

ON THE LEGALITY OF MARS COLONISATION

‘Humanity will not remain on the earth forever, but in pursuit of light and space it will at first timidly penetrate beyond the limits of the atmosphere, and then conquer all the space around the sun.’¹

ABSTRACT

Recent technological advancements made by governmental agencies and private industry have raised hopes for the future of human space flight beyond the Moon. These advancements are increasing the feasibility of endeavours to establish a permanent human habitat on Mars, as a safeguard for our species, for scientific endeavours, and for commercial purposes. This article analyses some of the legal issues associated with Mars colonisation, focusing on the lawfulness of such a venture and the legal status of colonists.

I INTRODUCTION

Recent technological advancements made by governmental agencies and private industry have raised hopes for the future of human space flight beyond the Moon. The United States’ National Aeronautics and Space Administration (‘NASA’) is developing a new generation of launch and crew systems that will enable

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¹ Letter from Konstantin Tsiolkovsky to Boris Vorobiev, 12 August 1911. See, eg, Rex Hall and David Shayler, *The Rocket Men: Vostok & Voskhod: The First Soviet Manned Space-flights* (Springer, 2001). Konstantin Tsiolkovsky is often referred to as the ‘father of rocketry’; eg, ‘Konstantin E Tsiolkovsky’, *NASA* (Web Page, 22 September 2010) <<https://www.nasa.gov/audience/foreducators/rocketry/home/konstantin-tsiolkovsky.html>>. Another fitting sentiment from the same letter is that ‘Earth is the cradle of humanity, but one cannot live in a cradle forever’: Hall and Shayler (n 1) 5. This ubiquitous Tsiolkovsky quote is an imprecise translation of the original ‘планета есть колыбель разума, но нельзя вечно жить в колыбели’, which more precisely translates as ‘a planet is the cradle of mind, but one cannot live in a cradle forever’: ‘Konstantin Eduardovich Tsiolkovsky’, *Reality Fiction* (Web Page, <<https://web.archive.org/web/20140219031703/http://www.rf.com.ua/article/388>>).

humans to travel deeper into space than ever before. Private organisations, such as SpaceX and Orbital ATK, are becoming increasingly involved in space activities, largely in collaboration with governmental agencies, creating new equipment and processes required for deep space flight.

The future of humanity in the event of a catastrophic Earth event is an oft cited justification for the establishment of a permanent human habitat on Mars. However, as with many pursuits of this magnitude, the attraction also lies in accomplishing something never before achieved; to be pioneers. While this may be one of the most exciting prospects currently facing humankind, if we are to become a multi-planet species, there are many legal issues that will first need to be considered. Current international space law treaties have not contemplated human habitation beyond the Earth,² and are notably silent on what happens when humans dwell among the stars.

Although the human spirit of adventure and discovery will be a great driving force in endeavours to inhabit Mars, so too will economic motivators. Commercial and governmental agencies are already planning missions to mine asteroids for their natural resources; other celestial bodies, including the Moon and Mars, are a natural progression.³ Whether for the sake of humanity or commercial gain, it seems that endeavours to establish permanent human habitats on celestial bodies, including Mars, will only intensify in the coming decades.

This article begins with an overview of steps taken towards a permanent human habitat on Mars. Highlighting some of the legal issues that arise from such a venture, it first analyses the lawfulness of such an activity and attempts to reconcile this with the principle of non-appropriation in the *Outer Space Treaty*. It then explores the legal status of the inhabitants of a Mars habitat, and some of the legal implications for humans residing beyond the surface of the Earth. The article argues that if humans

² *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 27 January 1967, 610 UNTS 205 (entered into force 10 October 1967) ('*Outer Space Treaty*'); *Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space*, opened for signature 22 April 1968, 672 UNTS 119 (entered into force 3 December 1968) ('*Rescue and Return Agreement*'); *Convention on International Liability for Damage Caused by Space Objects*, opened for signature 29 March 1972, 961 UNTS 187 (entered into force 1 September 1972) ('*Liability Convention*'); *Convention on Registration of Objects Launched into Outer Space*, opened for signature 14 January 1975, 1023 UNTS 15 (entered into force 15 September 1976) ('*Registration Convention*'); *Agreement Governing the Activities of States on the Moon and Other Celestial Bodies*, opened for signature 18 December 1979, 1363 UNTS 3 (entered into force 11 July 1984) ('*Moon Agreement*').

³ For example, Deep Space Industries, an American company with an ambition to mine asteroids, is perhaps prophetic of what is to come. The company 'believes the human race is ready to begin harvesting the resources of space both for their use in space and to increase the wealth and prosperity of the people on planet Earth': Isabelle Bouvet, 'An International Legal Framework to Govern Space Natural Resources Exploitation' (DPhil Thesis, McGill University, 2012) 6.

are to live among the stars, a change in narrative is needed which better captures and explains human habitation of celestial bodies, and distinguishes this activity from the taint of historical colonisation activities on Earth.

II TO MARS: THE FUTURE IS ALREADY HERE

The prescient science fiction author William Gibson is attributed to the statement that ‘the future is already here, it’s just not very evenly distributed’.⁴ Human habitation of celestial bodies has been a recurring theme within fiction and fantasy.⁵ However, true to Gibson’s statement, work to turn fiction into reality has already begun in earnest.

German rocket engineer Werner von Braun outlined the first serious plans for human exploration of Mars in a novel in 1948.⁶ Although conceived as a work of fiction to stave off boredom following the end of the V-2 rocket program in the United States, von Braun included detailed and highly precise calculations in the novel’s appendices. The meticulously planned mission was based upon a fleet of 10 spacecraft carrying 70 personnel, recommended for launch in 1965, with an intended 400-day duration on the planet.⁷

Though highly precise, the mission was based upon subsequently disproved scientific theories, including the use of horizontally landing winged spacecraft — a plan that would not succeed in a Martian atmosphere with approximately one percent the surface pressure of that found on Earth.⁸ The discovery of the Van Allen radiation belts by the NASA Explorer missions in 1958 would also necessitate changes to the design of von Braun’s spacecraft in order to shield passengers from the harmful effects of exposure to radiation.⁹

NASA has a long history of planned human spaceflight to Mars, including colonisation studies. A Mars expedition study was held in 1960, focusing upon the propulsion mechanisms and orbital trajectories necessary for a round-trip to Mars. These would later form the basis of lunar landings during the Apollo missions during 1963–2.¹⁰ The 1984 ‘Case for Mars II Conference’, partly funded by NASA, included discussion of a permanent Mars base that would serve as a precursor to permanent human

⁴ Pagan Kennedy, ‘William Gibson’s Future is Now’, *The New York Times* (online, 13 January 2012) 8 <<http://www.nytimes.com/2012/01/15/books/review/distrust-that-particular-flavor-by-william-gibson-book-review.html>>.

⁵ See, eg, Rob Kitchin and James Kneale, *Lost in Space: Geographies of Science Fiction* (Bloomsbury Publishing, 2005).

⁶ Werner von Braun, *The Mars Project* (University of Illinois Press, 1953)

⁷ *Ibid.* See also David SF Portree, *Humans to Mars: Fifty Years of Mission Planning, 1950–2000* (NASA History Office, 2001) 2.

⁸ *Ibid.* 1.

⁹ *Ibid.* 6.

¹⁰ *Ibid.* 5.

habitation.¹¹ In 2004, then President Bush proclaimed in his ‘Vision for Space Exploration’ that crewed missions to Mars were an important part of the United States’ objective to ‘extend human presence across the solar system’.¹²

In its *NASA Act of 2010*, the United States Government decreed that NASA shall conduct a crewed mission to orbit Mars by the mid-2030s.¹³ The *NASA Transition Authorisation Act of 2017* largely maintains the status quo of the 2010 Act, but specifically discusses the ‘requirements of future exploration and utilisation activities leading to human habitation on the surface of Mars’,¹⁴ including ‘the long-term goal of human missions near or on the surface of Mars in the 2030s’.¹⁵ NASA took a step closer to this goal on 26 November 2018, when its Mars InSight probe successfully landed on the surface of Mars.¹⁶ The 2018 budget blueprint released by the Trump administration also reflects a desire to maintain momentum towards Mars exploration: US\$3.7 billion has been allocated to the next generation launch and crew modules needed for deep space exploration (for the Space Launch System and Orion capsule respectively), while a further US\$1.9 billion has been allocated to progress a new Mars rover launch by 2020.¹⁷ In 2015–16, NASA conducted a trial in conjunction with the Russian State Space Corporation, Roscosmos, that saw an astronaut from each state spend one year on the International Space Station (‘ISS’) to study the ‘medical, psychological and biomedical challenges faced by astronauts during long-duration spaceflight’ as a precursor to future Mars missions.¹⁸ Extending the reach of humankind beyond the Moon is clearly an imminent goal of the United States Government.

Other states, although primarily focusing human spaceflight endeavours on lunar missions,¹⁹ are also continuing Mars exploration efforts. Roscosmos is planning lunar landing and uncrewed missions to Mars in 2019, as a precursor to later crewed

¹¹ Ibid 63.

¹² George W Bush, ‘A Renewed Spirit of Discovery: The President’s Vision for US Space Exploration’ (Press Release, January 2004) 2 https://history.nasa.gov/renewed_spiritofdiscovery.pdf (‘Vision for US Space Exploration’).

¹³ *NASA Authorisation Act of 2010*, Pub L No 111-267, § 301(5), 124 Stat 2805, 2813 (‘*NASA Act of 2010*’).

¹⁴ *NASA Transition Authorisation Act of 2017*, Pub L No 115-10, § 414(b), 131 Stat 18, 34.

¹⁵ Ibid § 432(b)(2)(A), 131 Stat 18, 39.

¹⁶ ‘NASA InSight Lander Arrives on Martian Surface’, *NASA* (Web Page, 26 November 2018) <<https://mars.nasa.gov/news/8392/nasa-insight-lander-arrives-on-martian-surface/?site=insight>>.

¹⁷ ‘America First: A Budget Blueprint to Make America Great Again’, *White House Office of Management and Budget* (Web Page, 2017) 43 <https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/budget/fy2018/2018_blueprint.pdf>.

¹⁸ ‘One-Year Mission: About’, *NASA* (Web Page, 31 January 2017) 1 <<https://www.nasa.gov/lym/about>>.

¹⁹ Igor Komarov, the head of Roscosmos, has stated that ‘NASA has Mars as the priority ... We at this stage are making the Moon our priority. We can be good in rounding each other out and working jointly on this program’: Anton Doroshev and Stepan Kravchenko,

Mars expeditions.²⁰ China successfully landed a rover on the previously unexplored far side of the Moon on 2 January 2019, and has an uncrewed Mars mission scheduled for 2020, with crewed missions to the Moon and beyond planned in the 2030s.²¹ The Indian Space Agency ('ISRO') successfully inserted a spacecraft into Mars orbit in 2014, with the nation's first human spaceflight slated for launch by 2022.²² The joint European Space Agency ('ESA') and Roscosmos' ExoMars mission remains on-track for a 2020 launch that will see an ESA rover transported to the Martian surface, despite the first lander crashing in 2016.²³ In February 2017, the United Arab Emirates unveiled its Mars 2117 project, which aims to 'establish the first inhabitable human settlement in Mars by 2117',²⁴ building upon its Mars Probe mission which aims to send the 'Arab world's first spacecraft to the Red Planet in a scientific exploration mission that will land on planet in 2021'.²⁵

Despite these efforts by states, it is the private sector that has emerged as a leader in pursuing human space flight to Mars. SpaceX, a private space manufacturing and launch company founded by Elon Musk, is the most notable example. At the September 2016 International Astronautical Congress in Mexico, Musk unveiled plans to develop an Interplanetary Transport System, with the ultimate goal of 'making humans a multi-planetary species'.²⁶ These aspirations were further refined in 2018, with the announcement of plans to develop Starship and Super Heavy,

'Russia Sets Out Moon Landing Ambition, Leaves Mars Plans to NASA', *Bloomberg* (online, 26 June 2015) 3 <<https://www.bloomberg.com/news/articles/2015-06-26/russia-sets-out-moon-landing-ambition-leaves-mars-plans-to-nasa>>.

²⁰ William Atkins, 'Manned Mission to Moon in Russia's Future', *IT Wire* (online, 3 September 2007) <<http://www.itwire.com/content/view/14267/1066/>>.

²¹ Stephen Clark, 'Chinese Rover Begins Exploring Far Side of the Moon', *Spaceflight Now* (online, 5 January 2019) <<https://spaceflightnow.com/2019/01/05/chinese-rover-begins-exploring-far-side-of-the-moon/>>.

²² Pallava Bagla, 'Is India Ready to Send Someone to Space?', *BBC News* (online, 22 August 2018) <<https://www.bbc.com/news/world-asia-india-45243908>>.

²³ 'Schiaparelli Landing Investigation Makes Progress', *European Space Agency* (Web Page, 23 November 2016) <http://www.esa.int/Our_Activities/Human_Spaceflight/Exploration/ExoMars/Schiaparelli_landing_investigation_makes_progress>. It was determined that although most guidance and navigation systems performed as expected, an erroneous signal from the Inertial Measurement Unit shortly following parachute deployment led to the navigation system determining that the lander had negative altitude, despite still being approximately 3.7 kilometres above the Martian surface. This led to early release of the deployed parachute, resulting in a terminal crash. See also 'The ExoMars Programme 2016–2020', *European Space Agency* (Web Page, 1 January 2019) <<http://exploration.esa.int/mars/46048-programme-overview/>>.

²⁴ 'Mars 2117 Project', *UAE Federal Ministry* (Web Page, 24 September 2019) <<https://government.ae/en/more/uae-future/2030-2117>>.

²⁵ 'VP, Mohamed bin Zayed Unveil "Mars 2117 Project"', *Emirates News Agency* (online, 14 February 2017) <<http://wam.ae/en/details/1395302597763>>.

²⁶ 'Making Humans a Multiplanetary Species', *SpaceX* (Web Page, 20 December 2018) <<http://www.spacex.com/mars>>.

a new spaceship and rocket respectively, that will be designed to carry as many as 100 people between planets.²⁷ SpaceX envisages that transportation to Mars will not be one-way, but will return to Earth (or Earth orbit). This was indeed the plan briefed by Musk during his September 2016 Mars colonisation conference, where he stated that customers would be offered one-way and return trips.²⁸

SpaceX's rocket technology is founded upon the basis of re-usability, such that operational costs are reduced to the point of making space travel feasible and accessible to more than just the world's wealthiest. As Byers has observed,

getting to space used to involve building the equivalent of a Boeing 787 and discarding it after a single three-minute flight. The rocket constituted 99 percent of the cost of a launch; that cost can now be spread over multiple missions.²⁹

Using the Interplanetary Transport System, Musk envisages up to 1,000 spacecraft leaving Earth every 26 months, enabling a permanent human presence on Mars of 1 million people within 40 to 100 years.³⁰ SpaceX took an historic step toward its goal on 30 March 2017, when it successfully launched and landed one of its Falcon 9 rockets that had been used for a previous space launch. This marked the first time an orbital class booster had ever been reused, providing an economic basis for SpaceX's future deep space plans.³¹ Further progress was made on 3 December 2018, when SpaceX launched and landed the same Falcon 9 booster for a third time.³² SpaceX is not alone in its ambitions, with other private companies, such as Blue Origin,³³ also having plans for increased human spaceflight to the Moon, Mars and beyond, either independently or in partnership with state space agencies.³⁴

²⁷ Ibid.

²⁸ Ibid.

²⁹ Michael Byers, 'Elon Musk, President of Mars?', *Washington Post* (online, 22 January 2016) <https://www.washingtonpost.com/opinions/elon-musk-president-of-mars/2016/01/22/732f1520-bfc7-11e5-bcda-62a36b394160_story.html?utm_term=.1bcef48fb241>.

³⁰ SpaceX (n 26).

³¹ 'SES-10 Mission', *SpaceX* (Web Page, 30 March 2017) <<http://www.spacex.com/press/2017/03/30/ses-10-mission>>.

³² 'Spaceflight SSO-A: SmallSat Express Mission', *SpaceX* (Web Page, 3 December 2018) <<https://www.spacex.com/news/2018/12/03/spaceflight-sso-smallsat-express-mission>>.

³³ Kenneth Chang, 'Jeff Bezos Unveils Blue Origin's Vision for Space, and a Moon Lander', *The New York Times* (online, 9 May 2019) <<https://www.nytimes.com/2019/05/09/science/jeff-bezos-moon.html>>.

³⁴ Jon Fingas, 'Jeff Bezos Outlines Blue Origin's Space Colony Ambitions', *Engadget* (online, 27 May 2018) <<https://www.engadget.com/2018/05/27/jeff-bezos-outlines-blue-origin-space-colony-ambitions/>>.

The presence of a permanent population of humans on Mars (or other celestial bodies) raises numerous legal issues; these must be considered and addressed prior to the arrival of the first crewed mission.

III THE LEGALITY OF HUMAN HABITATS ON MARS

The term ‘colonisation’ is often used to reference endeavours to establish human habitats on Mars and other celestial bodies. However, the term ‘colonisation’ itself taints these ventures with the negative memory of historical European colonialism. Indeed, the use of terminology such as ‘colony’ and ‘colonist’ suggests that the future Mars habitat will be territory belonging to an Earth state. However, the terrestrial rules for acquiring new territory, such as the discovery of terra nullius or the exercise of sovereign authority, are explicitly prohibited in outer space by international space law. Rather than being terra nullius — territory belonging to no-one — outer space is *res communis*, the common property of all humanity, and states are thus not able to acquire or appropriate any part of outer space, including celestial bodies:

The [space law] treaties were perhaps one of the first real attempts at establishing a global community that would work together to accomplish a goal. Space would not be divided up, as were the land masses on earth, through conquest and colonisation. Rather, the vision for space was one of humans working in harmony to better the lives of all mankind by exploring and possibly exploiting space resources for the good of all, in the spirit of cooperation and harmony.³⁵

The challenge then becomes how to reconcile this principle of non-appropriation with endeavours to establish a permanent human habitat beyond the surface of the Earth.

A *The Principle of Non-Appropriation*

The *Outer Space Treaty* provides the legal foundation for all activities in outer space. All current spacefaring states are party to the *Outer Space Treaty*.³⁶ Article I allows states parties to ‘use’ outer space, which at first glance would include the use by humans of Mars as a place to live, provided the habitat was operated for the ‘benefit and interests of all countries’.³⁷ However, the *Outer Space Treaty* also provides that outer space ‘shall be the province of all mankind’³⁸ and that ‘celestial bodies [are]

³⁵ Heidi Keefe, ‘Making the Final Frontier Feasible: A Critical Look at the Current Body of Outer Space Law’ (1995) 11(2) *Computer & High Technology Law Journal* 345, 346.

³⁶ As at 1 January 2019, the *Outer Space Treaty* (n 2) has been ratified by 109 states, and signed by a further 23 states: Legal Subcommittee on the Peaceful Uses of Outer Space, *Status of International Agreements Relating to Activities in Outer Space as at 1 January 2019*, 58th sess, UN Doc A/AC.105/C.2/2019/CRP.3 (1 April 2019) [10].

³⁷ *Outer Space Treaty* (n 2) art I.

³⁸ *Ibid.*

not subject to national appropriation'.³⁹ The legality of any human habitat on Mars depends then on whether it can be established consistently with these legal principles.

The principle of non-appropriation contained in Article II of the *Outer Space Treaty* provides that '[o]uter 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'.⁴⁰ It is arguably a principle of customary international law, having received widespread acceptance and representing state practice for more than 50 years. This means that outer space is a global commons, and no state can exercise legal control over any of part of outer space, including celestial bodies, as if it were that state's legal territory.⁴¹ While the term 'celestial bodies' is not defined in any of the space law treaties, the International Astronomical Union adopted definitions in 2006 which recognise the following as 'celestial bodies': the Sun; the planets; the Moon of Earth and the moons of other planets; near-Earth objects; dwarf planets; trans-Neptunian objects; asteroids, comets; and Kuiper belt objects.⁴²

States may 'land spacecraft on celestial bodies, collect materials, and leave equipment behind, [however] none of these actions extends or enhances their rights over any part of that body'.⁴³ Indeed, the *Outer Space Treaty* specifically recognises the right to establish facilities, stations, and other installations in the exploration of space and celestial bodies.⁴⁴ Although, as von der Dunk and Tronchetti observe, 'unlike the continents and seas [colonised] by European empires and their navies in previous centuries, outer space, including the Moon and all other celestial bodies, is not subject to national appropriation'.⁴⁵ While there is disagreement amongst scholars

³⁹ *Outer Space Treaty* (n 2) art II.

⁴⁰ Ibid. The principle of non-appropriation was among the earliest declarations at the beginning of the space age, being adopted unanimously by the General Assembly in 1961: *International Cooperation in the Peaceful Uses of Outer Space*, GA Res 1721 (XVI), UN Doc A/RES/1721 (XVI) (20 December 1961).

⁴¹ *Outer Space Treaty* (n 2) art II. See also, Carla Sharpe and Fabio Tronchetti, 'Legal Aspects of Public Manned Spaceflight and Space Station Operations' in Frans von der Dunk and Fabio Tronchetti (eds), *Handbook of Space Law* (Edward Elgar, 2017) 627; Melissa de Zwart, 'I've Always Wondered: Could Someone Take Ownership of a Planet or a Moon?' *The Conversation*, (online, 22 August 2018) <<https://theconversation.com/ive-always-wondered-could-someone-take-ownership-of-a-planet-or-a-moon-101464>>.

⁴² International Astronomical Union, *Definition of a Planet in the Solar System*, RES/B5, 24 August 2006. See also Leslie I Tennen, 'Enterprise Rights and the Legal Regime for Exploitation of Outer Space Resources' (2016) 47(2) *The University of the Pacific Law Review* 281, 284.

⁴³ Karl Leib, 'State Sovereignty in Space: Current Models and Possible Futures' (2015) 13(1) *Astropolitics* 1, 6.

⁴⁴ *Outer Space Treaty* (n 2) art IV.

⁴⁵ Frans von der Dunk, Susan Perlman and Fabio Tronchetti (eds), *Handbook of Space Law* (Edward Elgar, 2017) 5.

about whether this prohibition also extends to appropriation of mineral resources on celestial bodies,⁴⁶ the principle of non-appropriation clearly precludes any possibility of states expanding their territory through planetary exploration and the establishment of extraterrestrial human habitats.

Any human habitat on Mars, or any other celestial body, will thus be established in an environment where the rules relating to state sovereignty do not apply in the same way as they do on Earth. However, this is not the same thing as a law-free environment, as there will still need to be legal principles and rules governing a human habitat on Mars. One of the key issues that will need to be resolved before the first human habitat is established is who, in the absence of a responsible sovereign state, will be responsible for the ongoing operation of the habitat and maintaining the security and safety of its inhabitants. The answer to this question depends on whether and how the international community is able to resolve the complex issue of how property rights would operate in a permanent human habitat in outer space.

Traditional terrestrial understandings of property rights will not apply to a human habitat on Mars. A distinction needs to be drawn between space objects, over which states retain jurisdiction and control pursuant to Article VIII of the *Outer Space Treaty*, and the surface of Mars on which those objects are located. For property rights to be granted, there needs to be someone (usually the state) with the power to grant those rights. If no-one can own outer space, then there is no-one who can grant these property rights, despite attempts by some on Earth to purportedly sell land on the Moon and Mars, and lay claim to orbits.⁴⁷ While inhabitants, their states or private companies may be able to own a habitat, pod, or base on Mars, they would not be able to own the land on which it was located.⁴⁸

⁴⁶ See, eg, Fabio Tronchetti, 'Legal Aspects of Space Resource Utilisation' in Frans von der Dunk and Fabio Tronchetti (eds), *Handbook of Space Law* (Edward Elgar, 2015) 769; Andrew Brearly, 'Mining the Moon: Owning the Night Sky?' (2006) 4(1) *Astropolitics* 59; Tennen (n 42). Cf the expansion of the principle of non-appropriation in art 11 of the *Moon Agreement* (n 2) which expressly provides that no part of the Moon, its surface, subsurface, nor resources in place, shall become property of any governmental or non-governmental entity, including natural persons. It requires that states undertake to establish an international regime to govern the exploitation of the resources of the Moon, as such exploitation is nigh feasible.

⁴⁷ An organisation called 'The Lunar Embassy', founded by Dennis Hope, has purportedly sold in excess of two million plots of land on the Moon and nearly 1 million plots of land on Mars. See 'The Galaxy Can Be Yours', *Lunar Embassy* (Web Page) <<https://www.lunarembassy.com/>>. Note also the *Bogotá Declaration*, under which a group of equatorial developing states (Ecuador, Colombia, Brazil, Congo, Zaire, Uganda, Kenya, and Indonesia) asserted their sovereignty over the equatorial geosynchronous space: International Telecommunication Union, *Declaration of the First Meeting of the Equatorial Countries*, ITU Doc WARC-BS 81-E (3 December 1976) ('*Bogotá Declaration*').

⁴⁸ On the 'tragedy of the commons' in the context of outer space, see Scott J Shackelford, 'The Tragedy of the Common Heritage of Mankind' (2009) 28 *Stanford Environmental Law Journal* 109.

Some scholars have suggested that quasi-proprietary rights could apply in outer space,⁴⁹ however terrestrial property law is not easily transposable to the outer space environment. As Collins notes, the

simple delineation between equipment and land may be difficult to draw on Mars ... because the planet's atmosphere necessitates artificial construction, such as a greenhouse, in order to render the surface agriculturally productive or habitable ... there is a strong risk that an investment such as a base that possibly costs billions of dollars in preparation and transportation would become public property once it was placed on the planet's surface.⁵⁰

What does this mean for inhabitants who could find themselves occupying their habitat or pod in a perfect location, only to be pushed out of the way for others to secure access to minerals below the surface of Mars, or merely to secure a better view? If there are no ownership rights over the surface of Mars, then there may be little that can be done in response. Such a 'free for all' without any rules would lead to conflict amongst inhabitants, or between inhabitants and private companies, and would not bode well for the long-term future of the Mars habitat.

It is imperative that some form of legal regulation of property be considered and resolved in order to clarify the rights that various actors will have on Mars, in order to ensure that the risk of conflict between inhabitants is diminished, and to promote and encourage the considerable investment that will be required to establish a human habitat in outer space. While some scholars have suggested that property rights on celestial bodies could be awarded to the first possessor,⁵¹ such a first possessor regime would be contrary to the principle of non-appropriation and the *res communis* status of celestial bodies. A regime based on cooperation, however, provides a useful model for how a human habitat on Mars could operate consistent with the current international space law treaties. Indeed, as Wijkman observes the 'interdependence' of all actors in space provides 'strong incentives' for cooperative solutions.⁵²

⁴⁹ See, eg, Kurt Anderson Baca, 'Property Rights in Outer Space' (1993) 58(4) *Journal of Air Law & Commerce* 1041, 1065; Brandon C Gruner, 'A New Hope for International Space Law: Incorporating Nineteenth Century First Possession Principles into the 1967 Space Treaty for the Colonisation of Outer Space in the Twenty-First Century' (2004) 35(1) *Seton Hall Law Review* 299.

⁵⁰ David Collins, 'Efficient Allocation of Real Property Rights on the Planet Mars' (2008) 14(1) *Boston University Journal of Science & Technology Law* 201, 205.

⁵¹ Ryan Hugh O'Donnell, 'Staking a Claim in the Twenty-First Century: Real Property Rights on Extra-Terrestrial Bodies' (2007) 32(3) *University of Dayton Law Review* 461.

⁵² See Magnus Wijkman, 'Managing the Global Commons' (1982) 36(3) *International Organization* 535.

B *A Cooperative Regime?*

The ISS operates under the principle of international cooperation,⁵³ and provides a useful model for the establishment and operation of a human habitat on Mars. The ISS *Intergovernmental Agreement* provides ‘for unique solutions’ to issues of intellectual property rights, criminal jurisdiction, and the ‘extended inter-party waiver of liability and the fundamental application of the concept of time-sharing in terms of usage of the manned facilities part of the ISS’.⁵⁴ The legal rules and principles that govern the ISS significantly expand the provisions of the international space law treaties ‘in order to provide a legal framework capable of adequately addressing the specific issues resulting from human activities on board a manned station orbiting in low earth orbit’.⁵⁵

Prior to the establishment of the ISS, there were single-state operated space stations,⁵⁶ which remained within the jurisdiction of their state of registry under the *Registration Convention*.⁵⁷ Indeed, this was the legal position of the Soviet Union’s space station, the Mir, where the Union was entitled to exercise its jurisdiction on board on a quasi-territorial basis.⁵⁸ As such, for all legal purposes, these single-state owned space stations comprised a piece of ‘quasi-territory in the global commons of outer space’.⁵⁹ The ISS, however, was different both operationally and legally, and required the establishment of new rules and principles for its operation.

Unlike the earlier single-state space stations, the ISS is a modular space station, consisting of several elements which were assembled in space at different times. Building the ISS required the cooperation of multiple states who needed to agree on the design, assembly and operation of the ISS. A human habitat on Mars is likely to be built in a similar way, with many states and private companies contributing to

⁵³ The ISS was first established through a 1988 Intergovernmental Agreement: *Agreement Among the Government of the United States of America, Governments of Member States of the European Space Agency, the Government of Japan, and the Government of Canada on Cooperation in the Detailed Design, Development, Operation, and Utilization of the Permanently Manned Civil Space Station*, opened for signature 29 September 1988 (entered into force 30 January 1992). This was superseded by the 1998 Intergovernmental Agreement: *Agreement Among the Government of Canada, Governments of Member States of the European Space Agency, the Government of Japan, the Government of the Russian Federation, and the Government of the United States of America Concerning Cooperation on the Civil International Space Station*, opened for signature 29 January 1998, TIAS No 12927 (entered into force 27 March 2001) (*‘Intergovernmental Agreement’*).

⁵⁴ Sharpe and Tronchetti (n 41) 660.

⁵⁵ Ibid 619.

⁵⁶ Ibid 621; the Soviet Union launched the first space station, Salyut-I, in 1971. This was followed in 1973 by the United States’ Skylab Space Station.

⁵⁷ *Registration Convention* (n 2) art II.

⁵⁸ Sharpe and Tronchetti (n 41) 622.

⁵⁹ Ibid.

the design, build and operation. Indeed, the NASA Administrator, Charlie Bolden, has stated that '[a]ny mission to Mars is likely to be a global effort'.⁶⁰ Building on the legacy of the ISS, the human habitation of Mars could be undertaken as an internationally cooperative endeavour under some form of agreement between participating states and private companies. The agreement would need to reflect the inherently collaborative nature of such endeavours, and it is suggested that governance of the habitat should be based on contribution and participation in the venture. Such an agreement would need to address a range of issues, such as the behaviour of inhabitants, ongoing financial support for the habitat, liability, and intellectual property rights for inventions created in the Mars habitat.

Similar to the ISS, a future permanent human habitat on Mars is likely to result in the development of a *sui generis* regime, building on existing international space law. With creative solutions, consistent with existing international space law, that deal with the specific issues that will arise in relation to the establishment and operation of an extraterrestrial human habitat, a legal arrangement could be developed that governs a human habitat on Mars in the spirit of international cooperation and the future of humanity. A collaborative agreement, provided it is consistent with obligations under international space law, would avoid the problems inherent in 'unilateral settlement schemes and the almost inevitable conflicts such models would likely entail'.⁶¹

IV THE LEGAL STATUS OF HUMANS LIVING OFF-EARTH

'That makes me a pirate! A space pirate!'⁶²

The presence of humans living in extraterrestrial habitats raises significant questions relating to the legal status of such individuals. One of the key issues that will need to be resolved is whether every human beyond Earth's atmosphere will be classified as an 'astronaut' and thus be entitled to the special protections accorded to astronauts

⁶⁰ Ibid 659.

⁶¹ James Clay Moltz, 'Toward Cooperation or Conflict on the Moon? Considering Lunar Governance in Historical Perspective' (2009) 3(3) *Strategic Studies Quarterly* 82, 93.

⁶² Andy Weir, *The Martian* (Random House, 2011) 206; see also *The Martian* (Ridley Scott, 2015). This quote from the fictional character Mark Watney, an astronaut inadvertently abandoned on Mars, was based upon his conclusion that Martian territory outside of buildings was international waters. Although the quote has garnered much attention from international lawyers due to the numerous errors contained within, it is nonetheless a fascinating insight into the complexities and uncertainties of international law as it applies to activities in space. See, eg, Phil Steinberg, 'The Martian, Matt Damon, and Outer Space Law' (Blog Post, 7 November 2015) <<https://www.philsteinberg.wordpress.com/2015/11/07/the-martian-matt-damon-and-outer-space-law>>.

in the space law treaties.⁶³ Another key issue relates to citizenship of humans living permanently in a human habitat on Mars or other celestial body.

Article V of the *Outer Space Treaty* designates astronauts as the ‘envoys of mankind in outer space’ and obliges states to ‘render all possible assistance’ to astronauts in emergency situations, regardless of their state of origin or nationality.⁶⁴ The *Rescue and Return Agreement* is a little broader in the special treatment accorded, using both the terms ‘astronauts’⁶⁵ and ‘personnel of a spacecraft’.⁶⁶ Both treaties impose obligations on states parties to assist astronauts and return them promptly to the flag state of their spacecraft. However, neither treaty provides a definition of ‘astronaut’ or ‘personnel of a spacecraft’, which raises questions about whether humans living permanently off-Earth, or those en route to a human habitat on Mars or other celestial body, will be ‘astronauts’ or ‘personnel of a spacecraft’ and thus entitled to such special treatment. While the *Moon Agreement* provides that ‘any person’ on the Moon is to be regarded as an ‘astronaut’ by states parties,⁶⁷ this treaty has not been widely accepted and, as at 8 January 2019, has only 18 parties, none of which are major space faring states,⁶⁸ calling this expansive definition of ‘astronaut’ into question.

Interpretation of the terms ‘astronaut’ and ‘personnel of a spacecraft’,⁶⁹ might suggest that individuals falling within these categories have had some specialised training, an operational role in the flight, or a similar function. Indeed, Article V of the *Outer Space Treaty* requires them to be regarded as the ‘envoys of mankind’ which would seem to require some level of public function to be classed as an ‘astronaut’. The *ISS Principles Regarding Processes and Criteria for Selection, Assignment, Training and Certification of ISS (Expedition and Visiting) Crewmembers* distinguish between

⁶³ On the question of the legal status of space tourists see, eg, Steven Freeland, ‘Up, Up and ... Back: The Emergence of Space Tourism and its Impact on the International Law of Outer Space’ (2005) 6(1) *Chicago Journal of International Law* 1; Frans von der Dunk, ‘Space for Tourism? Legal Aspects of Private Spaceflight for Tourist Purposes’ (2007) *Proceedings of the Forty-Ninth Colloquium on the Law of Outer Space* 18; CE Parson, ‘Space Tourism: Regulating Passage to the Happiest Place off Earth’ (2006) 9(2) *Chapman Law Review* 493.

⁶⁴ *Outer Space Treaty* (n 2) art V.

⁶⁵ *Rescue and Return Agreement* (n 2) preamble.

⁶⁶ *Ibid* arts 1–4.

⁶⁷ *Moon Agreement* (n 2) art 10.

⁶⁸ As at 8 January 2019, the *Moon Agreement* (n 2) had 18 states parties and had been signed, but not ratified, by a further four states (France, Guatemala, India, and Romania). The 18 states parties are: Armenia, Australia, Austria, Belgium, Chile, Kazakhstan, Kuwait, Lebanon, Mexico, Morocco, Netherlands, Pakistan, Peru, Philippines, Saudi Arabia, Turkey, Uruguay, and Venezuela. See ‘Status of the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies’, *United Nations Treaty Collection* (Web Page) <https://treaties.un.org/Pages/ViewDetails.aspx?src=IND&mtdsg_no=XXIV-2&chapter=24&clang=_en>.

⁶⁹ *Vienna Convention on the Law of Treaties*, opened for signature 23 May 1969, 1155 UNTS 331 (entered into force 27 January 1980) art 31.

a professional astronaut (or cosmonaut) and a spaceflight participant, which would support the interpretation of 'astronaut' and 'personnel of a spacecraft' as requiring something more than mere presence in outer space.⁷⁰ Perhaps on the initial voyage to establish the human habitat on Mars all onboard the spacecraft will be regarded as 'astronauts' or 'personnel of a spacecraft', when it is imagined that a small group with very specific roles will be involved. But what about further into the future, when the technology has developed further and there are individuals who are simply along for the ride? It is hard to see the public function served by individuals who have no role in the mission of the spacecraft, hence it is arguable that they are not 'astronauts' or 'personnel of a spacecraft', merely passengers entitled to no additional special protections by international space law.

One implication of this interpretation for humans living permanently off-Earth could be that there is no obligation on astronauts of other states to render assistance to or rescue those individuals who are not 'astronauts' or 'personnel of a spacecraft' in the event of an emergency either en route to, or while in, a human habitat on Mars. Indeed, Article 2 of the *Rescue and Return Agreement* imposes the obligation to rescue and render assistance to 'personnel of a spacecraft' only where they land in territory under the jurisdiction of a state party. This would not extend to an obligation to rescue and render assistance to an extraterrestrial human habitat, as such a habitat cannot be the territory of a state as a consequence of the operation of the principle of non-appropriation. The special protections provided to 'astronauts' and 'personnel of a spacecraft' are not fit for the situation of humans residing permanently off-Earth.

Another legal consideration that arises in relation to humans living extraterrestrially is whether they retain citizenship of their origin states, or whether they would become citizens of Mars. This issue becomes more complex when considering the situation of children born in a human habitat on Mars. Article 7(1) of the *Convention on the Rights of the Child* provides, among other things, that all children 'shall have the right to acquire a nationality'.⁷¹ The issue of citizenship is something that needs to be resolved before any human children are born on Mars, or any other celestial body.

Here too the ISS can provide a useful starting point. Under the *Intergovernmental Agreement*, states retain jurisdiction, including criminal jurisdiction, over their nationals participating in ISS missions.⁷² This is consistent with the *Outer Space Treaty* which provides that states retain jurisdiction over personnel of any spacecraft

⁷⁰ 'Principles Regarding Processes and Criteria for Selection, Assignment, Training and Certification of ISS (Expedition and Visiting) Crewmembers', *ISS Multilateral Crew Operations Panel* (Web Page, November 2001) <www.spaceref.com/news/viewsr.html?pid=4578>.

⁷¹ *Convention on the Rights of the Child*, opened for signature 20 November 1989, 1577 UNTS 3 (entered into force 2 September 1990) art 7(1). This convention has been nearly universally ratified and is binding on all states, except the United States of America; the only state yet to ratify it.

⁷² *Intergovernmental Agreement* (n 53) arts 5 and 22.

launched under their registry.⁷³ Drawing on the model of international cooperation provided by the ISS, an agreement for governance of the human habitat on Mars should specifically consider and address the issue of citizenship, both for those leaving Earth to reside permanently off-Earth, and for those children born off-Earth. It should also specifically address the obligation to rescue inhabitants or contribute to a rescue operation in the event of an emergency in the Martian human habitat.

V THE PATH FORWARD

‘We are standing at the threshold of a new era. Human colonisation on other planets is no longer science fiction. It can be science fact ... If humanity is to continue for another million years, our future lies in boldly going where no-one else has gone before.’⁷⁴

In 1958, the Australian delegate to the First Committee of the United Nations General Assembly stated that ‘[e]xperience in Antarctica may suggest how difficult it may become to consider the problems of outer space impartially and on a universal plane if decision is left until states have established themselves permanently in the field’.⁷⁵ Ehrenfreund and Peter argue that we have already entered the era of ‘Space Exploration 3.0’, where a mix of state and private actors ‘will forge a global space endeavour that is “international, human-centric, transdisciplinary and participatory”’.⁷⁶ As endeavours to establish a permanent human habitat on Mars, and other celestial bodies, intensify in the coming decades, it is critical that a legal framework for such activities is developed, which is consistent with existing obligations under international space law.

The ISS and its principle of cooperation provides a successful model on which a legal framework for the establishment and operation of permanent human habitats on Mars and other celestial bodies can be based. The ISS project ‘has shown that governments can collaborate on technological, financial, political and legal levels to produce successful projects that provide for the benefit of all with little dispute and operational difficulty’.⁷⁷ As von der Dunk notes, ‘the absence of a clear international regime dealing with these issues also stifles any private activities with positive and honourable motives’.⁷⁸ Changing the narrative to distinguish these activities from the negative history of past colonisation on Earth is an important first step towards large-scale international cooperation, governmental and non-governmental, in the

⁷³ *Outer Space Treaty* (n 2) art VIII.

⁷⁴ Stephen Hawking, *Brief Answers to the Big Questions* (John Murray, 2018) 179–180.

⁷⁵ United Nations General Assembly, *Reports of the Committee on the Peaceful Uses of Outer Space*, UN GAOR, UN Doc A/C.I/SR.986 (17 November 1958).

⁷⁶ Quoted in Karl Leib, ‘State Sovereignty in Space: Current Models and Possible Futures’ (2015) 13(1) *Astropolitics* 1, 3.

⁷⁷ Sharpe and Tronchetti (n 41) 659.

⁷⁸ Frans von der Dunk et al, ‘Surreal Estate: Addressing the Issue of “Immovable Property Rights on the Moon”’ (2004) 20(3) *Space Policy* 149, 150.

development of a legal framework for the establishment and operation of human habitats on Mars, and other celestial bodies, for the future of humanity.

VI CONCLUSION

Humankind is achieving technological advancements that will soon see its reach extend beyond the Moon. Efforts to reach an agreeable position on the legality of such human endeavours need to continue, in order to avoid the need for reactive determinations once humankind makes the inevitable next giant leap among the stars. It is imperative that a legal framework is developed to govern a human habitat on Mars to ensure compliance with the rule of law, to ensure clarity of rights and obligations between inhabitants, and to provide a legally stable environment conducive to the venture's long term success. Changing the narrative is an important first step towards ensuring that the future of humanity as a whole, rather than the national interest of individual states, is at the forefront of endeavours to establish permanent human habitats in outer space.