# The Legal Aspects of Permanent Human Settlement on Celestial Bodies

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## Abstract

This thesis will consider the legal aspects of permanent human settlement on celestial bodies. Aside from the primal yearning to explore, humanity must soon begin space settlement activities to ensure the continued survival of the species. Chapter 1 will briefly describe the value of preserving the human genome, outline why space settlement is necessary for such preservation and discuss the various public and private preparatory activities currently underway. Chapter 2 will present, as a backdrop, the current legal regime of outer space and simultaneously apply its principles to permanent human settlement, paying particular attention to the now-fifty-year-old *Outer Space Treaty*. Chapter 3 will explore the apparent contradiction resulting from a contextualized reading of Articles I and II (in light of permanent human settlement) and offer a potential solution by way of a *human*-first international settlement organization. Given humanity's innate desire to explore new worlds, coupled with the numerous cosmological and anthropological threats to its survival, this thesis offers a topical analysis of how a burgeoning space activity can be harmonized with a legal regime meant to ensure the exploration and use of space benefits all of humanity indefinitely into space and time.



## Résumé

Ce mémoire examinera les aspects légaux de l'établissement de civilisations humaines permanentes sur les corps célestes. Mis à part la soif élémentaire d'exploration, l'humanité devra bientôt commencer à peupler l'espace pour assurer la survie de notre espèce. Le premier chapitre décrira brièvement la pertinence de préserver le génome humain et ainsi que la nécessité de l'établissement dans l'espace pour se faire. Il discutera aussi des activités préparatoires publiques et privées qui sont déjà entamées. Le chapitre 2 présentera, en guise de trame de fond, le régime légal actuel de l'espace et appliquera ces principes à l'établissement permanent des humains dans l'espace, en portant une attention particulière au Traité de l'espace qui date maintenant de cinquante ans. Le chapitre 3 explorera l'apparente contradiction qui résulte d'une lecture contextualisée des articles I et II (à la lumière de l'établissement permanent des humains dans l'espace) et offre une solution potentielle, soit une organisation internationale d'établissement centrée d'abord sur l'humain. Compte tenu du désir inné qu'ont les humains d'explorer des mondes nouveaux ainsi que des menaces cosmologiques et anthropologiques à leur survie, ce mémoire offre une analyse contemporaine pour harmoniser l'activité bourgeonnante dans l'espace avec un régime assurant une exploration et une utilisation de l'espace bénéficiant l'humanité indéfiniment dans l'espace et le temps.

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*Look again at that dot. That's here. That's home. That's us. On it everyone you love, everyone you know, everyone you ever heard of, every human being who ever was, lived out their lives. The aggregate of our joy and suffering, thousands of confident religions, ideologies, and economic doctrines, every hunter and forager, every hero and coward, every creator and destroyer of civilization, every king and peasant, every young couple in love, every mother and father, hopeful child, inventor and explorer, every teacher of morals, every corrupt politician, every "superstar," every "supreme leader," every saint and sinner in the history of our species lived there--on a mote of dust suspended in a sunbeam.*

…

*The Earth is the only world known so far to harbor life. There is nowhere else, at least in the near future, to which our species could migrate. Visit, yes. Settle, not yet. Like it or not, for the moment the Earth is where we make our stand.*[1]

[1] Carl Sagan, *Pale Blue Dot: A Vision of the Human Future in Space* (New York: Random House, 1994) at p 21 [Sagan]. In the 23 years since Sagan's infamous description of life on Earth, humanity has made incredible advances in all fields of science. The time has come to fortify the existence of the human species into space and satisfy Sagan's dream of becoming a multiplanetary civilization.

# Chapter 1: Settling the Cosmos

## Crawling Out of the Cradle of Civilization

For all of human history – indeed, for all *life*-history – Earth has been the only celestial body known to provide the circumstances necessary to sustain life.[2] Although Carl Sagan's spatialist account of human existence in the universe is accurate, in the near-quarter century since he penned such infamous words, humanity has made – and continues to make – advances in nearly every facet of life. It is with the same forward- and outward-gazing desire used by Sagan to deepen our understanding of the solar system that humanity today pushes the boundaries of what it knows and what it can accomplish as a species. While Earth will forever be the cradle in which humanity developed, and the platform from which it has safely explored its distant surroundings, it has now sufficiently matured as a species to investigate the cosmos through a more hands-on approach. Humanity has demonstrated the ability to reach and remotely-touch other celestial bodies and now possesses the tools and understanding necessary to embark upon manned-missions. Just as life once jumped from single-cellular to multi-cellular organisms and just as life evolved to adapt from aquatic to amphibian environments, the next step in the evolution of the species is to become multiplanetary: establishing permanent human settlements in space is the first step. Although the process by which humanity will settle the cosmos remains unclear, there is no doubt it will happen.[3] This thesis serves as an exploration into the scientific necessity of settlement and the legality of proposed projects.

## The Definition of Settlement

A space settlement is as simple, and as complicated, as creating a second home for humanity: at a minimum, it must support its inhabitants and, at a maximum, it would rival the comforts of Earth. A permanent settlement must provide the most basic of amenities (shelter, energy, water and food) and over time, offer some Earthly comforts to ensure long-term sustainability. A permanent human settlement in space, therefore, would begin as a small settlement intended to establish a foundation upon which

[2] This does not mean life has not or does not exist but rather if so, humanity simply does not know about it.

[3] "The settlement of Mars is about to happen far sooner than most people realize, and in a nonregulated way. [W]e have the capabilities to build on Mars… The potential is enormous, but the pitfalls are numerous. The time to think is now." Stephan Petranek, *How We'll Live on Mars* (Simon and Schuster: New York, 2015) at p 12 [Petranek 2015].

infrastructure growth will be possible and thereby capable of supporting more people over time and offering more diverse services and amenities as necessity dictates.

A settlement is distinct from a colony. For the purposes of making human life multiplanetary, the human effort must be to establish settlements rather than colonies. Settlements are characterized by their self-sufficiency, independence and overall internal motivation to thrive, whereas colonies are intended to support a *home-base*, operating to satisfy external beneficiaries and dependent upon various forms of outside support. In many cases, colonies conjure concepts of imperialism, subjugation, affluence, etc. at the cost of impoverishment, resource depletion, extinction of indigenous biota, etc.[4] Aside from the social and cultural struggles of past Earth-based colonies, a model in which a colony depends on its home-base for survival is not one that can be replicated effectively in outer space (most simply, because of physics). As such, in order to ensure the survivability of the human species and the permanence of human life in outer space, settlements (rather than colonies) must be the vehicles through which humanity establishes new footholds in the solar system and beyond.

Early on, a settlement's population growth will depend heavily on humans from Earth making the likely one-way journey to join those already living in the new settlement. The first settlers will likely be technically gifted, well-trained and equipped with a pioneering mindset. Overtime, as the cost and need for highly specialized settlers decreases, more and more *average* humans will make the journey from Earth, motivated either by adventure, economic opportunity or a new beginning. Eventually, as the settlement matures, more and more people will be born in the settlement, eventually at a rate that supersedes the number of Earth-emigrants. Many of these settlement-born humans will only ever know life on a planet other than Earth and will embody the completed objective of making humanity multiplanetary while, at the same time, further ensuring the continued existence of the human essence.

Although the permanence of space settlements will depend upon their self-sustainability, they will develop this capability over time as a result of prudent planning and capacity building. The genesis of space settlements, however, will come from Earth-based materials, supplies and people. Habitats in which to live, food to eat and water to drink will all have to be sent from Earth, prior to humans arriving, alongside the

[4] Quite separately, but equally important, for many of the human species' 7 billion individual members, the notion of a "colony" is associated with great animosity and distrust. So as to ensure the species does not repeat mistakes of its past, it is best to use the neutral term "settlement" rather than the loaded term "colony".

first settlers, and via frequent resupply missions. This process, however, is difficult, expensive and unsustainable.[5] As such, the more quickly settlers can use *in situ* space resources the higher their chances of survivability, sustainability and independence. As well, such reliance on Earth should not be seen as the creation of a relationship of dependence but rather one of assistance – as the species' home planet, Earth ought to act as a springboard, rather than a conveyor belt, for the establishment of new settlements.

In this sense, settlements must not only be self-sustaining but also self-directed. The interests of the settlers, as representatives of the human species, must be first and foremost in the decision-making processes that will determine how the settlement operates. From its inception to its establishment, the settlement must be positioned to operate in a manner that furthers its survivability and permanence. This may include establishing trade partnerships with specific States on Earth or operating completely internally, but the singular focus should be to develop the settlement into a self-sustaining enterprise as quickly as possible to quite simply increase the species' survivability odds.

In the discussions that follow, there will be a certain emphasis on settlements located on Mars or the Moon[6] – these two bodies will be highlighted solely because of their potential as the most realistic candidates for permanent human settlement. Notwithstanding, conceptually, settlements can take place on any celestial body other than Earth that features characteristics suitable to sustaining human life. It is worth noting that while certain celestial bodies may be capable of sustaining life, they may not be suitable for *human* life. For example, some speculate that celestial bodies in our solar system (such as Enceladus, Titan, Europa and even possibly Venus[7]) could host life – for humans, however, these environments may be too cold, too distant from the sun, have a poisonous atmosphere, lack physical landmasses or not contain accessible water.

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[5] As a result of Earth's deep gravity well, it is extremely costly to send objects to space. Roughly 10 kg of fuel are needed to launch 1 kg of payload, meaning 90% of any rocket leaving Earth is the fuel necessary to get to orbit – this severely limits the cargo settlers can take to Mars.

[6] The debate between settling Mars or returning to the Moon is ongoing. This author believes Mars will have greater positive implications for humanity as a species and therefore supports its settlement. For the purposes of this thesis, though, either will suffice. Eric Berger, *NASA's next stop – Mars or the Moon?*, Ars Technica, 22 Dec 2016, online: <https://arstechnica.com/science/2016/12/time-to-choose-between-the-moon-and-mars-or-nasa-isnt-going-anywhere/> [Berger].

[7] Most of these celestial bodies contain liquid water (or in the case of Titan, liquid ethane/methane and in the case of Venus an atmosphere of sulfur dioxide), a characteristic necessary to support life. Seth Shostak, *6 Most Likely Place for Alien Life in the Solar System*, Space.com, 16 May 2012, online: <http://www.space.com/15716-alien-life-search-solar-system.html>.

Although it is unlikely humanity will find a celestial body completely identical to Earth[8], the species requires only some of the Earth-like characteristics it has become dependent upon to survive. *Homo sapiens* have proven quite adaptable at tolerating less than perfect conditions and, with the help of technology, even less than ideal conditions. Humanity has sufficiently explored the immediate cosmos and identified the most viable locations for permanent human settlements; it is now time to actually settle.[9]

## The Necessity of Settlement

The continued existence and flourishing of the human species[10] is its single most important collective objective. Ensuring that its genes are passed on to the next generation is the only way to continue its evolutionary journey that ensures it remains adaptable to its environment and thus survives. Contrary to popular belief, the current iteration of the human species is not the pinnacle of evolution; rather, evolution is a process that continues indefinitely, with no attainable zenith. As environments continue to change, species must continue to adapt. The fact that humans can now alter their environments does not lessen the veracity of this statement; rather, as humans change their environment they must adapt even more quickly to the unforeseen consequences of such change to ensure their continued survivability. The only way to ensure such survivability is to pass on a species' genes to future generations.

While there may be valid arguments as to why the human species ought not further its existence (statistically, it is the deadliest species to ever roam the planet[11], having caused more destruction than billions of years of prehistory combined, for example), this thesis takes the position that the continued existence of

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[8] Astronomers are discovering an increasing number of planets located in the "Goldilocks Zone" of their sun, offering the potential for liquid water. Unfortunately, the closest are lightyears away. Sean O'Kane, *NASA finds evidence of 10 new Earth-sized planets in our corner of the galaxy*, The Verge, 19 Jun 2017, online: <https://www.theverge.com/2017/6/19/15829336/nasa-kepler-new-exoplanets-earth-worlds-life>.

[9] Rand Simberg, *It's the Space Development and Settlement, Stupid*, Moon and Back, 14 October 2011, online: <http://moonandback.com/2011/10/14/it%E2%80%99s-the-space-development-and-settlement-stupid/>.

[10] Although technically inaccurate, for ease of readability the terms "humanity", "human species" and "*homo sapiens*" will be used interchangeably throughout this thesis. Taxonomically, however, *homo sapiens* are one specific species of the human genus. The fact that the *sapiens* species is the only remaining species of the *homo* genus (all others having gone extinct) does not change this fact. Yuval Noah Harari, *Sapiens: A Brief History of Humankind* (McClelland & Stewart: United Kingdom, 2014) at pp 10-12 [Harari].

[11] Adam Vaughan, *Humans creating sixth great extinction of animal species, say scientists*, The Guardian, 19 Jun 2015, online: <https://www.theguardian.com/environment/2015/jun/19/humans-creating-sixth-great-extinction-of-animal-species-say-scientists>. Even the most conservative estimates demonstrate that humanity is causing extinction rates up to 100 times higher than the previous five great extinctions. *See also* Harari, *supra* note 10 at p 78.

*a* species has an objective value independent of external moral considerations. While it is up to individual members to consider their ontological or ecological impacts, the species itself has no interest in anything other than furthering its existence (save for the sub-motivation of creating conditions conducive to its own survivability).

The continued existence of the human species, however, is not a given – very real threats abound. Fortunately, humanity has devised a number of clever, potential solutions to further strengthen its collective existence. One such solution is the permanent settlement of the species on non-Earth celestial bodies, bringing about its transformation from a single- to multiplanetary species. Settling outer space would address a number of different issues currently facing the species: not only would it offer a potential solution to a number of extinction risks, but becoming a multiplanetary species would also help satisfy the natural yearning to explore the environment, establish more complicated and productive economic systems, spawn ingenious developments that improve life and diversify the collective human experience.

## The Human Species in Space and Time

Collectively, *homo sapiens* exist on Earth (one of eight planets), that orbits the Sun (one star of billions), in the Orion Arm (one of many spiral arms) of the Milky Way galaxy (one of many galaxies), in a Local Group (of many local groups) in the Virgo Supercluster (of many superclusters) in the Universe.[12] That is the species' spatial location. The universe *began* 13.8 billion years ago, with the Milky Way Galaxy beginning to form 8.8 billion years ago, with the solar system beginning to form 4.45 billion years ago, with unicellular life beginning 4 billion years ago, with multicellular life beginning one billion years ago, with the *homo* genus beginning 2 million years ago and *homo sapiens* thriving exclusively 10,000 years ago.[13] That is the species' temporal location. All things considered, it is difficult to argue that *homo sapiens* are anything but a mere blip in cosmic existence: the existence of *homo sapiens* as a species and, even more so, as an individual member of the species, living on a habitable planet, now, is simply dumbfounding.

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[12] Bill Bryson, *A Short History of Nearly Everything* (Broadway Books: New York, 2003), generally; Cool Cosmos, *Where is Earth's location in space?*, Caltech: Division of Physics, Mathematics and Astronomy, accessed on 7 Jul 2017, online: <http://coolcosmos.ipac.caltech.edu/ask/62-What-is-Earth-s-location-in-space->.

[13] Harari, *supra* note 10 at p 13.

Given that the Sun contains enough fuel to shine for another 6 billion years, one question to consider is whether *homo sapiens* will stay on Earth until the sun stops shining and go extinct or whether some members of the species will travel to different corners of the universe and buy more time. If settling other parts of the universe is an eventual reality, whether it happens tomorrow or in one billion years does not make a difference in cosmic terms – it simply matters that the species will propagate on other celestial bodies. If cosmic settlement occurs, however, will future generations of humans located off-Earth still be *homo sapiens* or will their evolutionary path diverge so far as to make them unrecognizable (to the extent that humans are as distinct from snow leopards today)? If the latter (such that future generations of Martians or Europians will be so different than Terrans), is there any value in even settling off-world to further the species (if, by doing so, it will no longer be the human species that continues into existence)?

This thesis takes the position that there is value – indeed, great value – in furthering the human species, even if the descendants of *homo Martian* one day consider *homo sapiens* as primitive and inconsequential as they today consider the first unicellular organisms that put them on the evolutionary path that brought them here. Of course, this position is a mere assumption that cannot be flushed out for either its philosophical, moral, legal or other value in a thesis as short as the present. That said, the survival of the human species is the most scientifically, objectively valid "meaning" that can be given to life – ensuring that survivability, therefore, is of paramount importance.

## The Value of Species Survivability

The single, unifying constant amongst all previous, current and future individuals of the human species is the desire and innate drive to further the existence of its genome: there is no activity, no desire, no capability more natural and more alive. Modern evidence regarding the development and evolution of *homo sapiens*, alongside many other *homo* species, suggests that it is but one single species that developed alongside many other species of the genus *homo* (such as *homo abilis*, *homo erectus*, *homo ergaster*, *homo denisova*, etc.) rather than as direct descendants of each other culminating, after billions of years of evolution, into *homo sapiens*. Acknowledging this reality – that *homo sapiens* are not the result of a direct evolutionary process as depicted in the famous picture of "crawling ape to upright man" – provides an accurate perspective on how to evaluate existence.

At any point in human history, the leaf on the bush of evolution that represents the existence of *homo sapiens* could have withered away: a single evolutionary misstep could have resulted in an inability to adapt to a new environment and one under-developed immunity could have wiped out the species. To appreciate that humanity exists, so long after its birth and so self-conscious of its origins, is a miracle in and of itself. Existence, therefore, is valuable in and of itself, as a self-fulfilling reality. Coupling this realization with a consideration of where *homo sapiens* are in space and time, the uniqueness of its existence on Earth becomes apparent. Out of the trillions of planets orbiting trillions of stars in the universe, Earth is the only body known capable of sustaining life and that does, in fact, host life – and, even more specifically, *intelligent* life. It would be a mistake, however, to assume that *homo sapiens'* lengthy survival, in and of itself, is emblematic of an overarching superiority to the evolutionary process. Although humanity is arguably the pinnacle of evolution thus far, it is by no means immune from extinction risks: at any given moment, human life can be permanently extinguished. Before undertaking a demonstration into the value of settling off-world as a potential species-survival mechanism, it is worth demonstrating the risks of staying on one planet.

## Extinction Risks Associated with Single Settlements

Protecting the human species by promoting the propagation of its genome off-Earth is one way of avoiding extinction – the ultimate goal of life. If one considers a species as a singular concept, such that so long as some individuals of the species survive and continue breeding the entire species survives, living on one planet alone limits the species' survivability and reduces its resiliency. Having individual members of a species on two or more planets increases the chance of survival if an Earth-wide catastrophe occurs.[14] Of course, the need for such resiliency is premised on the assumption that such catastrophes are real and pose a likelihood of occurring. Given survivability is the ultimate goal, even if there is the smallest chance of a catastrophe eradicating the species, settlement plans to prevent extinction deserve no debate. Notwithstanding, the case for settlement becomes easier as the likelihood of catastrophe increases: unfortunately (or fortunately for proponents of settlements), the chances of catastrophe striking Earth are high.

[14] Similarly, having human settlements in more than one solar system or galaxy would make the species more resilient to solar system-wide or galaxy-wide catastrophes.

Catastrophes can be separated into two different groups: cosmological and anthropological. Cosmological risks are those that exist independent of human activity and are simply the result of cosmic realities. Anthropological risks are those that exist because of human activity and, if realized, would be the result of human action. With both categories, there are anticipatable forms (regardless of understanding how or why they occur) and those that cannot be imagined (of which there are arguably an infinite number). While taking precautions, preparing and protecting against some risks is viable, some simply cannot be influenced. All past extinction-level catastrophes have been cosmological in nature, simply because neither humanity nor any other species has had the ability to change its landscape in as drastic a nature as is currently possible[15]. Similarly, humanity's current ability to cause the extinction of other species (at will or accidentally) is unprecedented in scope. This ability has developed so thoroughly that humanity is now positioned to cause its own extinction, if any number of events occur.[16]

Cosmological: Asteroid Collisions

The most apparent risk to the continued existence of humanity is that posed by asteroids, small celestial bodies leftover from the creation of the Universe. Composed of dust, gas, ice, rock, metals, etc., asteroids are captured by the gravity of their larger celestial neighbours around which they orbit in clusters.[17] Ranging in size anywhere from one meter to nearly 1,000 km across[18], asteroids often exist together in groups: in the Solar System alone, there is a significant accumulation between Mars and Jupiter, the Kuiper Belt just beyond Pluto and the Oort Cloud further out. In total, there are hundreds of thousands of asteroids, composed of various elements, with a combined value of over $100 billion per person on Earth.[19]

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[15] Evidence suggests humans are now living in the Anthropocene Epoch. This transition from the Holocene Epoch is a result of human activity (such as agriculture, global emissions and nuclear weapon tests) causing noticeable changes in rock formations (a signifier of epoch change). David Biello, *You have been living in a new geologic time all along*, TED Ideas: Science, 8 Sep 2016, online: <http://ideas.ted.com/you-have-been-living-in-a-new-geologic-time-all-along/>.

[16] The Doomsday Clock is a concept illustrative of this capability and is today closer to "apocalypse" than ever before, in part because of President Trump's denial of climate change and haphazard characterization of nuclear arsenals. Erin Ross, *Doomsday Clock ticks closer to apocalypse*, Nature, 26 Jan 2017, online: <http://www.nature.com/news/doomsday-clock-ticks-closer-to-apocalypse-1.21375>.

[17] Charles Q. Choi, *Asteroids: Fun Facts and Information About Asteroids*, Space.com, 16 March 2016, online: <https://www.space.com/51-asteroids-formation-discovery-and-exploration.html> [Choi].

[18] *Ibid*.

[19] "A single platinum-rich 500-meter-wide asteroid contains about 174 times the yearly world output of platinum, and 1.5 times the known world-reserves of platinum group metals (ruthenium, rhodium, palladium, osmium, iridium, and platinum)." Planetary Resources, *Mining and Delivery*, accessed 23 April 2016, online:

Although most asteroids exist in stables orbits, some (whether due to collision, altered gravitational pulls or otherwise[20]) end up with altered trajectories and new orbits. In rare cases, these new trajectories put them on a collision course (whether immediately or millennia later) with other celestial bodies, including Earth. Those with a certain proximity to Earth are classified as Near-Earth Objects (NEOs)[21] and have the potential to cross Earth's orbit and collide with the surface.[22] Such collisions are not a question of if but of when and how big: in the early 1900s an asteroid exploded over Siberia levelling forests over 100 miles away; in 1989, a large asteroid passed within 600,000 km of Earth, directly through its orbit and the spot where it had been six hours earlier[23]; in February 2013, an asteroid roughly 20 m across exploded over Chelyabinsk, Russia injuring 1,200 people.[24] A 500-m wide asteroid colliding with Earth would kick up enough debris and start firestorms releasing enough ash to cause a severe global cooling event.[25] A five km wide asteroid collision (such as the KT Extinction event that wiped out the dinosaurs 65 million years ago[26]) would generate one million times more energy than all of the nuclear weapons stockpiled during the height of the Cold War.[27] Suffice to say, a significant asteroid collision is cause for concern and a very real threat to the continued existence of the human species.

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<http://www.planetaryresources.com/asteroids/#harvestingwater>; Elizabeth Howell, *"Trillion-Dollar Asteroid" Zooms by Earth as Scientists Watch*, Space.com, 28 July 2015, online: <http://www.space.com/30074-trillion-dollar-asteroid-2011-uw158-earth-flyby.html>; Choi, *supra* note 17.

[20] It is unclear why extinction-level collisions occur with such regularity. One theory suggests the Sun has a companion star named "Nemesis" that approaches every 26-30 million years and triggers a shower of asteroids; after searching for such evidence for decades, astronomers have found none. Identifying a pattern may offer humanity a better chance at preventing a future collision. Sanna Alwmark and Matthias Meier, *Could Asteroids Bombard the Earth to Cause a Mass Extinction in 10 Million Years?*, Scientific American *via* The Conversation, 25 June 2017, online: <https://www.scientificamerican.com/article/could-asteroids-bombard-the-earth-to-cause-a-mass-extinction-in-10-million-years/>.

[21] This designation is often reserved for asteroids that are within 0.5 Astronautical Units (AU) of Earth. 1 AU is equal to the distance between the Sun and Earth.

[22] NASA, *Planetary Defence: Overview*, 14 January 2016, online: <http://www.nasa.gov/planetarydefense/overview>.

[23] Stephen Petranek, *10 ways the world could end*, TED Talk, Feb 2002, online: <https://www.ted.com/talks/stephen_petranek_counts_down_to_armageddon> [Petranek 2002].

[24] Choi, *supra* note 17.

[25] Petranek 2002, *supra* note 22.

[26] Carrie Nugent, *Adventures of an asteroid hunter*, TED Talk, Feb 2016, online: <https://www.ted.com/talks/carrie_nugent_adventures_of_an_asteroid_hunter#t-225044>.

[27] Phil Plait, *How to defend Earth from asteroids*, TEDxBoulder, Sep 2011, online: <https://www.ted.com/talks/phil_plait_how_to_defend_earth_from_asteroids#t-51064>.

Fortunately, there are existing efforts to identify and monitor the status of large NEOs and efforts are being made to document smaller ones as well.[28] NASA's recently created Planetary Defense Coordination Office (PDCO) of its Planetary Science Division, along with other entities such as the International Astronomical Union's Minor Planet Center[29] or the ESA's Space Situational Awareness-NEO Coordination Office[30], are identifying and monitoring asteroids and comets that pose a threat to Earth. Unfortunately, the current appetite for increased efforts in such activities are lacklustre and insufficient to locate and track all potential NEOs posing a collision risk – last year alone, a number of NEOs were detected days or hours before they passed within worrying proximity to Earth.[31] Even if such limited identification, tracking and engagement[32] mechanisms were improved, there remains the threat that a NEO would go unnoticed and collide with Earth, or would be identified but humanity could not do anything to prevent its collision. Such realistic situations do not bode well for a threat[33] that has the potential to cause the extinction of the species. Needless to say, having settlements off-Earth would reduce the chance of species extinction should humanity on Earth succumb to an asteroid collision.

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[28] John Dyer, *NASA Has Opened a Planetary Defense Office to Protect Earth from Cosmic Collisions*, Vice News, 13 Jan 2016, online: <https://news.vice.com/article/nasa-has-opened-a-planetary-defense-office-to-protect-earth-from-cosmic-collisions>.

[29] Minor Planet Center, *What is the Minor Planet Center?*, International Astronomical Union, access 7 Jun 2016, online: <http://www.minorplanetcenter.net/about>.

[30] ESA, *Near Earth Objects – NEO Segment*, Space Situational Awareness, accessed 7 Jun 2016, online: <http://www.esa.int/Our_Activities/Operations/Space_Situational_Awareness/Near-Earth_Objects_-_NEO_Segment>.

[31] Eric Mack, *An asteroid twice as close as most satellites slips by Earth*, CNET, 4 Apr 2017, online: <https://www.cnet.com/news/asteroid-2017-gm-space-orbit-satellites/>; Jay Greenberg, *NASA: An Asteroid Has Just Missed Earth 20 Times Closer Than The Moon*, Neon Nettle, 4 Mar 2017, online: <http://www.neonnettle.com/news/1949-nasa-an-asteroid-has-just-missed-earth-20-times-closer-than-the-moon>.

[32] NASA is now preparing its Double Asteroid Redirection Test (DART) to determine whether it can successfully alter the orbit of an asteroid. Jack Hauen, *NASA to test asteroid deflection method for 'planetary defense'*, National Post, 2 Jul 2017, online: <http://nationalpost.com/g00/news/nasa-to-test-asteroid-deflection-method-for-planetary-defense?i10c.referrer=https%3A%2F%2Fwww.google.ca%2F>.

[33] Individual members of the species living in the US are even more at risk, with a 1 in 20,000 chance of being killed by an asteroid – the same likelihood of dying in a passenger aircraft crash and more likely than dying from a tornado. Clark Chapman, *The Threat of Impact by Near Earth Asteroids*, Southwest Research Institute, presented before the Subcommittee on Space and Aeronautics of the Committee of Science of the US House of Representatives, 21 May 1998, accessed 3 July 2017, online: <http://www.boulder.swri.edu/clark/hr.html>.

Cosmological: Rogue Black Holes

All stars have a life cycle that includes birth, existence and death: black holes are the remnants left behind by a dead star. The size and age of a living star depends on its fuel – the more fuel it has, the longer it lasts, the larger it grows and the more intense its gravitational pull. Most big stars continue to grow and expand as they consume their fuel, increasing their gravitational pull on their surroundings and themselves.[34] In some circumstances, when a star's fuel runs out, its internal pressure will no longer be sufficient enough to withstand its own gravity, causing it to collapse under its own weight into a singularity. This singularity is an infinitely dense point in space with a gravitational pull so strong that not even light can escape: a black hole.[35] At the center of each known major galaxy is a supermassive black hole (SMBH), often millions or billions of times the mass of the Sun.[36] Aside from the SMBH at the center of each galaxy, however, there are millions of smaller black holes that similarly affect their relative neighbourhoods, on a smaller scale.[37]

Given the universal law of gravity, the direction and movement of almost everything in space is predicated on orbits defined by the interaction of massive forces. Since space is so vast and violent, the orbits of asteroids, planets, stars and even existing black holes are in constant flux. Asteroids colliding with planets cause craters, stars expanding swallow planets and colliding galaxies spin their central black holes out of control.[38] The latter have been dubbed "rogue black holes" by scientists and characteristically break free from their established orbits on new, uncharted trajectories.[39] Out of the millions of black holes in each galaxy, it is entirely possible that a significant number have gone or will go *rogue*. Fortunately, given the size of space, the likelihood of a rogue black hole colliding with the solar system is remote. Unfortunately, the mere appearance of a rogue black hole within a few billion kilometers of the solar system would cause

[34] NASA, *What is a black hole?*, NASA, 7 Mar 2017, online: <https://www.nasa.gov/audience/forstudents/k-4/stories/nasa-knows/what-is-a-black-hole-k4.html>.

[35] *Ibid*.

[36] Dennis Overbye, *Black Hole Hunters*, New York Times: Science, 8 Jun 2016, online: <https://www.nytimes.com/2015/06/09/science/black-hole-event-horizon-telescope.html>; Katia Moskvitch, *Hunt Is On for 'Rogue' Black Holes*, Space.com, 13 Mar 2014, online: <http://www.space.com/25048-rogue-black-holes-radio-telescopes.html>.

[37] *Ibid*.

[38] In one example, two galactic SMBHs collided with one another and, because of the gravitational waves created by its collision-based birth, the ensuing unified black hole was launched through space. This rogue black hole has travelled 35,000 light years from the center of its galaxy, wreaking havoc along the way. NASA, *Gravitational Wave Kicks Monster Black Hole Out of Galactic Core*, NASA, 23 Mar 2017, online: <https://www.nasa.gov/feature/goddard/2017/gravitational-wave-kicks-monster-black-hole-out-of-galactic-core>.

[39] Petranek 2002, *supra* note 22.

devastation to Earth and its life forms by warping its orbit around the Sun, raising and dropping temperatures between 150°C to -50°C.[40]

Of course, if a rogue black hole made an appearance and had untoward effects on Earth, nothing could be done to stop it: most complicated lifeforms on Earth would go extinct. A settlement on Mars or another celestial body within the solar system would likely suffer similar consequences. To safeguard the species against extinction from the threat of rogue black holes, therefore, humanity would require settlements in other solar systems. Such endeavours are beyond the species' current ability but may be possible in 100 generations, building upon the experiences of, and developments made while, settling closer celestial bodies.

Cosmological: Coronal Mass Ejections

The Sun's energy, upon which the human species relies, is emitted in the form of sunlight, heat and electromagnetic waves.[41] The chemical composition and the timing of its various cycles[42] determine the strength of its emissions. Although reasonably stable, every so often there is a build-up of internal energy that is released from the Sun in a phenomenon known as a coronal mass ejection (CME)[43] – an intense, high energy magnetic release that can extend thousands of km from the surface of the Sun into interplanetary space.

Depending on the strength of the CME, the resulting consequences on Earth can vary. Typically, when the magnetic energy released from a CME reaches Earth's magnetosphere it disrupts its natural balance and affects the electromagnetic fields of the ionosphere and upper atmosphere. Such changes increase electrical currents on the ground, potentially overloading power lines, transformers and even telecommunication systems. Additionally, CMEs can disrupt or destroy satellites not protected or hardened against such solar activity: given modern civilization's dependence on communication satellites, GPS,

[40] *Ibid*.
[41] *Ibid*.
[42] The Sun operates on 9- and 14-year cycles characterized by the level, intensity and frequency of its various emissions.
[43] Both solar flares and CMEs expel huge amounts of energy from the Sun. Solar flares emit light in all directions, whereas CMEs release electromagnetic particles in one direction. A solar flare takes 8 minutes to reach Earth, while a CME can take up to three days. Max Gleber, *CME Week: The Difference Between Flares and CMEs*, NASA, 21 Sep 2017, online: <https://www.nasa.gov/content/goddard/the-difference-between-flares-and-cmes>.

meteorological prediction, remote sensing, agricultural and climate change monitoring, etc. the loss of such systems would have untold effects on the species.

Historical records have documented numerous CMEs, the most notorious of which was the Carrington Event of 1859.[44] While it was not an "extinction level" event, humanity still suffered even though it was not as dependent on electricity and power grids as it is today. A less intense, but still serious, CME was the 1989 Quebec storm with an estimated economic cost of $13.2 billion.[45] While it is unclear when the next significant CME will occur, it is only a matter of time. Scientists studying stars similar to the Sun have discovered that, at its current age, a star often undergoes a period of short but intense CME activity, brightening by a factor of 20 – one CME during this stage would eliminate all life on Earth in an instant.[46] Similarly, scientists have also noticed that stars similar to the Sun slowly reduce the amount of energy they expel as they go through a period of diminishment that reduces their total energy output by about 1%: a reduction of 1% would trigger an ice age on Earth.[47]

Even if humanity manages to protect against common CMEs, there remains the possibility of such a significant emission that the species is rendered helpless and cannot cope. A permanent settlement on another celestial body would protect the genome and ensure species survival. As with rogue black holes, a settlement on Mars or the Moon may not guarantee species survival in the event of a solar system-wide super CME, however it would offer practice in the preparation to settle more distant solar systems to avoid such a fate.

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[44] The Carrington Event consisted of two CMEs (the first on 28 August and the second on 2 September) that took less than 18 hours to reach Earth – the fastest ejections on record. While the use of electricity was not common, communications lines suffered significant damage and some operators suffered physical electric shocks. Lloyd's, *Solar Storm Risk to the North American Electric Grid*, Lloyd's Insurance, 2013, online: <https://www.lloyds.com/~/media/lloyds/reports/emerging%20risk%20reports/solar%20storm%20risk%20to%20the%20north%20american%20electric%20grid.pdf> [Lloyd's].

[45] *Ibid*.

[46] Petranek 2002, *supra* note 22.

[47] *Ibid*.

Anthropological: War

For as long as humans have lived alongside each other, they have fought.[48] While these early skirmishes concentrated on access to hunting and foraging grounds[49], the rationale for war grew in complexity in correlation with human relationships. What started as tribal warfare with sticks and stones evolved into worldwide catastrophes with nuclear weapons. Humanity today is in a precarious situation where the press of a button would trigger extinction.[50] Although the threat of nuclear annihilation seemed to pass with the collapse of the Soviet Union (since the US was the exclusive superpower and ought to have no longer required its stockpile of nuclear weapons), recent political perturbations have reignited fears of their use. Recent comments by US President Trump, for example, regarding his willingness to use nuclear weapons[51] and his belief that other States should also have nuclear weapons[52] demonstrates the precariousness of the species' current position. The proliferation of nuclear weapons and the number of entities with such capabilities only increases the likelihood of their use and the risk of mutually assured self-destruction.[53]

All that is required for the complete or near-extinction of the human species is a single careless act or ill-begotten intention. As such, the situations leading to a potential nuclear war are endless: a rogue actor attaining a nuclear weapon; a rogue State developing nuclear capabilities; a breakdown in diplomatic relationships; a short-tempered state official subverting traditional checks and balances; etc. Even more dire, theorists have recently contemplated what would happen if one State, whether publicly or privately, were to develop a super-powerful AI capable of processing information millions of times faster than any human –

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[48] While it is impossible to tell whether violence was more or less rampant or frequent than today, there is evidence to suggest it occurred. Harari, *supra* note 10 at pp 72-74.

[49] To some degree, human conflict has always revolved around resource acquisition and retention. Earth's non-renewable resources may become a flashpoint, increasing in likelihood as time progresses.

[50] While it is unlikely that even the most devastating nuclear war would kill every individual member of the human species, the destruction and ensuing environmental changes (a nuclear winter, for example) would sufficiently threaten the survival of future generations. Just as the asteroid that caused the extinction of the dinosaurs did not kill them all on impact, its consequences led to their eventual demise.

[51] David Sanger, *Would Donald Trump Ever Use Nuclear Weapons First? He Doesn't Seem Sure*, New York Times, 27 Sep 2016, online: <https://www.nytimes.com/2016/09/28/us/politics/donald-trump-hillary-clinton-nuclear-policy-cyber.html>.

[52] Gene Gerzhoy & Nick Miller, *Donald Trump thinks more countries should have nuclear weapons. Here's what the research says.*, The Washington Post, 6 Apr 2016, online: <https://www.washingtonpost.com/news/monkey-cage/wp/2016/04/06/should-more-countries-have-nuclear-weapons-donald-trump-thinks-so/?utm_term=.1b4407f49258>.

[53] *Ibid*.

such a computer would be able to *think* millennia into the future, giving its handlers incredible foresight and capability. If put in charge of military strategy, no other State would stand a chance. Therefore, certain theorists are fearful that at the earliest whisper of such capabilities, other States would strike pre-emptively to eliminate the threat, thus triggering a global war.[54]

Having off-Earth settlements protects the human genetic code from being lost in the devastation of a nuclear war and the nuclear winter that would follow. The diversity of spatial location would allow non-Earth-bound *homo sapiens* to continue passing on their genes to future generations even if certain individual members of the species made decisions foolish enough to eliminate all on Earth. Permanent human settlements, therefore, would allow for the continued existence of the human species even after a nuclear war.

Anthropological: Disease

Although an individual human's survival depends on the symbiosis of billions of microorganisms, certain types can cause death. While some infectious diseases are localized or only affect certain populations, others are much more indiscriminate and spread thoroughly. Throughout recorded history, and certain periods of unrecorded history, there have been several serious outbreaks: for example, smallpox, the bubonic plague, yellow fever, the Spanish Flu, HIV, SARS, H1N1, Ebola and Zika.[55] While none of these have caused the extinction of *homo sapiens*, they have killed millions of individual members over time. The most recent, Zika, has the unique consequence of not harming the host but causing miscarriages, stillbirths or hindering the neurological development of a host's offspring. Potentially more damaging from a species-wide perspective is the effect such a disease has on childbearing individuals who are demotivated from having children, thus creating a generational impact.

Even more precarious would be a situation in which a super-bug or virus mutated so that it became extremely contagious and extremely deadly, immune to any antibiotics or vaccines. As was demonstrated during the last Ebola outbreak, human society is now so interconnected that before an outbreak can be

[54] Sam Harris, *Can We Build AI Without Losing Control Over It*, TED Talk, June 2016, online: <http://www.ted.com/talks/sam_harris_can_we_build_ai_without_losing_control_over_it/transcript?language=en#t-601075>.

[55] CNN Films, *Deadly Diseases: Epidemics throughout history*, CNN, accessed 4 Jul 2017, online: <http://www.cnn.com/interactive/2014/10/health/epidemics-through-history/>.

identified, it spreads to various communities with different quarantine and treatment capabilities. Even in developed States, with highly regarded health systems, outbreaks often overwhelm public capabilities. Even worse, a contagious microorganism with an extremely long incubation period would allow it to spread greatly within disparate population groups before it could be contained. Additionally, existing bacteria that quickly and continuously mutate to develop resistance to well-established and new treatments pose an even greater threat, as the mass production necessary to combat the disease would be impossible.[56]

Suffice to say, should an outbreak of sufficient size and scope befall the human population, unable to be contained or cured it could reasonably cause the extinction of the human species. There is some evidence that microorganisms may have caused the extinction of other species in the past.[57] A multiplanetary human species would prove resilient to such an epidemic as the great distances (spatially and temporally) would reduce the efficacy of a contagion spreading between colonies. Of course, as permanent settlements multiply and transportation becomes more effective, there is a chance intergalactic epidemics may one day take root. Ensuring humanity reaches a point where such a threat is possible, however, would first require it to protect against species-wide epidemics that threaten the existence of the species on Earth; establishing settlements would protect against this threat.

Anthropological: Climate Change

The Earth's climate is changing, as it always does: what is worrying for the current generation of humans is how quickly and how intensely it is changing. Nearly everyone educated on the matter[58] agrees that the changes taking place since the last century are unprecedented in planetary history and are the result

[56] Petranek 2002, *supra* note 22.

[57] Jennifer Viegas, *How disease can wipe out an entire species*, NBC News, 5 Nov 2008, online: <http://www.nbcnews.com/id/27556747/ns/technology_and_science-science/t/how-disease-can-wipe-out-entire-species/#.WVvw-mjytEY>.

[58] The international team of scientists compiling the results for the Working Group II Report synthesized over 70,000 journal articles dealing with the environmental, geographic, social and economic consequences of climate change. UN IPCC, *Climate Change 2014: Impacts, Adaptation and Vulnerability*, Working Group II Summary for Policy Makers: Fifth Assessment Report, 31 Mar 2014, online: <https://www.ipcc.ch/report/ar5/wg1/>.

of specific human activities.[59] The United Nations Intergovernmental Panel on Climate Change[60] regularly releases reports[61] highlighting the state of Earth and the most up-to-date understandings on how climate change will affect ecosystems, economies and livelihoods across the world.[62] Their conclusions paint a rather grim portrait of the years to come.[63] In particular, the Earth's "ice caps are melting, sea ice in the Arctic is collapsing, water supplies are coming under stress, heat waves and heavy rains are intensifying, coral reefs are dying, and fish and many other creatures are migrating toward the poles or in some cases going extinct".[64] Statements that such natural world changes will have unimaginable consequences for the human species is not the hyperbole of the environmentally inclined; it is a scientific reality.

In the twelve months since the IPCC issued its synthesis report for policymakers, international discussions reached a breakthrough with the signing of the Paris Agreement.[65] Celebration, however, was immature as the world's second largest polluter of greenhouse gases, the United States, announced its

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[59] The anthropocentric increase of atmospheric greenhouse gases (GHGs) (such as carbon dioxide, methane and nitrous oxide) since the industrial revolution are causing the current change in climate; in the last century, human activities reliant on fossil fuels (coal, oil and natural gas) have exponentially increased GHGs in the atmosphere, causing it to trap more of the Sun's heat and raise overall global temperatures. American Chemical Society, *What are the greenhouse gas changes since the Industrial Revolution?*, ACS Climate Science Toolkit, online: <http://www.acs.org/content/acs/en/climatescience/greenhousegases/industrialrevolution.html>; David Roberts, *Climate change is simple*, TEDxEvergreen State College, YouTube, online: <http://www.youtube.com/watch?v=A7ktYbVwr90>.

[60] The IPCC was created in 1998 to provide scientific reports to support the main international treaty on climate change, the *United Nations Framework Convention on Climate Change*, 1771 UNTS 107, open for signature 9 May 1992.

[61] UN IPCC, *Climate Change 2014: Impacts, Adaptation and Vulnerability*, Working Group II Summary for Policy Makers: Fifth Assessment Report, 31 Mar 2014, online: <https://www.ipcc.ch/report/ar5/wg1/>. The IPCC also released its Working Group III Report titled "Climate Change 2014: Mitigation of Climate Change" as well as its conclusory "Climate Change 2014: Synthesis Report", available online: <http://www.ipcc.ch/report/ar5/>.

[62] Climate Change, *In the Balance*, The Economist, 5 April 2014, online <http://www.economist.com/news/science-and-technology/21600080-new-report-ipcc-implies-climate-exceptionalism-notion>.

[63] *Ibid*; Justin Gillis, *Panel's Warning on Climate Risk: Worst is Yet to Come*, New York Times, 31 March 2014, online: <http://www.nytimes.com/2014/04/01/science/earth/climate.html?_r=1>.

[64] *Ibid*.

[65] *Paris Agreement*, 12 Dec 2015, being Section 7. d, Chapter XXVII of the *UN FCCC*, at Article 2. All but two States (Syria and Nicaragua – the former as it is in the midst of a civil war and the latter because it believed the agreement did not protect the environment enough) have agreed to try and maintain a less-than 2°C increase of pre-industrial levels, increase the ability to adapt to climate change and make efforts to financially incentivize low greenhouse gas emission developments. The agreement has so far collected 133 ratifications. United Nations Treaty Collection, *Status of Paris Agreement*, accessed 7 Mar 2017, online: <https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVII-7-d&chapter=27&clang=_en>. China and the USA account for 40% of global emissions. BBC News, *Paris climate deal: US and China formally join pact*, BBC News, 3 Sep 2016, online: <http://www.bbc.com/news/world-asia-china-37265541>.

intention to withdraw from the Agreement in June 2017.[66] Even if the US had remained a party, some still consider the non-binding nature of the agreement to be a failure[67] and do not anticipate its ability to maintain the self-imposed 2°C threshold. Notwithstanding that the remaining major powers have vowed to nevertheless reduce their emissions, it is likely the Earth's overall temperature will continue to rise and have untoward effects.[68] The uncertainty is not what the effects will be (heat waves and droughts will increase, extreme weather events will become more frequent, sea levels will rise, the arctic will thaw, etc.[69]) but rather the extent and intensity of those effects.

It is quite possible that the various consequences of climate change make life on Earth for the human species extremely difficult and possibly impossible. If the human species has, unknowingly at first and indifferently at present, opened Pandora's Box, it would be even less logical for the entirety of the species to remain on Earth. Permanent settlements off-Earth could be the lifeboat-equivalent to the sinking ship that is Earth: taking advantage of an opportunity to save the species ought to be acceptable.

## Preparatory Settlement Activities

From as early as 1948, visionaries and scientists have worked to make permanent human settlement in space a reality. The first true pioneer was Wernher von Braun[70], notable for masterminding the Saturn V that sent humans to the Moon, which he saw as a proving ground for the more complicated journey to Mars.[71]

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[66] Michael Shear, *Trump Will Withdraw U.S. From Paris Climate Agreement*, New York Times, 1 Jun 2017, online: <https://www.nytimes.com/2017/06/01/climate/trump-paris-climate-agreement.html>; Coral Davenport, *Top Trump Advisors are Split on Paris Agreement on Climate Change*, New York Times, 2 Mar 2017, online: <https://www.nytimes.com/2017/03/02/us/politics/climate-change-trump.html?_r=0>.

[67] Oliver Milman, *James Hansen, father of climate change awareness, calls Paris talks 'a fraud'*, The Guardian, 12 Dec 2015, online: <https://www.theguardian.com/environment/2015/dec/12/james-hansen-climate-change-paris-talks-fraud>.

[68] John Carey, *Why are we being such idiots about climate change?*, TED Ideas: Science, 2 May 2014, online: <http://ideas.ted.com/why-are-we-being-such-idiots-about-climate-change/>; John Carey, *The 9 limits of our planet… and how we've raced past 4 of them*, TED Ideas: Science, 5 Mar 2015, online: <http://ideas.ted.com/the-9-limits-of-our-planet-and-how-weve-raced-past-4-of-them/>.

[69] NASA, *The consequences of climate change*, Earth Sciences Communications Team of the Jet Propulsion Laboratory, 2 Mar 2017, online: <https://climate.nasa.gov/effects/>.

[70] Wernher von Braun used his rocketry genius to develop the V2 for Hitler before being relocated to the US as a "prisoner of peace" and put in charge of its most successful space projects. Published in 1952, *Das Marsprojekt* was von Braun's magnum opus on space travel (still highly relevant and instructional today) establishing exactly what was needed to land humans on Mars. Although NASA never followed through with his proposals, he predicted many of the technological developments needed to undertake his vision that have since come to fruition, such as the Space Shuttle and SpaceX's reusable rockets. Petranek 2015, *supra* note 3 at pp 13-15.

[71] *Ibid*.

Although US politicians never appreciated the feasibility of his vision, he single-handedly set humanity on a course for settling the Red Planet. Establishing a permanent settlement on another celestial body, however, is no simple task and for the current generation of humans, realistic settlement opportunities are limited to the Moon and Mars.[72] A number of entities, both public and private, have begun planning such missions, with the earliest realistic landing dates in the late-2020s. Even though some information has been made public, with most of the details still under wraps and such long mission timelines, it is likely the proposed plans will undergo significant change (or altogether abandonment). The entities listed below are only a sample of those planning or preparing for settlement activities.[73]

United States of America

As the undisputed leader in space capabilities since at least the 1970s, any US settlement plans ought to be considered seriously. Although the only State to successfully land humans on the Moon in the late-1960s and early-1970s, the US established neither a temporary nor permanent settlement. Recent rumblings have suggested the US may return to the Moon[74], which, given its strategic importance[75], may make sense, although from a scientific perspective it detractors argue it offers little in terms of development or advancement (especially when contrasted with a mission to Mars, for example). One key milestone in the policy shift to reinvigorate human deep space missions was Former President George W. Bush's 2004 space policy announcing "a new plan to explore space and extend a human presence across [the] solar system"[76], beginning with a foothold on the Moon to make further journeys more accessible.[77] By the time Former President Obama came to office in 2009, Bush's planned program was years behind schedule and over budget. Obama abandoned the Moon as a stepping stone (instead choosing an asteroid as an intermediary

[72] There is a very real debate as to which is more feasible. Berger, *supra* note 6.

[73] For example, India and Japan have expressed an interest in carrying out – or at least participating in – settlement activities, as has Moon Express (as part of its larger plan to commercialize the Moon).

[74] David Brown, *Trump Might be Thinking About a Moon Base*, The Atlantic, 4 Jan 2017, online: <https://www.theatlantic.com/science/archive/2017/01/the-moon-base-mirage/511943/>.

[75] "[T]he Moon increasingly appears to represent the "high ground" in battle for geopolitical supremacy between the United States and China. A Chinese spacecraft returning from the Moon could approach US spy satellites at geostationary orbit without being seen…" Berger, *supra* note 6.

[76] George W. Bush, *President Bush Delivers Remarks on U.S. Space Policy*, 14 Jan 2004, available at NASA Facts, online: <https://www.nasa.gov/pdf/54868main_bush_trans.pdf> at p 3.

[77] *Ibid*.

step[78]) and directed NASA to prepare for human landing on Mars by the mid-2030s.[79] By setting its sights on Mars, some argue the US alienated its international partners by undertaking a journey so ambitious other space agencies could not contribute.[80] Nevertheless, the US course remains set on Mars, with President Trump making statements that he believes in the value of a human mission to the Red Planet.[81] While no president's policy has explicitly provided plans for permanent settlement, the desire to send humans to the Mars is a clear stepping stone in that direction.

US executive decisions, however, must gain approval (often financially) by Congress before implementation. During Obama's tenure, Congress was opposed to allocating significant money for NASA to send humans to Mars but it is unclear if the current Republican legislature will be more inclined to grant a Republican White House the funding it requires for such missions.[82] Some members of Congress have independently proposed legislation to settle space: in 1988, Representative Brown proposed amending NASA's authorizing legislation to officially require the agency to investigate and undertake activities that would promote outer space settlement[83]; in 2016, Representative Rohrbacher proposed a similar bill to again amend NASA's authorizing legislation and similarly spur space settlement.[84] Most recently, Trump

[78] The Asteroid Redirect Mission will rendezvous with an asteroid, pluck a bolder, and transport the boulder to a lunar orbit for study.

[79] Mike Wall, *President Obama's Space Legacy: Mars, Private Spaceflight and More*, Space.com, 19 Jan 2017, online: <https://www.space.com/35394-president-obama-spaceflight-exploration-legacy.html>.

[80] Loren Grush, *Obama's NASA made strides on commercial space, but stumbled on exploration*, The Verge, 19 Jan 2017, online: <https://www.theverge.com/2017/1/19/14211964/obama-administration-nasa-legacy-private-sector-moon-vs-mars> [Grush].

[81] Jeff Foust, *Trump's Exuberance for Mars Faces Technical and Fiscal Challenges*, Space.com, 25 Apr 2017, online: <https://www.space.com/36593-president-trumps-mars-excitement-faces-challenges.html>.

[82] Grush, *supra* note 80.

[83] HR Bill 4218 (100th Congress), *Space Settlement Act of 1988*, GovTrack, 22 Mar 1988, online: <https://www.govtrack.us/congress/bills/100/hr4218>. While Bill 4218 never became law, the requirement that NASA report to Congress every two years on its progress regarding settlement activities was eventually incorporated. Nevertheless, NASA has never satisfied this requirement. Jeff Foust, *Proposed Legislation Would Make Space Settlement a National Goal*, Space News, 1 May 2015, online: <http://spacenews.com/proposed-legislation-would-make-space-settlement-a-national-goal/>.

[84] HR Bill 4752 (114th Congress), *Space Exploration, Development, and Settlement Act of 2016*, US Congress, 16 Mar 2016, online: <https://www.congress.gov/bill/114th-congress/house-bill/4752>.

reinstated the National Space Council, to be headed by Vice-President Pence, as a means of guiding space policy[85] – whether this will encourage space settlement remains to be seen.[86]

Although the US does not have a definitive plan for establishing a permanent settlement in outer space, its overall outlook includes missions into deep space, a necessary precursor to settlement. As well, the US commitment to establish an environment in which private entities can operate robustly[87] may lead to the development of effective future public-private partnerships. SpaceX's desire to build a permanent settlement on Mars can only be accomplished in such an environment.[88]

Russia

Even after the fall of the Soviet Union, Russia has maintained its status as a space superpower. Moving forward, its national space agency, Roscosmos, alongside the European Space Agency (ESA)[89], has planned to place a lander on the south pole of the Moon (a location permanently shrouded in shadows) [90] to explore the Moon for minerals and water-ice with its Luna 27 mission.[91] The objective is for the mission, scheduled for the 2020s, to return positive information regarding the existence of resources on the Moon and to develop, in the 2030s, a human settlement to sustain further scientific exploration, develop commercial opportunities and create a refuelling station for future space missions.[92]

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[85] Loren Grush, *Mike Pence will now oversee US space policy*, The Verge, 30 Jun 2017, online: <https://www.theverge.com/2017/6/30/15903230/national-space-council-executive-order-mike-pence-nasa-policy>.

[86] At the signing ceremony, there was a dearth of representation from private industry. Eric Berger, *No space for new space at Trump's space council rollout*, ArsTechnica, 30 Jun 2016, online: <https://arstechnica.com/science/2017/06/no-space-for-new-space-at-trumps-space-council-rollout/>.

[87] For example, *see* HR Bill 2262 (114th Congress), *US Commercial Space Launch Competitiveness Act*, US Congress, 25 Nov 2015, online: <https://www.congress.gov/bill/114th-congress/house-bill/2262/text>.

[88] SpaceX's CEO, Elon Musk, has expressed deep gratitude for the foundational work undertaken by, and continued support of, NASA. Elon Musk, *Making Humans a Multi-Planetary Species*, New Space, 2017, Vol 5, No 2, online: <http://online.liebertpub.com/doi/full/10.1089/space.2017.29009.emu> [Musk].

[89] Oli Smith, *European and Russians to team up to colonize the Moon*, Express.co.uk, 17 Oct 2015, online: <http://www.express.co.uk/news/science/612759/European-Russians-team-up-colonize-Moon>.

[90] Since certain parts of the Moon's poles do not receive any sunlight, it is possible that any water left over from its formation would exist in the form of ice, which can be used to create rocket fuel (as the water is split into its component parts of oxygen and hydrogen).

[91] Pallab Ghosh, *Europe and Russia mission to assess Moon settlement*, BBC News: Science & Environment, 16 Oct 2015, online: <http://www.bbc.com/news/science-environment-34504067> [Ghosh}.

[92] *Ibid*.

Although its plans are in the very early stages and details are scant, the fact that Russia has publicly stated it intends to create a settlement in space is a sign of things to come. Unlike the US visits during the Cold War, future visits to the Moon will be motivated by scientific and commercial development rather than prestige; as such, visits will likely last longer and permanent settlements will eventually become reality. While Russia has not made explicit statements about the long-term implications of a settlement on the Moon, one can expect the desire to create a refuelling station for increasingly frequent deep space missions would suggest permanence. Even if a Russian station purely acts as an outpost, it will inevitably inspire others to develop larger settlements.

European Union

Europe, as headed in its space activities by ESA, also has plans to settle outer space. Mere days after arriving at the helm of ESA as its Director General, Johann-Dietrich Woerner made clear his desire to create a "Moon Village"[93], established and manned by members of the international community.[94] The settlement would act as a proving ground for new technologies necessary for future settlements, allow for lunar perspectives in space science and act as a launching point for future deep space missions. The Moon Village would continue carrying out the important science conducted aboard the ISS after its retirement and offer an opportunity for continued international cooperation in space.[95]

Woerner's vision has been gaining traction in Europe[96], where there is a renewed interest in the Moon and its potential resources.[97] ESA's most recent funding call from member States resulted in more

[93] European Space Agency, *Moon Village*, YouTube, 22 Mar 2016, online: <https://www.youtube.com/watch?v=amYK5voqLSk>.

[94] Richard Hollingham, *Should we build a village on the Moon?*, BBC: Future, 13 July 2015, online: <http://www.bbc.com/future/story/20150712-should-we-build-a-village-on-the-moon>. Japan recently pronounced its desire to send astronauts to the Moon in an international effort. Ben Westcott, *Japan wants to put a man on the moon, accelerating Asian space race*, CNN, 29 Jun 2017, online: <http://www.cnn.com/2017/06/29/asia/japan-moon-landing-jaxa/index.html>.

[95] David Brown, *Trump Might be Thinking About a Moon Base*, The Atlantic, 4 Jan 2017, online: <https://www.theatlantic.com/science/archive/2017/01/the-moon-base-mirage/511943/>.

[96] Leonard David, *Europe Aiming for a "Moon Village"*, Space.com, 26 Apr 2016, online: <http://www.space.com/32695-moon-colony-european-space-agency.html>.

[97] The International Lunar Decade is an advocacy group for building "infrastructure in cislunar space and on the Moon to open the space frontier" to establish a self-sustaining economy. It advocates for EU leadership as the US is committed to Mars and other major space powers (Russia, China, India, etc.) are not currently poised to support lunar activities. Vidvuds

than $10 billion for Woerner's Space 4.0 – blending public and private space operations for the benefit of humanity.[98] As a part of this Space 4.0 vision, ESA will flesh out its plans for a village on the far side of the Moon and begin the process of developing a settlement capable of sustaining permanent human life.

China

Although in some respects China's space program is behind other developed States, it is quickly closing the gap by improving launch capabilities[99], upgrading orbital space stations and planning manned missions.[100] As one example of its growing capability, China's Chang'e 3 mission in 2013 successfully landed a rover on the Moon, the first time a spacecraft made a soft landing on the Moon since the 1970s. With the Chang'e 4 and 5 missions, China plans to further refine its lunar operations[101] as well as send a probe to Mars (possibly in anticipation of a manned mission) by 2020.[102]

China has stated that while it's short term goals are to orbit, land and return samples from the Moon, it's long term goal is to land, explore and build a settlement on its surface.[103] In preparation for such activities, China will land a probe on the far side of the Moon to explore for, and potentially harvest, surface ice. While China is currently acting on its own, it has made public announcements that it desires to undertake such programs in collaboration with other States, particularly the US. If geopolitics allows[104], an international effort directed towards the Moon could establish it as a staging point to support various future

Beldavs, Jim Crisafulli et al, *Major role for EU in lunar development*, International Lunar Decade, 2016, online: <https://ildwg.wordpress.com/major-role-for-eu-in-lunar-development/>.

[98] Cecille De Jesus & Todd Jaquith, *ESA's Plan for a "Moon Village" is Slowly Starting to Come Together*, Futurism, 8 Jan 2017, online: <https://futurism.com/esas-plan-for-a-moon-village-is-slowly-starting-to-come-together/>.

[99] Loren Grush, *China's most powerful rocket failed yesterday. What does that mean for the country's space plans?*, The Verge, 3 Jul 2017, online: <https://www.theverge.com/2017/7/3/15913448/chinese-rocket-long-march-5-failure-moon-mission>.

[100] Emma Grey Ellis, *China wants Moon. But first, it has to spend a month in space*, WIRED, 19 Oct 2016, online: <https://www.wired.com/2016/10/china-wants-moon-first-spend-month-space/>.

[101] Mike Wehner, *China is going to beat the United States back to the Moon*, BGR, 27 Dec 2016, online: <http://bgr.com/2016/12/27/are-we-going-back-to-the-moon/>.

[102] Louise Watt, *China plans to land probes on far side of moon, Mars by 2020*, Phys.Org, 27 Dec 2016, online: <https://phys.org/news/2016-12-china-probes-side-moon-mars.html>.

[103] BBC News, *China's plans for the Moon, Mars and beyond*, BBC News: Science & Environment, 17 Apr 2017, online: <http://www.bbc.com/news/av/world-asia-36085659/when-will-china-get-to-mars>.

[104] Precedent exists for collaborative space missions: the West continues to work with Russia on the ISS despite tensions.

deep-space missions. Irrespective, China is poised to be the second country to put astronauts on the Moon[105] and, by all accounts, this will only be the beginning of their deep space missions.

United Arab Emirates

Although the United Arab Emirates only recently joined the cadre of space-faring nations, it has done so with characteristic gusto. Its first satellite, DubaiSat-1, was launched in 2009 as an Earth observation satellite[106], followed by DubaiSat-2, its second Earth observation satellite, in 2013.[107] KhalifaSat, an even more capable Earth observation satellite, is scheduled for launch in 2018.[108] The speed with which the UAE's space programme is growing is indicative of how it will achieve its ultimate objective of establishing a human settlement on Mars by 2117.[109]

Dubbed the Emirates Mars Mission (EMM), the desire to settle Mars will begin with the 2021 launch of a Martian probe, dubbed Hope, that will study the Martian atmosphere.[110] This will be followed by the recruitment and training of Arab astronauts for a trip to the International Space Station[111], developing a "scientific city" to mimic life on Mars and developing an experimental laboratory in zero gravity[112]. Although details on these proposed steps have not yet been released, the UAE still has 100 years to flesh out the specifics that will support its vision of settlement. Importantly, it has made quite clear its intention that the

[105] Ghosh, *supra* note 91.
[106] Government of Dubai, *Dubai Sat 1*, Mohammed bin Rasheed Space Center, online: <https://mbrsc.ae/en/page/dubai-sat-1>.
[107] Government of Dubai, *Dubai Sat 2*, Mohammed bin Rasheed Space Center, online: <https://mbrsc.ae/en/page/dubai-sat-2>.
[108] Government of Dubai, *Khalifa Sat*, Mohammed bin Rasheed Space Center, online: <https://mbrsc.ae/en/page/khalifa-sat>.
[109] Andrew Blum, *Oil won't last forever, so Dubai is betting big on science and tech*, Popular Science, 15 May 2017, online: <http://www.popsci.com/dubai-science-tech-innovation>.
[110] Government of Dubai, *Hope Mars Probe*, Mohammed bin Rasheed Space Center, online: <https://mbrsc.ae/en/page/mars-probe>.
[111] RT, *UAE launches space program to boost colonization of Mars by 2021*, Russian Times, 13 Apr 2017, online: <https://www.rt.com/news/384638-uae-space-program-mars-colonization/>; Khaleej Times, *UAE leaders launch programme for Mars missions*, Khaleej Times: General, 13 Apr 2017, online: <http://www.khaleejtimes.com/news/general/uae-leaders-launch-programme-for-mars-missions>.
[112] *Ibid*.

Martian settlement be an international effort and that it inspire generations of youth (in the Middle East and elsewhere) to take up the mantle of outer space exploration.[113]

Mars One

Sensing that governments and other public entities entrusted with space exploration had no real urgency to make human habitation on Mars a reality in their lifetime, Bas Landsdorp and Arno Wielders decided in 2011 to establish Mars One to complete the task. Without substantial funding sources to finance its objective, Mars One's business plan focussed on broadcasting a "reality television" like-show of the first inhabitants journey to, and life on, Mars to paying subscribers: initial statements suggested it would generate up to $7 billion.[114]

Unfortunately, following significant scheduling delays and corporate hiccups, Mars One lost the momentum of its original campaign and has since been ridiculed by some communities over its inept scientific prognosis.[115] Even if Mars One fails to send humans to Mars, its endeavour represents the opportunity available to private entities for space settlement and demonstrates the quantifiable excitement of individual members of the human species for deep-space missions.[116] If Mars One's only contribution to sending humans to Mars is generating a concept exciting enough to permeate the *zeitgeist* and spur on future developments, it can be considered a success in helping make the human species multiplanetary.

Space X

The most publicized plans for human settlement off-Earth have come from SpaceX CEO Elon Musk, who since founding the company in 2002 has made a self-sustaining Martian settlement his ultimate

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[113] Rae Paoletta, *The UAE Drops More Clues About Its Mysterious Plans to Colonize Mars*, Gizmodo, 9 May 17, online: <http://gizmodo.com/the-uae-drops-more-clues-about-its-mysterious-plan-to-c-1795056023>.

[114] Daniel Engber, *Why Thousands of People are Willing to Die on Mars*, Popular Science, 18 Feb 2015, online: <http://www.popsci.com/article/science/why-thousands-people-are-willing-die-mars#page-3>.

[115] Kelly Dickerson, *Two MIT students lay out the facts about why the Mars One mission is bogus*, Business Insider, online: <http://www.businessinsider.com/mars-one-mit-students-mission-not-feasible-debate-2015-8>.

[116] Mars One, *Over 200,000 apply to first ever recruitment for Mars settlement*, Mars One, 9 Sep 2013, online: <http://www.mars-one.com/news/press-releases/over-200000-apply-to-first-ever-recruitment-for-mars-settlement>.

objective.[117] In fact, SpaceX has intentionally developed its entire architecture so as to focus on reusability and successfully send humans to Mars. In September 2016, Musk unveiled the specifics of SpaceX's plan in a presentation to the International Astronautical Congress in Mexico[118] and in July 2017 released a 16-page outline of how SpaceX would establish a million-person settlement on Mars.[119]

The details are fascinatingly simplistic: master the reusability of spacecraft to reduce the average cost of a trip to Mars to a price-point affordable for an average human.[120] Musk has routinely stated his intention is for a Mars settlement to become self-sustaining, with humans living as comfortably on the Red Planet as they would on Earth. Although there are numerous challenges with accomplishing such a goal, SpaceX's track record of succeeding at what others deem impossible speaks for itself and provides the human species with hope that it will, within the next decade, have humans on Mars.

## Conclusion

The continued existence of the human species is a biological imperative embedded deep within the genes of individual members – valuable in and of itself. Marooned on Earth, humanity is susceptible to any number of extinction-level threats, both cosmological and anthropological. The continued survival of the species, therefore, depends on it becoming multiplanetary so as to ensure any Earth-localized catastrophes do not spell the end of the species. Efforts are currently underway by both public and private entities, independently and collaboratively, to achieve the objective of establishing permanent human settlements in space. While the most likely first destinations are the Moon and Mars, it is only a matter of time before humans set foot on celestial bodies across the cosmos.

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[117] Kenneth Chang, *Elon Musk's Plan: Get Humans to Mars, and Beyond*, New York Times, 27 Sep 2016, online: <https://www.nytimes.com/2016/09/28/science/elon-musk-spacex-mars-exploration.html>.
[118] *Ibid*.
[119] Musk, *supra* note 88 at p 50.
[120] Along with reusability, refilling propellant in orbit and generating propellant on Mars are the other keys to bringing down the cost. *Ibid*.

*For all its material advantages, the sedentary life has left us edgy, unfulfilled. Even after 400 generations in villages and cities, we haven't forgotten. The open road still softly calls, like a nearly forgotten song of childhood. We invest far-off places with a certain romance. This appeal, I suspect, has been meticulously crafted by natural selection as an essential element in our survival. Long summers, mild winters, rich harvests, plentiful game—none of them lasts forever. It is beyond our powers to predict the future. Catastrophic events have a way of sneaking up on us, of catching us unaware. Your own life, or your band's, or even your species' might be owed to a restless few—drawn, by a craving they can hardly articulate or understand, to undiscovered lands and new worlds.*[121]

[121] Sagan, *supra* note 1 at p 10.

# Chapter 2: Governing the Cosmos

## Foundations of the Outer Space Legal Regime

All human activities in outer space are governed by international space law[122], a subset of general international law. Although Article III of the *Outer Space Treaty*[123] provides that space activities are to be carried out in accordance with international law, this does not include international law *in toto*.[124] Therefore, international space law is *lex specialis*[125] to general international law: where they conflict, international space law governs[126] and where there is a gap, general international law fills in. Global and national politics, economics and social variations result in the constant evolution of international space law through new or amended treaties, declarations, resolutions and other bi- and multi-lateral instruments. Notwithstanding these various sources, States are only bound to the treaties to which they are a party and established custom[127].

Although the OST is commonly considered the first formal outer space law, it encapsulated a number of provisions already in existence. The 1963 Declaration[128], for example, espoused numerous foundational

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[122] Ram S. Jakhu, *Sixty Years of Development of International Space Law*, Proceedings of the Symposium Celebrating the 90th Anniversary of the Cologne Institute of Air and Space Law, 2016 at p 2 [Jakhu].

[123] *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and other Celestial Bodies*, opened for signature on 27 Jan 1967, 610 UNTS 205 (entered into force 10 Oct 1967) [OST].

[124] Some subjects of international law are environment-specific and therefore do not apply to outer space. Manfred Lachs, *The Law of Outer Space*, eds. Tanja Masson-Zwaan and Stephan Hobe (Leden: Nijhoff, 2010), at pp 13-14 [Lachs 2010].

[125] Jakhu, *supra* note 122 at 2.

[126] There are exceptions; if an international space law conflicts with a *jus cogens* principle it would not override the peremptory norm.

[127] Although customary international law often develops slowly through established State practice and the belief that such practice is obligatory (*opinio juris*), since universal application is not always necessary it can emerge instantly among involved parties. This nuanced view will play an important role in space law as new technologies/activities quickly develop into common practice among the relatively few space-faring nations. Bin Cheng, *Studies in International Space Law*, (New York: Oxford University Press, 1997) at pp 136-139 [Cheng 1997]; Manfred Lachs, *Some Reflections on the State of the Law of Outer Space*, (1981) 9 J of Space L 3 at 8 [Lachs 1981].

[128] *Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space,* GA Res 1962 (XIIX), UN Doc A/RES/18/1962 (13 Dec 1963) [1963 Declaration]; Stephan Hobe, "Historical Background", *Cologne Commentary on Space Law: Volume I*, eds. Stephan Hobe, Bernhard Schmidt-Tedd, Kai-Uwe Schrogl, (Carl Heymanns Verlag: Luxembourg, 2009) at p 13, para 40 [CoCoSL]. For a discussion on the binding character of resolutions, declarations, treaties, etc. in international law, *see* Cheng 1997, *supra* note 127 at pp 129-136.

principles[129] that undoubtedly coloured perceptions of what would be and what would not be governed in outer space: for example, it provides that the "the exploration and use of outer space… shall be carried out for the benefit and in the interests of all countries" in addition to establishing that outer space is not subject to any form of appropriation nor the sovereign jurisdiction of any State. Although not a treaty, the 1963 Declaration encapsulated the desire of many States that outer space not fall victim to the same kinds of colonial and imperialist tendencies that befell the New World, at the hands of Europeans, centuries before (from which, many States still suffered). The geopolitical reality was also such that the US and USSR were the only two major spacefaring powers and their ideological differences forced them to compromise on issues related to space: as a result, the underlying principle that emerged from the 1963 Declaration uncharacteristically conceptualized humanity as a single entity, and its provisions sought to reinforce this new, unitary recognition.

The OST was intended to formalize these principles into a binding[130] international treaty that States could more easily accept and ratify, while also codifying its various provisions into "hard law". As with any international agreement, there is value in outlining the intentions of the State parties that influenced their positions when negotiating, drafting and ultimately ratifying the OST. Under international law, the intentions and objectives behind the language chosen by the drafters can play an important role in determining how a text ought to be interpreted and applied. Specifically, in situations where a strict application of the literal text leads "to a result that is manifestly absurd or unreasonable"[131], "[r]ecourse may be had to supplementary means of interpretation, including the preparatory work of the treaty and the circumstances of its conclusion."[132] For the purposes of this thesis , therefore, contextualizing the OST would satisfy the dual purpose of articulating the treaty's underlying principles and providing a background to the analysis of individual provisions that will follow.

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[129] "The 1962 resolution, in nine operational paragraphs, contains the fundamental principles of exploration and use of outer space, which would form the basis for the main legally binding provisions of the Outer Space Treaty." CoCoSL, *supra* note 128 at p 23, para 10.

[130] Treaty obligations are legally binding upon State parties. *Nuclear Tests* (Australia v France), 1974 ICJ 253 (Dec 20) at 268.

[131] *Vienna Convention on the Law of Treaties,* 23 May 23 1969, 1155 UNTS 311 (entered into force 27 Jan 1980) at Art 32(b) [VCLT].

[132] *Ibid* at Art 32.

## Background to the Outer Space Legal Regime

Carefully examining the draft versions of the OST, the statements made by various delegates and the circumstances surrounding the conclusion of the treaty reveal an intentional movement away from individual, State-centric interests towards a more unified internationalization of outer space.[133] Whatever the reason States embarked on such an untraditional path (away from individual sovereignty towards collective goodwill)[134], this ideological shift offered a new perspective through which to consider human endeavour in outer space. Statements made by the delegates during the negotiations and immediately after the conclusion of the OST preserve this sentiment. The delegate from Argentina, for example, remarked "that the treaty recognized 'mankind' as a new subject of international law."[135] Similarly, the "representative of Cyprus, in welcoming the [OST], hailed it as going: 'beyond international law and the Charter, which regarded nations as independent sovereign agents, whereas the treaty saw mankind as a single entity.'"[136] The responsibilities that flow as a result of recognizing mankind as a new entity or subject of international law are significant. In this respect, the Brazilian delegate drew attention to the "the necessity of maintaining a proper balance between the rights and obligations of the space Powers and those of non-space Powers".[137] In doing so, he forewarned that the interests of developed and developing States would not always align and, when they differed, a "balance of interests" would prove necessary. While the balance of interests necessarily considered the rights, obligations, opportunities, etc. of both developing and developed States, the ultimate goal was the betterment of mankind, in a holistic, non-national sense.[138]

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[133] "In addition to the traditional obligation of all states not to interfere with the activities of other states, developed countries are now obligated to make the benefits of their exploration available to developing nations. This is an obligation of an entirely new kind, and its emergence indicated that the traditionally paramount value of the interest of the individual sovereign state is being replaced by a new interest in the interdependent world community of which all states are members." Erik Valters, "Perspectives in the Emerging Law of Satellite Communication", (1970) 5 Stan J Int'l Stud 53 at p 58 [Valters].

[134] CoCoSL, *supra* note 128 at p 53, para 34; Jakhu, *supra* note 122 at p 24.

[135] *Ibid* at p 57, para 55.

[136] Cheng 1997, *supra* note 127 at p 234.

[137] CoCoSL, *supra* note 128 at p 58, para 60, note 72.

[138] Valters, *supra* note 133 at p 61. "Since the economic and social advancement of the developing countries represents both a generally held national aim of the developing countries themselves and, at the same time, a stated goal of the world community as a whole, the two approaches… may be treated as components of a single-international-community perspective."

Importantly, developed States echoed the pronouncements made by developing nations. Although a contingent of non-space powers initially pushed for the recognition of a balanced approach to outer space[139], the two Cold War superpowers made statements confirming this conceptualization. The Soviet delegate emphasized this balance as a "principle of equality between space and non-space Powers"[140] and the US delegate stated "the spirit of compromise shown by the space Powers and the other Powers had produced a treaty which established a fair balance between the interests and obligations of all concerned, including the countries which had as yet undertaken no space activities".[141] The Soviet delegate added "that the treaty was not 'a mere statement of the rights of States' but was designed 'to guarantee that the interests, not only of individual States, but of all countries and of the international community as a whole, would be protected.'"[142] Such statements demonstrate that there was a willingness by all parties to establish a regime in outer space that would balance interests and, in doing so, benefit all States.

The legal framework that emerged therefore contains both permissive and prohibitive elements to ensure that the exploration and use of outer space benefits all. When examining the provisions of space law applicable to permanent human settlement, it is important to keep in mind that the super-national legal regime valued the interests of humanity above those of individual nations. Therefore, in instances where the OST intentionally limited the general permission to freely explore and use outer space, such limitations were meant to act as safeguards, rather than barriers, to ensure the self-interests of a small number of space-faring nations did not inhibit the advantages of outer space for all of humanity.

## Specific Provisions of the Outer Space Treaty

Building upon the concepts espoused in the 1963 Declaration, the OST weaved together many of its most important principles and solidified the foundation of space law. While all treaties must be read in their entirety and individual provisions should not be analyzed in isolation, there is value in examining discrete topics for discussion purposes. Although some of the OST's provisions are more interrelated than others, all flow from the general spirit presented in the Preamble. For the purposes of permanent human settlement

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[139] Nandasiri Jasentuliyana, *International Space Law and the United Nations* (The Hague: Kluwer Law International, 1999) at p 174 [Jasentuliyana].
[140] CoCoSL, *supra* note 128 at p 58, para 60, note 72.
[141] *Ibid* at p 58, para 60, note 72.
[142] *Ibid* at p 57, para 55.

in outer space, therefore, this thesis will examine the provisions most poignant to such activity while remaining cognizant of their relationships.

Preamble

> *Inspired by the great prospects opening up before mankind as a result of man's entry into outer space,*
> *Recognizing the common interest of all mankind in the progress of the exploration and use of outer space for peaceful purposes,*
> *Believing that the exploration and use of outer space should be carried on for the benefit of all peoples irrespective of the degree of their economic or scientific development,*
> *Desiring to contribute to broad international cooperation in the scientific as well as the legal aspects of the exploration and use of outer space for peaceful purposes,*
> *Believing that such cooperation will contribute to the development of mutual understanding and to the strengthening of friendly relations between States and peoples,*
>
> …

The preamble of a treaty is not legally binding. Nevertheless, the preamble outlines the context and aides in the interpretation of a treaty[143], and must be considered alongside all other provisions and annexes when attempting to understand or apply a treaty's principles. The preamble "is the symbol of the aspirations of the parties, of their motives for the conclusion of the treaty and of other important aspects that the treaty partners had in mind when they concluded the agreement."[144] When attempting to determine whether the language of a fifty-year-old treaty would allow for new activities brought about by technological advances (for example, the OST and human settlement), the preamble assists in the ensuing legal analysis.

The OST's preamble offers an overview of the drafter's intended objectives associated with humankind's use of outer space; specifically, that space activities benefit humanity, strengthen friendly relations, reinforce international cooperation and generate equality by peaceful means. The preamble also speaks of progress as a common interest of all mankind and, cognizant of such desired progress, the drafters intentionally left the preambular language vague so as to ensure it would not quickly become outdated. Importantly, such allusions to continued progress demonstrate the legal regime's intention to spur, rather

[143] VCLT, *supra* note 131 at Art 31(2). "[The fact that the] preamble forms part of a treaty for purposes of interpretation is too well settled to require comment." International Law Commission, *Draft Articles on the Law of Treaties with Commentaries*, A/CN.4/185 221 (1966).
[144] CoCoSL, *supra* note 128 at p 20, para 2.

than hinder, developments in space: the creation of a clear, consistent normative framework[145] was intended to provide the legal foundation and legal certainty upon which to achieve this end.

A permanent human settlement in outer space, therefore, is likely the kind of progressive activity envisaged by the drafters as it would enhance the prospects of the human species, would greatly benefit individual humans, would spur great progress (technological, social, political, economical, etc.) and would strengthen international cooperation and mutual understanding (thereby strengthening peace). Whether a permanent human settlement is attempted by a single State, an international organization, a private entity, a consortium of companies or a combination thereof, if carried out in accordance with the elements laid out in the preamble, the negotiating parties' desire that space be used to benefit humanity can be satisfied.

Article I

> *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, irrespective of their degree of economic or scientific development, 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 international cooperation in such investigation.*

Although there is no primacy among individual provisions of a treaty, from an anthropocentric perspective Article I plays a singularly important role in space law by establishing the permission from which all human space activities derive their legitimacy. Although many of the other space law provisions temper this broad freedom, Article I, in and of itself, tempers its own permissive framework by requiring that space activities be carried out for the benefit and in the interests of all countries, not just the entity undertaking the activity.[146] In fact, the content of Article I is to a large extent a restatement of certain preambular principles. This repetition is indicative of the desire of all parties, especially developing States, to solidify in the operative part of the treaty the notion that outer space benefit all countries.[147] The fact that developed

[145] *Ibid* at p 14, para 44.
[146] "… Article I is a microcosm of the entire Outer Space Treaty in that it grants freedoms for certain activities, which it then regulates by specified limitations." *Ibid* at p 27, para 4.
[147] "This implied reference to developing countries [as economically or scientifically lagging], which was originally included in the text of the Soviet draft as a preamble, was embodied in Article I, paragraph I on a proposal by Brazil supported by

States agreed to this repetition demonstrates their acceptance that the use of space ought to benefit humanity as a whole.

Article I consists of three paragraphs, the first describing the beneficiaries of outer space activities, the second permitting space activities and the third desiring for States to cooperate in their scientific investigations of outer space. Since the OST does not explicitly define any terms, it is unclear what exactly "exploration and use" amount to[148], or how they differ from "scientific investigation". For the purposes of Article I's application to permanent human settlement, neither a definition nor a comparative analysis is necessary: the *exploration* of outer space, including celestial bodies, in search of locations suitable to establishing settlements and the *use* of such settlements are permitted.

Notably, the legal framework requires that the exploration and use of such settlements must be for the benefit and in the interests of all countries. Although the phrases "for the benefit of" and "in the interest of" are not defined, it can be inferred from their everyday use[149] that they pertain to a general advantage, improvement or profit. Regarding permanent human settlement, satisfying this requirement in the context of exploration ought to be straightforward; discoveries relating to location, habitability, best-practices, etc. can be shared quite easily. It is less clear how the "use" of a particular settlement (especially one designed, financed and operated by a single entity) would be for the benefit and in the interest of all countries[150]; it may entail providing information related to how the settlement functions, distributing models of the settlement's social dynamics, sharing new scientific discoveries, not patenting inventions created *in situ*, etc. So long as the exploration and use of a settlement offer certain benefits to humanity, they are permitted.

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several other developing and socialist countries (Egypt, India, Czechoslovakia and Hungary among others) who insisted that it be part of the binding treaty commitment." Jasentuliyana, *supra* note 139 at p 174.

[148] "While the term 'use' still awaits more detailed definition, 'exploration' and 'investigation' have specific meanings. Indeed, at this stage they constitute the main centre of activities in outer space. Yet even those formulae will require further elaboration in detail." Lachs 2010, *supra* note 124 at p 44. Some argue that the "use" granted by Article I extends so far as to include the "exploitation" of outer space. *See* CoCoSL, *supra* note 128 at p 34, para 35. The author does not agree that "use" necessarily includes "exploitation" – simply because something can be used, does not mean that it may be exploited. Although a more nuanced discussion would fall outside the scope of this thesis, there is no evidence that the negotiating parties intended "use" to include "exploitation".

[149] VCLT, *supra* note 131 at Art 31.

[150] It is unclear to what extent an activity must benefit all countries. Current state practice (taking telecommunication or broadcast satellites as an example) suggests that the "benefit" requirement may be satisfied by a "trickle-down" effect. Notwithstanding, the general characterization of "a benefit to humanity" must be considered temporally – space activities must make tomorrow better than yesterday. Similarly, current space activities must not run counter to the principle of inter-generational equity. CoCoSL, *supra* note 128 at p 34, para 33.

Overall, however, a permanent human settlement most clearly benefits and is in the interests of all countries by virtue of its preservation of the human species. Accepting that the survival of the species is important – indisputably so for the species *itself* – a permanent human settlement, however it is carried out, benefits all countries simply by ensuring the continued existence of the species. Therefore, settlement activities, whether temporary or permanent, are permitted under Article I.

Article II

> *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.*

Article II prohibits the appropriation of outer space, simultaneously limiting and preserving the rights afforded under Article I: States are limited from claiming ownership or securing property rights in space thereby preserving for all other States the general freedom to use and explore. As the "non-appropriation" principle, Article II prevents an entity from claiming ownership over a particular spot in space, a plot of land on a celestial body or even an orbit around a moon[151]; while exploration and use are permitted, ownership is prohibited. Therefore, regardless of the scope of use or degree of reliance on a particular phenomenon of outer space, an entity cannot claim an individual benefit permanently. As a result, the USSR could not claim the orbit in which Sputnik made its maiden voyage[152], the USA could not claim the Sea of Tranquility as its territory after planting its flag on the Moon[153] nor could the equatorial countries exclude others from using the geostationary orbit located approximately 36,000 km above their territories[154].

Although the OST does not define "appropriation"[155], the prohibition outlined in Article II must be understood to limit not only explicit claims of property or ownership but also, what can be called,

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[151] Leslie Tennen, *Outer Space: A Preserve for All Humankind*, (1979-1980) 2 Hou J of Int'l L 145 at 153 [Tennen].

[152] Representative of the USSR in 1962: "No human activity on the Moon or any other celestial body could be taken as justification for national appropriation." Lachs 2010, *supra* note 124 at p 41, en 6.

[153] Representative of the US in 1966: "We have rejected the concept of national sovereignty in outer space. No Moon, no planet shall ever fly a single nation's flag." Lachs 2010, *supra* note 124 at p 41, en 6.

[154] *Declaration of the First Meeting of the Equatorial Countries*, 3 Dec 1976, ITU Doc WARC-BS 81-E.

[155] As with many other provisions in the OST, the drafting parties chose to leave the provisions vague so as not to hamstring their application to unconceived future realities. When it comes to appropriation, given the serious consequences that would follow from either explicitly denying private property or explicitly announcing a particular definition, the parties chose to remain silent in its specific application.

"appropriation by action" – an activity that, without ever claiming to do so, appropriates outer space through its indirect consequences. An appropriate understanding of appropriation, therefore, becomes vital when determining whether proposed new and emerging technologies (such as permanent human settlement or space mining) may appropriate outer space, in one way or another, without ever claiming to do so.[156] Although a truly meaningful investigation into the definition of appropriation is outside the scope of this thesis, moving forward without a useful conceptualization would be imprudent; therefore, a brief investigation into the drafting parties' motivations for including the non-appropriation principle is warranted.

During Article II's deliberations, many State representatives announced their support of the non-appropriation principle as a way of ensuring space activities would not undermine the general objectives of the OST (that outer space serve the interest of all States and not just the State undertaking a particular activity). Specifically, there was a desire that outer space not devolve into another domain of exploitation and imperialism, as had the New World and Africa during the fifteenth through nineteenth centuries.[157] As Judge Manfred Lachs reminds: "Need one recall how frequently the practices of dividing and disposing of lands and whole continents led to conflict and strife? The lesson should have been learnt."[158] Indeed, for many of the negotiating parties the lesson had been learned. Rather poignantly, the years in which such space-related discussions were taking place were also a period of great decolonization and independence, with States acutely aware and hyper-prescient of the consequences of imperialism.

Since there is no evidence that space harbours other life forms, some have argued that mimicking the imperialism of the past in space would not result in harm as it did on Earth. What must be remembered, however, is that imperialism generates great inequality aside from the fact that it often subjugates certain classes. Ambitious territorial landgrabs in space, currently only possible for developed space-faring States, would cement economic advantages far into the cosmos and further exacerbate the inequality amongst nations on Earth. This will be the case regardless of whether alien civilizations exist. There is no question

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[156] Ernst Fasan, *Human Settlements on Planets: New Stations or New Nations*, (1994) 22 J Space L 47 at 47 [Fasan].

[157] "The universe is the common heritage of mankind, and all human beings have a right to participate in and benefit from the use of space. The cosmos is not, therefore, an arena free for the conquest and exploitation by entities with the most advanced capabilities. Rather, activities in space must be conducted while recognizing the rights of humanity. Outer space is, and should remain, a preserve for all humankind." Tennen, *supra* note 151 at 158.

[158] Lachs 2010, *supra* note 124 at p 20.

that space affords humanity great opportunity – what is questionable is how such opportunity will be distributed.[159] Prohibiting appropriation was one method chosen by the negotiating parties to ensure the satisfaction of the OST's underlying objective that space activities benefit all of humanity and not simply those with exploitative capabilities.[160]

The appropriation of outer space, therefore, can be accomplished by an activity that results in the same kinds of consequences as private ownership – exclusive use, profiting, unilateral decision making, etc. While such characteristics are necessarily true of certain activities (such as orbital positions[161]), they are temporary and often available for someone else to use nearly simultaneously. A human settlement, with its notable permanence in a particular location, is neither temporary nor can it be used by multiple users concurrently – once established, its location will be restricted to other users.[162] The general argument that space is vast (and so a single settlement site will not reduce the available real estate or subsequent users can simply choose another suitable site) undercuts the reality that space, while expansive, offers certain irreplaceable advantages depending on location.[163] Notwithstanding, any realistic permanent human settlement will necessarily require affixing its structures to the ground, thereby appropriating that specific area in favour of the structure's owner. In discussing this position, Judge Lachs reiterates that all activities in space ought to be for the benefit of all countries and Dr. Nicolas Matte draws the conclusion that: "moveable objects 'attached to celestial bodies become immovables', which grants the State to which they belong a right to the 'soil' of celestial bodies or at least a right to the surface'. Thus it is contended that 'we arrive at an ownership… by technical and industrial occupation, without giving it a name."[164] Both Judge Lachs and Dr. Matte warned against State appropriation of celestial bodies to avoid the ever-present conflicts on Earth caused by similar situations.

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[159] Lachs 1981, *supra* note 127 at 9.

[160] "One important, even decisive, element [in technological development] is that each of the inventions, each of the great achievements of our generation and each of the three revolutions we have gone through can be used for the good or evil of man, for its progress or its destruction." *Ibid* at 6.

[161] Notably, however, orbit designations are made in coordination with the International Telecommunications Union to ensuring non-interference and appropriate access to all States.

[162] Fasan, *supra* note 156 at 47. *But see* the discussion on Article XII below.

[163] For example, some Martian locations will be more suitable than others in terms of access to water, radiation shielding, solar exposure, etc.

[164] Lachs 2010, *supra* note 124 at p 50, en 30.

In an attempt to get around this prohibition on national appropriation, some private enterprise proponents developed a nuanced argument focussing on the inclusion of the word "national" to claim that private, non-governmental entities were not prohibited from appropriating outer space and celestial bodies.[165] Indeed, a plain language, straightforward reading of Article II suggests that since only *national* sovereignty is listed as a prohibited ground, other forms of appropriation may be permitted. Notwithstanding that Article VI makes it clear that States are responsible for their private entities' space activities (thus if a private entity claimed sovereignty, their State would be responsible and thereby violate Article II), most delegates participating in the negotiations of Article II were of the opinion that it prohibited both public and private appropriation.[166] This remains the consensus today.[167] Plainly, the appropriation of outer space by private entities would have similar consequences as State appropriation – imperialistic exploitation conducted by SpaceX is still imperialistic exploitation. Therefore, arguments that claim private entities can appropriate outer space are legally invalid.

The conclusion, therefore, seems to be that any permanent human settlement would necessarily appropriate the celestial body upon which it is located and therefore violate Article II. Although there is no denying that States or private entities can establish stations or installations in space, the intention and permanence of the structures may give rise to an activity that violates international law.[168] However, if the settlement activity were undertaken in a particular manner (as will be explored more thoroughly in Chapter

[165] "The [OST] in its present form appears to contain no prohibition regarding individual appropriation or acquisition by a private association or an international organization… [in relation to] any part of outer space." Steven Gorove, *Interpreting Article II of the Outer Space Treaty*, (1969) 37 Fordham L Rev 349, at p 351. But see Tennen, *supra* note 151 at 151.

[166] CoCoSL, *supra* note 128 at p 50, para 24, fn 35.

[167] "[S]tatements made by Brazil, Chile, Japan, the Netherlands, and the Philippines, in which they referred to the effect of the non-appropriation provision in preventing colonialism, international rivalries and internationalisation of outer space, would suggest that they were of the view that the provision related to the prohibition of state sovereignty only. It is clear, however, on a detailed review of the *travaux preparatoires* that no State stated positively that Article II… does not and should not extend to prohibit property rights on celestial bodies." Ricky J. Lee, "Creating a Practical Legal Framework for the Commercial Exploitation of Mineral Resources in Outer Space", (2009) Doctoral Thesis, Murdoch University, accessed online: <http://researchrepository.murdoch.edu.au/1665/> at pp 343-344. (citations omitted); CoCoSL, *supra* note 128 at p 58, para 58.

[168] "Freedom of access to all areas of celestial bodies confers on all States the right to establish stations and installations, to conduct experiments and make use of the celestial body as a whole and any part of it. Equality requires that this right be exercised only to an extent compatible with due regard for the corresponding rights and interests of other States." Lachs 2010, *supra* note 124 at p 45.

3, an interpretation of Article II, in light of the object and purpose of the overall treaty, may justify its violation.

Article III

> *States Parties to the Treaty shall carry on activities in the exploration and use of outer space, including the Moon and other celestial bodies, in accordance with international law, including the Charter of the United Nations, in the interest of maintaining international peace and security and promoting international cooperation and understanding.*

Article III requires space activities[169] to be carried out in accordance with international law. Although space law is a part of general international law and *lex specialis* to the outer space environment, the *corpus juris* of general international law still applies. International law characterizes the body of rules that govern relationships between States (the main actors of international law) and outlines acceptable and unacceptable conduct. International law applies to all State activities or endeavours (for example, international investment, the transport of radioactive materials, aviation accidents, etc.) and are governed by distinct bodies of law. State activities are often complex and a single situation may be governed by distinct yet interconnected subsets of international law (for example, the law of the sea, the law of armed conflict and trade law may all apply to a naval blockade enforcing economic sanctions). Although it may seem obvious that not all regimes of international law apply to all activities[170], Article III expunges any doubt that existing and future rules of international law apply to outer space[171]. As such, concepts that have emerged since the drafting of the OST (international environmental law, Internet law, the most-favoured nation principle, etc.) apply to outer space and its activities with the same vigour as do concepts at the heart of international law (States as subjects of international law, the equality of States, cooperation, etc.).

Similarly, Article III's explicit mention of the UN Charter – which, as a component of international law makes its reference superfluous – removes any doubt as to its applicability. As a result, no State may

[169] The term "activities" applies not only to those activities carried out in space, but also to activities undertaken on Earth in support of space activities (such as "the launching, the operation or the return of space objects"). CoCoSL, *supra* note 128 at p 66, para 9.

[170] "None of this, however, implies an automatic extension to outer space and celestial bodies of 'international law, including the Charter of the United Nations' *in toto*. Many parts of their chapters are destined for specific environments and thus do not lend themselves to application in some areas." Lachs 2010, *supra* note 124 at p 13.

[171] CoCoSL, *supra* note 128 at p 67, paras 13-14.

undertake activities in space that may amount to aggression[172] (such as using a satellite to intentionally crash into another satellite), States may defend themselves[173] (such as taking evasive manoeuvers, without first giving notice, if an intended collision is anticipated) and States may reasonably expect that their conflicts can be resolved by peaceful means[174] (such as Canada taking Russia to the ICJ over a question of liability), etc. Of course, there are aspects of the UN Charter that do not apply to space activities and some that will likely never apply.

Given the application of general international law to outer space, permanent human settlements must abide not only to the explicit components of space law but also to the legal principles established in international law. This is especially true given the OST and subsequent space treaties do not address every possible scenario characteristic of life in a settlement. For example, there is no suggestion of the individual rights applicable to settlers (other than rendering assistance or securing their return). Therefore, issues of self-determination[175], the freedom from slavery[176] or even the right to practice one's religion[177] will be determined on the basis of the *United Nations Convention on Political Rights*[178] rather than specific provisions of space law. Countless other legal principles not explicit to space will also apply to settlements as the expectation is that such activities will provide long-term, sustainable homes for settlers. Although such concerns may seem trivial at this early stage, the day-to-day governance and operation of permanent human settlements will rely much more on general legal maxims than space-specific ones. In this context, it is important to recognize that the purpose of international law, especially in establishing the legal framework of permanent human settlement, is to establish clear, understandable and practical rules that help States predict the outcomes and consequences of their actions in order to avoid disagreements and, in situations of disagreement, offer avenues through which situations can be defused peacefully and amicably.[179]

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[172] *Charter of the United Nations*, 26 Jun 1945, 1 UNTS XVI (entered into force 24 Oct 1945) at Art 39 [UN Charter].
[173] *Ibid* at Art 51.
[174] *Ibid* at Art 94.
[175] *International Covenant on Civil and Political Rights*, 16 Dec 1966, 999 UNTS 171 (entered into force 23 Mar 1976) at Art 1.
[176] *Ibid* at Art 8.
[177] *Ibid* at Art 18.
[178] This will remain true so long as the State involved is a party to the treaty or these provisions are customary international law.
[179] "There is little doubt that the main object and purpose of the basic principles of contemporary international law is to safeguard peaceful relations amongst States." Lachs 2010, *supra* note 124 at p 14.

Article IV

> *States Parties 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 such weapons in outer space in any other manner.*
> *The Moon and other celestial bodies shall be used by all States Parties to the Treaty exclusively for peaceful purposes. The establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military manoeuvres on celestial bodies shall be forbidden. The use of military personnel for scientific research or for any other peaceful purposes shall not be prohibited. The use of any equipment or facility necessary for peaceful exploration of the Moon and other celestial bodies shall also not be prohibited.*

Article IV seeks to prevent the conversion of outer space into a new theatre of war by preventing the placement of nuclear weapons or weapons of mass destruction into orbit and forbidding the creation of any military installations in outer space. The geopolitical reality of the Cold War era, with its characteristic shadow of nuclear war looming large, necessitated the inclusion of such a provision. To a large extent, Article IV has successfully prevented the weaponization of space, although some criticize it has not successfully prevented its militarization.[180]

Regarding permanent human settlement, Article IV is directly relevant insofar as it explicitly prohibits the "establishment of military bases, installations or fortifications" on celestial bodies and that "the Moon and celestial bodies shall be used exclusively for peaceful purposes". Therefore, it is forbidden to establish a settlement in space with the intention of bolstering one's military capability or presence. Even if military personnel are selected as settlers (either exclusively or in association with civilians), the settlement itself cannot be operated as if it were, or a part of, a military operation. In association with Article V, all military settlers would likely be considered astronauts and their previous affiliations would play no role. Importantly, the settlement itself – regardless of who or how it is operated – must be directed towards peaceful ends. While it is not necessary for a settlement's general objective to be the promotion of peace, the normal operation of settlement activities must be carried out peacefully.

The application of Article IV regarding permanent human settlement will be more pronounced in the foreseeable future when there are multiple settlements on a single celestial body and their interactions become more complicated. When significant disputes cannot be resolved diplomatically, humans tend to

[180] Weaponization refers to placing weapons in space whereas militarization refers to simply using space to support Earth-based military activities. Some argue that preventing the militarization of space was never the OST's objective.

consider resorting to non-peaceful measures; so long as settlements abide by Article IV's prohibition on establishing military bases in times of tranquility, they would not have the organized means of conducting a military operation in times of disagreement. Although in certain circumstances international law may justify a military response[181], the ability to carry out such a response in space would require a stockpiling of military personnel, arms, bases, training, etc. Therefore, the mere *ability* to carry out an otherwise lawful military response in space would amount to a violation of Article IV. Although it is likely Article IV will be amended to serve local interests in the 100 or 1,000 years after settlements become commonplace, at least in the initial formational phase of settlement creation Article IV will channel such activities to be peaceful.[182]

Article V

> *States Parties to the Treaty shall regard astronauts as envoys of mankind in outer space and shall render to them all possible assistance in the event of accident, distress, or emergency landing on the territory of another State Party or on the high seas. When astronauts make such a landing, they shall be safely and promptly returned to the State of registry of their space vehicle.*
> *In carrying on activities in outer space and on celestial bodies, the astronauts of one State Party shall render all possible assistance to the astronauts of other States Parties.*
> *States Parties to the Treaty shall immediately inform the other States Parties to the Treaty or the Secretary-General of the United Nations of any phenomena they discover in outer space, including the Moon and other celestial bodies, which could constitute a danger to the life or health of astronauts.*

Article V[183] creates the specific designation of "astronaut" for humans travelling to outer space and grants them the special status of "envoys of mankind". The desire to specify humans in space as astronauts was two-fold: first, both the US and the USSR wanted their citizens to be treated correctly in the case of an emergency landing in the other's territory and second, the negotiating parties believed people travelling to outer space deserved humanitarian protections.[184] The drafters bestowed upon astronauts the

[181] For example, self-defence (Art 51) or when the Security Council decides to implement the use of force (Art 44). UN Charter, *supra* note 172.
[182] The author realizes this statement contradicts the desire that space settlements (by virtue of their unique opportunities to establish new social structures) do not replicate problems endemic to Earth in space, but also realizes the likely vanity of such a desire.
[183] This section of the thesis will also reference the *ARRA*, a separate treaty that expands on the concepts espoused in Article V of the OST. *Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched Into Outer Space*, 22 Apr 1968, 672 UNTS 119, (entered into force 3 Dec 1968) [*ARRA*].
[184] CoCoSL, *supra* note 128 at p 95, para 1.

characterization of "envoys of mankind" as they believed the human exploration of outer space, as a domain separate from Earth, should be undertaken with the interests of all of humanity in mind.

Unfortunately, without a clear definition of the term "astronaut", the special protections afforded to such individuals remains ambiguous. The first paragraph of Article V renders it unclear whether the term "astronaut" is used prescriptively or descriptively: a prescriptive approach would suggest that anyone who travels into space is an astronaut and therefore attracts special protections whereas a descriptive approach would suggest that there are certain classes of people who are astronauts (in space or otherwise) and when those astronauts travel to space they are afforded certain protections. Since at the time of drafting anyone who went to space was already considered an astronaut (or cosmonaut), it is likely the negotiating parties did not dwell on this distinction.[185] Consequently, most operations today categorize professionally trained crewmembers as "astronauts" (of which, there are mission specific distinctions) and categorize most others as "spaceflight participants"[186]. Importantly, State practice seems to suggest that a "spaceflight participant" does not attract the designation of "astronaut" nor the special status of an "envoy of mankind" (although they do attract the protections afforded to them as "personnel of a spacecraft").

Applying such phraseology to permanent human settlers, all those who transit to outer space would qualify as personnel of a spacecraft and continue to attract such attribution for the duration of their stay (regardless of whether they are also considered astronauts). The protections afforded to personnel of a spacecraft apply so long as someone is in outer space and has not returned to Earth (irrespective of whether they actually leave their spacecraft). Since most permanent settlers will be making one-way journeys, the legal logic suggests that they remain characterized as "personnel of a spacecraft" for the remainder of their lives, possibly passing on the classification to any children born in a settlement as well. The consequences of such a characterization are such that all "personnel of a spacecraft" must be afforded any assistance that is capable of being delivered to ensure their survival: this requires other space settlements, nearby space

[185] It is worth noting, however, that in the ARRA, aside from the title and in the preamble, the treaty refers to "personnel of a spacecraft" rather than astronauts. Although the rationale behind shifting the language remains unclear, one can assume it was intentional.

[186] For example, NASA uses astronaut to refer to their professionally trained crew and assigns mission-specific titles to each. Russia does the same with its cosmonauts. For non-professional participants making the journey to the International Space Station, the designation of "spaceflight participant" has been used. CoCoSL, *supra* note 128 at p 97, paras 8-12.

stations, ground support systems, etc. to provide assistance in circumstances of distress, which has the potential of devolving into an extremely onerous responsibility for assisting parties.

Further, Article V requires States to provide relevant information they may possess that could endanger an astronaut[187] – assuming most settlers will be characterized as "personnel of a spacecraft" rather than "astronauts", the application of this responsibility will be limited. Notwithstanding, if a settlement contained astronauts, all State parties would be responsible for notifying that settlement of any potential hazards of which they become aware. It is likely this "notification of information" requirement will become more of an issue when multiple settlements with different capabilities exist on the same celestial body, and the most advanced will be required to notify all other settlements of impending danger. This requirement stands even if the different settlements are competitors, where harm suffered by one would be advantageous to another; such a reality may make satisfaction of this responsibility more difficult in the future.

Article VI

> *States Parties to the Treaty shall bear international responsibility for national activities in outer space, including the Moon and other celestial bodies, whether such activities are carried on by governmental agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions set forth in the present Treaty. The activities of non-governmental entities in outer space, including the Moon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty. When activities are carried on in outer space, including the Moon and other celestial bodies, by an international organization, responsibility for compliance with this Treaty shall be borne both by the international organization and by the States Parties to the Treaty participating in such organization.*

Article VI deals exclusively with international responsibility[188] in space. International responsibility is a well-developed domain of general international law[189] that determines accountability for States' actions: "[R]esponsibility implies a person's answerability for his or her own acts."[190] State obligations are created

[187] There is no similar, explicit requirement in the ARRA and therefore does not apply to "personnel of a spacecraft".
[188] In the English version of the text, the term "responsible" is used in Article VI and the term "liable" is used in Article VII. In the Chinese, French, Russian, Spanish and Arabic versions, the same term is used in both Articles VI and VII. Bin Cheng, *Article VI of the 1967 Space Treaty Revisited: "International Responsibility", "National Activities", and "The Appropriate State"*, (1998) 26 J Space L 7 at 10 [Cheng 1998]. Since all versions (except the Arabic) are equally authentic (Article XVII), the English distinction is less consequential than it may at first seem.
[189] International Law Commission, *Articles on Responsibility of States for Internationally Wrongful Acts with commentaries (2001)*, 53 UNGA OR Supp (No 10), UN Doc A/56/10 (2001) [ASR].
[190] Cheng 1998, *supra* note 188 at 308.

either explicitly (such as when it enters into treaties or adopts a code of conduct) or implicitly (such as when a norm becomes a rule of customary international law); failing to uphold an obligation is a violation of international law, for which a State will be internationally responsible. Consequently, States are responsible for all of their space-related activities, whether conducted on Earth or in space. Failing to uphold space-related obligations (for example, placing a nuclear weapon in orbit) would result in a State being responsible for violating Article IV of the OST.[191]

The first sentence of Article VI is superfluous insofar as it outlines the application of international responsibility to outer space; as Article III makes sufficiently clear, the concept of international responsibility (as a part of general international law, and, arguably, as a rule of customary international law) would undoubtedly apply to State activities in outer space regardless of Article VI's reiteration. Article VI's true importance, therefore, lies in the fact that it permits private entities to operate in outer space by offsetting their responsibility to States.[192] This space-specific extension of responsibility (from private to public) is unique in international law, as States are typically not responsible for the activities of their private entities. This deviation resulted from the US and USSR's ideological differences, where the former desired to grant private entities the right to operate in space[193] while the latter desired to limit space activities to States alone: the UK proposal that both States and private entities could operate in space, but States would always remain responsible, satisfied all sides.[194]

To abate concerns that private entities, free from responsibility, would abuse the space environment, Article VI also requires an appropriate State to authorize and supervise the activities of private entities (again, a unique feature of space law). Although the term "appropriate" is not defined, it was substituted for the phrase "concerned State" (as used in the 1963 Declaration[195]) and alludes to the belief that a State that is able to suitably authorize and continuously supervise the activities carried out by a private entity ought to be responsible. An appropriate State is determined by considering the territory in which the activity is

[191] Violating international law can result in a violating State making reparations (restitution, compensation or satisfaction). *Case Concerning the Factory at Chorzów* (Germany v Poland), (Sep 13) 1928 PCIJ Ser A, No 17 at 23; ASR, *supra* note 189 at Ch II.
[192] Tennen, *supra* note 151 at 149.
[193] In fact, around the time the negotiations were taking place, the US had already decided that it would privatize its telecommunication services and therefore sought to ensure such activities would be permitted under international law.
[194] CoCoSL, *supra* note 128 at p 105, paras 5-8.
[195] *Ibid* at p 105, paras 5-8.

undertaken or the nationality of the people undertaking the activity (criteria routinely considered in general international law).[196] It is possible, therefore, that more than one State is deemed "appropriate" (for example, if Canadian nationals are undertaking space activities in the US), and such a determination of most-appropriate would be made given the specific circumstances.

The requirement to authorize often entails a government review of projects and the distribution of licenses before launch whereas the requirement to supervise often entails reporting, audits and inspections. To competently carry out its authorization and supervision requirements, a State must have in place infrastructure for proper oversight; this would include experts in satellite construction and launch, a radiofrequency spectrum distribution policy, orbital trajectory competence, environmental sustainability forecasts, compliance officers, etc. As more private entities enter the market with dreams of undertaking more novel and ambitious space activities, the need for State oversight will increase even in developed space-faring States.[197] Traditionally, States gained the expertise necessary to oversee private actors by first undertaking such activities themselves; it remains to be seen whether the same will be true moving forward as the more ambitious of space-related activities originate with private entities rather than national space programmes.[198]

Regarding permanent human settlement, Article VI will play a significant role in attributing responsibility for settlement activities to a particular State (whether directly or through authorizing and supervising a private entity). A State's responsibility would extend from the initial conceptualization of the project, to the launch, transit and installation of the settlement.[199] Any individual involved in any of these

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[196] Some would argue that the State on whose registry a space object is listed would also be the appropriate State. *Ibid* at p 113, para 46.

[197] For example, Moon Express was finally granted a licence to launch by the US only after months of internal-haggling between the Federal Aviation Administration, the Federal Communications Commission, the State Department, the Department of Defence, the National Oceanic and Atmospheric Administration, NASA and the White House on how to licence this new space activity. Mike Wall, *Moon Express Approved for Private Lunar Landing in 2017, a Space First*, Space.com, 3 Aug 2016, online: <https://www.space.com/33632-moon-express-private-lunar-landing-approval.html>; Loren Grush, *Moon Express become first private company to get us approval for lunar mission*, The Verge, 3 Aug 2016, online: <https://www.theverge.com/2016/8/3/12361256/moon-express-private-mission-spaceflight-us-government-approved>.

[198] How States evaluate their competence in authorizing or supervising activities with which they have no experience remains to be seen.

[199] There is some debate on whether activities conducted on Earth or in airspace, in support of a space activity, fall under the purview of the OST and related legal regime. Current consensus suggests it does and the author believes this

phases would also be the responsibility of the State under international law, regardless of whether the operation was public, private or a combination thereof. Further, the management (or supervision) of the settlement and its day-to-day activities would also be the responsibility of the appropriate State, a task of seemingly unimaginable proportions long-term. Using the ISS as an example, the level of technical expertise, ground support and redundancy necessary for, at most, managing a half-dozen astronauts is significant; carrying out the operation or supervision of an entire settlement would require an astronomical effort (at least until some form of autonomy is generated).

A vocal minority[200] have recently begun to argue that the regulation of private space activities, through established authorization and supervision procedures, is going beyond the intentions of the OST and thereby unnecessarily preventing private industry from flourishing in space. While the OST intentionally limits unabated private activity in space, it does so for good reason: the physics of outer space does not allow for localized harm and responsibility and liability are apportioned to States. If the space activities of private entities were not regulated, a single, foreseeable disaster could render an entire orbit or celestial body unusable for generations and the appropriate State would be responsible and liable. Given this legal reality, States must undertake steps to properly authorize and supervise private activities – failing to do so would be imprudent. Acknowledging that such oversight for certain activities (including permanent human settlement) would be significant, the need is nevertheless not mitigated.

Article VII

> *Each State Party to the Treaty that launches or procures the launching of an object into outer space, including the Moon and other celestial bodies, and each State Party from whose territory or facility an object is launched, is internationally liable for damage to another State Party to the Treaty or to its natural or juridical persons by such object or its component parts on the Earth, in air space or in outer space, including the Moon and other celestial bodies.*

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perspective falls in line with the OST's overall objective that space be used to benefit all people. CoCoSL, *supra* note 128 at p 107, paras 19-21.

[200] Although this position is often advanced in support of space mining, it can also apply to settlements. For example, Laura Montgomery, an attorney formerly with the FAA's Office of Commercial Space Transportation, has stated: "Life is full of activities, from brushing one's teeth to playing a musical instrument, [that take place on Earth and in space]. Just because those activities take place in outer space does not have to mean that they suddenly require oversight." Characterizing the functional role of authorization and supervision in this manner is plainly wrong; such a caricature does nothing to further constructive discussion on how private entities ought to operate in space effectively. Jeff Foust, *Is it time to update the Outer Space Treaty?*, The Space Review, 5 June 2017, online: <http://thespacereview.com/article/3256/1>.

Article VII[201] deals with liability stemming from damages caused by space objects: a State that 1) launches a space object, 2) procures the launch of a space object, 3) from whose territory a space object is launched or 4) from whose facility a space object is launched is internationally liable for any damage caused by the space object, whether the damage occurs in outer space, in airspace or on Earth.[202] States are internationally liable for their own space objects as well as the space objects of private entities for which they are the appropriate State under Article VI.[203] Aware of the inherent risks associated with "ultrahazardous" space activities[204], the negotiating parties sought to establish a clear legal framework for the apportionment of liability; as a counterbalance to the freedom of exploration and use in Article I, any damage caused by a space object would be attributed to at least one State.[205]

A launching State remains liable for damage caused by a space object long after its successful launch: so long as a space object remains in space, the launching State remains liable. Regarding space settlements, a State would be liable for any "space settlement object" that causes damage, regardless of how long after reaching the settlement the space object causes damage. For this reason, if SpaceX launches the component parts for a settlement on Mars from the US, the US would be liable for any damage caused by those component parts indefinitely into the future. Interestingly, Article VII of LIAB does not apply to damage caused by a State to one's own nationals[206]; depending on the make-up of a permanent human settlement, therefore, the liability regime may not apply to damage caused by space objects to settlers.[207] Furthermore, since Article VII does not limit itself to the launch of space objects from Earth, launches from celestial bodies

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[201] This section of the thesis will also reference the *LIAB*, a separate treaty that expands on the concepts espoused in Article VII of the OST. *Convention on International Liability for Damage Caused by Space Objects,* 29 Mar 1972, 961 UNTS 187 (entered into force 1 Sep 1972) [LIAB].

[202] Articles II and III of the LIAB demarcate between damaged caused in outer space (to which fault based liability would apply) and damage caused in airspace or on Earth (to which absolute liability would apply).

[203] States are therefore internationally responsible *and* liable for private entities' space activities. In a way, Article VII incentivizes rigorous authorization and supervision processes to ensure liability-risk is minimized. Some States go so far as to require the procurement of insurance and condition licences with indemnity clauses.

[204] For example, a single collision in LEO could render the entire orbit unusable for decades.

[205] Since there are four grounds under which a State can be the launching State, any one can be found liable for damage. CoCoSL, *supra* note 128 at p 130, para 6.

[206] Article VII of the LIAB provides: "The provisions of this Convention shall not apply to damage caused by a space object of a launching State to… [n]ationals of that launching State. LIAB, *supra* note 201. *See also* CoCoSL, *supra* note 128 at p 135, para 30.

[207] This also means if one settlement of a State caused damage to a separate settlement of that same State, national laws would apply rather than the Article VII or the LIAB. For example, if Blue Origin set up a settlement on Mars and caused damaged to SpaceX's settlement, US laws would govern.

are also subject to the liability regime outlined in the OST and LIAB.[208] Therefore, settlements engaged in resource mining or product manufacturing in space that export their goods to Earth or other celestial bodies would be required to launch and thereby subject themselves to the outer space liability regime.

Article VIII

> *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 celestial body. Ownership of objects launched into outer space, including objects landed or constructed on a celestial body, and of their component parts, is not affected by their presence in outer space or on a celestial body or by their return to the Earth. Such objects or component parts found beyond the limits of the State Party to the Treaty on whose registry they are carried shall be returned to that State Party, which shall, upon request, furnish identifying data prior to their return.*

Article VIII[209] concerns itself with the registration of space objects to ensure identification and connection, for the purposes of international responsibility, to an appropriate State.[210] Although Article VIII does not impose an obligation on States to establish a national registry, it does incentivize doing so by granting States jurisdiction and control over their appropriately-registered space objects.[211] A robust registry ensures international awareness of various space activities and an appreciation for how such activities may affect individual and collective interests.[212] Ensuring the registration of space objects also promotes compliance with other space laws as any violation can be attributed to a State and appropriate remedies may be sought.

The crucial element of "jurisdiction" relates to the fact that States, as subjects of international law, have the right to enact certain rules, regulations, etc. to govern activities within their territory (territorial

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[208] Since territoriality does not extend in space, the launching State can only be determined based on the facility from where it is launched, the State that procures a launch or the State that actually undertakes the launch.

[209] This section of the thesis will also reference the REGI, a separate treaty that expands on the concepts espoused in Article VIII of the OST. *Convention on Registration of Objects Launched into Outer Space*, 6 Jun 1975, 1023 UNTS 15 (entered into force 15 Sep 1976) [*REGI*].

[210] Comprehensive registration would also aid in the tracking and monitoring of space objects, thereby increasing space traffic management and reducing collisions.

[211] Article II of the REGI requires States to establish national registries and Article IV requires them to submit certain information to the UN Registry. Not registering a space object in a national registry means a State does not have jurisdiction and control over its space object. Failing to register in the UN Registry does not have the same consequence.

[212] "Article VIII puts the jurisdiction and control over a space object in the hands of a single launching State through the mechanism of registration. Registration creates, in a sovereignty-free area, a chain of attribution between the launching State, the space object, international responsibility for space activities and jurisdiction and control by the registering State." CoCoSL, *supra* note 128 at p 147, para 2.

jurisdiction) and over their people (personal jurisdiction).[213] For example, as a State, Canada has territorial jurisdiction over its land (granting it the right to govern the activities taking place within it) and personal jurisdiction over its citizens (granting it the right to govern them, even if they are not in Canada). Separately, the element of "control" relates to a State's capability to influence something, either by its own administrative channels or through its national legal mechanisms.[214] For example, Canada has control over the Canadarm affixed to the ISS through its command center at the Canadian Space Agency, as well as control over private Canadian remote sensing system operators through the *Remote Sensing Space Systems Act*. Since jurisdiction and control extends not only to the space object but also its personnel, a State of registry's civil, criminal, tort, intellectual property, etc. legal regimes also apply to the personnel of the space object.[215] In multi-national endeavours, therefore, an individual may be subject to the laws of the State of registry of the space object in which they are located as well as the laws of the State of which they are a national.

Although space is a domain in which traditional property rights do not apply (as per Article II), a State (or private entity) nevertheless maintains ownership of its space object while in space, whether or not it is registered in a national or UN registry. As with ownership rights on Earth, the owner of a space object can transfer (sell, lease, etc.) its property at will. However, since only launching States can be the State of registry of a space object, unless the entity buying/leasing the space object was also a launching State (or is the private entity of a launching State), the original State of registry would retain jurisdiction and control.[216] For example, if a Canadian entity procures a launch of a space object from a US launch provider and registers the space object on the Canadian registry, the Canadian entity may sell or lease the space object to any third party but Canada will maintain jurisdiction and control over that object (unless the purchaser/lessor is the US or an American entity, in which case the US can become the State of registry).[217]

Article VIII will play an important role in determining the State that has jurisdiction and control over a permanent human settlement since most of the component parts necessary to establish the settlement will be launched as space objects and likely registered. Paradoxically, a strict application of Article VIII would

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[213] *Ibid* at p 157, para 50.
[214] *Ibid* at p 157, para 51; Fasan, *supra* note 156 at 51.
[215] CoCoSL, *supra* note 128 at p 159, para 59; Fasan, *supra* note 156 at 52.
[216] *Ibid* at p 155, para 40.
[217] Such a transfer, on its face, would not affect the responsibility and liability of the original State unless the agreement transferring the space object also included language that passed on responsibility and indemnified against claims for damage.

seem to grant jurisdiction and control to the State of registry of the component parts that make up a settlement over the area of the celestial body upon which the settlement is established, a seeming violation of Article II: if a habitat module is registered by Canada, and the habitat module is permanently fixed to Crater A on Mars, Canada would seem to have jurisdiction and control over Crater A. However, such a conclusion is inaccurate since the "jurisdiction and control" granted by Article VIII is not a transfer of sovereignty but rather a clarification of legal, rather than physical, authority.[218] In this way, Article VIII's granting of "jurisdiction and control" to the State of registry furthers Article II's non-appropriation objective; by ensuring a State (the subject of international law and legal entity responsible for upholding international obligations) has the legal authority to ensure space activities do not violate space law, space activities (whether public or private) can be managed to ensure the underlying objectives of the OST are honoured. For example, as the State of registry, Canada would have jurisdiction and control over the activities occurring in Crater A and the legal authority to ensure violations do not occur.

Since a State of registry's "jurisdiction and control" extends to personnel within a space object, settlers living and working in a permanent human settlement would be subject to the national laws of the State of registry of the space objects that make up that settlement.[219] Although this approach may work effectively when all of a settlement's component parts are registered with the same State (to the extent the laws of a State millions of kilometers away can be effective), this will prove cumbersome in an international settlement where different component parts are registered in different States.[220] One unresolved question is how to deal with component parts created from naturally occurring resources in space: although Article VIII would seemingly grant ownership of a locally-produced product to the original entity, it is less clear whether the State of registry's "jurisdiction and control" would extend to it as well (or whether it could even be registered if it is not "launched"). Further, what legal regime (if any) would apply to settlers that venture outside of their habitats (be it a habitat launched from Earth or one created *in situ*)?[221]

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[218] Fasan, *supra* note 156 at 51.

[219] CoCoSL, *supra* note 128 at p 159, para 59.

[220] For example, although the ISS's numerous modules are registered by different States, an Inter-Governmental Agreement takes precedence and simplifies what would otherwise be a potentially inefficient system. *Ibid* at p 159, para 60.

[221] Naturally, if one considers a spacesuit a space object or a component part, the question is rendered moot.

Article IX

> *In the exploration and use of outer space, including the Moon and other celestial bodies, States Parties to the Treaty shall be guided by the principle of cooperation and mutual assistance and shall conduct all their activities in outer space, including the Moon and other celestial bodies, with due regard to the corresponding interests of all other States Parties to the Treaty. States Parties to the Treaty shall pursue studies of outer space, including the Moon and other celestial bodies, and conduct exploration of them so as to avoid their harmful contamination and also adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter and, where necessary, shall adopt appropriate measures for this purpose. If a State Party to the Treaty has reason to believe that an activity or experiment planned by it or its nationals in outer space, including the Moon and other celestial bodies, would cause potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space, including the Moon and other celestial bodies, it shall undertake appropriate international consultations before proceeding with any such activity or experiment. A State Party to the Treaty which has reason to believe that an activity or experiment planned by another State Party in outer space, including the Moon and other celestial bodies, would cause potentially harmful interference with activities in the peaceful exploration and use of outer space, including the Moon and other celestial bodies, may request consultation concerning the activity or experiment.*

Article IX mandates that all States conducting space activities must: give due regard to the corresponding interests of all other States; avoid the harmful contamination of outer space and Earth; and enter into consultations with other States in situations where harmful interference may occur. Although, Article IX parallels Article I's permissive nature insofar as it encourages cooperation and mutual assistance in the exploration of outer space, it subtly tempers the right to explore and use outer space. In this way, Article IX upholds the foundational objective of the OST (that space benefit all people) by ensuring the permissible activities of one State do not unduly restrict other States either currently or in the future.

The obligation to pay due regard to the corresponding interests of other States was intended to ensure that States, in carrying out otherwise-acceptable space activities, take appropriate care and pay appropriate attention to mitigate potential hazards. The unique physics of outer space make it more susceptible to collateral damage than other domains, requiring increased prudence to ensure activities do not cause unnecessary harm: the side-effects of a forest fire in Saskatchewan are much more localized than a satellite collision in LEO. Due regard, as a legal principle, places an obligation on States to consider how their use of outer space would affect the overall space environment and therefore other States' opportunities in space. The negotiators desired that the requirement to conduct such considerations would cause space-faring nations to avoid operating in a manner that would hamper, undermine or limit other States from

realizing the benefits of outer space.[222] Under general international law, satisfying the principle of due regard entails acting diligently in mitigating potential harm and due diligence entails the adoption of appropriate measures and a certain level of vigilance in monitoring activities[223]; a State ought not act negligently[224].

The obligation to avoid the harmful contamination of outer space stems from the recognition that space is a unique environment that demands diligence in assuring its preservation. Since all space activities are *de facto* ultra-hazardous[225], States must ensure that they take appropriate precautions when conducting their activities to minimize contamination of the space environment. Although "contamination" is not defined, an ordinary reading suggests a relationship between an activity and its adverse side-effects that may cause harm (whether known or unknown). Therefore, it is a State's responsibility to prevent the occurrence of known harms as well as to anticipate and mitigate against potential harms that have not yet materialized. Article IX's insistence on preventing contamination in outer space runs parallel to principles of international environmental law, such as transboundary harm[226], intergenerational equity[227] and the precautionary principle.[228] Contamination can also refer to the inadvertent transportation of microorganisms from Earth to space, a reality that is in some respects unavoidable yet equally harmful.

The obligation to avoid causing adverse changes to the Earth-environment is built upon humanity's appreciation for the delicate balance between ecosystems that allows life to thrive on Earth. As human activities in space diversify, space objects will likely return to Earth with more frequency, increasing the chance of "back contamination". While the nature of certain activities (like space agriculture) may pose more of a threat than others (like space mining), ensuring that all objects returning to Earth are free from contaminants is of paramount importance to maintaining the continued habitability of the planet. Requiring

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[222] "Under the [principle of "corresponding interests"], space activities carried out by a given State should be in accordance not only with its own interests, but also with the interests and rights of the remaining States Parties to the Outer Space Treaty." CoCoSL, *supra* note 128 at p 176, para 27.

[223] *Pulp Mills on River Uruguay* (Argentina v Uruguay), 2010 ICJ 14 (Apr 20) at para 197.

[224] *Fisheries Jurisdiction Case* (United Kingdom v Iceland), (Jul 25) 1974 ICJ 3.

[225] "An ultra-hazardous activity is perceived to be an activity with a danger that is rarely expected to materialize but might assume, on that rare occasion, substantial proportions." CoCoSL, *supra* note 128 at p 176, para 28.

[226] International Law Commission, *2001 Draft Articles on the Prevention of Transboundary Harm*, A/56/10 in *Yearbook of the International Law Commission, 2001*, Vol II, Part Two. The "corpus of international law relating to the environment" includes the obligation to prevent transboundary harm. *Legality of the Threat or Use of Nuclear Weapons*, Advisory Opinion, (Jul 8) 1996 ICJ 226.

[227] EB Weiss, *Climate Change, Intergenerational Equity, and International Law*, (2008) 9 Vt J Envtl L 615 at 623.

[228] Article III of the OST ensures that such principles apply to both activities in outer space and the outer space environment.

space-faring States to undertake their space-to-Earth activities with the same diligence currently applied to Earth-to-space missions would help preserve the Earth-environment.

The requirement to enter into consultations upon realizing that a space activity may cause harmful interference with the activities of another State cements the desire that space be used peacefully and cooperatively by all States. Consultations are a common prescription under international law and seek to open a dialogue between States to alleviate real or perceived issues before they devolve into chaotic situations. Under Article IX, however, even though a State is mandated to enter into consultations (based on objective circumstances), it is required to do so only when it believes its activity may cause harmful interference (a subjective decision): a State would not, therefore, be required to consult if it is unaware that its activities may cause harmful interference or if it unilaterally concludes its activities will not amount to harmful interference. To balance against a State intentionally side-stepping this obligation by virtue of their subjective beliefs, Article IX also grants a potential victim-State with the right to request consultations.[229] Unfortunately, Article IX does not outline the consequences of failing to enter into consultations requested by another State.

Regarding permanent human settlement, the requirement to pay due regard to the corresponding interests of other States may manifest itself in curious ways. Given the inhospitability of all non-Earth celestial bodies, the first settlements will understandably seek to leverage every positive attribute of the host celestial body (such as proximity to sources of water, positions with superior natural radiation shielding and latency with communication satellites) by choosing a specific location. While such a strategy seems obvious, what will happen if two competing States desire to build settlements on the same celestial body and only one location offers such an array of amenities? Would both States be required to consider the impact their decision to use a specific location would have on another State? If so, what would result from such consideration? If State A realizes their decision to settle Crater A would hinder State B's desire to settle there as well, ought State A choose a less suitable location to its own detriment? Ought State B make the same determination? Although multiple settlement missions directed towards the same location are unlikely, it is worth questioning the extent to which States must pay due regard to corresponding interests of other States.

[229] This balance still favours the State undertaking the potentially harmful activity as a victim-State may not know another State's activity has the potential to interfere with its own.

Avoiding the contamination of outer space in the context of establishing a permanent human settlement will prove particularly challenging, especially in the biological context. To a certain degree, contamination is inevitable: even with the extreme care currently utilized in sending unmanned rovers and orbiters (constructed under strict guidelines in "clean rooms") to celestial bodies, there remain acceptable levels of contamination as complete sterilization is near impossible. With human settlements, it will be impossible to prevent contamination as human life depends on the symbiosis of billions of microorganisms.[230] Although it is possible many of these microorganisms will die if exposed to the space environment, it is likely some will survive (possibly even thrive). Given this inevitability of contamination, containment and monitoring will prove remarkably important to ensure a celestial body's ecosystem is not overrun. Similarly, to prevent back-contamination, any settlers or space objects arriving to Earth must be subjected to quarantine or other measures to ensure microorganisms exposed to the space environment have not mutated or evolved, posing a threat to Earth. If a settlement's principal role is to extract space resources or manufacture products *in situ* and send them to Earth, preventing back-contamination will be of unparalleled importance.

The consultative processes of Article IX will play an important role as the number of permanent human settlements increase, particularly on the same celestial body. There are countless opportunities for the settlement activities of one State to potentially cause harmful interference to those of another, making consultations an indispensable diplomatic tool in quelling potential conflicts. For example, the misuse of collective resources, the monopolistic use of unique geographical features, the accidental jamming of communication relays, the creation of pollution, etc.[231] can all cause discord between neighbouring settlements. Consultations may help resolve disputes amicably and well in advance of conflict.[232]

Article XI

> *In order to promote international cooperation in the peaceful exploration and use of outer space, States Parties to the Treaty conducting activities in outer space, including the Moon and other celestial bodies, agree to inform the Secretary-General of the United Nations as well as the public and the international*

[230] Sarah Fect, *Do Earth Laws Apply to Mars Colonists?*, Popular Science, 27 Sep 2016, online: <http://www.popsci.com/who-would-rule-colony-on-mars?dom=fb#page-3>.

[231] Of course, a State's non-settlement space activities can also potentially cause harmful interference, thereby creating near-infinite opportunities to enter into consultations.

[232] Depending on settlement locations, it may be prudent to position State representatives *in situ* as communication delays between Earth and a settlement can be serious. Further, all attempts should be made for local, autonomous decision making to ensure conflicts can be resolved as quickly and thoroughly as possible.

*scientific community, to the greatest extent feasible and practicable, of the nature, conduct, locations and results of such activities. On receiving the said information, the Secretary-General of the United Nations should be prepared to disseminate it immediately and effectively.*

Article XI prescribes the mechanism through which Article I's objective can be carried out: by providing information to interested parties, the benefits derived from one space experiment or activity can be disseminated to numerous parties.[233] According to Article XI, States ought to share information related to "the nature, conduct, locations and results of" their activities, as well as those of their private entities, to promote cooperation in the peaceful exploration and use of outer space. Without specific definitions, the obligation to provide information is rather broad and would likely include all information used, generated, retained, etc. related to, or in support of, a space activity. Article XI lists the proposed recipients of this information as the Secretary General of the UN, the public and the international scientific community. Given current technologies, most entities currently satisfy this requirement by submitting electronic documents to UNOOSA, establishing and maintaining entity- and activity-specific websites and presenting scientific findings in academic journals and other settings.

While such information sharing is expansive, Article XI's inclusion of the phrase "to the greatest extent feasible and practicable" weakens the extent to which information is shared. Given the various national or commercial interests associated with space activities, it would be understandable for a State or private entity to not want to share information that may jeopardize national security or undermine a competitive advantage. And without explicit definitions of "feasible" or "practicable", a State uninterested in sharing information can justify their non-disclosure on the vagueness of Article XI's language. Since the wording places a subjective determination on feasibility and practicability, States or private entities may conjure less-than-legitimate reasons to avoid providing information related to their space activities. Nevertheless, failing to provide information that ought to be provided is a violation of international law.[234]

The sharing of information associated with permanent human settlements carries the potential to benefit all people. The success of a settlement will demand truly revolutionary scientific and technological

[233] CoCoSL, *supra* note 128 at p 195, para 34.

[234] Ironically, a violation of Article XI would be difficult to detect and prove without first being aware of the information that was not shared.

developments[235] and sharing such information can easily cascade into countless other avenues of human existence. The extent to which such information is shared, however, will depend on the willingness of the undertaking party to apply Article XI's prescription liberally. It is possible, however, that an entity undertaking such activities withholds its discoveries to benefit exclusively, without relinquishing its competitive advantage. Some may argue, as is currently true regarding space mining, that the entity that invests the money and dedicates the time to undertake settlement activities ought to be rewarded.[236] And while intuitive, it does not change the fact that the legal regime (agreed to for very specific reasons) clearly requires certain concessions (that are otherwise not required on Earth) to ensure space activities benefit all people; sharing information regarding activities is one such concession.

Article XII

> *All stations, installations, equipment and space vehicles on the Moon and other celestial bodies shall be open to representatives of other States Parties to the Treaty on a basis of reciprocity. Such representatives shall give reasonable advance notice of a projected visit, in order that appropriate consultations may be held and that maximum precautions may be taken to assure safety and to avoid interference with normal operations in the facility to be visited.*

Article XII furthers the OST's dedication to generating international cooperation in space activities and ensuring space is used peacefully. The obligation that States provide access to their "stations, installations, equipment and space vehicles"[237] on the basis of reciprocity to representatives of other States helps solidify international cooperation and simultaneously deters non-peaceful or non-legal activities (as one can be visited and discovered at any time[238]). Although the operative terms in Article XII are vague and open to interpretation, the negotiating parties' overall motivations solidify this objective. The broad

[235] For example, in launch technologies, spacecraft design, construction materials, human psychology, energy storage, etc.
[236] The author does not disagree that entities undertaking ambitious activities ought to benefit; the question is the extent of the benefit. Ilie Marian, *The Status of Property Rights in International Space Law*, (2012) 4 Contemp Readings L & Soc Just 306 at 309. *See also* Tennen, *supra* note 151 at 157.
[237] The sentence continues: "on the Moon and other celestial bodies". Therefore, States are under no obligation to make available, and other States have no right to request, visit to their "stations, installations, equipment and space vehicles" in outer space or in orbit of a celestial body – with the impending popularity of orbiting space habitats, this may be a space activity requiring further investigation.
[238] There is always the possibility that after having received notice, a violating party hides their illegal activity. Notwithstanding, the provision still has the effect of deterring certain behaviour just as laws against murder deter most, although not all, homicides.

characterization of facilities open to visits increases transparency and a likelihood, in coordination with Article XI, that knowledge generated from space activities be spread widely to benefit all people. Curiously, the use of the phrase "representative of other States Parties to the Treaty", rather than "other people" or "astronauts" seems to limit the number of actors who may take part in sanctioned visits. Although it is possible an astronaut would also carry the designation of "State representative", it is less clear if "spaceflight participants", "personnel of a spacecraft" or astronauts sent by international intergovernmental organizations would also qualify.[239]

The application of Article XII in relation to permanent human settlements is intuitive. State representatives of one settlement may visit another settlement for any reasonable purpose, including to neutralize suspicions of wrongful conduct or simply exchange information that is mutually beneficial. Since the obligation to maintain openness of one's facilities is dependent upon reciprocity, if one State refuses to grant access (a violation of international law) the State being refused may then also refuse in the future (which would not be a violation of international law). Of course, such non-transparency would be contrary to the intentions of the OST and ought to be avoided. Since Article XII simply provides for visits, without listing what may or may not be done during a visit, State parties ought to determine what is allowed during their consultations.

## Conclusion

Permanent human settlement will be governed by international space law in the same way all other space activities fall within its purview. Although the negotiating parties did not explicitly reference settlement activities, their general foresight ensured that the broad legal framework they established could govern such activities. In short, permanent human settlement is a permitted activity, so long as it promotes the interests of and benefits all countries. Settlement activities must be undertaken in accordance with international law and, specifically, must be peaceful and non-militaristic. The individual settlers that make their way to the Moon, Mars and beyond will benefit from the application of humanitarian principles and all States must assist in times of distress. An appropriate State will be responsible for all settlement activities, whether undertaken publicly or privately, and the launching State will be liable for any damage that occurs.

[239] CoCoSL, *supra* note 128 at p 210, para 14.

The State of registry will maintain jurisdiction and control over the settlement and its settlers, including any component parts that are created *in situ*. States must ensure they consistently take into consideration the corresponding interests of other States, prevent the harmful contamination of space (and the back-contamination of Earth) and enter into related consultations as necessary. States must also provide information regarding their settlement activities to the international community (as is feasible), while also ensuring that their settlements remain open to representatives of other States on a reciprocal basis. The application of each of these principles can be applied relatively straightforwardly. The only outstanding legal consideration is how to harmonise the prohibition on appropriation with the fact that all settlements will necessarily appropriate a part of the celestial body on which they are located.

*Of all the fields of mathematics, technology, and science, the one with the greatest international cooperation… is the field called "Earth and space sciences." Studying this world and others, by its very nature, tends to be non-local, non-nationalist, non-chauvinist. … And once you experience such cooperation—humans from different parts of the planet working in a mutually intelligible scientific language as partners on matters of common concern—it's hard not to imagine it happening on other, nonscientific matters. I myself consider this aspect of Earth and space sciences as a healing and unifying force in world politics; but, beneficial or not, it is inescapable.*[240]

[240] Sagan, *supra* note 1 at pp 153-154.

# Chapter 3: Benefitting from the Cosmos

## The Paradox of Permanent Human Settlement

As described in Chapter 1, the human species faces an existential threat: it is all-but statistically guaranteed that at some indeterminate point in the future, a catastrophic event will occur on Earth causing the extinction of humanity. Given the species' current cosmological and anthropological realities, the likelihood of an extinction-level event increases with each passing day, threatening to relegate humanity to a historical footnote alongside the dinosaurs. Before such an event, humanity must determine whether it will remain solely on Earth or whether it will become a multiplanetary species. If the species values its continued survivability – which, intrinsically, it must –, it must make decisions that reduce its risk of extinction. Expanding the human footprint into the cosmos would provide redundancy to the species' genetic code, rendering it capable of independent proliferation to ensure its continued flourishing off-Earth. Becoming a multiplanetary species, therefore, is quite simply an existential backup plan. Acknowledging that a number of entities currently desire to create off-Earth settlements, coupled with the existential necessity to do so, it is prudent to explore the legal mechanisms through which such activities ought to take place.

As described in Chapter 2, the OST is the foundational instrument through which human space activities derive their legitimacy. Article I provides all States with the right to explore and use space so long as its activities benefit all of humanity, while Article II preserves this universal accessibility by ensuring sanctioned space activities do not devolve into territorial land grabs. The permanent human settlement of space, therefore, emerges as a space activity that is simultaneously permitted and prohibited by the OST: Article I provides legitimacy to settlements that would benefit humanity whereas Article II prohibits them on the basis of non-appropriation. Having accepted that permanent human settlement in outer space is necessary for the continued existence of the human species, a treaty dedicated to preserving and improving the human condition ought therefore promote, rather than prohibit, such a worthwhile activity. Given the drafters' vision and foresight in crafting the OST fifty years ago, there must be some way permanent human settlement can be justified within the OST framework, thus preserving its status as the foundation of international space law.

The remainder of this thesis will investigate how a legal regime dedicated to benefitting humanity seemingly prohibits an activity that would unquestionably lead to its benefit. As will be demonstrated,

solving this paradox requires a careful juxtaposition of the OST's intentions and an exposition on how real-world settlement activities ought to be undertaken.

## Absurdity and Unreasonableness in International Law

The VCLT provides that in circumstances where the interpretation of a treaty in its ordinary language[241] "leads to a result that is manifestly absurd or unreasonable"[242], "recourse may be had to supplementary means of interpretation, including the preparatory work of the treaty and the circumstances surrounding its inclusion" in order to determine the meaning of the treaty.[243] Since applying Articles I and II of the OST to settlement activities results in an absurdity, the preparatory work and context contemporary to the drafting of the treaty ought to be used to reach an interpretation that satisfies both the objective of the treaty and its real-world application. Although the VCLT came into force after the OST, it is undisputed that the principles related to treaty interpretation were rules of customary international law before they were codified and before the OST's negotiation.[244] Therefore, the clear principles of interpretation outlined in the VCLT can be applied to the OST when attempting to harmonize its seemingly contradictory principles.

## Solving the Permanent Human Settlement Paradox

As the foundational space law instrument, the OST provides an outline of how space activities are governed. Many of the substantive principles that were eventually codified in the OST underwent a maturation process many years in the making, starting out as ideological objectives, finding their way into resolutions or declarations and finally in a treaty. One such principle was the realization that humanity, as a collective of individual members, ought to be considered as a single entity with unique interests. In considering such interests in relation to space, it was obvious, even at such nascent stages, that space would offer humanity and its individual members unparalleled opportunity. Given this potential bounty, the negotiating parties agreed, and were determined to ensure, that the legal regime of this new domain would prevent a single entity (other than humanity itself) from benefitting from space at the expense of another.

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[241] VCLT, *supra* note 131 at Art 31.
[242] *Ibid* at Art 32.
[243] *Ibid*.
[244] *Gabčikovo-Nagymaros Project* (Hungary v Slovakia), (Sep 25) 1997 ICJ 7 at para 46.

With this unified perspective of humanity in place, the State parties to the OST solidified their beliefs that outer space was to be explored and used for the benefit of all countries. The statements of many State representatives supported this position.[245] Although the Preamble and Article I both make clear that States are free to explore and use space so long as they do so for the benefit and in the interests of all countries, the drafters wanted to ensure that such freedom would not be exploited. To bolster this State-wide and timeless availability of opportunity, it was agreed that outer space and celestial bodies could not be appropriated. The drafters were concerned that allowing the appropriation of space would lead to a small number of capable nations controlling vast areas of outer space, replicating in the cosmos what already occurred in the Americas and Africa centuries before. Aware of the devastation wrought by such imperialistic ambitions, State parties agreed that "the exploration and use of outer space… [would] be the province of all mankind" and prohibited territorial conquest.

Notwithstanding the drafter's proactive response (and possibly because of it), the past fifty-years have seen little interplay between Articles I and II.[246] As space activities continue to mature, however, the right to use outer space and the prohibition on appropriation will clash more often. Permanent human settlement, for example, exemplifies this paradox whereby an entity has the right to establish a settlement on a celestial body as part of its freedom to use outer space but is simultaneously prohibited from doing so as such an activity would necessarily amount to appropriation.[247] An easy way of avoiding this paradox would be to never undertake settlement activities. Unfortunately, since settlement is necessary to the survival of

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[245] Valters, *supra* note 133.

[246] There have been a few instances. For example, when the US planted a flag on the Moon, the US House and Senate committee responsible for authorizing and funding NASA's first landing stated that the planting of the US flag was merely symbolic of its achievement and by no means a claim of sovereignty. Anne Platoff, *Where No Flag Has Gone Before: Political and Technical Aspects of Placing a Flag on the Moon*, 11 Oct 1992, Presented at the 26th Meeting of the North American Vexillological Association, available online: <https://www.hq.nasa.gov/alsj/alsj-usflag.html#TX17>. Similarly, when a US citizen claimed parking fees from the US government for a space object it had landed on an asteroid over which the citizen claimed ownership, the Department of State responded that "private ownership of an asteroid is precluded by Article II." Letter dated 15 August 2003 to Gregory William Nemitz of Carson City by Ralph L. Braibanti, Director, Space and Advanced Technology, United States Department of State, Bureau of Oceans and International Environment and Scientific Affairs, Washington DC, United States, as cited in CoCoSL, *supra* note 128 at p 56, para 50.

[247] This apparent contradiction was present in the minds of some delegates during the negotiation of the treaty. For example, the French delegation announced their dissatisfaction with the wording of Article II, such that there remained "ambiguity between the principle of non-sovereignty – which falls under public law – and that of non-appropriation, flowing from private law." Cheng, *supra* note 127 at p 230. S*ee also* CoCoSL, *supra* note 1238 at p 50, para 23.

the species, this is not a realistic solution. Fortunately, this absurdity[248] (that the international treaty meant to ensure outer space benefits humanity is preventing humanity from benefitting from outer space) can be rectified under international law.

## Acceptable Appropriation

Since Article II's prohibition on appropriation was motivated by a desire to prevent States from engaging in space-based imperialism (which would lead to great inequality in the cosmos and on Earth, thereby undermining the very objective of the OST), a conceptualization of appropriation that does not lead to imperialism and inequality can be justified under the VCLT even though it would violate Article II of the OST. Therefore, even though all settlement activities would necessarily appropriate the celestial body on which they are located, it may be possible to justify a settlement if it would avoid the space-based imperialism (that would necessary lead to disadvantage and disparity) of which the drafters were so weary.

The difficulty with current settlement proposals, aside from the fact that they would appropriate space, are that they would be undertaken by a single entity (either public or private)[249] and none have demonstrated (and, even more questionably, none have claimed) that their settlement activities would benefit all people.[250] Consequently, as settlements increase in size and number (further cementing concepts of Earth-based territoriality in space) the amount of celestial territory appropriated by such settlements will correspondingly increase, bringing with it the same long-term and systemic advantages characteristic of colonialism on Earth.[251] As was the case during the OST's negotiations, out of the nearly-200 States and countless private entities in the world, only a handful have the capability to undertake settlement activities. Realistically, therefore, it would not be possible to justify a single-entity settlement under the VCLT, as the

[248] VCLT, *supra* note 131 at Art 32.

[249] Even ESA's proposal to create a Moon Village is unjustifiable as it will exclude a majority of States and not be conducted in the name of humanity.

[250] It is also questionable whether a settlement operated by a single entity *can* benefit all people.

[251] The same consequences would flow if settlement activities were undertaken by a regional body (such as the EU through ESA) or an alliance (such as the EU, USA, Russia, China and India). So long as State-based entities are undertaking such activities, "humanity" is not the one that is undertaking such activities and therefore the vision that space activities would make humans less nationalistic/partisan is eroded.

permitted appropriation would only benefit entities capable of undertaking settlement activities, thus defeating the OST's objective.[252]

One solution[253] to avoiding the harmful and prohibited form of appropriation consistent with single-entity settlement operations is to undertake a global or *human* settlement. A non-nationalist, international effort to settle a celestial body, without any public or private affiliation to a single entity, with the sole objective of creating new cosmic communities in which humans can survive and thrive, would avoid the consequences Article II sought to prevent. Since, by definition, a *human* settlement (as opposed to an American, Chinese or SpaceX settlement) would not have negative imperialist consequences[254], the act of settling, while still amounting to appropriation, would avoid Article II's concerns and satisfy Article I's desire that space benefit all of humanity. In this way, an internationalized effort – paying homage to the desires of the drafting parties that space would create a community of nations working together to improve humanity's interests as a single collective entity – would play the subsidiary role of uniting humanity towards a common goal by highlighting the similarities of those on Earth, regardless of country, colour or creed. As the epitome of cooperation, an international effort, conducted in the name of all of humanity (present and future), would not contravene the intentions behind the prohibition on appropriation – in fact, an international settlement programme would further the objectives that the principle of non-appropriation was meant to safeguard.

## International Settlement Activities

The most important component of the proposed settlement model is that it conducts settlement activities on behalf of humanity, free from individual affiliations to a State, a group of States, a corporate entity, an individual cult, etc.; every aspect must be directed to serving the human interest rather than nationalist, regional, corporate or other ambitions (even if such ambitions are seemingly directed towards

[252] Unquestionably, 100 or 1,000 years after permitting "single-entity settlements" there would be grave disparity between settlement-capable entities and those not capable. Access to territory in space will necessarily spur a new imperialist landgrab so familiar to historians and anthropologists today. Harari, *supra* note 10 at Ch 16.

[253] And, to the author's mind, the only solution.

[254] This, of course, presumes that no other life forms exist. Given even the most conservative estimates, scientists have now deduced that over the history of our cosmos there have been one trillion civilizations (and presumably far, far more life forms that did not reach "civilizationhood"). Adam Frank, *Yes, There Have Been Aliens*, New York Times, 10 June 2016, online: <http://www.nytimes.com/2016/06/12/opinion/sunday/yes-there-have-beenaliens.html?_r=0>. In reality, it is probable that at some point in the future the current proposal will be seen as imperialistic from the perspective of human ambition – for better or worse. This will be especially true for non-humans, should they exist.

human interests). Of course, this does not exclude public entities, regional bodies, private companies, etc. from playing an important role; indeed, a permanent human settlement will necessarily require such combined efforts to ensure its suitability and sustainability. States will necessarily contribute substantial resources (in terms of money, material and manpower) as part of their responsibility to look after the interests of their citizens whereas private entities will have an opportunity to work for profit in developing the technologies and tools necessary to complete a task as ambitious as establishing permanent human settlements in space. At no point, however, will a single entity control or have claim to the settlement – it will be undertaken in the name of humanity, by the human collective, for human survivability.

Legally, the proposed settlement activities will be undertaken by a novel subject of international law, *humanity*, and in line with the instruction that outer space be explored and used as the province of all mankind. The current proposal, therefore, is simply an extension of what was desired and anticipated by the drafters of the OST fifty years earlier. This would require those individuals (States, companies, employees, etc.) to act towards furthering objectives that are common to the species rather than focusing on issues that are specific to their State or company. In this way, a new international organization would need to be created to carry out the settlement activities. The recent "infotainment" TV series produced by National Geographic titled "Mars" does a commendable job of visually demonstrating what a partnership between public and private entities, directed towards creating a permanent human settlement on Mars, would look like as well as how the world community could work together to achieve this end.[255]

## An International Intergovernmental Organization for Permanent Human Settlement

The implementation of a *human* settlement (again, rather than an American, Chinese or SpaceX settlement) will require an international entity capable of undertaking the various activities necessary to reach this end: planning to launch humans to another celestial body, designing the settlement in which they will live, recruiting experienced State personnel to contribute to the mission, awarding contracts to private entities to complete certain elements of the mission, supervising settlement activities on the celestial body,

[255] In the first episode of "Mars", a character, in describing his motivation for becoming an astronaut headed to Mars, states: "If humankind [can] find a way to come together and move toward a healthy evolution, this mission will have been about more than just finding another place to live." Indeed, one of the motivations for undertaking permanent human settlement is to reorient humanity's focus on its similarities rather than its differences.

etc. There is no existing international entity with either the capability or mandate to carry out these required tasks. In the space domain, the closest existing model to what is proposed would be the International Space Station. Unfortunately, the ISS is a poor representation of what is hoped to be achieved for a number of reasons, least of which is that there is no international entity centrally directing its missions. Instead, the ISS is simply a patchwork of individual modules (registered, controlled and operated by individual States), held together by an agreement that determines participation on the basis of contribution. Such is not a model that ought to be replicated permanently on celestial bodies. What is required is a new international entity that would oversee all operations, allocate resources, direct development, manage personnel, etc. with the singular focus of carrying out permanent human settlement activities in the name of humanity.

Unsurprisingly, proposing the creation of a new international entity capable of overseeing various space activities is not novel. In fact, not only have suggestions to this end been made by many scholars over the years, the *Moon Agreement*[256] itself proposed the implementation of an international regime[257] to address the exploitation of space based natural resources nearly forty years ago. Although the *Moon Agreement* did not explicitly provide guidelines on how the international regime would be implemented or who would implement it, one can assume the negotiating parties contemplated the creation of a new international organization. Further, although the *Moon Agreement's* proposed international regime was explicitly directed towards the acquisition of space based resources, many of the principles[258] provided in support of the creation of an international regime are also applicable to permanent human settlement.

Notwithstanding the *Moon Agreement's* proactive suggestion, it never materialized. Therefore, it will prove valuable to consider existing international organizations (tasked with addressing human-first domains

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[256] *Agreement governing the Activities of States on the Moon and Other Celestial Bodies*, 5 Dec 1979, 1363 UNTS 3 (entered into force 11 Jul 1984) [Moon Agreement]. As per 1 January 2017, the Moon Agreement has been ratified by 16 States and signed by four more. The ratifying States include: Australia, Austria, Belgium, Chile, Kazakhstan, Kuwait, Lebanon, Mexico, Morocco, the Netherlands, Pakistan, Peru, Philippines, Saudi Arabia, Turkey Uruguay and Venezuela. The signatory States include: France, Guatemala, India and Romania. With such few ratifications and signatories, the MA is often looked upon as an unsuccessful treaty. UNCOPUOS, *Status of International Agreements relating to activities in outer space as at 1 January 2017*, online: <http://www.unoosa.org/documents/pdf/spacelaw/treatystatus/AC105_C2_2017_CRP07E.pdf>. Regardless of the number of States committed to its principles, once a treaty comes into force States that have ratified it are bound by its provisions and States that have signed it "obliged to refrain from acts which would defeat the object and purpose of the treaty." VCLT, *supra* note 131 at Art 18.

[257] *Ibid* at Art 11.

[258] *Ibid* at Arts 11(1)-(4).

similar to settling celestial bodies) when seeking a model upon which to develop the present proposal, namely, the International Telecommunications Union (ITU)[259] and the International Seabed Authority (ISA)[260]. As the oldest specialized agency of the UN, the ITU has successfully assigned orbital slots around Earth and regulated the use and application of radio frequencies for many years, hosting regularly-scheduled intergovernmental conferences attended by its members (both States and private actors).[261] Since decisions are made by way of State consensus, vocal opponents can stymie progress. In this way, the ITU is more of a convener that helps direct discussion and decision making than it is a regulator. Further, since radio frequencies and orbital slots are non-tangible and non-exhaustible, the ITU is not required to consider the same kinds of legal and organizational questions as would an entity responsible for permanent human settlement. Notwithstanding, the ITU model demonstrates that international cooperation in a domain that requires such is possible when an appropriate venue invites collaboration and the interests of all parties are taken into consideration.

The ISA model is likely more appropriate in analogizing an organizational structure that will be responsible for settlement. After nearly a decade of negotiation, the international community agreed on the *United Nations Convention on the Law of the Sea*[262], which largely codified existing rules into a single text. Part XI of UNCLOS, however, was unique in that it created an organization (the ISA) tasked with overseeing the seabed resources of the high seas (deemed the common heritage of mankind[263]). Although the initial proposal was resisted by developed countries, subsequent modifications were accepted by a majority of States. One stalwart objector, the US, never ratified UNCLOS because of the ISA.[264] Undeniably, without the participation of a significant world power there are questions as to the ISA's efficacy in regulating the extraction of seabed resources, let alone ensuring such activities benefit all States as the common heritage of mankind. Separately, however, the ISA falls short as an ideal model for the proposed international entity that will oversee space settlement as it does not undertake seabed resource mining itself, nor does it facilitate the process in such a way as would be necessary to satisfy the OST's Articles I and II-paradox as described

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[259] *Constitution of the International Telecommunications Union*, 22 Dec 1992, 1825 UNTS 331 (entered into force 1 Jul 1994).
[260] United Nations General Assembly, *1994 Agreement Relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea*, 28 Jul 1994, A/RES/48/263 [ISA Agreement].
[261] CoCoSL, *supra* note 128 at p 61, para 71.
[262] *1982 Convention on the Law of the Sea*, 10 Dec 1982, 1833 UNTS 3 (entered into force 16 Nov 1994) [UNCLOS].
[263] ISA Agreement, *supra* note 260 at Preamble.
[264] The US has since accepted that everything in UNCLOS, other than Part XI, is customary international law.

above: in short, the ISA is a regulatory body rather than an operational body. Nevertheless, the ISA is instructional in how an international organization can be formed to address a specific domain and activity when the aspirations and interests of States line up, regardless of whether one or two States choose to self-exclude.

While the ITU and ISA are international organizations established to address certain issues within their domains, other examples of international intergovernmental organizations (IGO) exist that may prove even more fruitful in presenting a useful model upon which to develop settlement activities. The International Telecommunications Satellite Organization (INTELSAT[265]) was first created to ensure that communications by means of satellites would be available to all nations on a global and non-discriminatory basis.[266] In this way, INTELSAT was an international consortium of various States that worked together to address a global concern in a manner that took into consideration the interests of all parties. As an IGO, INTELSAT was created through an international agreement[267] that outlined the logistics of its operations and cemented the role of States as the ultimate ruling authority over the entity.[268] The various member States were responsible (as per Article VI of the OST) for INTELSAT's activities as well as for providing authorization and supervision.[269] In terms of permanent human settlement activities, a model similar to INTELSAT (such as the proposed INTERLUNE[270]) may prove useful to ensure human settlement activities are carried out in such a way as to honour the principles of the OST. Such a model would allow all States to actively pursue a common objective that ensures humanity's interests, rather than an individual or group of

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[265] INTELSAT is distinct from Intelsat, the latter being the private company that took over INTELSAT operations to improve its competitiveness in the international marketplace. The references to INTELSAT in this thesis are to the IGO before it was privatized.

[266] ITSO, *About ITSO: Frequently Asked Questions*, ITSO, accessed 2 Aug 2017, online: <http://www.itso.int/index.php?option=com_content&view=article&id=486&Itemid=28&lang=en>.

[267] *Agreement relating to the International Telecommunications Satellite Organization "INTELSAT"*, 20 Aug 1971, entered into force 12 Feb 1973.

[268] Franz von der Dunk, *Handbook of Space Law* (Northampton: Edward Elgar, 2015) at p 319.

[269] *Ibid* at pp 320-321.

[270] The INTERLUNE proposal is modelled on INTELSAT and while the author agrees with the general conceptualization of INTERLUNE, the motivation for creating the IGO – as specified in the article – seems misguided. In particular, the notion that the State contributing the most capital to fund INTERLUNE would have the most control over its operations seems contrary to the proposal that space settlement activities be derived from a humanist (rather than nationalist) perspective. Christopher Joyner & Harrison Schmitt, *Extraterrestrial Law and Lunar Bases: General Legal Principles and a Particular Regime Proposal (Interlune)*, in Wendell Mendell, *Lunar Bases and Space Activities of the 21st Century* (Lunar and Planetary Institute: Houston, 1985) at p 745.

States' interests, are exclusively taken into consideration, with its independent international character resulting in the operational and regulatory freedom to undertake such an ambitious activity.

## Ideological Realism

It is clear, therefore, that the creation of a single international organization, directed by the interests of mankind, to undertake settlement activities will be novel. The author is unaware of an existing international organization with a structure sufficient to carry out a task as significant as permanent human settlement. Undoubtedly, the current proposal is ideological. Some may even argue unrealistic. This does not mean, however, that such an ambitious proposal is dead-on-arrival – with the right international appetite (which stems from individual citizens demanding governments to undertake ambitious, human oriented projects) anything is possible. Indeed, when the human species is at risk, everything is possible. Considering the alternative is the collapse of the fifty-year-old legal regime that has thus far prevented space from succumbing to many Earthly conflicts, preventing a space-settlement-race that would breach the OST is important.

With ever increasing disparity between the developed and developing worlds and with ever increasing domains in which a global response is the only acceptable way forward (for example, tackling climate change, addressing terrorism, managing resources, etc.), there is reason to believe a concept as revolutionary as that presently proposed should succeed.[271] For decades, developed States have gone to great lengths extolling the virtues of equality, cooperation and other positive ideological principles but rarely commit to the corresponding programmes necessary to achieve their verbose visions.[272] Regarding space in particular, in 1996 the United Nations General Assembly adopted the Space Benefits Declaration[273] by

[271] Compared to other revolutions, a proposal that humanity work collaboratively towards its own betterment is hardly revolutionary.

[272] "It is ironic that although the wealthy states never tire of lecturing the world community on the importance of 'human rights', 'humanitarian intervention', 'human security' (Canada's contribution) and 'humanitarian law' – they do very little to erase the enormous economic and health gap between them and most of mankind. … [A] global organization whose principal task will be to employ space technology primarily for the benefit of the majority of mankind, could reduce this gap. It is, admittedly, an idealistic proposal, but there should be at least some room for idealism in a world currently dominated by the very pragmatic 'market economy'." George Dietrich, *Extending the Principle of Common Heritage of Mankind to Outer Space*, LLM Thesis at the Institute of Air and Space Law, McGill University, July 2002, available online: <http://digitool.library.mcgill.ca/webclient/StreamGate?folder_id=0&dvs=1501011065439~220>.

[273] United Nations General Assembly, *Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Account the Needs of Developing Countries*, 13 Dec 1996, A/RES/51/122.

consensus, intending to solidify the international cooperation in space activities that Article I demanded. The present proposal pays homage to that principle by requiring developed States to work alongside developing States in undertaking permanent human settlement for the benefit of the species; not only will doing so satisfy this requirement but it will demonstrate how everyone can benefit by cooperating in space.

## Future Considerations

The proposed creation of an IGO does not end with a mere theoretical pronouncement of its utility or necessity. What is also required is a thorough analysis[274] into how the IGO would be set up, what its mandate would be, where it would draw the capital and resources necessary to carry out its function, what role private entities would play in satisfying its objectives, etc. Most of these characteristics would be outlined in the international agreement entered into by States establishing the IGO, which would act as a constitution creating the IGO's framework and internal regulatory structure. Once States agree on the role they will play within the IGO, the degree of autonomy enjoyed by the IGO (in contrast to its reporting requirements to States), the opportunities available for private investment and contracting, etc., the specific scientific and technological considerations of permanent human settlement can be addressed. One principle of paramount importance is that the proposed IGO ought to truly retain the interests of humanity in mind; this must be its guiding star. Regardless of the composition of member States, the IGO must always conduct its operations so as to ensure the beneficiary of its activities is humanity since individual States (while necessary under international law) are not the interested parties in this endeavour. To this end, the IGO must not prohibit any State from joining and indeed must encourage all States to join, including States traditionally maligned by the international community (such as Iran or North Korea). The reality is such that the IGO's activities are not directed to the benefits of one State or one group of people but rather all humans regardless of their geographic location – since humans exist in States like Iran and North Korea as much as they do in the US or China, their participation is equally important.

[274] Unfortunately, the suggested analysis exceeds the scope of this thesis. Nevertheless, future scholarship may seek to address, and benefit from, the points elucidated herein.

## Conclusion

The negotiating parties successfully crafted a forward-looking treaty that has, for the past fifty years, appropriately regulated space activities. As the current trend towards privatization and monetization of space activities increases, the original State parties' desire to ensure space benefits all people must not be lost. With novel activities on the horizon, the international community must remain cognizant of the harm associated with public and private imperialism and must ensure its harms do not spread to the cosmos. Regarding permanent human settlement in space, efforts must be made to ensure that such activities, while necessary, are carried out in a manner that sustainably promotes human interests. Given the existing legal framework, the creation of an IGO to help materialize such ambitions is necessary. Notwithstanding the ideological loftiness of such an undertaking, if the developed and developing worlds are to successfully dissipate the current disparity between them, such seemingly-revolutionary processes are required.

# Conclusion

The objective of this thesis has been to demonstrate that permanent human settlement in space is not only necessary but legally permissible. As the human species continues its evolution, it must begin to consider, in earnest, the existential question of whether it will become multiplanetary or remain solely on Earth until some catastrophic event causes its extinction. If it decides to become multiplanetary, the current legal framework applicable to outer space will allow, under specific circumstances, for such activity.

As the negotiating parties of the *Outer Space Treaty* realized fifty years ago, outer space offers unparalleled opportunity for the human species. In an effort to ensure the bounties offered by space would benefit all people, the negotiating parties established a legal regime that simultaneously permits the exploration and use of outer space while prohibiting claims of sovereignty. To this end, Article I grants legitimacy to all space activities while Article II prevents appropriation. Given the geopolitical situation of the 1960s (the Cold War, the independence of former colonies, etc.), the negotiating parties were acutely aware of the harm associated with imperialism and sought to ensure outer space did not succumb to the same empire-building tendencies that occurred on Earth. The legal framework upon which they agreed, therefore, contemplated a new, unified vision of the international community – one that was a representation of a single human species rather than a collection of States.

The only way to ensure the necessary act of permanent human settlement does not devolve into an imperialistic enterprise is to grant settlement authority to an international intergovernmental organisation tasked with this singular focus. States, private industry and non-governmental organizations can all work through this newly created entity to satisfy the human yearning to explore, propagate and survive in a manner that honours the principles enshrined in the *Outer Space Treaty*, particular that which requires the use and exploration of space to benefit all people.

In the context of the evolution of life, humanity permanently settling another celestial body will be as significant as the progress from unicellular to multicellular life on Earth. Given our understanding of the universe thus far, *homo sapiens* are the only known species in the billions of years of cosmic existence capable of making such a leap. Remaining cognizant of this fact ought to motivate humanity to ensure that its first forays into cosmic settlement are undertaken with the purest of intentions and the genuine desire that the species moves forward in a manner that benefits each of its individual members.

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