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Protecting the Cosmos: Defining Celestial Bodies in the Outer Space Treaty

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Protecting the Cosmos: Defining Celestial Bodies in the Outer Space Treaty

David Epstein

Lack of a clear definition of the term “celestial bodies” as used in the 1967 Outer Space Treaty risks exporting legal and political conflict into the cosmos. *This essay is updated from a previously published version and appears here by permission of the Journal of Space Law at Ole Miss.

The fundamental precept of the Outer Space Treaty is that the exploration and use of outer space are “the province of all [hu]mankind”¹ and “shall be carried out for the benefit and in the interests of all countries.”² While the Treaty provides that “there shall be free access to all areas of celestial bodies,”³ Article II of the Outer Space Treaty 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.”⁴

The United States has signaled, through its national law⁵ and through the development and execution of international agreements such as the Artemis Accords,⁶ that it interprets Article II to mean that it is permissible, particularly for private enterprises and individuals, to extract and utilize resources from space, including the Moon and other celestial bodies, without running afoul of the provisions of Article II of the Outer Space Treaty or any other international law or obligation. As of March 2024, over 30 nations have signed the Artemis Accords, indicating their agreement with this interpretation.⁷ However, this understanding merely scratches the surface of the implications and meaning of Article II.

Deconstructing the language of Article II suggests that it may have truly been intended to restrict national – versus private – appropriation. Moreover, as we consider space with far

¹ The author would urge that future developments in space law should employ the inclusive term “humanity” rather than the more limiting, exclusionary, and etymologically archaic “mankind” in reference to the human race and human civilization.
³ Id. at Art. II.
⁴ Id. at Art. II.
⁶ The Artemis Accords: Principles for Cooperation in the Civil Exploration and Use of the Moon, Mars, Comets, and Asteroids, NASA,https://www.nasa.gov/specials/artemis-accords/img/Artemis-Accords-signed-13Oct2020.pdf [hereinafter Artemis Accords]. The original signatories were representatives from Australia, Canada, Italy, Japan, Luxembourg, the United Arab Emirates, the United Kingdom, and the United States; these original parties have (as of this writing) since been joined by Angola, Argentina, Bahrain, Brazil, Bulgaria, Colombia, Czech Republic, Ecuador, France, Germany, Greece, Iceland, India, The Isle of Man, Israel, South Korea, Mexico, New Zealand, Poland, Romania, Singapore, Spain, Ukraine, Rwanda, The Netherlands, Saudi Arabia, Nigeria, and Uruguay.
more knowledge than we had when the Outer Space Treaty was negotiated, we must consider what is meant by the term “celestial body,” and even the term “outer space” itself. At first blush, the language of Article II suggests that nothing in space, including an orbital slot, or even the energy generated by our sun, may be “appropriated.” Yet it would be absurd to apply that literal meaning to Article II. Are parties to the Outer Space Treaty obligated not to “appropriate” even a miniscule speck of cosmic dust? If the resources contained in a so-called “celestial body” are extracted to the point where the celestial body disappears, does that cross a threshold into appropriation?

This paper suggests that we need to consider the implications of Article II carefully and the various ways it can be interpreted. It will review the history of Article II as well as the concept of “celestial bodies” and “outer space,” existing proposals to address these matters, and challenge participants in this discussion to apply a common-sense approach to the meaning of both terms to explore possible further solutions.

On June 13, 2010, in what was described as a “breathtakingly beautiful” streak of light across the sky over the South Australian outback, the Japan Aerospace Exploration Agency’s (JAXA) Hayabusa spacecraft became the first ever human object to land on an asteroid – a near-Earth object named Itokawa – and return to Earth with a sample of “1,500 tiny particles.”

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On average, the particles were just “one-tenth the width of a human hair.” Scientists describe Itokawa as “a ‘rubble pile’ loosely held together by gravity.”

The Outer Space Treaty states that the “exploration and used of outer space, including the Moon and other celestial bodies, shall be carried out for the benefit and in the interest of all countries … and shall be the province of all [hu]mankind.” Additionally, the OST calls for “freedom of scientific investigation in outer space, including the Moon and other celestial bodies.” Finally, the OST notes 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

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9 Wendy Zukerman, Spacecraft is First to Bring Asteroid Dust to Earth, NEWSSCIENTIST, (Nov. 16, 2010).


11 Wendy Zukerman, Spacecraft is First to Bring Asteroid Dust to Earth, NEWSCIENTIST, (Nov. 16, 2010).


14 Outer Space Treaty, supra note 3.

15 Id. at art. I.

16 Id.
occupation, or by any other means.”17

Under these provisions, one can argue that Japan must share these 1,500 particles with the rest of humanity. Of course, JAXA shared its bounty with allied nations and scientific results were made publicly available.18 And indeed, no State Party to the OST objected to the mission, just as no nations objected when the Soviet Union, the United States, and China returned sample material from the Moon. Certainly, it would feel absurd to argue that the collection of 1,500 particles smaller than a human hair for the purposes of scientific discovery collected from a pile of rubble held together by gravity violates the substance or purpose of the Outer Space Treaty.

In December 2020, JAXA completed another sample return mission, Hayabusa 2.19 Similarly, the United States, an OST signatory, launched an asteroid sample-return mission which successfully touched down on and collected a sample from its target asteroid.20 Each of the asteroids targeted by Japan and the United States are named objects and range in size from 330 meters to 1 kilometer in diameter.

One can imagine, just a decade or so from now, not a return mission that retrieves a scientific sample, but an operation to mine an asteroid solely for commercial benefit. It could even be that the asteroid would be mined out of existence. Can this be permissible under the Outer Space Treaty? Limiting the definition of “celestial bodies” based on size (or whether an object is named) should be considered as non-dispositive or incomplete criteria. This paper analyzes the language of Article II, considering what is meant by the concept of appropriation and argues that: 1) Article II was not intended to reach private non-State entities; 2) the Outer Space Treaty does not prohibit the appropriation or extraction of resources from extraterrestrial objects that do not fall within the meaning of the term “celestial bodies;” and that 3) that term itself should be limited and clearly defined. The paper will explore some prior approaches to these same questions and ways in which they require further elaboration. The focus of this paper is on the term “celestial body” with some consideration, too, to the extent of the application of space law in general and, thus, the definition of “outer space” itself.

The Outer Space Treaty employs the term “celestial bodies” repeatedly throughout its text. However, the term has never been concretely defined in an academic, scientific, or legal context. While the lack of any definition has not, heretofore, caused any difficulties, advances in technology will soon empower governments, public and private enterprises, and even private citizens to engage in extraterrestrial activities21 that will be impacted by how the term “celestial

17 Id. at art. II.
bodies” is defined or interpreted. How we think about and define “celestial bodies” will impact the application of and limitations imposed by Article II.

Steven Gorove posed the question this way in 1969: Does the prohibition extend to the collection of dust particles or other special elements during flight in outer space? Does the prohibition extend to the appropriation of cosmic rays, gases or the sun's energy, or to the collecting of mineral samples or precious metals on the moon or other celestial bodies? Should the answer depend on the type of resource involved, or on its availability in unlimited (cosmic rays, meteorites, gases) or limited (minerals, metals) quantities or perhaps on its location? Further, does the concept extend to objects that come to Earth naturally as opposed to those brought back by human intervention? Additionally, are any intangible cosmic phenomena, such as Lagrange points, to be included as a “celestial body?” All of these questions remain unanswered.

Part II of this paper reviews space law in general and focuses on the language contained in Article II of the Outer Space Treaty. Part III analyzes the term “celestial bodies” from a historical standpoint and within the context of the Outer Space Treaty, also explaining why a definition is important. Part IV reviews different past proposals to define “celestial bodies,” and Part V provides the author’s proposed solution.

THE SPACE TREATIES

Generally

In October 1957, Sputnik 1 became the first human-made object to reach space. Shortly thereafter, the United Nations (UN), “[r]ecognizing the common interest of [hu]mankind in outer space . . . and that it is the common aim that outer space should be used for peaceful purposes [and] [w]ishing to avoid the extension of present national rivalries in this new field,” created an ad hoc committee to, among other things, report on the “nature of legal problems which may arise in the carrying out of programmes to explore outer space.” The Committee on the Peaceful Uses of Outer Space (COPUOS) was made a permanent body in 1959. COPUOS was the backdrop for negotiation and implementation of the treaties which today govern space activities.

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23 Id. (“With respect to location, it could be argued that if any parts of outer space, including the moon and other celestial bodies, were found on the earth, they would not be subject to the prohibition of national appropriation since they would become part and parcel of the earth. Under a strict interpretation it may also be argued that the prohibition extends to the resource irrespective of its location”).
24 Sputnik 1, NASA.GOV, https://www.nasa.gov/multimedia/imagegallery/image_feature_924.html
26 Id.
Five treaties related to sovereign space activities were negotiated in the COPUOS, colloquially known as the Outer Space Treaty, 28 Rescue Agreement, 29 the Liability Convention, 30 the Registration Convention, 31 and the Moon Agreement. 32 The Moon Agreement has been ratified by only eighteen States, 33 and none of the major space-faring nations, including China, the United States, or Russia, has done so.

Negotiated during the Cold War essentially by the world’s two superpowers, the four widely ratified treaties reflect a remarkable – and to date successful – détente. The overriding concern was, as the name of the COPUOS suggests, peace. The key principles of the Magna Carta for peace in space are peace, collaboration, and freedom, 34 while more tangential matters, including cultural heritage preservation and private resource mining are unaddressed.

That said, the activities of private entities are not entirely overlooked. Article VI of the Outer Space Treaty makes it quite clear that States bear “international responsibility for national activities in outer space . . . whether such activities are carried on by governmental agencies or by non-governmental entities.” 35 The Article further indicates that States must assure that all “national activities are carried out in conformity with the provisions set forth” in the OST. 36

Article II

Article II of the Outer Space Treaty states in full: “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.” 37

Sovereignty

28 Outer Space Treaty, supra note 3.
32 Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, Dec. 18, 1979, 1363 U.N.T.S. 3 [hereinafter Moon Agreement].
34 Article I of the Outer Space Treaty encompasses three foundational aspects of all space activities: the exploration and use of space is the “province” of all humankind; space, including the Moon and other celestial bodies “shall be free for exploration and use by all States;” and “States shall facilitate and encourage international co-operation” in scientific investigation. Outer Space Treaty, supra note 3, art. I. Article IV avers that “the Moon and other celestial bodies shall be used . . . exclusively for peaceful purposes.” Id. art IV.
35 Id. art VI.
36 Id.
37 Outer Space Treaty, supra note 3, art. II.
The international community seems largely to agree that no sovereign may make a claim to extraterrestrial territory. Indeed, it is a principal so embedded in the bedrock of space exploration as to be considered by many to be not just a treaty obligation but customary international law. Nevertheless, an argument can be made that this provision does not apply to non-State entities.

First, the Article plainly indicates that space shall not be subject to national appropriation. Second, the primary restriction is against appropriation by claiming sovereignty. Arguably, then, if a non-State entity asserts proprietary rights, it is not a “national appropriation,” nor is it “by claim of sovereignty.” This interpretation might be further supported by the United Nations Declaration of Human Rights, which, in Article 17 plainly states that “[e]veryone has the right to own property alone as well as in association with others.” While not binding international law, the Declaration could be viewed as customary law at this point that applies to space activities through Article III of the Outer Space Treaty, which requires States to “carry on activities in . . . space in accordance with international law.” As such, it could arguably be a violation of customary international law not to permit private ownership in space.

As Stephen Gorove put it: “an individual acting on his [or her] own behalf or on behalf of another individual or a private association or an international organization could lawfully appropriate any part of outer space, including the moon and other celestial bodies.” This argument notwithstanding, seemingly no State Party to the Outer Space Treaty interprets Article II in this manner. Instead, debate centers on what actually constitutes national appropriation. The “sweeping language” of Article II could have been interpreted to apply both to areas as well as resources.” interestingly, the Moon Agreement clearly states that “[n]either the surface nor the subsurface of the moon, nor any part thereof or natural resources in place, shall become property of any State, international intergovernmental or non-govermental organization, national organization or non-governmental entity or of any natural person.” The Moon Agreement goes on to seek to establish, without prejudice to the preceding text, “an international regime … to govern the exploitation of the natural resources of the moon . . . . ” Tellingly, the Outer Space Treaty does not include this language. In other words, Article II could be interpreted to allow for the ownership of resources extracted from space, the Moon, and other celestial bodies.

It is also worth reiterating that each of the United States, China, Russia, and Japan have

40 Outer Space Treaty, supra note 3, art. III
41 Gorove, supra at note 21
43 Moon Agreement, supra note 31, art. 11(3) (emphasis added).
44 Id. Art 11(5).
Celestial Bodies

obtained material directly from the Moon or other extraterrestrial objects without objection. Therefore, there are clearly instances in which the national non-appropriation principle may not apply, such as when the objects in question are not, in fact or in law, “celestial bodies.”

By Any Other Means

The OST phrase “by any other means” appears to be affected, however, by other provisions of the Outer Space Treaty. Article VI of the OST establishes “responsibility for national activities in outer space, … whether such activities are carried on by governmental agencies or by non-governmental entities.”45 However, Article VI, which requires “authorization and continuing supervision,”46 appears to create a mere liability relationship between the state and private actors, and does not imply that the responsible nation exercises ownership, possession, or sovereignty over anything affected or undertaken by any private party. Further, pursuant to Article VIII, objects left in space remain under the ownership and control of the State that put them there.47 In fact, under Article VII of the Outer Space Treaty and Article III of the Liability Convention, States are “internationally liable” for damage caused to an object in space belonging to another State.48 Yet leaving the objects in situ, essentially results in perpetual occupation of that location. This notion could even be extended to locations that exist in an even more confounding state for legal and physical consideration, such as a Lagrange points.49 Given that any object sent to space would occupy or appropriate the physical space of the object itself, applying a prohibition on the appropriation of the space an object occupies by the fact of its existence would be an “absurd” interpretation of Article II.50 However, this approach could certainly be argued to run afoul of the non-appropriation principle encapsulated in Article II and evidences the incompatibility of “appropriation in the broadest sense of the word” and what the actual, practical, and preferable meaning of the term might be.51

Additionally, while it is clear that the use or threat of force to exclude access to any part of space would be prohibited under the Outer Space Treaty,52 merely stating that an act by or

45 Outer Space Treaty, supra note 3, art. VI.
46 Ibid.
47 Outer Space Treaty, supra note 3, art. VIII.
48 Id. art. VII. Liability Convention, supra note 15, art. III. To compound matters, under both the Outer Space Treaty and Liability Convention liability is not based on ownership of the object, but on a country’s status as a so-called “launching state.” Per the treaty regime, any one of four States may be considered a “launching State” for liability purposes: 1) the State which launches; 2) the State which procured the launch; 3) the State from whose territory the object was launched; and 4) the State from whose facility the object was launched. Liability Convention, supra note 15, art. I.
49 This is not idle conjecture, but present reality. The James Webb Telescope, for example, jointly operated by NASA, the European Space Agency, and the Canadian Space Agency, currently occupies the Lagrange point designated as L2.
50 Timothy Justin Trapp, June 30, 2013, 2013 U. Ill. L. Rev. 1681 at 1691.
51 Ibid.
52 Id at 1698; See also, Leslie I. Tennen, Towards A New Regime for Exploitation of Outer Space Mineral Resources, 88. NEB. L. REV. 794 at 804. (2010)
presence of an object does not constitute appropriation, such as is the case with the International Space Station,53 cannot sufficiently resolve the matter.54 Others have argued that “if States cannot appropriate the extraterrestrial realms, then a fortiori neither can their nationals … and State endorsement of private appropriation would be a form of national appropriation.”55 Therefore, whether by mere existence, location, national endorsement, or otherwise, “by any other means” lacks the clarity necessary to give clear effect to the terms of the Outer Space Treaty.

Virgiliu Pop argues, in fact, that this can be resolved not by determining the scope and application of Article II of the OST to private persons in the context of property rights as such, but to the objects governed themselves.56 This approach is an inspired starting point to resolve this issue, though requires additional criteria and limitations. Further, this postulation does not sufficiently take the acts and assertions of individual nations or advances in technology whether to date or into the future into account.

SCOPE OF APPLICATION IN OUTER SPACE LAW

In addition to considering what is or is not a “celestial body” we must also consider to what extent we might apply this term when finally agreed. Given the vastness of space57 we must also contemplate the limits of, or distinctions between different areas of space as we consider defining terms such as “celestial bodies” and the broader development and application of space law in general. Should we determine where space begins58 and simply apply the agreed terms ad infinitum (and ad absurdum), in turn coining a new legal maxim of lex terre est sine fine in universo (translation: The law of the earth is without end in the universe)? Or,

53 See, e.g., Agreement Among the Government of Canada, Governments of Member States of the European Space Agency, the Government of Japan, the Government of the Russian Federation, and the Government of the United States of America Concerning Cooperation on the Civil International Space Station, Jan. 29, 1998, T.I.A.S. No. 12927, Art. 2 (noting, “(2) Nothing in this Agreement shall be interpreted as … (c) constituting a basis for asserting a claim to national appropriation over outer space or over any portion of outer space.”).
54 Trapp, supra note 49 at 1700.
56 Id at 48.
58 A widely accepted notion for the edge of space is the “Von Karman Line,” which defines space as beginning 100 kilometers (54 nautical miles; 62 miles; 330,000 feet) above Earth's mean sea level. (See, Rodney W. Johnson, “Problems of Law and Public Order in Space,” American Bar Association Journal , JUNE 1966, Vol. 52, No. 6 (JUNE 1966), p. 556); various alternative proposals have been put forth, which often define the lower limits of outer space as being closer to the surface of the Earth. (See, Eric Betz, “The Kármán Line: Where does space begin?,” Astronomy. [March 5, 2021] noting that the actual boundary between Earth and space could lie anywhere between 30 kilometers (8.5 miles) above the surface to more than a 1.6 million km (over a million miles) away. (See also, Robert F. A. Goedhart, “The Never Ending Dispute: Delimitation of Air Space and Outer Space,” Volume 4 of Forum for Air and Space Law. Editions Frontières, 1996).
should we adopt the proposed construct of distinct regions of space such as “solar space” (which itself is subject to debate\textsuperscript{59}), “galactic space” (The entirety of our Milky Way Galaxy outside of the Solar System), and “extragalactic space” (the rest of the universe beyond the Milky Way)?

Therefore, the question should also be asked: where does the Outer Space Treaty’s jurisdiction end? This question affects the debate and our understanding of whether any physical object or phenomena falls within the meaning and prohibitions prescribed by Article II of the Outer Space Treaty. According to Pop, considering whether a “celestial body” is a legal “thing” requires the application of common sense and the reasonable person standard, and terrestrial \textit{corpus juris spatialis} should be also restricted to our solar system.\textsuperscript{61} The author could not agree more.

It should be noted that there is no agreed standard defining where national or international air space stops and outer space begins.\textsuperscript{62} As such, determining exactly when the application of the Outer Space Treaty’s provision begins is difficult. As noted, however, more difficult would be considering the outer limits of the application of the Outer Space Treaty.

The first, undeniably “celestial object” one encounters as we travel farther from the Earth is the Moon, so clearly and universally agreed to be a “celestial body” that it has been singled out for specific and more rigorous, though as yet unsuccessful, legal treatment. Past the Moon, however, Lagrange Points, other planets and dwarf planets, their respective satellites or companions, and the myriad other objects and phenomena encountered within the solar system require legal definition. We may also need to consider those objects that regularly traverse the solar system, or which may enter it at some point and remain for periods of time measured in geologic or galactic timescales. Surely, we cannot presume that the term “celestial body” applies to every speck of dust beyond Earth’s atmosphere AND its authority extends throughout the entire Universe. The author would contend that, so far as seems reasonable, the Solar System would be the maximum extent of the applicability of the jurisdiction of the Outer Space Treaty.

\textit{Examples of National & International Interpretations of Article II:}

The United States, UAE, Luxembourg, and Japan


\textsuperscript{61} Pop, supra note 54 at 48.

The United States is party to four of the five space treaties. Rather than ratify the Moon Treaty, however, the United States pursued national legislation and policy declarations to supplement and interpret the Outer Space Treaty and the other broadly ratified space-related legal instruments. Beginning with the Spurring Private Aerospace Competitiveness and Entrepreneurship Act of 2015 (or the SPACE Act),\(^63\) the United States recognized the right of private citizens to own and trade in natural resources obtained from an “asteroid resource or a space resource.”\(^64\) While this legislation does require government authorization for activities covered by the law, the same distinction between national appropriation versus the permissibility of private appropriation exists as those identified above in the exploration of the relationship between Articles II and VI of the OST.

Additionally, the United States explicitly omits the term “celestial bodies” while identifying “asteroid resources,” which would seem to be separate and apart from OST terminology. U.S. space policy pronouncements also explicitly assert that, “[t]he United States will pursue the extraction and utilization of space resources in compliance with applicable law, recognizing those resources as critical for sustainable exploration, scientific discovery, and commercial operations.”\(^65\)

Moreover, the United States crafted the Artemis Accords, which enjoy a growing number of signatory parties, and which distinguish space both physically and legally from other aspects of human activity. The Artemis Accords, and the executive order issued by then-President Trump, declare that “Americans should have the right to engage in commercial exploration, recovery, and use of resources in outer space, consistent with applicable law. Outer space is a legally and physically unique domain of human activity, and the United States does not view it as a global commons. Accordingly, it shall be the policy of the United States to encourage international support for the public and private recovery and use of resources in outer space, consistent with applicable law” (emphasis added).\(^66\) Taken together, it would appear there are ample grounds to argue that the United States recognizes broad interpretation of Article II of the Outer Space Treaty for certain appropriation of celestial bodies, particularly when these activities are private in nature.

The United Arab Emirates (UAE) is an active and relative newcomer to space, space policy, and space law. UAE only established its national space agency in 2014 under the

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\(^{64}\) ibid.


\(^{66}\) Executive Order 13914, Encouraging International Support for the Recovery and Use of Space Resources. (Signed:04/06/2020, Published:04/10/2020) FR Citation:85 FR 20381; FR Doc. Number:2020-07800.
Celestial Bodies

authority of Decree No. 1 of 2014.67 The UAE Space Agency swiftly established a bold program, launching The Hope orbiter on July 19, 2020, which entered orbit around Mars on February 9, 2021.68 To support its rapid entry into the community of space nations, the UAE partners with other national space programs69 and has worked swiftly to establish national space legislation and a national space policy.70 While the legislation addresses various space activities, the UAE’s stated aim of this legislation is “stimulating investment and encouraging private sector participation in space sector activities." Additionally, the UAE views its legislation as supporting the nation’s commitment to implement the provisions of international conventions and treaties related to outer space.71 The UAE is a party to the Outer Space Treaty and, as a signatory to the Artemis Accords, the UAE is affirming that the Artemis Accords comply with these international conventions and treaties related to outer space. Finally, UAE’s National Space Policy states that, “partners, in collaboration with and with the support of the UAE Space Agency, shall embark on, or contribute to, inspirational programs, such as: … Exploration, mining, extraction and utilization of resources in space …”73 Thus UAE appears not to deem all objects in outer space as “celestial bodies” under the terms of the OST and excluded from legal use.

Another, often unexpected, space actor is Luxembourg, which has already undertaken steps to address several aspects of commercial space activities.74 Luxembourg’s National Action Plan for Space and Technology 2020 – 202475 and its legal framework reflect the nation’s understanding that, “[i]nternational space treaties remain untested regarding who would own the rights to minerals, gases and water found in outer space.”76 To begin to resolve this

71 Id at 53.
72 Ibid.
73 Ibid.
state of affairs, in 2017 Luxembourg adopted a legal and regulatory space law framework (“2017 Luxembourg Space Law”) that “ensures stability and guarantees a high level of protection for investors, explorers and miners.” Luxembourg is clear to note, however, that the 2017 Luxembourg Space Law “does not have an objective, purpose or effect of paving the way for any national appropriation of outer space, including the Moon and other celestial bodies themselves,” but, rather, seeks to ensure “that private operators can be confident about their rights [to] resources they extract in space.” Like the UAE, Luxembourg is also a party to the Artemis Accords and ratified the Outer Space Treaty, providing further support for the notion that not only do the Artemis Accords comply with extant international treaties, but that private extraction and use of space resources is permissible under the current legal structure.

Japan’s space activity history and policy stretch back decades. Over several years, Japan developed its space policy, space law, and space capabilities while engaging in activities that could be deemed extraction, or exploitation and use, of at least part of a celestial body. However, Japan has thus far not engaged in any actions to which any parties to the Outer Space Treaty have objected. Japan is also a party to the Artemis Accords, further entrenching the notion that State Parties to the Outer Space treaty do not view the Artemis Accords or their individual space activities as violative of international treaties or law. The Artemis Accords feature quite prominently in Japan’s latest national space policy, and clearly Japan believes its capture of scientific samples does not violate the Outer Space Treaty despite the fact that its asteroid missions could easily be cast as “national appropriation … by means of use … or by any other means.” Therefore, the only reasonable conclusion one could draw from Japan’s space activities and the (non) reaction of other nations is the fact that they do not view the objects from which Japan drew samples as “celestial bodies” under the Outer Space Treaty.

The Artemis Accords

The Artemis Accords are a non-binding, “political commitment” intended to “increase the safety of operation, reduce uncertainty, and promote the sustainable and beneficial use of space for all humankind.” The Artemis Accords reinforce existing international space law and

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78 Id at 65.


81 The Artemis Accords: Principles for Cooperation in the Civil Exploration and Use of the Moon, Mars, Comets, and Asteroids, NASA, https://www.nasa.gov/specials/artemis-accords/img/Artemis-Accords-signed-13Oct2020.pdf. The original signatories were representatives from Australia, Canada, Italy, Japan, Luxembourg, the United Arab Emirates, the United Kingdom, and the United States.
reaffirm that space activities are to be undertaken for “peaceful purposes” and “in accordance with relevant international law.”82  Most importantly for our purposes here, the Artemis Accords aim to promote specific interpretations of the Outer Space Treaty concerning the extraction and utilization of space resources.83  Clearly the extraction of space resources must come from somewhere; without a concrete definition, that somewhere could inadvertently be a celestial body.  Moreover, Artemis strives for extraterrestrial heritage protection of “historically significant human or robotic landing sites, artifacts, spacecraft, and other evidence of activity on celestial bodies in accordance with mutually developed standards,”84 and the Artemis Accords implicitly designate the Moon and Mars as “celestial bodies” as those are the locations on which “human or robotic landing sites” as well as any artifacts, spacecraft, and other evidence of activity” are to be found.

As the Artemis Accords are open to any nation to join as a State Party, and the list of those electing to do so continues growing, the Artemis Accords have the potential to achieve much in the way of establishing not only a broad range of acceptable standards of responsible behavior in outer space, but to help resolve the many outstanding issues left unanswered by the Outer Space Treaty.

WHAT IS OR WHAT SHOULD BE A CELESTIAL BODY?

As noted, we cannot employ a single term, “celestial bodies” to refer to all matter in the universe or even the solar system.  The definitive “A Guide to Space Law Terms” does not include a separate entry for “celestial bodies” but rather uses the term to help define other entries.85

N. Jasentuliyana and Roy S.K. Lee concisely articulate the surprising generality attributed to the Moon in the OST and to “celestial bodies” generally:

The Moon and other celestial bodies come under the scope of application of the Treaty. It was perhaps presumptuous and inappropriate to consider in one single instrument such separate elements as outer space (which is not a res but an infinite ocean of ether), the Moon (only natural satellite of earth) and other celestial bodies (which represent finite and microcosmic entities). It was also surprising that the Moon and all the other celestial bodies were considered together ... 86

We receive little help from the International Astronomical Union (IAU) in defining “celestial bodies.” The IAU only applies the term “celestial body” to its definition of planets and “dwarf

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82 Id at § 3
83 Id at §§ 9 & 10
84 Ibid. § 9
85 A Guide To Space Law Terms (2012), Space Policy Institute, George Washington University, and Secure World Foundation
86 N. JASENTULIYANA & ROY S.K. LEE, MANUAL ON SPACE LAW Vol. 1 253 (1979)(emphasis in the original, citation omitted).
planet[s]” in IAU Resolution B5. Resolution B5 lists the planets as Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune. Moreover, Pluto is alternatively included amongst the IAU’s definition of “celestial bodies” and excluded. Further, the IAU troublingly does not count natural satellites of planets to be “celestial bodies” in their own right; this would exclude the Moon, which could not have been the intent of the drafters of the OST or its State parties. Limiting the definition of “celestial bodies” to the objects identified and named by the IAU, however, would be both too restrictive and confusing, while opening the rest of the solar system to a legal void and a potential free-for-all by both sovereign states and private actors.

Humanity’s Evolving Understanding of the Cosmos and Celestial Bodies

For eons, human beings have gazed at the night sky and experienced a personal, spiritual, or religious connection to certain celestial objects in our solar system. However, before the 17th century, all that was known of our solar system was the Sun, Earth and Moon, Mercury, Venus, Mars, Jupiter, and Saturn. While it was not until the 20th Century that the human race even came to know of Pluto, a portion of humanity expressed dismay at its reclassification as a “Dwarf Planet.” We should consider whether, therefore, there are specific objects that hold a special place in the hearts and minds of humanity, regardless of their location, time of discovery, or physical properties, which would make them not only “celestial bodies” for the purposes of the OST, but part of the Common Heritage of Humanity. To speak of a Common Heritage of Humanity in space as an element of defining “celestial bodies” we may wish to determine what exactly that Common Heritage is by also considering the relative cultural – or even emotional – value humanity applies to any and all objects of any mass within the solar system. Undoubtedly all would agree that Earth’s moon, the named planets, and many of the natural satellites of the solar system, as well as several other named objects should be counted as “celestial bodies.” Reasonable people could differ, however, on the exact boundaries of this list.

Excellent scholarship has been produced regarding the legal status of “celestial bodies,” while others have explored the question of mining in space in the context of

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88 IAU Resolution B5, 24 August 2006 26th General Assembly IAU.
89 Ibid.
90 Ibid; (See also, https://www.iau.org/public/themes/pluto/ and https://www.iau.org/public/themes/naming/#dwarfplanets)
91 Ibid.
international and domestic, national legal regimes.\textsuperscript{93} Still others have examined the general landscape of current space law and the perceived gaps therein.\textsuperscript{94} However, none of the literature has or proposes a concrete definition or mechanism to define “celestial bodies.”

The Czech scholar Vladimir Mandl first introduced the term “celestial body” to the lexicon of Space law in 1932,\textsuperscript{95} and it appeared at the U.N. via a General Assembly resolution in December, 1961.\textsuperscript{96} More challenging still is the fact that even where others have attempted to define “celestial bodies” beyond mere scientific terminology, the distinctions have been couched in notions of technical capabilities, which is itself ever-changing.\textsuperscript{97} Notably, definitions such as those offered by the IAU are of recent provenance and could change again in the future. As recently as August 2006 the IAU downgraded the status of Pluto to that of “dwarf planet.” However, many people alive still count Pluto amongst the “nine planets around the sun,”\textsuperscript{98} or at least identify it as a “celestial body” elevated in the minds of much of humanity even if its designation has been reduced.

\textit{Theories on the Question of What Is Celestial Body}

The common heritage of humanity or the common heritage principle is a principle of international law which holds that defined territory and elements of humanity’s common heritage – cultural and natural – should be held in trust for future generations and be protected from exploitation by nations, entities, or even individuals.\textsuperscript{99} As we can see from the language of the Artemis Accords, clearly Neil Armstrong’s footprint on the Moon and the \textit{Curiosity} rover on Mars should be considered “historically significant human or robotic landing sites.”\textsuperscript{100} The recently concluded agreement between the United States and Japan makes a similar effort to protect “Lunar Sites of Historical or Scientific Value.”\textsuperscript{101}

\begin{thebibliography}{9}
\bibitem{matthews} Dave Mattheams Band, 1994, \textit{Typical Situation}, “Under The Table and Dreaming.” RCA. “Nine planets around the Sun repeat.”
\bibitem{alshadaifat} Alshadaifat, supra note 61, FN 4 at 2.
\bibitem{infra} \textit{Infra} at 80 at § 9.
\bibitem{framework} FRAMEWORK AGREEMENT BETWEEN THE GOVERNMENT OF JAPAN AND THE GOVERNMENT OF THE UNITED STATES OF AMERICA FOR COOPERATION IN THE EXPLORATION AND USE OF OUTER SPACE, INCLUDING THE MOON AND OTHER CELESTIAL
\end{thebibliography}
One of the founders of space law, Argentinian Ambassador, professor, and lawyer Aldo Cocca stated that “the international community [has] endowed that new subject of international law - [humanity] - with the vastest common property (res communis humanitatis) which the human mind could at present conceive of, namely outer space itself, including the Moon and the other celestial bodies [emphasis added].”102 Without defining “celestial bodies” or even “space” itself, is all of space or all matter in the universe to be considered somehow protected as common heritage?” Perhaps select, explicitly catalogued objects within our solar system can and should be, excluding all else. One could imagine, for example, a time when comets would be freely harvested for their water ice and other resources without objection, while humanity finds itself acutely protective of Haley’s Comet or Saturn’s Rings as part of the “common heritage of humanity.”

Terrestrial Analogs

The need to define “celestial bodies” is well established.103 Some approaches draw on the Law of the Sea, The Antarctic Treaty, the concept of res nullius, res communis omnium, as well as numerous intermediate or hybrid combinations of the same.104 One common argument holds that as the laws of the Earth derive from the facts and conditions of the Earth, space law will derive from the facts and conditions of space.105 While the author embraces the unique, emerging, and evolving nature of space law, there are certain corollaries with terrestrial law that can be invoked. For example, while nobody would credibly argue that any entity could claim ownership and exclusive use of the Jovian satellite Europa, just as one would not claim that any individual could seek to claim ownership or exclusive use of all the sand on a public beach, so too would no individual or group of individuals argue that a child could not collect some seashells on that same beach nor that a scientist could not collect samples of the ice and subsurface ocean of Europa.

But where is the limit and to what degree would such a limit inform our understanding and ability to define “celestial body?” Should each of the asteroids targeted by Japan and the United States for sample-return missions be considered as the shared sand or the seashells? Such are the questions when considering celestial bodies and their legal definition, as this definition can then inform political, commercial, scientific, and security considerations and, hopefully, advance the cause of space for all of humanity rather than serve to export our
terrestrial conflicts into the cosmos.

That space should be used for peaceful purposes is not only a foregone conclusion, but an enshrined aspect of international law. Despite the fact that several concepts and provisions of the Outer Space Treaty were modeled on and often compared to the Antarctic Treaty, the Antarctic Treaty is insufficient to understand the OST and cannot be duplicated and merely applied to Outer Space. Other sources of inspiration for space law have come from both common and statutory law such as the Convention on the High Seas, which states that “the high seas being open to all nations, no State may validly purport to subject any part of them to its sovereignty,” and goes on to guarantee the “freedom of fishing.” In considering Space law in the context of maritime law, some objects in Outer Space are more akin to fish, rather than the sea itself or “any part” thereof. Pop similarly compares icebergs with comets to help illustrate this point, drawing similar comparisons to the examples above contrasting seashells with the beach, or individual fish versus the sea.

Movable versus Immovable

One argument, elegantly articulated by Pop, suggests that one should consider and “distinguish between immovables – celestial bodies – and movables in outer space literally,” and that moveability would render it appropriable, and thus outside of Article II of the OST. Smirnoff in his work also notes that the scholarly history on the subject dates to Working Group III of the International Institute of Space Law, which asserted that celestial bodies should be considered, in the legal sense, as “natural objects in outer space ... which cannot be artificially moved from their natural orbits.” While, again, this view and the arguments extending therefrom are hugely helpful, they are incomplete as we must immediately recognize the rapid

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109 Id. at Art. II
110 See Pop, supra note 54, at 57.
111 See Pop, supra note 54, at 53.
112 See Smirnoff, supra note 91, at 13.
advances in technology that would allow an ever growing number of objects in the cosmos to be moved at a later date.

Science fiction literature is replete with story lines envisioning the movement of objects with astounding mass. Archimedes asserted that with a sufficiently long lever he could move the world, and serious theorists have posited strategies to move the earth such that it maintains a favorable position relative to the sun throughout the coming eons to ensure continued habitability. So, again, if one could eventually move the earth itself, any definition of “celestial bodies” would need not only to perhaps specify a list of objects and / or classes of objects more clearly, but perhaps also take into account size, mass, and even current and future technological capabilities of humanity.

Spatial versus Functional / Object Approaches

Another discussion regarding “celestial bodies” relates to the spatial versus functional argument. We recall the metaphor above regarding the seashell on the beach versus the entire quantity of the sand. While this thought experiment helps make a point, it is limited in its practical utility. What, for example, should we do with a child seeking to take home a bucket of sand from the beach? What about two buckets? Where do we draw the line?

Again, Pop provides a helpful, though insufficient understanding of this framework. Pop explains that “[w]here there is no natural boundary, or one cannot discover it, law can set a conventional boundary. Such is the case with the age of legal adulthood.” To elucidate the point, Pop cites Gyula Gal, noting that determining the limits between outer space and air space has confounded experts for decades; Pop also notes that “setting a spatial boundary between territorial sea and the high seas” is also illustrative of the challenges, arbitrariness, and mutability, or relying exclusively on a spatialist approach.

However, noting that one can create an arbitrary boundary between different classes of things does not help determine where that boundary is or should be. Moreover, even within these distinctions, there are limitations and exceptions. Individuals reaching the age of maturity, but possessing serious, violent criminal records are often prohibited from exercising certain rights or engaging in other activities otherwise granted to all other legal adults. Individuals with severe visual impairment, despite otherwise qualifying, are not permitted to operate a motor vehicle. Which crimes would trigger the former, and what degree of visual

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114 See, e.g., Science and Futurism with Isaac Arthur, Planet Ships, (https://www.youtube.com/watch?v=oim7VvUURd8)
115 See Pop, supra note 54, at 52.
116 Ibid. See also, Gyula Gal, Thirty Years of Functionalism, 40 PROC. COLL. L. OUTER SPACE 125 (1997), p 126.
117 Pop, supra note 54, at 52
impairment would impose the latter? How would we qualify our arbitrary, determined definition of “celestial bodies?”

Pop again employs Gal to suggest we consider not the nature of the object or its characteristics, but the actions applied to such objects and how they are to be used – known as a “functionalist” approach. One proposed functional or objective use of a natural space object would be the reformation of the same into a space habitat or space station, losing its natural appearance, together with its possible legal status of “celestial body” by becoming a manmade structure, i.e., legally a space object. The author would suggest that this approach is also insufficient as (a) once an object is deemed a “celestial body” the same prohibitions would apply regardless of the use in most cases, but especially in the use and consumption of the object, and (b) if the item is not deemed a “celestial body” the use to which it is put is irrelevant. Instead, once more, we could consider the idea of functionalism as part of a greater complexity of criteria in defining what is or is not a “celestial body.”

Other Matters for Consideration: Physical Phenomena – Lagrange Points

One other area for consideration when discussing “celestial bodies” is whether or not intangible features should also be considered. What are lawyers and scholars to think of Lagrange Points? Currently, a number of Lagrange Points are occupied by artificial objects, such as the ESA’s Solar and Heliospheric Observatory (SOHO), NASA’s Global Geospace Science (GGS) Wind satellite, NASA’s Advanced Composition Explorer (ACE or Explorer 71), and NOAA’s Deep Space Climate Observatory (L1); and the ESA Gaia probe, the joint Russian-German high-energy astrophysics observatory Spektr-RG, and the NASA, ESA and CSA James Webb Space Telescope (L2). These locations are of great value as, theoretically, less energy would need to be expended to maintain an object, such as a satellite or even a space station, at those locations. In considering the idea of what is or is not a “celestial body” we must also entertain Lagrange Points. If they are to be considered “celestial bodies” their treatment will be governed by one set of principles and restrictions, whereas if they are excluded from this definition, new questions will arise as to whether they should be treated as res communis omnium, and, in that case, whether objects occupying any one Lagrange Point

118 Pop, supra note 54, at 55 referencing Gal supra note 115.
119 One example of such structures are colloquially known as O’Neil Cylinders in reference to their conception by Gerard K. O’Neill. O’Neill Cylinders could be created out of the raw materials of asteroids or other celestial objects through simply hollowing out the body or by refashioning the raw materials themselves. (See, e.g., Gerard K. O’Neill, The Colonization of Space, Physics Today, 27(9):32-40 American Institute of Physics. [September, 1974]; See also, Science and Futurism with Isaac Arthur, O’Neill Cylinders, [Science and Futurism with Isaac Arthur]).
120 A Lagrange point is a location in space where the combined gravitational forces of two large bodies, such as Earth and the sun or Earth and the moon, equal the centrifugal force felt by a much smaller third body. The interaction of the forces creates a point of equilibrium where a spacecraft may be "parked" to make observations, or engage in other activities. https://www.space.com/30302-lagrange-points.html (last retrieved May 31, 2022).
121 https://solarsystem.nasa.gov/resources/754/what-is-a-lagrange-point/
would be subject to the legal framework of “innocent passage.”

POSSIBLE DEFINITIONS AND SOLUTIONS

We cannot consider every speck of dust, natural object, or phenomenon in the cosmos to be a “celestial body.” Beginning from that premise, as well as the self-evident notion that there are objects in the solar system that are indisputably “celestial bodies,” we must determine what is and is not a “celestial body.” We must also accept that prior scholarship is a helpful guide, but insufficient. We must recognize that the proposition offered by Pop,122 that we can limit ourselves merely to the objects (or phenomena) under consideration and not the actors physically interacting with them, has been superseded by national legislation and international agreements, we are forced to engage in a formulaic application of science and law. Some areas for consideration follow.

Current or Near-Term Anticipated Technology

Just as with the beach and seashell analogy described above, looking at what current or near-term anticipated technology might achieve could be a basis for aiding in defining “celestial bodies.” Several private enterprises have declared their intentions to exploit the resources of the solar system both for profit and to support humanity’s expansion into the cosmos, which appears to be permissible if not endorsed by several nations’ commercial space legislation, and international agreements, as described above. Any limitations to these plans lie not with the technical capability to achieve these objectives given sufficient time, but, rather, the legal framework when considering mining and resource exploitation in outer space. While the Outer Space Treaty would seem to prevent any and all such extraterrestrial mining undertakings, there could be a solution if we limit the definition of “celestial body.” If “celestial body” is read to exclude any objects that could be captured, manipulated, or consumed in their entirety within a reasonable period of time, say within the technological capabilities we anticipate being possible within the next 100 years, these proposed activities would not run afoul of the OST.

We must also appreciate the fact, however, that allowing such limitations to the definition of “celestial bodies” alone would not be sufficient, and could undermine the other purposes of the Outer Space Treaty, namely, the peaceful use of Outer Space and the avoidance of the export of terrestrial conflict into Outer Space if it triggered a resource free-for-all that saw nations, entities, and individuals competing over each and every resource as it became accessible. Individuals and entities would need to agree how even these excluded objects would be claimed for ownership, appropriation, and use.

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122 See, Pop, supra note 54
An Arbitrary but Agreeable Definition and the Catalogue of Celestial Bodies

The above criterion of a technology-based, size and mass-derived definition of what is or is not a “celestial body” is, itself, arbitrary. Much like the arbitrary but agreed upon age of maturity for the purposes of certain rights and responsibilities in the myriad terrestrial jurisdictions, national legislation and international agreements could seek to define “celestial bodies” in an arbitrary, but agreeable fashion. In addition to the size and mass as mentioned above, earth-based authorities could establish a list of those objects deemed part of the “Common Heritage of Humanity” and therefore “celestial bodies” within the Solar System, to the exclusion of any and all other objects of any mass. Clearly this list could be subject to revision, much like Pluto found itself expelled from the IAU’s list of “planets” not so long ago.

However, objects or “celestial bodies” would not need to fit into nice and orderly categories but could be individually selected. The author would also propose that any celestial objects heretofore undiscovered or unidentified would not meaningfully be called a “celestial object” protected from appropriation and use in any event, so the list could be exhaustive and would likely get pared down over time rather than expanded. Therefore, in addition to other considerations, we could add an arbitrary agreed date of discovery to the definition of “celestial bodies,” and exclude any and all objects of phenomena discovered thereafter.\(^\text{123}\)

Such a list could recognize that there are certain objects that, due to their role in humanity’s history, either as inspiration for religion, culture, literature, or otherwise, possess a special place and are, thus, the preserved “celestial bodies” of the OST. Most legislative or deliberative bodies would likely include in this list all the named planets, many if not most or all of their natural satellites, as well as numerous asteroid belt and Kuiper belt objects. Beyond this list, however long it may ultimately become, extraterrestrial objects, material, and phenomena might then be available for legally recognizable appropriation and use. Such a formula may be deemed to suit the needs of terrestrial authorities hoping to encourage scientific and economic activity in outer space. While the current international relations climate or the general scope of this issue may make a universally agreed list unlikely at present, beginning to develop such a list via national legislation or via the Artemis Accords could, in time, lend itself to achieving an internationally recognized and agreed inventory of celestial bodies.

CONCLUSION

Humanity rightly sought to preempt the exportation of earthly conflict into the cosmos. In crafting the Outer Space Treaty, the authors of space law’s Magna Carta identified the pressing issues that could, would, and today imminently confront nations and private actors

\(^{123}\) The author would suggest July 20, 2019 to commemorate the 50th anniversary of the first human to set foot on the moon.
Epstein

alike. As technology advances, however, greater clarity is required to refine and define the terms of the OST further in such a way that its purpose – peaceful use of outer space for all humanity, whether scientific or commercial – can be realized. The solutions offered in the past provide laudable guideposts, too, to advance this discussion, though national and international actions, as well as technical and scientific discoveries, reveal that further discussion must continue to define and apply the terms and applicability of the Outer Space Treaty more fully. The above examination of the issue aims to advance that discussion further and provide some additional elements for consideration in determining what is a “celestial body.” Building off the works of the likes of Gorove and Pop, the above analysis and considerations are designed to fill in the outstanding gaps in this field, while remaining flexible in the face of future developments. Take, for example, the possibility that at some future date humanity will discover biology on an otherwise unremarkable object. Whether an asteroid or, more likely, a Kuiper Belt Object, this mass, whatever its size or other characteristics, can quickly be included in the finite list proposed above for protection and preservation, without otherwise altering the proposed “celestial bodies” classification system. To begin, each of the named planets and dwarf planets, along with their largest natural satellites, should be included in such a listing. So too, should the most recognizable comets, such as Haley’s and Hale-Bopp be accepted, despite the fact that the latter will not return to the inner solar system for millennia. Beyond that, the catalogue would be for humanity to decide.

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