky. Yet its enormous potential value as a future human settlement possibly to save humanity, can only be actualized as it becomes physically attainable through space travel – and habitable through colonization. As Mars will be rendered valuable by adding the characteristics of accessibility and habitability to it, then the party who reaches and develops it first should be able to claim ownership of it. In addition to compensating the first productive uses, first possession rewards the daring of the claimant possessor. In literal terms, then, an equal distribution of property rights on Mars among all nations undermines the vast resources expended in the achievement of technological supremacy of states like the United States, Russia, and the European Union.⁵⁸

While relatively straightforward and based upon historic precedent, the doctrine of first possession may not be the most efficient way to direct resources towards the exploration and development of Mars because the first nation to land on Mars is not

⁵⁴ Baca, *supra* note 22 at 1054-1056

⁵⁵ Gruner *supra* note 25 at 349. Gruner advocates granting private property rights through first possession with settlers will act on “behalf of the interests of humanity” at 354

⁵⁶ Epstein, *Possession as the Root of Title*, *supra* note 45 at 1232 and 1241. This doctrine is seen also in modern trademark law which grants protection to words based on their first usage. 15 USC § 1114(1).

necessarily the one that will use the planet's land in the most productive way. The failure of homestead farms in American history showed that the rush to possess empty land pulled these resources out of the hands of other more productive uses that came later.⁵⁹ Under the doctrine of first possession, resources could be drawn from more productive uses at a rate faster than optimal.⁶⁰ For example, resources spent on getting to Mars quickly may have been more efficiently directed to technology that could develop Mars more fully at some later point, or on technology that could combat the effects of global warming (possibly rendering humanity's future escape to Mars unnecessary). Of course, a Mars mission could lead to indirect gains - technological innovations with applications in other industries. It is reasonable to expect that such innovations, for example food synthesis or alternative energy sources, could lead to the improvement of the standards of living for people on Earth, which is an explicit aim of the Moon Treaty⁶¹, as well as of the United Nations itself⁶². Moreover there are important non-market gains to be achieved from winning a space race to Mars, such as a morale boost to claimant nation. Still, one NASA analyst cautions that without a credible and immediate scientific purpose, such a "cheap-and-dirty" approach to a Mars mission would amount to little more than a technological demonstration.⁶³ That the principle of first possession can lead to over-investment in the activities that the law requires as a means of obtaining legal title

⁵⁷ Ignoring for the purposes of comparison the aboriginal presence in the American west.

⁵⁸ Frakes, *supra* note 50 at 425.

⁵⁹ Robert P. Merges and Glenn H. Reynolds, *Space Resources, Common Property and the Collective Action Problem* 6 NEW YORK UNIVERSITY ENVIRONMENTAL L J 107 (1997/98) at 117.

⁶⁰ *Id.* at 117.

⁶¹ Art IV

⁶² Preamble to the UN Charter: "To promote social progress and better standards of life in larger freedom"

⁶³ Jim Garvin cited in BERGEN, *supra* note 10 at 321.

demands investigation into other more efficient ways of allocating real property rights on Mars.

VI ALLOCATING PROPERTY RIGHTS ON MARS BEFORE ARRIVAL

In order to stimulate productive use of the land on Mars while avoiding an inefficient race to first possession, initial property rights allocation could be achieved via competitive bidding in advance of actually landing on Mars. In this way the party that values Mars the most, and therein would accordingly be expected to make the most valuable use of it, will be granted title to the planet. This method has been rejected as inefficient because of the immense bureaucracy that would be needed to conduct auctions.⁶⁴ There are also logistical problems regarding the way in which the auction would be conducted.⁶⁵ The more pressing problem with this system is that the winning bidder would be forced to expend vast resources in compensating the losers rather than in a Mars expedition itself, clearly an inefficient cost from the perspective of space resource improvement, much as a race for first possession would be. Even if the auction were to involve the purchase of parcels of Martian land, rather than rights to the entire planet (as suggested below), such that there could be multiple “winners”, valuable resources would still be wasted in the purchase of the land, i.e. the allocation of pre-existing rights based on a principle of common ownership, that could have been channeled more efficiently into reaching or developing the planet.

⁶⁴ Merges and Reynolds *supra* note 59 at 118

⁶⁵ The winning bidder could “pay off” all other losing bidders for their share of the planet. The funds from the highest bid could be distributed evenly among all other bidders, or perhaps only to those nations that could actually have made good on their bid to reach Mars. The bid funds could be divided to every nation equally or they could be distributed per capita.

The more realistic Mars exploration and settlement becomes the more costly such entitlement payments would become. As future technology and the need to resort to Mars for resources or habitation increase, such payments could become economically prohibitive: it would cost more to purchase advance Martian property rights than the eventual profits derived from the use of that land.⁶⁶ However, if compensation payments are static, meaning that they are locked in to a current (probably low) value that reflects the current high level of risk associated with a Mars mission, then the parties could bargain as envisioned by the Coase Theorem.⁶⁷ According to the theory, goods will end up in the hands of the party, or parties in the case of a vast resource like a planet, who values a good the most. The theory explains that initial legal entitlements are irrelevant; the efficient allocation of resources will be achieved through bargaining, provided that transaction costs are zero⁶⁸. With this in mind, putative Mars explorers could pay a “Mars Tax” or use tax which could be distributed to all the nations of the world in recognition of the pre-existing entitlements of “Common Heritage of Mankind” and more specifically, Article XI.7b of the Moon Treaty which calls for an “equitable sharing of the benefits” derived from the resources of the planets. Such an arrangement might also fit well with the requirement of an “international regime ... to govern the exploitation of the natural resources” of the planets, as mandated by Article 11.5 of the Moon Treaty. Provided that the compensation fee was sufficiently low so as not to discourage exploration, then efficient development of Mars would be undertaken regardless. A non-economically

⁶⁶ This is provided, of course, that such anticipated Mars missions are for economic purposes and not survival ones, such as escaping Earth because of our own planet’s inability to sustain life in which case there are strong moral, non-economic reasons

prohibitive level of “Mars Tax” is likely given the future discount⁶⁹ that many nations would likely place on the uncertain prospect of Mars exploration in exchange for giving up their claims. A use tax on Mars would be much less prohibitive than one say on the Moon, the exploitation of which is more readily achievable with current technology. Most nations would be willing to concede future property claims of dubious (although potential large) value to exploring parties in exchange for guaranteed though marginal payment today⁷⁰. Such tax could be looked upon as an ordinary transaction cost – such as highway taxes or landing fees at airports that are a necessary cost associated with market participation. Compensation payments of this nature might take another form – that of the government “taking” of property as seen in the Eminent Domain clause of the US Constitution⁷¹. An international Earth government, such as some future version of the United Nations, could seize land on Mars for public use, for example in the event of an emergency on Earth, compensating the original owner in the process. Provided that full market value is paid, as required for example under the Constitutional provision, then such a transaction amounts to efficient bargaining. Seizures for something less than the full market value should be prohibited both from a standpoint of fairness as well as efficiency.

As an alternative to a use tax on Mars, in order to uphold the spirit of the Outer Space Treaty and the Moon Treaty, a portion of the Martian terrain could be set aside as common territory for the people of the Earth as envisioned in Article 7.3 of the Moon

⁶⁷ Ronald Coase, *The Problem of Social Cost* 3 J OF L AND ECONOMICS 1 (1960). The Coase theorem’s neglect of transaction costs is particularly problematic in the realm of space exploration where there is international activity as well as high uncertainty, Merges and Reynolds, *supra* note 31 at 116

⁶⁸ Which of course they never are in reality, the key flaw in the Coase Theorem.

⁶⁹ This is known as Discounted Cash Flow Analysis, see eg VELJANOVSKI *supra* note 34 at 29

Treaty which references “scientific preserves.” This land could be the interplanetary equivalent of land set aside for public use, such as parks, during the construction of housing subdivisions. Perhaps 25% of the Martian equatorial zone, where conditions for human habitation are most favorable, could be reserved for public uses in the future.

VII BOUNDED FIRST POSSESSION BY LANDFALL

As an alternative to fixing future claims on Mars based upon a re-allocation of pre-existing ones, the most efficient mechanism of real property allocation of an un-owned *res nullius* planet Mars would be a limited form first possession: the allotment of only a portion of land to the first arriving organization, not the entire surface of the planet. The size of the allocation would be set at the optimal level to encourage exploration and development while conserving land for future explorers. The first landers could claim all terrain, for example, within a hundred kilometer radius of their landing point subject to an increase if productive use is made of an even larger portion. The rest of the planet would remain un-owned and available to become possessed by subsequent explorers. This bounded first possession is in keeping with the language of the Outer Space Treaty and Moon Treaties which prohibits only sovereign claims to the celestial body, which could be taken to mean the planetary sphere itself. Such a credible interpretation reads in the word “entire” to the following provision for the purpose of clarity: “neither the *entire* surface or *entire* subsurface of the Moon [or Mars] shall become the property of any State.”⁷² Partial allocation as described is just because landing on one minuscule portion

⁷⁰ The famed Manhattan purchase for \$24 comes to mind as an historic precedent

⁷¹ Fifth Amendment.

⁷² Art XI.3

of a world should not entitle a claimant to ownership of all of it, much of which may be left completely idle by the original explorer, resulting in an inefficient use of the planet's resources. The problem of inefficient races to achieve the legal right to first possession will be avoided by this regime, as second and third place finishers will be rewarded with other plots of land on the surface. Consequently pre-mature and therefore non-productive missions will be avoided because there is no risk of exclusion for failing to land first; the marginal benefit of arriving second will be as high as the marginal benefit of arriving first. Of course, the pride engendered by first arrival, such as that generated by the first Moon landing, would help to encourage earlier Mars expeditions rather than later ones. Incentive to settle Mars before others may similarly result from the fact that some regions of the planet could be more valuable than others. For example, the equatorial zone would probably hold greater value because of their warmer climates just as the flat, northern hemisphere would may be more conducive for agriculture than the rugged southern hemisphere.⁷³ Part of the concern of developing nations in espousing the Common Heritage principle for planetary bodies was that by the time nations with weaker initial resource endowments (the developing world) are capable of exploiting the land on Mars, the planet's resources will already be depleted.⁷⁴ Plot ownership would address this concern as vast regions of Mars would likely remain un-owned for centuries, giving developing nations a chance to "catch up".

Private easements and restrictive covenants arrived at by bargaining among the landed owners (rather than through international political consensus) and enforced through private litigation would control competing land uses such as over exploitation or

⁷³ BERGEN, *supra* note 10 at 305

pollution in order to produce an efficient allocation of resources. At least in the early stages of colonization there would be no need to incur the cost of a special “Mars Court” to adjudicate such disputes, instead landowners could litigate in the courts of their choice on Earth, subject of course to that court’s own rules on taking jurisdiction. Thus for example an American corporation owning land on Mars could bring suit in nuisance against another American land owner in the Federal court of the United States⁷⁵. Disputes between sovereign land owners on Mars could similarly be brought in the International Court of Justice⁷⁶. Again, it is expected that such private land use adjudication among fewer parties should be less costly than public control of commonly held land through regulation.⁷⁷ Moreover, bargaining among a limited number of initial owners should arrive upon the most efficient manner of land use without the need to resort to lawsuits. Excessive land use regulation resulting from the need to satisfy all decision-makers could diminish the overall productivity of the land, especially if such regulations were imposed *ex post* and thus wasted resources already spent on existing activities. It is further expected that land owners on Mars would adopt the self-imposed obligation to engage in reasonable and productive use of that land in order to maximize the value of their own holdings. Such “injunctions against waste”⁷⁸ would become more significant in later stages of settlement when vacant land on Mars has become scarcer. Accordingly, if a plot is not being used efficiently, for example by an owner that held expertise in space travel but not in colonization, then title in the land could be transferred

⁷⁴ Frakes, *supra* note 50 at 433

⁷⁵ Possibly as an extension of the subject matter jurisdiction over admiralty and maritime issues under Article III of the Constitution.

⁷⁶ As a general court of law regarding disputes between sovereign nations as constituted under Chapter XIV of the UN Charter.

on the authority of a court, perhaps through the Common Law doctrine of adverse possession⁷⁹, to another party that had these skills and intentions.

Should a terraforming project be undertaken – transforming the whole of Mars into an environment that could sustain life - landowners would have an incentive to “free ride” by not contributing resources to such an inherently communal project, allowing them to benefit from the labors of others without cost. Perhaps a mandatory fee could be imposed upon all residents by a court in order to address this problem – although it is unclear what legal precedent could be invoked to do so, at least in advance of the establishment of zoning or centralized governance on the planet.⁸⁰ Market forces should provide, however, that a party not adding value to its land through development would have an incentive to sell or lease it to a party that would make a more productive use of it. Thus the first explorers might wish simply to sell their claims, as suggested above. To facilitate such bargaining among landowners, the establishment of a land registry system which would also set standardized plot dimensions and record transactions would be necessary, representing one of the few costs associated with private ownership of land on Mars.⁸¹

The recognition of bounded land claims on a planet appears already to be envisioned by the text of the Moon Treaty which, as noted above, permits individual states to retain jurisdiction and control over their personal property brought to the moon,

⁷⁷ COOTER AND ULEN *supra* note 32 at 141 and VELJANOVSKI *supra* note 34 at 70.

⁷⁸ Epstein, *Possession As the Root of Title*, *supra* note 45 at 1230.

⁷⁹ Eg *Fletcher v Fuller* 120 US 534 (1887) and *Peabody v United States* 231 US 530 (1913)

⁸⁰ Baca notes how a similar system mandating a “reasonable use” is implemented by the International Telecommunications Union for geostationary orbits: Baca, *supra* note 22 at 1079.

⁸¹ Merges and Reynolds, *supra* note 59 at 119.

such as bases and equipment.⁸² However, as noted above, the rights in such chattels are not full property rights such as those exercised by terrestrial landowners as there is no exclusivity – treaty requires parties to allow others to use these equipment and facilities when requested.⁸³ On one hand such compulsory property sharing is economically efficient because it would encourage further development by minimizing one of the costliest aspects of settlement. A subsequent arrival could benefit from existing infrastructure devoting resources to the more productive development of the region without redundant expenditure that would impede overall progress. However, the common property regime envisioned by the space treaties ignores the reality that without adequate compensation for such sharing there might be an incentive to free-ride by waiting for another explorer to incur the initial costs of establishing a Mars base with oxygen / fuel production facilities. It would therefore be more cost effective to be the second or third Mars colonizer, potentially inducing a strategic waiting game. To resolve this problem it should be permissible to charge a fee for the use of one's facilities because such fees represents the fundamental economic gain of granting property rights in land on Mars – developed land, such land with a base upon it that could sustain human life, becomes valuable to subsequent visitors and this can generate revenue that will offset the initial costs. Bargaining would naturally set the use fee at an optimal level that encouraged subsequent parties to land and make use of existing facilities but yet would not be too low to deter the initial landing and construction. Thus the direction to share resources in the Moon Treaty might be unnecessary – sharing might increase wealth for all parties, much as land values increase in proportion to the rise in population of an area.

⁸² Art XII

Given that large scale inhabitation of Mars might only result from a catastrophe on Earth there may be some need to incorporate the common law defense of necessity for emergency trespass, although this defense would not preclude the payment of reasonable compensation for use or damage to existing infrastructure.⁸⁴

VII CONCLUSION

The much-maligned Common Heritage of Mankind doctrine is little more than “a lofty academic concept that looks good on paper, but fails in practice”⁸⁵ that has done a disservice to space exploration. When the immanent manned missions are ultimately undertaken we can expect that they will not be as productive as they might have been because the prohibitive uncertainty of expected tangible gain is exacerbated by a legal regime that disregards private ownership of extra terrestrial land that may be enhanced, at great cost, to support human life. The potential of the planet Mars as a future site of human settlement is predicated on an investment in infrastructure on the planet’s surface to render it habitable for long-term human habitation. In order to facilitate such productive activities and to create incentives for manned missions to Mars, international law must allocate private and sovereign ownership of real property on the planet in a manner that will allow the recovery of costs through user fees imposed upon subsequent visitors. This article has suggested a system of bounded first possession by landfall of limited plots of land on Mars, the use of which will be controlled by relatively low cost private bargaining and litigation. Although multiple ownership may negate the

⁸³ Art XIV.

⁸⁴ *Vincent v Lake Erie Transport* 124 N.W. 221 (1910) (Sup Ct of Minn).

⁸⁵ Frakes, *supra* note 27 at 420.

competition of a winner takes all approach, this system will foster efficient investment in space travel and colonization because it will offer the potential of reward for effort to as many explorers who wish to undertake the risk. A stable legal regime such as this must be put in place now as the first manned missions are being planned so we can achieve the timely and beneficial development of Mars in anticipation of a time when it will host our future generations.