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The Doctrine of Appropriation and Asteroid Mining: Incentivizing the Private Exploration and Development of Outer Space

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INTRODUCTION

A wise man once said that space exploration is a force of nature unto itself.[1] History would probably agree. Since the beginning of our species' history, people have looked up with wonder at the moon and the stars. Some early cultures even believed the stars to be gods or thought they foretold the future. Ancient Babylonian catalogs of constellations drew lines between stars to form pictures and stories, and early sailors navigated using starlight. Eventually, a Polish astronomer named Copernicus came up with a solar system model where the Earth revolved around the Sun, and the idea of space travel soon followed.

For centuries, the idea of space travel littered the pages of science fiction, intrigued the scientific community, and captivated the human imagination. In 1957, space exploration became a reality when Yuri Gagarin became the first person to be sent into orbit. Space exploration became an issue of political superiority, and both the Soviet and the United States governments devoted money and resources to the development of national space programs. In 1969, the world watched as an American astronaut took a few small steps that proved mankind was capable of space travel, and it seemed like humankind was headed toward the stars.

Today, the technology for space travel is almost ready, yet the progress of space exploration has been slowed to a crawl. National funding for space programs has dwindled, and under current international treaties, the development and exploration of space is shackled to outdated international legislation that limits the profitability of such endeavors. In modern times, national space programs cannot afford to fund missions, and private corporations—rather than government entities—are poised to take space exploration to its next stage. Even now, companies are preparing to venture out into

1 *Neil deGrasse Tyson Quotes*, BRAINYQUOTE 1, http://www.brainyquote.com/quotes/authors/n/neil_degrasse_tyson.html (last visited Mar. 19, 2015).

the unknown to discover and develop space resources that have never been tapped. However, unless international legislation is reformed, these companies' preparation is essentially an exercise in futility. Under current international treaties, neither government nor private entities can own anything in space except what they send up in the first place.

New international legislation that allows for commercial claims over celestial bodies like asteroids is necessary to incentivize and regulate space exploration. Society has a strong interest in the exploration and development of space, especially in modern times when space and minerals are in short supply. In order to advance the development of space, the international community must change. Other scholars have recognized this need, and have written about possible methods for adjudicating outer space claims. However, the adoption of those proposals would come at the cost of creating a system that would lead to waste and the recognition of abstract claims. This Comment will explain how the doctrine of appropriation, a modified version of the rule of capture, is a reasonable doctrine to incentivize the development of space and benefit society in a way that would reduce waste and prevent the monopolization of space resources.

I
THE DOCTRINE OF APPROPRIATION AND ITS ROOTS IN THE AMERICAN WEST

The doctrine of appropriation developed in the context of water and mineral rights during the rapid American expansion into what is now the western United States. Courts used the doctrine to grant landowners the right to use the water from natural streams on their newly settled property. Rights were granted in order of seniority. Thus, when a dispute arose over the rights to a natural stream, courts gave senior priority to the first person to have diverted water from the stream and apply it to some beneficial use.[2] Beneficial use was defined broadly as "water depleted and usefully employed by the activities of man."[3] A senior appropriator could use as much of the water as he or she could put to beneficial use and could continue enlarging that share until another person (called a "junior appropriator") began appropriating

2 Montana v. Wyoming, 131 S. Ct. 1765, 1772 (2011).

3 *Id.*

water from the same source.[4] Junior appropriators also received rights in the source of water, and, under the "no-injury rule," could even prevent the senior appropriator from enlarging the senior's share to the junior's detriment.[5]

American courts used the doctrine of appropriation to manage the varied interests of different parties in the resources of the American West. Courts aimed for an equitable balance, whereby the first party to successfully make use of land was rewarded, but the party was not granted a monopoly on that land's limited resources. As the Supreme Court of the United States stated in 1874, water claims should be "exercised with reference to the general condition of the country and the necessities of the people, and not so as to deprive a whole neighborhood or community of its use and vest an absolute monopoly in a single individual."[6] In a time when the United States was concerned with westward expansion, this equitable legal philosophy promoted discovery and development of the American West, without rewarding waste or abstract claims in which resources were claimed before they could be put to use.

A. The Doctrine of Appropriation Developed as a Modification of the Rule of Capture, Which Has Its Roots in English Common Law

The doctrine of appropriation was derived from the English common law rule of capture, which provided that the first person to establish the requisite control over a resource should be granted ownership.[7] This doctrine was applied to resources that the courts believed to be wild and migratory in nature, and it relied on the philosopher John Locke's theory that a person acquires rights in a thing when he mixes his labor with a thing.[8]

The Latin maxim, *Cuius est solum, eius est usque ad coelum et ad inferos*, means "whoever owns the soil, it is theirs all the way up to the heavens, and down to hell."[9] Early American courts were influenced by this idea, and it provided the roots of early American property law.

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4 *Id.*

5 *See id.* at 1777–78.

6 *Basey v. Gallagher*, 87 U.S. 670, 683 (1874).

7 *See Pierson v. Post*, 3 Cai. 175, 179 (N.Y. Sup. Ct. 1805).

8 *See* Jeffrey M. Gaba, *John Locke and the Meaning of the Takings Clause*, 72 MO. L. REV. 525, 536 (2007).

9 Samantha J. Hepburn, *Ownership Models for Geological Sequestration: A Comparison of the Emergent Regulatory Models in Australia and the United States*, 44 ENVTL. L. REP. NEWS & ANALYSIS 10310, 10313 (2014).

Under early American and English jurisprudence, the owner of the land was also the owner of resources connected to the land both above and below the soil. Despite this, courts were often reluctant to grant an individual absolute ownership of wild and migratory resources that move free and unconnected to the land.[10] The rule of capture and the doctrine of appropriation were doctrines that sought to equitably mediate claims over such fugacious resources, while promoting society's interest in putting such resources to use.

Once of the earliest references to the rule of capture is found in the iconic case, *Pierson v. Post*.[11] In *Pierson*, the plaintiff-hunter pursued a fox with his hounds across unowned land into a meadow where the defendant was also hunting.[12] The chase brought the plaintiff-hunter and the fox near the defendant, whereupon the defendant shot and killed the animal and acquired its carcass before the plaintiff hunter could do so.[13] Upon appeal, the Supreme Court of Judicature of New York considered whether the plaintiff-hunter, by means of pursuit of the animal with hounds, established a right to ownership over the animal.[14] The court concluded that he did not and found for the defendant-hunter.[15] The court reasoned that the defendant-hunter had actual possession of the fox, and stated that the plaintiff-hunter would only have acquired rights in the animal if he had mortally wounded or entrapped the animal, so as to deprive the beast of its natural liberty.[16] The court's articulation of the rule of capture in this case represents the rule in its traditional form.

Since *Pierson*, the doctrine has been modified and applied in many different areas of the American legal system. For example, during the same period of American westward expansion, the rule was also used to grant property rights in gas and minerals. In *Westmoreland & Cambria Nat. Gas Co. v. De Witt*,[17] for instance, the court stated that a landowner whose land was positioned over a gas reserve and who had

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10 *See, e.g.*, R.R. Comm'n of Texas v. Rowan & Nichols Oil Co., 310 U.S. 573, 579 (1940).

11 *See Pierson v. Post*, 3 Cai. 175 (N.Y. Sup. Ct. 1805).

12 *Pierson*, 3 Cai. 175, at 176.

13 *Id.* at 177.

14 *Id.*

15 *Id*.

16 *Id.* at 178.

17 *Westmoreland & Cambria Nat. Gas Co. v. De Witt*, 18 A. 724 (Pa. 1889).

established control of the gas had gained property rights to the gas.[18] Although the statement was made in dicta, for nearly twenty years following the decision, other courts applied the rule of capture evenhandedly to grant rights in minerals and gas to landowners who were able to establish control over the resource.[19] To establish control over the natural gas under this traditional version of the rule of capture, an owner simply needed to bring the gas out of the reserve and above ground.[20]

The rule of capture served to motivate expansion and development by rewarding individuals who made the effort to secure and control resources, and some American jurisdictions continue to apply the rule. In Texas, for example, a modified rule of capture is applied to adjudicate oil claims. Under Texas's version of the rule, an owner of land that contains oil beneath the surface has a right to the oil, but his ownership is subject to his neighbor's power to drain the oil away.[21] This "offset drilling" rule of capture serves to equitably distribute subsurface rights in oil, so as to maximize its use and prevent potential waste that would result from the granting of a monopoly to a single individual situated over a rich oil deposit.

In the context of natural gas, the Texas Supreme Court has stated that the rule of capture prohibits claims for subterranean trespass where a landowner tries to bring suit against a neighbor who drains gas from underneath his property.[22] In *Coastal Oil and Gas*, a company tried to bring suit against another company for subterranean trespass when the second company drilled into a gas deposit from a neighboring tract of land to avoid a royalty fee.[23] The court did not even reach the merits of the case. It decided that the rule of capture prevented a claim, because the plaintiff company had no claim of ownership over the gas until they brought it to the surface to capture it.[24]

This case illustrates the need for a flexible doctrine that prevents a landowner from having absolute dominion over resources. Had the case been decided under the traditional rule of appropriation, the landowner who lived upon the gas deposit could prevent the use of the resource,

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18 *Id.* at 725.

19 Bruce M. Kramer & Owen L. Anderson, *The Rule of Capture–An Oil and Gas Perspective*, 35 ENVTL. L. 899, 906 (2005).

20 Hague v. Wheeler, 27 A. 714, 720 (Pa. 1893).

21 *R.R. Comm'n of Texas v. Rowan & Nichols Oil Co.*, 310 U.S. 573, 579 (1940).

22 *Coastal Oil & Gas Corp. v. Garza Energy Trust*, 268 S.W.3d 1, 12 n.24 (Tex. 2008).

23 *Id.* at 8.

24 *Id.* at 12–13.

despite the fact that the landowner had no control over or personal use for the resource. The modification to the traditional rule of appropriation created a more flexible doctrine that prevents the owner of the land above the gas deposit from having absolute dominion over the resource, which allows the untapped resource to be developed by other interested parties who are actually prepared to do so.

Despite its continued use in some jurisdictions, there are problems with the application of the rule of capture in its traditional form. Without modification, the rule of capture does nothing to prevent waste and the creation of abstract claims, which is why, over time, the rule of capture was modified by courts and legislatures as it was applied in new areas of the law. Waste occurs when someone is allowed to own a resource that he or she cannot or will not develop, and abstract claims occur when someone is allowed to reserve the right to resources that he or she has not or cannot use. Both lead to the sequestration of resources beneficial for society in a way that hinders development. An examination of the rule's application in the context of natural gas illustrates this point.

Under the traditional application of the rule of capture, natural gas reserves would be the property of the landowner who captured the resource, regardless of the use to which he or she put it, even if such use would constitute waste. Such was the issue in *Hague*, a case involving three competing entities that owned land above a single gas deposit.[25] Two of the three parties had an active market for the gas, but all three parties had wells that accessed the gas supply.[26] One party had no market for the gas, and did not have a cap on the well to prevent the gas from escaping the ground. The two parties with a market for the gas sued for an injunction to stop the third party from allowing the precious resource to escape.[27] The court declined to enforce an injunction and stated that the third party, by bringing the gas to the surface, had established control of the resource, and therefore ownership under the rule of capture, even if his "use" of the gas was foolish, or even malicious.[28] As such, the plaintiff companies had no

25 *See generally Hague*, 27 A. at 714–15.

26 *Id.*

27 *Id.*

28 *Id*. at 720.

standing because they did not own the gas that was being released by the defendant's wells.[29]

Under the rule illustrated in *Hague*, a landowner had the rights to the resources contained under his or her property, even if he or she was simply wasting the resource. The court also implicitly recognized that the landowner had a possessory interest in the resource based on the abstract claim that it might be of some use to him or her in the future. By recognizing an owner's right to waste a resource or to lay an abstract claim based on some supposed use for a resource in the future, the courts created a chilling effect on the development of useful resources in a way that led to waste.

To combat such wasteful results, some courts and legislatures began to address the concerns posed by the application of the traditional rule of capture by modifying the rule to prevent waste and the creation of abstract claims. The doctrine of appropriation was one of several modified rules derived from the rule of capture to address the concerns that appeared in the context of water, gas, and mineral claims.

B. The Doctrine of Appropriation Was a Modification of the Rule of Capture that Sought to Equitably Distribute Ownership Rights in Water that Traveled Unconnected to Land, While Preventing Waste and Abstract Claims

The doctrine of appropriation is a modified version of the traditional rule that attempts to prevent waste and abstract claims by attaching a beneficial use requirement to the traditional rule. While the doctrine of appropriation has, for the most part, seen its application in the context of water rights, the doctrine deals with many of the same concerns posed by the application of the rule of capture on mineral and oil claims. If the doctrine of appropriation were applied in *Hague*, the landowners with realistic markets for the natural gas would have had a cause of action against the wasteful third party, because they would have acquired rights in the gas reserve as soon as they began to put the gas to beneficial use.

Like the rule of capture, the doctrine of appropriation grants rights in a person or entity that establishes control over a resource. Only the doctrine of appropriation limits the claim to what that person or entity can beneficially put to use.[30] Further, the doctrine of appropriation

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29 *Id.*

30 Montana v. Wyoming, 131 S. Ct. 1765, 1772 (2011).

limits a senior appropriator's rights when a junior appropriator begins to use the same source.[31] Both the senior and junior appropriator gain rights over the resource, and the no-injury rule prevents either from enlarging their respective shares at the other's expense.[32] The doctrine is especially important in the context of water because of its limited availability and commercial importance in many different locations and industries.

C. Asteroids Are Similar to Water in Their Connection to Real Property and Their Value to Society in an Untapped Form

Asteroids are "metallic, rocky bodies without atmospheres that orbit the sun and are too small to be classified as planets."[33] Like water, asteroids are limited resources that are unconnected to any form of real property. Asteroids vary greatly in size, and are believed to consist primarily of metals and water, sometimes in staggering quantities.[34] As such, asteroids may contain significant resources that would help serve to incentivize and facilitate the exploration of space.

Asteroids can be divided into classes, the three most commercially relevant being C-type, M-type, and S-type.[35] C-type asteroids (carbonaceous) are the most common variety, and approximately half of the near Earth asteroids that are at least 1km large are C-type asteroids.[36] These asteroids have a high content of water, hydrogen, and methane, all of which could potentially be mined to create rocket fuel on-site.[37] Rocket fuel storage provides a limit on how far space vessels can be sent into deep space, so the creation of rocket fuel on asteroids would allow missions to probe deeper into space without having to bring enough fuel for a return trip. This could reduce the cost and difficulty of such endeavors significantly, allowing for more efficient exploration and development of deep space.

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31 *Id.*

32 *Id.*

33 *Asteroids (From the NEAR Press Kit)*, NAT'L AERONAUTICS & SPACE ADMIN., http://nssdc.gsfc.nasa.gov/planetary/text/asteroids.txt (last visited Mar. 20, 2015).

34 *Id.*

35 *Id.*

36 *Id.*; *see also* SHANE D. ROSS, NEAR EARTH ASTEROID MINING 8 (2001), *available at* www2.esm.vt.edu/~sdross/papers/ross-asteroid-mining-2001.pdf.

37 *Id.* at 4.

M-type asteroids (metallic) have the high radar reflectivity characteristic of metals,[38] and are probably the most economically attractive targets for mining missions because of the commercial value of the metals in an Earth market. S-type asteroids (stony) are rocky mixtures of silicates, sulphides, and metals,[39] but the metals they contain may not be as valuable as those found in M-type asteroids, so they will probably not be the target of initial space mining missions.

Recent scientific reports have suggested a single asteroid may contain staggering quantities of rare metals.[40] One report estimated that a moderately sized (1 km) M-type asteroid with a fair enrichment in platinum group metals may contain twice the tonnage of platinum group metals already harvested on Earth combined with economically viable platinum group metal resources still in the ground.[41] Put simply, it is believed a single asteroid could contain more platinum than has ever been mined or ever will be mined on Earth. While the economic gain from a mining mission on such an asteroid would be offset by the huge initial cost of reaching the asteroid and capturing the metals, this figure suggests mining missions to asteroids could be extremely profitable. Planetary Resources, a fledgling asteroid mining company, has already targeted a metallic asteroid for a possible future mining mission.[42] According to Planetary Resources, this single asteroid may contain more platinum than has ever been mined on Earth.[43]

Scientific reports have also suggested asteroids may contain large quantities of volatiles, such as hydrogen and methane, which could potentially be broken down and used to synthesize rocket fuel and transport spacecraft between space environments.[44] Several companies are already researching how to successfully mine the metals contained in asteroids by using frozen water contained in the asteroid to produce rocket fuel for a return journey.[45]

Asteroids are similar to water in many respects: both have economic and practical importance and limited availability; both exist as floating objects unconnected to land; and both are practically and commercially

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38 *Id.* at 8.

39 *Id.*

40 *Id.* at 6.

41 *Id.* at 8.

42 *Asteroid Targets of Interest*, PLANETARY RESOURCES, http://www.planetaryresources.com/asteroids/#asteroids-targets (last visited Mar. 19, 2015).

43 *Id.*

44 ROSS, *supra* note 35.

45 *See* Planetary Resources, *supra* note 42.

important to society and many different industries both in the context of space travel, and in the context of natural resource acquisition. However, unlike water, under the current international treaties regarding space, claims by either private or government entities on celestial objects are prohibited.[46]

II
THE CURRENT INTERNATIONAL TREATIES THAT REGULATE THE OWNERSHIP OF ASTEROIDS FAIL TO INCENTIVIZE THE DEVELOPMENT AND EXPLORATION OF OUTER SPACE

Currently, there are two outdated international treaties that attempt to adjudicate the use and exploration of space. The first treaty, the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (1968), is an archaic but influential agreement ratified by nearly all of the world nations that have successfully launched a shuttle into space.[47] The second treaty, The Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (1979), was an attempt to reform some of the principles from the Outer Space Treaty that failed to garner popular acceptance because it was not signed by any nations with national space programs.[48] While both treaties attempt to deal with many issues, including the ownership of celestial bodies, both fail to allow for the ownership and development of asteroids by government or private entities. Because they were written during the space race in a period of international distrust, it makes sense that these treaties would be concerned with tempering the race to establish sovereign control over celestial bodies. However, as space exploration shifts from being financed and controlled by national governments to being financed by private industry, these concerns may be less important.[49]

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46 *See generally* Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, Dec. 5 1979, 1363 U.N.T.S. 3 [hereinafter Moon Treaty]; United Nations Treaties and Principals On Outer Space, Jan. 27, 1967, UNOOSA, http://www.unoosa.org/pdf/publications/ST_SPACE_061Rev01E.pdf (last visited Mar. 19, 2015) [hereinafter Outer Space Treaty].

47 *See* Outer Space Treaty *supra* note 46.

48 *See* Moon Treaty *supra* note 46.

49 *See generally NASA Prepares for Giant Leap into Privatized Space Travel*, STANDARD-EXAMINER, www.standard.net/Business/2014/08/22/NASA-prepares-for-giant

NASA (National Aeronautics and Space Administration), the U.S. space program, was once a well-funded program. It was the focus of the American people in 1961 when President John F. Kennedy announced before a joint session of Congress the ambitious goal of sending a man to the moon.[50] The funding for NASA has dwindled in modern times, and the organization now gets around 0.5% of the federal budget, which is the lowest it has been since Kennedy's 1961 speech.[51]

Despite a decrease in national space program funding, corporate space missions are on the rise. In 2010, President Obama proposed that NASA exit the business of flying astronauts from Earth to low Earth orbit and move it to private companies.[52] Several companies have stepped up to bat, and corporate space programs now include space tourism, supply missions, and in one case a one-way colonization mission to Mars.[53] Corporate interest in space tourism and development demonstrates a strong private commercial interest in space as an industry, which could serve to finance the exploration of space in a period where national governments do not have an active financial interest in space. However, under current international treaties, the ownership of asteroids is prohibited, preventing corporations willing to invest in asteroid mining from having a secure claim.

-leap-into-privatized-space-travel (Aug. 22, 2014) (showing an example of a space mission being contracted out by NASA to private-sector companies).

50 *The Decision to Go to the Moon: President John F. Kennedy's May 25, 1961 Speech Before Congress*, NAT'L AERONAUTICS & SPACE ADMIN., http://history.nasa.gov/moondec.html (last visited Mar. 20, 2015).

51 *See NASA Budgets: U.S. Spending on Space Travel Since 1958*, THE GUARDIAN (Feb. 1, 2010), http://www.theguardian.com/news/datablog/2010/feb/01/nasa-budgets-us-spending-space-travel.

52 *See Private Spaceflight*, WIKIPEDIA, http://en.wikipedia.org/wiki/Private_spaceflight (last visited Mar. 20, 2015).

53 *See, e.g.*, *Mars One Mission*, MARS ONE, http://www.mars-one.com/mission (last visited Mar. 20, 2015).

A. The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (1967) Prohibits Commercial Property Claims

The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (Outer Space Treaty of 1967), is currently the most influential source of international legislation regarding space law.[54] Ratified in 1967 by most of the U.N. nations that had successfully launched a shuttle into space, the Outer Space Treaty of 1967 carries much more weight than the subsequent "Moon Treaty" of 1978.

The Outer Space Treaty of 1967 addresses many different issues, including the military development of space,[55] the commission of aid to distressed astronauts,[56] international liability for damage caused by space objects,[57] and the guaranteed cooperation between state-actors in space.[58] While the agreement does an admirable job dealing with many of these issues, it fails to grant any kind of ownership claims over celestial bodies.

Under the Outer Space Treaty of 1967, both government and private entities are prohibited from claiming ownership over celestial bodies. Article II of the agreement explicitly states that, "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."[59]

While this statement seems reasonable for preventing a government from, say, claiming the moon, it makes no distinction between the moon and asteroids, planets, meteorites, comets, or other celestial bodies. By preventing the ownership of celestial bodies, even those that have no utility beyond the resources they contain, the treaty effectively

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54 *See* Outer Space Treaty, *supra* note 46. Since the Outer Space Treaty was ratified, several new countries have developed space programs. The reactions of those countries to the treaty are not discussed in this paper, as the development of space programs in new countries that did not ratify the treaty only reinforces the premise that the treaty is outdated legislation that needs to be revisited by the international community.

55 *Id.* part 1(A) art. IV.

56 *Id.* part 1(A) art. V.

57 *Id.* part 1(A) art. VII.

58 *Id.* part 1(A) art. IX.

59 *Id.* part 1(A) art. II.

destroys the financial gain that could motivate corporations to explore and develop space.

B. The Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (1979) Also Fails to Recognize the Need to Provide Ownership Rights in Celestial Bodies

The Agreement Governing the Activities of States on the Moon and Other Celestial Bodies of 1979 (The Moon Treaty) also fails to create property rights in celestial bodies in a way that would incentivize space travel.[60] Widely considered a failure, the Moon Treaty was an attempt to reform the Outer Space Treaty of 1967, but it was not ratified by any nation that had successfully launched a shuttle into space.

The Moon Treaty took an idealistic approach to international space law, and if it were more effective it would have established an international regime to carry out its goals.[61] The stated goals of the regime were to develop the natural resources of the moon and other celestial bodies, rationally manage those resources, and expand opportunities for parties to use and share the resources.[62]

While the creation of said regime never occurred, it is clear the drafters of the Moon Treaty clearly foresaw the need for international agreement regarding space resources. Among other things, the Moon Treaty prohibits state parties from developing a military presence on the moon or any other celestial body,[63] or excluding other state parties from scientific investigation in space.[64] The Moon Treaty also attempts to require that any scientific discoveries useful to mankind be shared with the Secretary-General of the United Nations as well as the public and the international scientific community.[65] Unlike the Outer Space Treaty of 1967, the Moon Treaty calls for the U.N. to maintain control over space, and has numerous provisions that call for approval by the Secretary-General of the United Nations before a state party can act.

The Moon Treaty was an attempt to rationally manage space resources by creating an international regime to oversee space development. It fell short, however, by failing to grant substantive commercial rights that would incentivize space travel, making no

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60 *See* Moon Treaty, *supra* note 46.

61 *Id.* art. 11 ¶ 5.

62 *Id.* art. 11 ¶ 7 (A–D).

63 *Id.* art. 3 ¶ 1.

64 *Id.* art 6.

65 *Id.* art. 5 ¶ 1.

distinction between planets, comets, asteroids, or space debris with respect to its provisions (like the Outer Space Treaty), and by applying its provisions exclusively to state parties with few references to private action.[66]

Article 11, paragraph 2 of The Moon Treaty states that "[t]he moon is not subject to national appropriation by any claim of sovereignty, by means of use or occupation, or by any means."[67] Thus, under the Moon Treaty, no entity can lay claim of ownership upon anything in space, regardless of the purpose of the claim. The agreement goes further to say explicitly that the surface, subsurface, and the natural resources in place on the moon will not become property of any state; international intergovernmental or nongovernmental organization; national organization or nongovernmental entity; or of any natural person.[68] Put differently, the Moon Treaty explicitly prohibits both private and government actors from making commercial claims over the moon, and since the treaty is meant to apply to any celestial body within the solar system, it follows that the same rule applies to space resources like those found on asteroids. While protecting space resources for science is certainly a laudable goal, the Moon Treaty prevents commercial claims in space, effectively stonewalling space's development. One can hardly imagine a corporation spending the tremendous amount of money necessary to launch a space mission if the only payoff would be the chance to do research that would ultimately have to be shared with the public, including the corporation's competitors.

Like the Outer Space Treaty of 1968, the shortcomings of the Moon Treaty demonstrate the need for new international legislation regarding the right to own and use space resources like asteroids. The exploration and development of space could be incentivized and facilitated by a new international treaty that affords property rights to private and government entities in asteroids. The doctrine of appropriation would be a logical governing rule.

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66 *Id.*

67 *Id.* art. 11 ¶ 2.

68 *Id.* art. 11 ¶ 3.

III
THE APPLICATION OF THE DOCTRINE OF APPROPRIATION TO ASTEROID MINING WOULD INCENTIVIZE CORPORATE SPACE EXPLORATION WHILE PREVENTING WASTE AND ABSTRACT CLAIMS

Like water during the expansion of the American West, the exploration of space can be financed and incentivized by granting rights in resources to those who secure new resources and put them to beneficial use. Some legal scholars have suggested the traditional rule of capture be applied to asteroids,[69] or that rights to asteroids be purchased directly from an international agency and owned as chattel.[70] However, like water during America's westward expansion, asteroids are not easily classified under traditional property regimes. Thus, a doctrine of appropriation would be more appropriate for asteroids than a traditional rule of capture or a chattel system, because a system based on the traditional rule of capture or chattel would result in waste, abstract claims, and complicated legal issues.

First, asteroid claims cannot be adjudicated under the traditional rule of capture, or as chattel, because such systems would be incredibly wasteful. As of now, scientists have observed approximately 450,000 asteroids in our solar system.[71]

But only a fraction of the observable bodies will be cost effective to mine. While it might one day be possible for a single entity to finance several mining missions at once, current costs associated with such a venture would limit almost any space-mining program to one or two asteroids, at least initially.[72] The traditional rule of capture could allow an entity to quickly claim multiple asteroids merely by landing on them and planting a flag, without requiring the entity to show it can reasonably use the resources they have claimed.

Even worse would be a system where the same corporation could claim asteroids simply by discovering their existence and registering the claim. Allowing this type of unregulated claim would incentivize larger corporations capable of space travel to quickly claim reachable asteroids, but the claims could easily outpace those entities' realistic

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69 *See* Matthew Feinman, *Mining the Final Frontier: Keeping Earth's Asteroid Mining Ventures from Becoming the Next Gold Rush*, 14 U. PITT. J. TECH. L. & POL'Y 202 (2014).

70 *See* Andrew Tingkang, *These Aren't the Asteroids You Are Looking For: Classifying Asteroids in Space as Chattels, Not Land*, 35 SEATTLE U. L. REV. 559 (2012).

71 *See generally* Planetary Resources, *supra* note 40.

72 *Id.*

expectations on what they could use. Under a traditional rule of capture system, the solar system could be divvied up long before the resources could conceivably be mined. A rule similar to the doctrine of appropriation used for water claims in the United States would alleviate this concern by limiting claims to those where a claimant can show a reasonable beneficial use for the resource.

Another concern posed by the traditional rule of capture or chattel system would be the creation of abstract claims. Some legal scholars have advocated for a system where asteroids would be categorized as chattel, and rights in asteroids would be granted to an entity that could identify an asteroid and register ownership of it with an international agency.[73] The advantage of such a system would be that it would allow an international agency to keep track of asteroids, and it would allow for the mapping of the reachable solar system. The problem with this approach, however, is that it would result in abstract claims. If an entity could claim the rights to an asteroid without actual possession, there is nothing to prevent that company from claiming ownership long in advance of any real possibility of landing on it. One of the reasons for creating the doctrine of appropriation was to limit abstract claims over resources that were not being used in any reasonable way. Just as the plaintiffs in *Hague* had no recourse against the third party who wasted the natural gas reserve, there would be no cause of action against an entity that has the rights to an asteroid, but chooses not to exercise them.[74] This may be particularly harmful to society because asteroids contain volatiles that may be essential to creating rocket fuel in space, which, in turn, may be crucial to deep space exploration.

Using asteroid-bound volatiles to make rocket fuel would reduce the cost and increase the range of space exploratory missions, possibly improving the human race's ability to explore and develop space. Under a system were entities could claim asteroids without actual possession, those entities could exclude others from landing on the asteroids and using such resources, even when such resources are languishing unused in space. To prevent the creation of such abstract claims over asteroids, the doctrine of appropriation could be modified as to only grant rights only to entities who are able to demonstrate both actual possession and beneficial use. This would ensure that asteroids

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73 *See* Tingkang, *supra* note 70.

74 *See Hague v. Wheeler*, 27 A. 714 (Pa. 1893).

claims are limited to those where the resources are actually being used, thus, maximizing the utility of such celestial bodies to society.

Finally, asteroids cannot be adjudicated under the traditional rule of capture or a chattel system because their unique propensity to collide with other celestial bodies would result in vexing legal issues. Pop culture has popularized the notion of an asteroid crashing into the surface of Earth in movies and books, but interspace collisions may be a real concern. Asteroids are constantly moving through space, and they often crash into other asteroids or space debris, and sometimes onto the surface of planets. So real is the concern that space agencies regularly keep track of NEOs, or Near Earth Objects, which include around 10,000 asteroids large enough to be tracked in space.[75] Imagine the scenario in the popular movie *Armageddon*, where society wrestles with the mechanics of destroying a huge asteroid that is headed straight for Earth.[76] It would be strange, indeed, if the situation were further complicated by an entity owning the asteroid. Would the Earth have to compensate the company for the loss of resources, or would the company be forced to assume liability for the damage caused by the collision? What if the asteroid, rather than crashing into Earth, crashed instead into another asteroid owned by different entity? It makes sense that a company with actual possession of an asteroid should have a claim for actual mining equipment destroyed, but it seems unreasonable to treat the entire rock as the entity's chattel. By limiting asteroid claims under a doctrine of appropriation-like system, society will be saved the headache of attempting to adjudicate such absurd situations.

Because the traditional rule of capture or a chattel system for the ownership of asteroids would result in waste, abstract claims, and absurd legal dilemmas, a modified doctrine of appropriation should replace existing outdated international space law relating to asteroids.

CONCLUSION

The doctrine of appropriation is a reasonable rule for adjudicating asteroid claims, and it could easily be modified to apply to asteroid mining. In the context of water rights, the doctrine of appropriation requires that the claimant be a landowner in order to claim the right to use a water source. It does not make sense, however, for the

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75 *See generally Near Earth Object Program*, NASA, http://neo.jpl.nasa.gov/ca/ (last visited Mar. 20, 2015).

76 ARMAGEDDON (Touchstone Pictures 1998).

international community to grant complete ownership over asteroids to a single entity, so the landowner requirement of the rule should be removed. A similar modification would need to be made to the "beneficial use" language of the doctrine.

In the context of water rights, an appropriator obtains rights only to water that he or she can reasonably put to beneficial use. The metals contained in asteroids have a high level of marketability. For that reason, a mining entity could potentially put any amount of obtained metal to beneficial use, in the sense that the resources can be sold. This, however, would defeat the purpose of the rule, which is to limit such unreasonable claims. To ameliorate this problem, the doctrine of appropriation could be modified to define "beneficial use" constructively by providing that beneficial use is assumed for any resources that have been removed from the asteroid that the mining entity can reasonably hope to transport to market in a return journey. With the astronomical cost of undertaking a trip to such an asteroid, this modification would limit mining entities to only what they can carry back, thereby leaving the untapped resources available to other entities capable of making the same trip. Considering the size and profitability of metal deposits on asteroids, this modification to the doctrine of appropriation would not be overly burdensome to corporate interests. At the same time, it would satisfy the economic imperative of promoting the rapid development of asteroid resources.

By changing the landowner requirement, and qualifying the "beneficial use" language, the doctrine of appropriation would be essentially ready for application to asteroid mining claims. The only other changes necessary would be some additional requirements that are common to other space related provisions, like those found in the Outer Space Treaty of 1968. For example, a reporting requirement or a clause guaranteeing asylum for other astronauts. A functional rule might read something like this:

State parties or private entities may, upon actual possession, lay claim to natural resources found on or below the surface of asteroids. Rights to appropriate are given in order of seniority, starting with the first party to land on the surface of the asteroid and establish control over the resources, be it water, methane, metal, or any other beneficial substance. A party will be said to have established control over a resource once he has mined the substance and removed it from the asteroid. A senior appropriator may use as much of the asteroid's

resources as he can take from the asteroid and put to beneficial use, and may continue to enlarge his share until another junior appropriator begins to appropriate resources from source for beneficial use. For the purposes of this Agreement, "beneficial use" refers to the amount of resources that an appropriator has removed from the asteroid that the actor may reasonably hope to bring home in a return voyage. Resources in excess of what an appropriator can reasonably hope to transport to market in a single voyage do not qualify as having a beneficial use, and are therefore not yet claimed. This means that the extraction of metal from an asteroid does not serve to provide ownership if the appropriator plans on letting the resources languish until another voyage is undertaken to secure the resources and bring them back to Earth. Junior appropriators receive rights in the source of resources (the asteroid) as they find it, and may prevent the senior appropriator from enlarging his share to the junior appropriator's detriment under a no-injury rule. No state party will attempt to hinder other parties from landing on or using the asteroid, and parties will assist other entities on an asteroid, should they need emergency assistance. Mining claims on asteroids will be reported to the Secretary-General of the United Nations, and state parties agree to release the location of the asteroid, and any scientific findings to the United Nations, the general public, and the scientific community. In the event that the asteroid is on a collision course with any other celestial body, all state parties agree to follow the course of action suggested by the United Nations. Should the United Nations decide the asteroid must be destroyed, no state party may claim liability for resources contained within the asteroid, but not yet captured. This provision applies only to asteroids as classified by the scientific community, and does not apply to planets, comets, meteorites, or any other celestial body not mentioned.

There is no doubt that asteroids may be extremely beneficial to mankind, both as a source of resources and as a jumping-off point to far off locations in space. The human-race has progressed scientifically and technologically to the point that space travel is within commercial reach, and the need for new international laws governing the ownership of space has never been more apparent. The Outer Space Treaty of 1968 made great strides in developing rational rules for space and many of its provisions should be maintained in their original form. However, by allowing ownership of asteroids under the doctrine of appropriation, the international community can incentivize the exploration and development of space in a way that reflects the needs of society in

general, without vesting an absolute monopoly in a single entity. The doctrine of appropriation helped drive American westward expansion, and its application to space mining would help drive the human race in its expansion into the space, the final frontier.