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GOVERNING THE UNKNOWN: HOW THE DEVELOPMENT OF INTELLECTUAL PROPERTY LAW IN SPACE WILL SHAPE THE NEXT GREAT ERA OF EXPLORATION, EXPLOITATION, AND INVENTION

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“The urge to explore has propelled evolution since the first water creatures reconnoitered the land. Like all living systems, culture cannot remain static; they evolve or decline. They explore or expire.”¹

INTRODUCTION

Since the beginning of humanity’s time on Earth, individuals have stared up into the sky in awe and wonder. The technological advancements of the five decades since the first successful moon landing have only fueled this sense of curiosity and have done little to satiate humanity’s obsession with the unknown.² In that time, the huge popularization of outer space science fiction, which “centered around who we are, where we’ve been, and where we are going,”³ has exemplified the sentiments of curiosity and fascination with the unknown that have only grown stronger as humanity positions itself to go farther into space.

The development and enforcement of law often follows human necessity. The proliferation of trade via water made societies more interconnected and led to the creation of customs that eventually evolved into formalized maritime law. Similarly, aviation’s expansion from military to commercial and civilian use made the world even smaller and more accessible to humanity, which led to formalized aviation law.

Since its formation in 1945, the United Nations (U.N.) has positioned itself as the world’s facilitator and coordinator of legal and practical standards. While its conventions, treaties, and resolutions lack formal enforcement, the influence of the U.N. cannot be understated, and its continued relevance speaks to its success and the collective consent of its member nations.

The U.N. Outer Space Treaty is widely recognized as the first and most formidable international legal framework regarding space. It formalized the altruistic and humanistic goals for humanity’s future in space, which include a ban on claims of sovereignty and a ban on the installation of weapons of mass destruction. Following the technological advances achieved during both the arms race and the space race amid the Cold War era, and with the popularization and proliferation of both state-

¹ Ivan De Luce, *21 Quotes from the Apollo 11 Astronauts on Everything from Walking on the Moon to the Future of Spaceflight*, BUS. INSIDER (July 15, 2019, 7:09 PM), <https://www.businessinsider.com/quotes-from-the-apollo-11-astronauts-2019-7#buzz-aldrin-on-exploration-21> [<https://perma.cc/EAK5-F5V6>].

² Ian Harris, *Why Are We Obsessed with Space Movies*, MICH. DAILY (Sept. 17, 2019), <https://www.michigandaily.com/section/arts/why-are-we-obsessed-space-movies> [<https://perma.cc/DV8K-LPPM>].

³ *Id.*

sponsored and private explorations of space, intellectual property issues have begun to be raised in connection with extraterrestrial activities.⁴

The disparate aims of both the U.N. Outer Space Treaty—that space is meant for all humanity—and the goals of intellectual property law—to protect the rights of the individual—have yet to be reconciled. A frequently raised issue is the applicability of national or regional patent law in outer space regarding the inventions made and/or used while operating in outer space. According to existing international space law, the state in which the space object is registered retains jurisdiction and control over that space object and would therefore extend its applicable legal framework. In the absence of explicit international rules, registered space objects are treated as quasi-national territory for the purposes of intellectual property. The wheel need not be reinvented; space law, and its relevant issues surrounding intellectual property, will likely follow the development of maritime and aviation law.

I. OFF TO THE RACES

Following World War II, the United States and the former Union of Soviet Socialist Republics (U.S.S.R.) engaged in a tense, symbolic series of “races” running concurrently with the Cold War, as proxies for an actual armed conflict between the reigning superpowers.⁵ Each championed a different type of governance, democracy and communism, respectively, with the victory of the races acting as evidence of the victorious government’s efficiency, political superiority, and economic might.⁶ Two of the more notorious races were the ballistic missile-based nuclear arms race⁷ and the space race.⁸ The “bloodless” battles between the superpowers for both supremacy in nuclear warfare and supremacy in spaceflight were seen by many as products and protections of their respective national pride, necessary for the advancement of their greater national security, and requirements to cement their individual reputations in history.⁹

⁴ *Patent Expert Issues: Inventions in Space*, WORLD INTELL. PROP. ORG., https://www.wipo.int/patents/en/topics/outer_space.html [https://perma.cc/D323-32ZE].

⁵ *Cold War History*, HIST., <https://www.history.com/topics/cold-war/cold-war-history> [https://perma.cc/A7EH-Z3DK].

⁶ *Space Race*, SMITHSONIAN NAT’L AIR & SPACE MUSEUM, <https://airandspace.si.edu/exhibitions/space-race/online/> [https://perma.cc/L2TC-PCXT].

⁷ John Swift, *The Soviet-American Arms Race*, HIST. TODAY (Mar. 2009), <https://www.historytoday.com/archive/soviet-american-arms-race> [https://perma.cc/B6HM-UEDX].

⁸ Adam Mann, *What Was the Space Race?*, SPACE (2019), <https://www.space.com/space-race.html> [https://perma.cc/WZ8P-MUEA].

⁹ Dominic Sandbrook, *The Space Race: How Cold War Tensions Put a Rocket Under the Quest for the Moon*, SCI. FOCUS (July 4, 2019, 3:17 PM), <https://www.sciencefocus.com/space/the-space-race-how-cold-war-tensions-put-a-rocket-under-the-quest-for-the-moon/> [https://perma.cc/GG6C-MWSW].

The nuclear arms race began in August 1942 when the U.S. government established the Manhattan Project to develop and produce the world's first nuclear weapons.¹⁰ With the bombings of Hiroshima on August 6 and Nagasaki on August 8 in Japan in 1945, the U.S. remains the only nation on the planet “to have used a nuclear weapon in wartime.”¹¹ On January 24, 1946, the U.N. responded to the atrocities by calling for the complete elimination of nuclear weapons with the adoption of its very first resolution, Resolution 1. This resolution established a commission, reporting to the U.N. Security Council, to ensure “the elimination from national armaments of atomic weapons and all other major weapons adaptable to mass destruction,” among other responsibilities.¹² Suddenly, the organization that the U.S. and the other founding members worked diligently to establish “[t]o maintain international peace and security . . .” was, in its first formal action, indirectly sanctioning nuclear development spearheaded by the U.S.¹³ In this tenuous post-World War II era, the U.S. justified its rampant and unprecedented development and buildup of nuclear weapons with its “containment” strategy of the Soviet threat, as described by George Kennan before the U.S. Congress in 1947.¹⁴ With ever-increasing tensions between the two nations and their strategies of nuclear mutually assured destruction, the U.S. and U.S.S.R. dumped radioactive waste into the atmosphere and shaped a generation of humans in constant fear of nuclear annihilation.¹⁵ The Cold War ended in 1991 with the dissolution of the U.S.S.R.,¹⁶ but the goal of a nuclear-free world and the official end of the nuclear arms race continues to elude the global community to this day.¹⁷

The space race began in 1957 with the U.S.S.R. launching the first intercontinental ballistic missile (ICBM) into space, the first artificial

¹⁰ *The Manhattan Project*, ATOMIC HERITAGE FOUND., <https://www.atomicheritage.org/history/manhattan-project> [<https://perma.cc/5KK6-VLP2>].

¹¹ *United States: Nuclear*, NUCLEAR THREAT INITIATIVE (July 2017), <https://www.nti.org/learn/countries/united-states/nuclear> [<https://perma.cc/T6RH-XDTR>].

¹² G.A. Res. 1 (I), at 9 (Jan. 24, 1946).

¹³ U.N. Charter art. 1, ¶ 1.

¹⁴ HIST., *supra* note 5.

¹⁵ *Id.*

¹⁶ *The End of the Cold War*, ATOMIC ARCHIVE, <https://www.atomicarchive.com/history/cold-war/page-22.html> [<https://perma.cc/94VJ-KUQL>].

¹⁷ See Simon Tisdall, *The Nuclear Arms Race is Back . . . and Ever More Dangerous Now*, THE GUARDIAN (Aug. 17, 2019, 9:00 AM), <https://www.theguardian.com/world/2019/aug/17/nuclear-arms-race-is-back-and-more-dangerous-than-before> [<https://perma.cc/RF6Q-BANN>].

satellite in space with Sputnik 1, and the first dog in orbit with Sputnik 2, also known as “Muttnick.”¹⁸

With these displays of superior technological achievement, the Soviets loudly claimed victory in the first, and incredibly crucial, leg of the space race.¹⁹ In rapid response to the actions taken by the Soviets, the U.S. launched its own satellite, Explorer I, the following year.²⁰ President Dwight D. Eisenhower cemented the U.S.’ commitment to the continuous development of spaceflight technology and the greater exploration of space with the signing of the National Aeronautics and Space Act into law on July 29, 1958, formally establishing the National Aeronautics and Space Administration (NASA).²¹ The two superpowers traded minor spaceflight achievements until, on April 12, 1961, the U.S.S.R. launched the first man into space, Yuri Gagarin.²² Gagarin circled the Earth for 108 minutes and became a Soviet national hero.²³ The U.S. responded with the climactic success of the Apollo 11 mission in 1969, accomplishing its primary objective, as set out by President John F. Kennedy in 1961, to “perform a crewed lunar landing and return to Earth.”²⁴ As tensions between the U.S. and the U.S.S.R. began to wane, the first cooperative Apollo-Soyuz mission was launched in mid-1975, where “the two commanders, Tom Stafford and Alexei Leonov exchange[d] the first international handshake [in space]. This act can be seen to symbolically end the Space Race. . . .”²⁵ Since the first moon landing by the U.S. in 1969, space exploration has become increasingly collaborative, as evidenced by the development of other national space programs, as well as the development of and continuous cooperation required for the success of the International Space Station (ISS).²⁶

¹⁸ Elizabeth Howell, *Sputnik: The Space Race’s Opening Shot*, SPACE (Sept. 29, 2020), <https://www.space.com/17563-sputnik.html> [https://perma.cc/PLH2-UBV7].

¹⁹ See *The Sputnik Shock*, THE GLOBALIST (Oct. 3, 2007), <https://www.theglobalist.com/sputnik-shock/> [https://perma.cc/34CN-FL3B].

²⁰ *Mission to Earth: Explorer I*, NASA JET PROPULSION LAB’Y CAL. INST. OF TECH., <https://www.jpl.nasa.gov/missions/explorer-1/> (last visited May 12, 2021).

²¹ See Steven J. Dick, *Why We Explore*, NASA (Mar. 28, 2008), https://www.nasa.gov/exploration/whyweexplore/Why_We_29.html [https://perma.cc/VCE6-KVX9].

²² Nola Taylor Redd, *Yuri Gagarin: First Man in Space*, SPACE (Oct. 12, 2018), <https://www.space.com/16159-first-man-in-space.html> [https://perma.cc/7C7V-2RHU].

²³ *Id.*

²⁴ *Apollo 11 Mission Overview*, NASA, https://www.nasa.gov/mission_pages/apollo/missions/apollo11.html/ [https://perma.cc/94ZE-KHDM].

²⁵ *Space Race Timeline*, ROYAL MUSEUMS GREENWICH, <https://www.rmg.co.uk/discover/explore/space-race-timeline> [https://perma.cc/35AS-TBMG].

²⁶ *History and Timeline of the ISS*, ISS NAT’L LAB’Y, <https://www.issnationallab.org/about/iss-timeline/> [https://perma.cc/V7YX-ZVCM].

The overlap of the arms race and the space race was exemplified by the U.S.S.R.'s successful launch of an ICBM into space in 1957, after both a successful atomic bomb test in 1949²⁷ and thermonuclear bomb test in 1953.²⁸ Suddenly, the nuclear threat no longer required delivery by a mounted bomber but instead could be launched and detonated remotely, a capability that continues to terrorize the world today.²⁹ Both the U.S. and the U.S.S.R. poured incredible amounts of human and financial capital into the development of nuclear arms and anti-missile defense systems, with critics questioning the necessity of such actions and lamenting them as waste.³⁰ It was within this context that the U.N. took action.

II. U.N. ACTION FOR SPACE

In 1966, the United Nations passed the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, otherwise known as the Outer Space Treaty.³¹ The treaty addressed and established key international, and now extraterrestrial, principles, including Article 1, which reads:

The exploration and use of outer space, including the Moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, . . . and shall be the province of all mankind.

Outer space, including the Moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies.

There shall be freedom of scientific investigation in outer space, including the Moon and other celestial bodies, and States shall facilitate and encourage cooperation in such investigation.³²

And Article II, which reads, "Outer space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of

²⁷ *Soviet Atomic Program – 1946*, ATOMIC HERITAGE FOUND. (June 5, 2014), <https://www.atomicheritage.org/history/soviet-atomic-program-1946> [<https://perma.cc/ZDK6-PQEA>].

²⁸ *Soviet Hydrogen Bomb Program*, ATOMIC HERITAGE FOUND. (Aug. 8, 2014), <https://www.atomicheritage.org/history/soviet-hydrogen-bomb-program> [<https://perma.cc/3AYA-EY8Q>].

²⁹ *Id.*

³⁰ William J. Broad, *From the Start, the Space Race Was an Arms Race*, N.Y. TIMES (Sept. 25, 2007), <https://www.nytimes.com/2007/09/25/science/space/25mili.html> [<https://perma.cc/ASQ7-W7JH>].

³¹ G.A. Res. 2222 (XXI), at 13 (Dec. 19, 1966).

³² *Id.*

sovereignty, by means of use or occupation, or by any other means.” Similar sentiments of equal and altruistic use and the recognition of humanity’s common goal of exploration are echoed in the Antarctic Treaty, signed twelve years prior in 1959.³³ In the mid-1900s, territorial positions taken within Antarctica “creat[ed] a tension that threatened [invaluable] scientific cooperation.”³⁴ The Antarctic Treaty has been “recognised as one of the most successful international agreements. Problematic differences over territorial claims have been effectively set aside and as a disarmament regime it has been outstandingly successful.”³⁵ It is no wonder that the drafters of the U.N. Outer Space Treaty incorporated similar sentiments in an attempt to repeat some of the success of the Antarctic Treaty in both the realms of sovereignty and nuclear disarmament.

While reaffirming basic principles on exploration and use established in a previous resolution,³⁶ the U.N. Outer Space Treaty also sought to address the multitude of issues posed by the development and use of nuclear arms and spaceflight technology.³⁷ The U.N. addressed those concerns with Article IV, which reads, “[p]arties to the Treaty undertake not to place in orbit around the Earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction, install such weapons on celestial bodies, or station weapons in outer space in any other manner.”³⁸ The U.N. Outer Space Treaty, with 109 signatories, was proposed and signed during the height of the Cold War and stressed repeatedly that space was to be used for “peaceful purposes,” formalizing the global wish to keep *all* weapons, including weapons of mass destruction, out of space.³⁹ The sweeping, indiscriminate language has been said to have been “a direct product of the Cold War and ‘primarily addresses concerns of that era,’” which by most accounts was rapid nuclear proliferation.⁴⁰ Scholars across

³³ Loren Grush, *How an International Treaty Signed 50 Years Ago Became the Backbone for Space Law*, THE VERGE (Jan. 27, 2017, 11:14 AM), <https://www.theverge.com/2017/1/27/14398492/outer-space-treaty-50-anniversary-exploration-guidelines> [https://perma.cc/XT27-CQ32].

³⁴ *The Antarctic Treaty Explained*, BRITISH ANTARCTIC SURV., <https://www.bas.ac.uk/about/antarctica/the-antarctic-treaty/the-antarctic-treaty-explained/> [https://perma.cc/3XS3-D652].

³⁵ *Id.*

³⁶ G.A. Res. 1962 (XVIII), at 15 (Dec. 13, 1963).

³⁷ Daryl Kimball, *The Outer Space Treaty at a Glance*, ARMS CONTROL ASS’N (Oct. 2020), <https://www.armscontrol.org/factsheets/outerspace> [https://perma.cc/BCL6-NJEW].

³⁸ G.A. Res. 2222 (XXI), at 14 (Dec. 19, 1966).

³⁹ David Lenefsky, *Abandoning Treaties: Is the Outer Space Treaty Next?*, N.Y. L.J. (Oct. 17, 2019, 12:00 PM), <https://www.law.com/newyorklawjournal/2019/10/17/abandoning-treaties-is-the-outer-space-treaty-next/> [https://perma.cc/XTZ2-75MC].

⁴⁰ Cristin Finnigan, *Why the Outer Space Treaty Remains Valid and Relevant in the Modern World*, SPACE REV. (Mar. 12, 2018), <https://www.thespacereview.com/article/3448/1> [https://perma.cc/27XW-Q2FX].

the globe have lamented the treaty's simultaneously broad yet limiting language and many are clamoring for an update, as the treaty has not aged well in the fifty years since it was ratified.⁴¹ It is no wonder that it has not withstood the test of time, as the drafters of the U.N. Outer Space Treaty were not at that point faced with the immediate effects of private commercial space companies and their activities. Instead, they were primarily concerned with the actions of national governments.

Certain major signatories to the U.N. Outer Space Treaty have recently created controversy. For example, the U.S. passed the updated Commercial Space Launch Competitiveness Act of 2015, which explicitly allows citizens of the U.S. to engage in commercial space exploration and in the exploitation of space resources.⁴² Luxembourg followed suit with a similar law in 2016.⁴³ These laws stand in direct violation of Article VI of the U.N. Outer Space Treaty, which states that “the activities of non-governmental entities shall require authorization and continuing supervision by the appropriate State Party,” to ensure conformity with the treaty.⁴⁴ This “has served as a continuing source of confusion for the U.S. government and for U.S. companies and citizens that plan to operate in outer space”⁴⁵

The intent of the U.S. Space Competitiveness Act is to allow private sector American businesses the legal opportunity to build and protect a robust commercial outer space economy, but does so seemingly against the principles established in the U.N. Outer Space Treaty.⁴⁶ The ethereal situation has instead been interpreted with the understanding that:

Article VI is not self-executing . . . [which] means that it does not have the force of law within the US without an explicit act of Congress applying it to a

⁴¹ Jill Stuart, *The Outer Space Treaty Has Been Remarkably Successful – But Is It Fit for the Modern Age?*, THE CONVERSATION (Jan. 28, 2017, 3:59 AM), <https://theconversation.com/the-outer-space-treaty-has-been-remarkably-successful-but-is-it-fit-for-the-modern-age-71381> [<https://perma.cc/VHG6-5UQZ>].

⁴² U.S. Com. Space Launch Competitiveness Act, 51 U.S.C. § 10101 (2021).

⁴³ *Star Wars: Protecting and Exploiting IP in Space*, WORLD INTELL. PROP. REV. (Apr. 12, 2019), <https://www.worldipreview.com/contributed-article/star-wars-protecting-and-exploiting-ip-in-space> [<https://perma.cc/2KBV-PRCN>].

⁴⁴ G.A. Res. 2222 (XXI), at 14 (Dec. 19, 1966).

⁴⁵ Laura Montgomery, *US Regulators May Not Prevent Private Space Activity on the Basis of Article VI of the Outer Space Treaty 3* (2018) (unnumbered working paper) (on file with Mercatus Ctr at Geo. Mason Univ.) <https://www.mercatus.org/system/files/montgomery-outer-space-treaty-mercatus-working-paper-v1.pdf> [<https://perma.cc/K5WU-RYFT>].

⁴⁶ See Jacob Aron, *US SPACE Act Extends Easy Ride for Commercial Space Ventures*, NEW SCIENTIST (May 22, 2015), <https://www.newscientist.com/article/dn27583-us-space-act-extends-easy-ride-for-commercial-space-ventures/> [<https://perma.cc/K7VW-8ZVB>].

private space activity and assigning authority over that specific activity to whatever regulatory agency Congress considers most appropriate.⁴⁷

There is also an interpretation of the U.N. Outer Space Treaty that would allow for the exploitation of materials mined or otherwise gathered in space, “so long as the nation conducting the space mining activity does not lay claim to the celestial body,” though not everyone agrees.⁴⁸ While the U.N. Outer Space Treaty lacks enforceability, it remains the fallback for governance over space exploration and is often the first place where industry experts look for guidance when contemplating the greater legal questions that the proliferation of commercial space exploration and exploitation poses.⁴⁹

Article VIII of the U.N. Outer Space Treaty somewhat addresses questions of jurisdiction and governance by establishing a mechanism for a signatory state to extend its sovereign jurisdiction to space objects launched or constructed by that state. However, it sets up neither a legal framework nor enforcement mechanism for the U.N., nor for any other international governing body, to enforce this treaty or subsequent agreements.⁵⁰ While this is problematic, it is not unprecedented, as we have seen examples throughout history where jurisdiction and enforcement were challenged by time and distance and methods were developed to overcome them.

III. WHAT THE DEVELOPMENT OF MARITIME & AVIATION LAW CAN TEACH US

The development of maritime law over the centuries was due in large part to necessity created by human ingenuity. While the “transportation of goods and passengers by water is the most ancient channel of commerce on record,” it was not until the development of complex and interconnected economies that societies felt the need to develop formal rules of the waterways beyond local custom.⁵¹ The laws led to predictable treatment of merchants and their vessels, which in turn led to a sense of security and contributed greatly to flourishing economic success.⁵² These early maritime laws were uniform, “suitable to the needs of a community which knows no

⁴⁷ See Hailegabriel Gedecho, *Historical Development of Maritime Law*, ABYSSINIA L. (July 20, 2013), <https://www.abyssiniainlaw.com/study-on-line/item/1072-historical-development-of-maritime-law> [<https://perma.cc/ZEZ3-FUU9>].

⁴⁸ Stefan Paterson & Robert Wulff, *The Role of Intellectual Property in Space*, SPACETECH ASIA (July 31, 2018), <https://www.spacetechnasia.com/the-role-of-intellectual-property-in-space/> [<https://perma.cc/BU35-4FBW>].

⁴⁹ Kimball, *supra* note 37.

⁵⁰ G.A. Res. 2222 (XXI), at 14 (Dec. 19, 1966).

⁵¹ Gedecho, *supra* note 47.

⁵² *Id.*

national boundaries,” though this uniformity saw a marketable decline with the rise of nationalism and the expanded reach of Western society and ships.⁵³ Modern efforts have been made to reverse this trend and continue on the quest towards uniformity, most decidedly with the founding of the International Maritime Organization in 1948 and its commitment to the “efficient regulation of safety and security of shipping and the prevention and control of pollution by ships.”⁵⁴

The basics of maritime law are as follows: If you are within up to twelve nautical miles from a coastal State’s baseline, defined as the low-water line along the seashore of a sovereign nation, you are within that State’s territorial sea, where that State has sovereignty and jurisdiction.⁵⁵ The rights of the sovereign State are limited somewhat by the concept of innocent passage, where “[a] vessel . . . may traverse the coastal [S]tate’s territorial sea continuously and expeditiously, not stopping or anchoring,” without causing disruption.⁵⁶ Extending from the territorial zone and up to a maximum of twenty-four nautical miles from the baseline, a State may establish a contiguous zone where that State has a more limited set of rights, specifically “the right[s] to both prevent and punish infringement of fiscal, immigration, sanitary, and customs laws.”⁵⁷ Reaching even further than the contiguous zone, a State “may claim an Exclusive Economic Zone (EEZ) that extends 200 nautical miles from the baseline,” where that State has the exclusive right to harvest natural resources.⁵⁸ Beyond the established EEZs lie international waters, also known as the “high seas,” where the vessel must adhere to the laws of the country in which it is registered.⁵⁹

Explaining the basics of maritime law in other words: A vessel may be registered in whatever country it wishes, and while traveling in international waters, the laws of the State in which it is registered are applicable to all activity onboard the ship.⁶⁰ When that vessel has entered

⁵³ *Id.*

⁵⁴ *Reducing Administrative Burdens*, INT’L MAR. ORG. (2019), <http://www.imo.org/en/OurWork/rab/Pages/default.aspx> [<https://perma.cc/F8U4-TLJ8>].

⁵⁵ TUFTS UNIV., *LAW OF THE SEA: A POLICY PRIMER* 12, (John Bhurgess et al. eds., 2017), <https://sites.tufts.edu/lawofthesea/files/2017/07/LawoftheSeaPrimer.pdf> [<https://perma.cc/P2V7-V48G>].

⁵⁶ Simon Williams, *Maritime Security: The Concept of Innocent Passage*, THE MAR. EXEC. (Dec. 17, 2014, 3:38 AM) <https://www.maritime-executive.com/features/Maritime-Security-Private-The-Concept-of-Innocent-Passage> [<https://perma.cc/LA7W-4MQJ>].

⁵⁷ TUFTS UNIV., *supra* note 55, at 12.

⁵⁸ *Id.* at 60.

⁵⁹ *Id.* at 6.

⁶⁰ Jules Suzdaltsev, *What Laws Apply In International Waters?*, SEEKER (Nov. 3, 2015, 12:00 AM), <https://www.seeker.com/what-laws-apply-in-international-waters-1792719537.html> [<https://perma.cc/4L4D-P2RC>].

the contiguous zone of a specific coastal State, it is then subject to that State's limited rights.⁶¹ Once the vessel has crossed into the territorial waters of that State, the applicable laws onboard switch to those of that sovereign State.⁶² The vessel itself never changes, but its relative position causes its governing laws to change.

A similarly bumpy development history can also be observed in aviation law. Real property rights used to be informed by the Latin maxim *cuius est solum, eius est usque ad coelum et ad inferos*, translated to "whoever's is the soil, it is theirs all the way to Heaven and all the way to Hell."⁶³ The invention and proliferation of military and commercial aircraft made the application of the *ad coelum* maxim as applied to real property rights untenable, since passing aircraft would commit trivial trespass violations whenever it passed over someone's land without permission.⁶⁴ In 1946, the U.S. Supreme Court decided *US v. Causby*, which rejected the government's claim to "possess" air space down to ground level and held that title to land includes domain over lower altitudes.⁶⁵ As a result, the maxim of *ad coelum* as it applied to privately owned, real property was out, and suddenly the federal government held exclusive "air rights" over its domestic airspace above the low-altitude levels of private landowners and extending into space.⁶⁶

The commercial airplanes themselves and their ever-increasing range of travel and capacity for passengers caused their own unique headaches. Recognizing the increased popularity of international air travel and the need for regulation, the Convention on International Civil Aviation, also known as the Chicago Convention, was signed in late 1944 and established the International Civil Aviation Organization (ICAO), a specialized agency of the U.N., to coordinate international air travel and standards of aviation.⁶⁷ At the time of signing, World War II had not yet ended and "[m]any of the countries . . . represented were still occupied," yet the delegates met to "promote cooperation" and "create and preserve friendship

⁶¹ TUFTS UNIV., *supra* note 55, at 12.

⁶² *Id.*

⁶³ Kurt Kohlstedt, *From Heaven to Hell: Exploring the Odd Vertical Limits of Land Ownership*, 99% INVISIBLE (June 19, 2017), <https://99percentinvisible.org/article/heaven-hell-exploring-odd-vertical-limits-land-ownership/> [https://perma.cc/2L3T-PC9T].

⁶⁴ *Id.*

⁶⁵ *United States v. Causby*, 328 U.S. 256, 262 (1946).

⁶⁶ Kohlstedt, *supra* note 63.

⁶⁷ See *Convention on International Civil Aviation – Doc 7300*, ICAO, <https://www.icao.int/publications/pages/doc7300.aspx> [https://perma.cc/K8J9-D9XW].

and understanding among the nations and peoples of the world.”⁶⁸ The ICAO has no regulatory power but instead “facilitates consensus among its member states . . . which form the basis for actions by [those] states to implement procedures, practices, services, facilities and regulations that will meet the objective of the standard or recommended practice.”⁶⁹

The governance of human behavior that occurs while on an airplane in flight presents additional complexities. According to the Convention on Offenses and Certain Other Acts Committed on Board Aircraft, otherwise known as the Tokyo Convention, signed in 1963, jurisdiction is given “to the airline’s country of registration . . . [and] leaves the door open for several other nations to . . . exercise their criminal jurisdiction, including the country of the offender [and] of the victim (if there is one).”⁷⁰ Still, there are loopholes and the ICAO has attempted repeatedly to close them. Most recently in 2014 when the ICAO adopted the Montreal Protocol, which extends potential jurisdiction to “the states in which the operator is located and that [of] the destination of the flight (including a state to which a flight may be diverted),” although it has yet to receive the required number of accession nations for ratification.⁷¹ By creating a plethora of options for jurisdiction for the prosecution of an individual who allegedly commits a crime while an aircraft is in flight, the U.N. is attempting to create a legal framework to prevent perpetrators from walking free.⁷²

Within a decade of the *Causby* decision, air rights once again required an overhaul. With the invention and proliferation of state-sponsored and commercial spaceflight, spacecraft suddenly found themselves in the same position as aircraft had been before them: by passing over privately owned and government-controlled property on their route to space or, in the case of satellites in non-geosynchronous orbit, as they rotated around the Earth, the space objects continuously committed trespass violations. This challenged established notions of the upward bounds of national sovereignty, which at that point had simply replaced that of the private

⁶⁸ *The History of the ICAO and the Chicago Convention*, ICAO, <https://www.icao.int/about-icao/History/Pages/default.aspx> [https://perma.cc/MTK3-DSKC].

⁶⁹ *How Changing ICAO Standards Impact Business Aviation*, NAT’L BUS. AVIATION ASS’N (Mar. 13, 2017), <https://nbaa.org/aircraft-operations/international/customs-and-regulatory-issues/changing-icao-standards-impact-business-aviation/> [https://perma.cc/Y752-4QW3].

⁷⁰ Louis Cheslaw, *What Happens When a Law Is Broken on a Plane*, CONDÉ NAST TRAVELER (July 8, 2019), <https://www.cntraveler.com/story/what-happens-when-a-law-is-broken-on-a-plane> [https://perma.cc/Z3PK-KENZ].

⁷¹ Judy R. Nemsick, *Trump Administration Could Ratify Montreal Protocol 2014 Addressing Unruly Airline Passengers*, HOLLAND & KNIGHT (Jan. 20, 2017), <https://www.hklaw.com/en/insights/publications/2017/01/trump-administration-could-ratify-montreal-protoco> [https://perma.cc/KJ3L-PCWZ].

⁷² Cheslaw, *supra* note 70.

landowner, as this “does not correspond with the realities of the use of space as they have developed.”⁷³ While it is generally understood that the vertical limit of state sovereignty, is somewhere between nineteen miles above Earth, which is the altitude of the highest airplanes and balloons, and ninety-nine miles above Earth, which is the altitude of the lowest orbiting satellites,⁷⁴ no state has ever explicitly established a vertical limit.⁷⁵ As recently as 2018, the U.N. Committee on the Peaceful Uses of Outer Space has called upon its greater members to seriously pursue a multilateral legal solution regarding “the delimitation of the boundary between airspace and outer space,” highlighting this issue’s poignancy and the potential solution’s practical application.⁷⁶ Much like the Montreal Protocol, by asking the member nations to pursue this issue of formally delineating airspace from outer space, the U.N. is attempting to avoid future jurisdictional issues that may allow potential wrongdoers to walk free.

IV. PARALLELS IN THE DEVELOPMENT OF SPACE LAW

The development of space law has somewhat paralleled the development we have observed in maritime and aviation law; that is, it has developed in response to necessity. The U.N. signed the Outer Space Treaty in 1966, laying out the foundational legal principles with regards to space exploration and scientific pursuit, by which the signatory nations have promised to abide.⁷⁷ Similar to the establishment of the International Maritime Organization (IMO) and the ICAO, whose main functions are to facilitate consensus among member states, the U.N. established the Office for Outer Space Affairs, which “works to promote international cooperation in the peaceful use and exploration of space. . . .”⁷⁸ Even with the existence of the Office for Outer Space affairs, the signatories of the Outer Space Treaty are left to regulate their own adherence, and that of private actors within their borders, to the treaty and its subsequent amendments. This condition has caused significant confusion and debate,

⁷³ FRANCIS LYALL & PAUL B. LARSEN, *SPACE LAW: A TREATISE* 164 (2009).

⁷⁴ See Wendover Prods., *Space Law – What Laws are There in Space?*, YOUTUBE (Feb. 6, 2016), https://www.youtube.com/watch?v=h6AWAoc_Lr0 [<https://perma.cc/YCH7-VVZG>].

⁷⁵ See Dean N. Reinhardt, *The Vertical Limit of State Sovereignty*, 72 J. AIR L. & COM. 65, 66 (2007).

⁷⁶ Comm. on the Peaceful Uses of Outer Space, Rep. of the Legal Subcomm. on Its Fifty-Seventh Session, ¶ 4, U.N. Doc. A/AC.105/C.2/L.302 (2018).

⁷⁷ See G.A. Res. 2222 (XXI), at 13 (Dec. 19, 1966).

⁷⁸ About Us, U.N. OFF. FOR OUTER SPACE AFFS., <https://www.unoosa.org/oosa/en/aboutus/index.html> [<https://perma.cc/U886-8AR9>].

as discussed in Section III of this Note, regarding the U.S. Commercial Space Launch Competitiveness Act.⁷⁹

An additional development parallel to maritime law specifically is the matter surrounding “innocent passage.” The issue of the extent to which national sovereignty is absolute has been debated for centuries. Its amorphous actuality was expressed by Chief Justice Marshall in 1812 in *Schooner Exchange v. McFadden* with the holding that “all sovereigns have consented to a relaxation in practice, in cases under certain peculiar circumstances, of that absolute and complete jurisdiction within their respective territories which sovereignty confers.”⁸⁰ Chief Justice Marshall’s articulation of the indefiniteness of national sovereignty inherent in a highly-interconnected and interdependent world helps explain and rationalize the maritime custom of innocent passage.⁸¹ With the current lack of a clear and uniform delineation between sovereign airspace and universal outer space, “a good case can be made for the existence at the present time of a customary rule of international space law permitting the innocent passage of space vehicles through national airspace.”⁸² Innocent passage should not be understood to mean free passage in navigable airspace into outer space, as launches require intense planning and coordination with a multitude of logistical bodies.⁸³ For most U.S.-based commercial spaceflight companies, the airspace required for launch into space lies within the domestic borders of the U.S. or exists over international waters where passage is permissible. However, with the further proliferation of international spaceports and launch sites, greater discussion and coordination between nations, potentially regarding innocent passage in airspace, will be required to ensure the safety and success of commercial space companies.⁸⁴

The governance of criminal conduct perpetrated while in space closely follows what was discussed in Section III with regards to jurisdiction of conduct while in aviation flight. Article VIII of the Outer Space Treaty states, “[a] State Party to the Treaty on whose registry an object launched into outer space is carried shall retain jurisdiction and control over such object, and over any personnel thereof, while in outer space or on a

⁷⁹ Montgomery, *supra* note 45, at 3.

⁸⁰ *Schooner Exch. v. McFaddon*, 11 U.S. 116, 136 (1812).

⁸¹ *See United States v. Causby*, 328 U.S. 256, 260–61 (1946).

⁸² Carl Q. Christol, “*Innocent Passage*” in *the International Law of Outer Space*, 7 U.S.A.F. JAG L. REV. 22, 29 (1965).

⁸³ *See* Christian Davenport, *Companies in the Cosmos: Gridlock in the Sky*, WASH. POST (Dec. 12, 2018), <https://www.washingtonpost.com/graphics/2018/business/spacex-falcon-heavy-launch-faa-air-traffic/> [<https://perma.cc/8XS9-6SFB>].

⁸⁴ *See id.*

celestial body.”⁸⁵ In other words, if a crime occurs on a spacecraft of a specific country, that country retains jurisdiction as an extension of its national sovereignty.⁸⁶ This is not a novel concept, as sovereign nations already have the ability to extend their legal power beyond their territorial boundaries through extraterritorial jurisdiction; Article VII simply formalizes its pertinency in space.⁸⁷

While applicability is straightforward on spacecrafts manufactured or registered with one nation, the jurisdiction determination is muddier on collaborative spacecraft, such as the International Space Station. In 1998, representatives from fifteen participating nations signed the International Space Station Intergovernmental Agreement (IGA), which states, “each Partner shall retain jurisdiction and control over the elements it registers . . . and over personnel in or on the Space Station who are its nationals.”⁸⁸ In determining the appropriate jurisdiction concerning an alleged crime committed on the ISS, in what module on the ISS the crime was committed, to whom the module was registered, the nationality of the perpetrator, and the nationality of the victim are all considered and weighed.⁸⁹ The agreement also stipulates extradition rights among the participant nations such that if a crime were committed which affected the life or wellbeing of a citizen of a State other than that of the perpetrator, the victim’s nation would have the ability to extradite that individual, regardless of the existence of a formal extradition treaty between those two nations.⁹⁰

Experts applaud the efforts of the IGA for “anticipat[ing] a wide variety of problems and pitfalls, and [for] provid[ing] creative solutions,” and commend the document’s acknowledgement that “the expansion of human activity into outer space is evolutionary in nature, and will require many more decades of negotiations, addendums, and revisions.”⁹¹ As humanity increases its activities in outer space, future agreements will require this level of ingenuity and flexibility.

⁸⁵ G.A. Res. 2222 (XXI), at 14 (Dec. 19, 1966).

⁸⁶ Chelsea Gohd, *Who Investigates a Crime in Space?*, SPACE (Aug. 29, 2019), <https://www.space.com/who-investigates-space-crime.html> [<https://perma.cc/EAH7-VNG3>].

⁸⁷ Extraterritorial Jurisdiction, NAT’L ACTION PLANS ON BUS. AND HUM. RTS., <https://globalnaps.org/issue/extraterritorial-jurisdiction/> [<https://perma.cc/MWF4-ZHDD>].

⁸⁸ Agreement Concerning Cooperation on the Civil International Space Station art. 5, Jan. 29, 1998, T.I.A.S. No. 12,927.

⁸⁹ *See id.*

⁹⁰ Agreement Concerning Cooperation on the Civil International Space Station art. 22, Jan. 29, 1998, T.I.A.S. No. 12,927.

⁹¹ Becky Ferreira, *What Happens When an Astronaut Commits a Crime in Space?*, VICE (Feb. 11, 2015, 4:00 AM), https://www.vice.com/en_us/article/ezvqmk/what-happens-when-an-astronaut-commits-a-crime-in-space [<https://perma.cc/HL27-DWQ5>].

V. A FEW OF THE PROBLEMS FACING
INTELLECTUAL PROPERTY LAW IN SPACE

With the development and success of national and private space programs, we find ourselves on the cusp of the next great exploration age. But in order to achieve this, “governments must have relevant, effective regulation to ensure that they meet their international legal obligations and to provide a degree of stability and predictability for commercial companies in space and their investors.”⁹² The momentum in the commercial space industry fueled in part by the advancements of Blue Origin, SpaceX, and Virgin Galactic has only highlighted the “need to ensure that their intellectual property . . . is protected.”⁹³ There are inherent tensions between the stated goals of the U.N. Outer Space Treaty, to protect outer space and ensure its benefits for all mankind—and intellectual property law—and to protect “private interests for the benefit of the rights holder at the expense of all others[,]” and action should be taken now to reconcile these diasporic objectives.⁹⁴

As explained, Article VIII of the U.N. Outer Space Treaty extends the jurisdiction of the State with whom the space object is registered. The intellectual property laws of that state will also govern the use of technology and the development of intellectual property aboard that spacecraft.⁹⁵ The geographical limitations that protect intellectual property on Earth would add additional layers of complexity in space, as, “U.S. patents . . . do not confer rights of action against those who infringe outside the borders of the U.S.”⁹⁶ A product patented within the U.S. and manufactured aboard a U.S.-registered spacecraft or module could also be manufactured next door in a foreign-registered spacecraft or module with no patent infringement. There are numerous import and export issues as well. A person carrying a patented product from one spacecraft or colony module to another, each under separate jurisdictions, could inadvertently infringe upon those patent rights or expose the product to jurisdictions where it has no registered patent protections, much to the chagrin of the patent holder.⁹⁷

⁹² Joanne Gabrynowicz, *Space Is a New Frontier, and so Are the Laws Governing It*, WASH. POST (Feb. 4, 2016, 2:18 PM), <https://www.washingtonpost.com/news/in-theory/wp/2016/02/04/space-is-a-new-frontier-so-are-the-laws-governing-it/> [<https://perma.cc/DDY8-M963>].

⁹³ Paterson & Wulff, *supra* note 48.

⁹⁴ *Id.*

⁹⁵ See *Star Wars*, *supra* note 43.

⁹⁶ J. Jonas Anderson, *Hiding Behind Nationality: The Temporary Presence Exception and Patent Infringement Avoidance*, 15 MICH. TELECOMM. & TECH. L. REV. 1, 2 (2008).

⁹⁷ Paterson & Wulff, *supra* note 48.

The issues posed by transnational technologies are nothing new. They may not require an evolution of traditional territorial patent limits, but they may require an extension.⁹⁸ For instance, the Paris Convention for the Protection of Industrial Property has been applied in such a way that, “if ships, aircraft or land vehicles temporarily visit foreign countries, their owners are not required to obtain licenses on patents in force in these countries in order to avoid infringing such patents.” This is a concept commonly known as the “doctrine of temporary presence.”⁹⁹ The question remains whether this doctrine will be applied to patent protections in space, but if it were, and the individual described above met the additional conditions laid out in the Paris Convention, they need not worry about their trivial jaunt through jurisdictions.

Ultimately, traditional patent and intellectual property protections must be reimagined for applicability and enforceability in an age where travel, manufacturing, and invention exist beyond the confines of Earth. A basic requirement for space enterprise is a proper legal environment and we have the opportunity to act before greater issues arise.¹⁰⁰

VI. THE NEXT GREAT RACE

The implications of the technological advances achieved during the arms race and space race during the Cold War era continue to be felt today in everything from sophisticated satellite communications, the proliferation of nuclear power, and our greater understanding of the immensity of the universe.¹⁰¹ While it has been argued that the historical space race ended with a handshake in 1975, a new, current space race is just getting started.

The space industry, after experiencing a period of stagnation, has reinvented itself, making space “smaller, closer, and cheaper,” than ever before.¹⁰² Diminishing barriers to entry and greatly reduced launch-to-orbit costs mean space is now accessible to more than just a few sovereign

⁹⁸ Anderson, *supra* note 96, at 2.

⁹⁹ G. H. C. BODENHAUSEN, UNITED INT’L BUREAUX FOR THE PROT. OF INTELL. PROP., GUIDE TO THE APPLICATION OF THE PARIS CONVENTION FOR THE PROTECTION OF INDUSTRIAL PROPERTY 82 (1968).

¹⁰⁰ *Space Law is Inadequate for the Boom in Human Activity There*, ECONOMIST (July 18, 2019), <https://www.economist.com/international/2019/07/18/space-law-is-inadequate-for-the-boom-in-human-activity-there> [https://perma.cc/47R5-QVXG].

¹⁰¹ See Martand Jha, *This is How the Space Race Changed the Great Power Rivalry Forever*, THE NAT’L INT. (July 27, 2017), <https://nationalinterest.org/feature/how-the-space-race-changed-the-great-power-rivalry-forever-21690> [https://perma.cc/JPX9-NMV8].

¹⁰² *What If I Told You . . . Space Is Once Again the New Frontier*, SMITHSONIAN MAG. (July 11, 2016), <https://www.smithsonianmag.com/sponsored/what-if-i-told-you-space-once-again-new-frontier-180959457/> [https://perma.cc/BYX5-M4UP].

nations.¹⁰³ Influential heavyweights in the industry have lent their opinion on the future of space travel, including Buzz Aldrin, who commented, “[p]ublic and private space partnerships, as well as a healthy dose of competition, will shape the 21st century space agenda for the benefit of all—as long as we seek a common, unified goal of spurring humanity to utilize and explore space together,” echoing the sentiments of the opening articles of the U.N. Outer Space Treaty.¹⁰⁴

It is within this context of simultaneous collaboration and competition that humanity once again returns to an era defined by a profound “race.” The space race has reignited with what has been deemed “The Great Rocket Race.”¹⁰⁵ Recent private spaceflight companies with “audacious aspirations” promise disruption in the industry already dominated by giants such as Boeing and Lockheed Martin.¹⁰⁶ The race now focuses on, in addition to lowering costs and increasing safety, the development of a key piece of spaceflight technology: the engine.¹⁰⁷ This challenge, among many others, is a challenge that must be addressed on Earth before spaceflight and greater space exploration become more conventional. Until then, humanity will continue to gaze up at the sky in wonder, unable to fathom the enormity of mysteries to be discovered and answers to be found.

CONCLUSION

“I really believe that if the political leaders of the world could see their planet from a distance of, let’s say 100,000 miles, their outlook would be fundamentally changed. The all-important border would be invisible, that noisy argument suddenly silenced.”¹⁰⁸

Today, humanity finds itself on the brink of another great age of exploration as a direct result of the technological achievements of both the arms race and the space race. The development of space law will likely follow the development of maritime law and aviation law before it. The United Nations will likely continue to be the world’s facilitator and coordinator of international legal and practical standards. Humanity will continue to create situations that necessitate the development of law,

¹⁰³ *Id.*

¹⁰⁴ Buzz Aldrin, *The Next Giant Leap for Space Exploration*, WASH. POST. (Feb. 3, 2016, 8:00 AM), <https://www.washingtonpost.com/news/in-theory/wp/2016/02/03/buzz-aldrin-the-next-giant-leap-for-space-exploration/> [<https://perma.cc/A59N-H977>].

¹⁰⁵ Clay Dillow, *The Great Rocket Race*, FORTUNE (Oct. 26, 2016, 5:30 AM), <https://fortune.com/longform/spacex-ula-lockheed-boeing-rocket-race/> [<https://perma.cc/8C2N-Y6T6>].

¹⁰⁶ *Id.*

¹⁰⁷ *See id.*

¹⁰⁸ Michael Collins (@AstroMCollins), TWITTER (May 14, 2019, 11:02 AM), <https://twitter.com/AstroMCollins/status/1128329810835587073> (last visited May 22, 2021).

custom, and practice. The disparate goals of the U.N. Outer Space Treaty and of intellectual property law will be reconciled through future legal frameworks. Developments in spaceflight, exploration, and exploitation will fuel the next great era of ingenuity and invention.

The coming decades will be measured by our ability to collaborate as a planet on social, economic, environmental, political, and legal issues. The coordination between sovereign nations today will allow us to send humans and space objects farther into our universe, further expanding our knowledge of who we are, where we have been, and where we are going next, in addition to feeding humanity's obsession with knowing the unknown.