UiT The Arctic University of Norway

Faculty of Humanities, Social Sciences and Education

Aiming for the Moon

Exploring the Geopolitical Significance of the Artemis Program

Sebastian Gerhard Lyhne Hanssen

Master's thesis in Political Science, STV – 3900, May 2023

Table of Contents

Abstract

This thesis is a case study of ongoing U.S. space policy and space exploration efforts aimed at human exploration of the Moon, focusing particularly on the Artemis human lunar exploration program. The thesis assesses the geopolitical significance (including the possible consequences, and near/long-term implications) of said efforts as they relate to questions of international space law, space weaponisation, and the concept of "space power". To achieve this, the thesis examines four works of theoretical literature dealing with the application of geopolitics theories to the domain of outer space, by authors Everett Dolman, Fraser MacDonald, Nayef Al-Rodhan, and Daniel Deudney. This thesis finds that Artemis is likely to pose a challenge to the existing international outer space regime, wherein outer space is viewed as the common ownership of all humanity. This thesis also finds that the Artemis program, and its associated space efforts, serves to strengthen the ties between the United States and its international partners in space exploration, as well as increasing the ability of the United States to exercise space power and to benefit from future lunar exploitation.

1 Introduction

In 1962, speaking before a stadium of forty thousand people in Houston, Texas; President John F. Kennedy delivered his now-famous Address at Rice University on the Nation's Space Effort. It is best known by the phrase "We choose to go to the Moon", by which President Kennedy affirmed the nation's commitment to send a human crew to the surface of the Moon by the end of the decade. His speech paints a clear picture of outer space: A "new sea" that beckons the very best of humanity to explore for the benefit of all; a vast, open frontier that will challenge and reward those who are bold enough to venture forth. But his words also serve up a powerful warning. "Whether it will become a force for good or ill depends on man," he argues, and suggests that outer space may either be a "sea of peace", or a "terrifying theater of war", and that it is up to humanity (and, in particular, the United States) to see that the latter is averted. Eight years later, Apollo 11 would successfully land two humans on the surface of the Moon, where they would leave behind an American flag.

Outer space is seldom considered an arena for geopolitics. It is instead more common to think of outer space as mainly a realm of science, with many of the most public-facing space-related activities having primarily a scientific purpose which bears no seeming implication of note in the realm of international politics or geopolitics. High-profile space missions such as the James Webb Space Telescope or the Perseverance Mars rover may push the envelope of scientific discovery and help maintain a public interest in space science, but are rarely thought of as important or significant in the political domain. When space and politics do intersect, it is often through a symbolic lens. The Apollo program and Kennedy's famous speech may be easily evoked in a conversation about the Cold War and the so-called "space race" between the United States and the Soviet Union, but is then primarily viewed as a symbolic competition of skill and capability, the outcomes of which are not so important as the capacities they demonstrate. There is much symbolic prestige to be had in planting a flag on the Moon, but the "real" motive underneath is to flex one's ability to conduct a large-scale nuclear attack, in the hopes that it deters one's military rivals.

This is a prevailing view in which most of space exploration is geopolitically sidelined. It is, in many ways, a realist view—consigning the scientific and symbolic nature of space exploration to political irrelevance. The existing international legislation on the topic further contributes to the notion that outer space is decidedly non-political. Enshrined in the Outer Space Treaty of 1967—the most central international treaty on anything to do with outer

space—is the principle that space is a global commons, not subject to national claims or territorial dispute. The notion of conflict in, and over outer space, is a running theme in such legislation. The Outer Space Treaty itself repeatedly stresses a commitment to "peaceful uses" for outer space, and prohibits the deployment of weapons of mass destruction beyond the Earth. Furthermore, the Space Race of the Cold War period is, by all accounts, long past finished. The years proceeding since then have seen a global space regime consisting mostly of peaceful international cooperation, limited to robotic probe exploration and the manning of one space station in low-Earth orbit.

The world is also growing increasingly reliant on space technology. Satellites are a vital part of modern infrastructure, and the technology to deploy and service them is thus made important in its own right, as well as being a proxy for missile technology. The infrastructural importance of space technology means that space assets become an important strategic concern, and this is reflected in the establishment of dedicated space branches of modern militaries, such as the United States Space Force, and the Russian Space Forces. It can even be imagined that if a single state could wrest control of all near-Earth space, it would in turn have effective control over the entire planet. It thus becomes pertinent to pay close attention to what the world's leading space powers have planned in terms of their presence in outer space. Just like during the Cold War, much of that ambition now involves the Moon, as exemplified by the Artemis program.

The Artemis program, named for the twin sister of Apollo in the Greek myth, began in bits and pieces through other attempted programs intending to succeed the Apollo Moon landings. Its purpose is to once again place human astronauts on the surface of the Moon, much in the fashion of the old Apollo missions. Unlike the Apollo program, however, Artemis aims to deliver a much more permanent presence on and around the Moon, with plans for a lunar-orbiting crewed space station and future provisions for long-term surface habitats, echoing the various unrealised "Moon-base" plans of the Space Race heydays. Artemis also seeks to make good use of lunar resources, extracting and processing the lunar "soil" to create spacecraft fuel, construction components for elements of a surface base, and more.

To accompany this, the United States has launched the Artemis Accords—an international agreement which expands upon the provisions of the Outer Space Treaty, and affirms that such a use of lunar resources is to be allowed under international law. Together with domestic legislation making mentions of permitting U.S. citizens to mine the Moon for commercial

benefit, this has raised concerns that the U.S. is looking to eventually change the international paradigm on outer space, to profit from space resources, and perhaps stake claims to territory on the Moon and elsewhere. As the Artemis program begins to take shape—having already launched the first uncrewed test flight to the Moon and back—the questions surrounding the material use of outer space become increasingly pertinent.

Between control of the Moon and control of Earth's orbital space, the geopolitical importance of outer space is more significant than is often presumed. This thesis will lay out the history and context underpinning the Artemis program, as well as the details of the program itself, in the interest of discussing the potential implications and significance of Artemis in world geopolitics. To support this, prior theoretical works concerning the application of theories of geopolitics to the domain of outer space will be consulted, and used to examine and discuss the Artemis program.

1.1 Structure of the Text

This thesis will assess the geopolitical significance of the Artemis program. In order to do this, a review of relevant theories of geopolitics and works dealing with the geopolitics of outer space will be conducted, with a focus on the latter. Four principal works dealing with the application of geopolitics theories to outer space are examined in detail: *Astropolitik: Classical Geopolitics in the Space Age* by Everett C. Dolman; Fraser MacDonald's *Anti-Astropolitik - Outer Space and the Orbit of Geography*; Nayef Al-Rodhan's *Meta-Geopolitics of Outer Space: An Analysis of Spacepower, Security, and Governance*; and Daniel Deudney's *Dark Skies*.

Following on from the review of theory and literature, the thesis will lay out the broad context of the Artemis program, proceeding in four parts. The first will lay out the history of U.S. spaceflight, such as it pertains to geopolitics, space policy, exploration of the Moon, and the Artemis program. The second will focus on space militarisation and weaponisation, explaining key concepts and developments relevant to the military side of spaceflight. The third will focus on the development and current state of international law concerning space and spaceflight, including the "Artemis Accords" launched by the United States in tandem with the Artemis program. Finally, the fourth part tackles the Artemis program itself, laying out in broad detail the various facets of the program, its related international collaborations, and other related space programs.

With theory and context established, this thesis will then discuss the geopolitical significance of Artemis. This will involve examining the geopolitical significance and importance of outer space in a broad sense, as well as the Moon and lunar exploration, before also examining implications specific to the Artemis program, and its significance both to the United States, its partners and rivals, and to long term space exploration.

1.2 Research Question and Methodology

The central research question of this thesis is: What is the geopolitical significance of the Artemis program and its associated supporting space programs? The term "geopolitical significance" is chosen to encompass both the consequences and implications of the Artemis program in relation to geopolitics, and the developments which surround the program both in terms of U.S. and international policy, and spaceflight and space exploration.

This thesis is a consideration of space activities as they relate to geopolitical competition, using the United States and the Artemis program as a crucial case. Outer space is a developing area of international interaction, and this thesis will argue that the Artemis program represents a crucial case in examining the geopolitical dimensions therein. This topic concerns state behaviour which cannot be fully explored without understanding the specific political and technical context in which it finds itself. A qualitative approach has therefore been applied, as qualitative methods are more suited to explaining and understanding the "full picture" of the matter at hand (Vromen, 2018, pp. 244-245).

This thesis makes use of existing theoretical literature on the topic of applying geopolitics theories to space exploration and outer space. This thesis then lays out the history of spaceflight and space policy, as well as explaining key concepts like space militarisation and space law, before then detailing the Artemis program itself. Finally, the Artemis program and its surrounding space exploration endeavours are analysed and discussed in light of established theory, enabling the assessment of their geopolitical significance. To achieve this, this thesis utilises theoretical literature, historiographical texts, historical and technical documents, policy documents, relevant news articles, and educational websites from space-related organisations such as NASA.

2 Theory

2.1 Why Geopolitics?

Before laying down a theoretical framework, it is worthwhile to establish why outer space ought to be examined with the lens of geopolitics. As will be laid out shortly, the term "geopolitics" has many uses, but a general fixture of most uses of this term involve some relationship between states and their physical and technological circumstances. Outer space and space exploration are strongly linked with these circumstances. Space technologies such as rockets and satellites provide a wide array of both military and civilian uses, becoming assets with political importance on both the domestic and international level, as will be argued extensively in this thesis. Beyond this, the lingering questions of land ownership and resource use on celestial bodies like the Moon and other planets is pertinent to geopolitical analysis, which is often concerned with the ownership and control of resources, strategic locations, and state competition for territory. As such, this thesis will use geopolitical perspectives in an effort to understand the significance of space exploration, particularly the Artemis program.

2.1.1 "Geopolitics"

In order to briefly review the context of geopolitics as a field, it is useful to examine the term "geopolitics" in itself, as the term may be used to refer to multiple theories and methods of analysis, as well as its frequent use as a synonym for "international relations" (Dolman, 2002, p. 11). Where geopolitics as theory is concerned, different approaches and schools of thought exist and have seen varying predominance within the larger field of international politics, but shared among these differing ideas of geopolitics is a focus on material resources and geographical locations as they pertain to states and state-level actors (Sloan & Gray, 1999, p. 2). This domain of analysis is multifaceted, and has seen differing ways in which the relationships between state actors and geography may be understood and expressed. Geopolitical concerns are often closely related to military concerns, as there is a close relationship between geography and military strategy (Sloan & Gray, 1999, p. 3). As such, many influential theorists and practitioners of geopolitical ideas have been chiefly interested in matters of war and conflict.

Geopolitics as a political science is traced back to the ancient Greeks, with writers such as Aristotle and Thucydides offering materialist and naturalist explanations for political behaviours, and is developed through later writers during the Enlightenment and modern periods, with early examples such as Montesquieu and Machiavelli and later, more modern

writers like Alfred Thayer Mahan, Sir Halford Mackinder, Nicholas Spykman, and more. Where the earlier influences on geopolitics are often naturalist in nature, emphasising only the direct effects of geography upon states and strategies, the later theorists of the 19th and 20th centuries become more materialist, and recognise the importance of technology and technological change as it pertains to geography and natural resources (Deudney, 2000, p. 78).

The term "geopolitics" itself has waxed and waned in terms of popularity, with some attributing its fall from prevalence in the mid-20th century to its association with the German school of *geopolitik*, which is in turn closely associated with Nazi Germany and its attempts to justify military conquest through natural, racial superiority (Sloan & Gray, 1999, p. 9; Dolman, 2002, pp. 11-13) This waning has also been attributed to the relationship between geopolitics as a field and the school of realism within international relations theory. Realism as a school is often seen as "dominant" within international relations theory, and may thus have eclipsed more explicitly geopolitical perspectives on realist observations (Deudney, 1997, p. 91). Simultaneously, the subsequent re-emergence of geopolitics as theory in the latter half of the 20th century can be attributed to Henry Kissinger, who made extensive use of the term in his 1979 book The White House Years, in which the term was used to denote a concept of "global equilibrium" and national interests in the world's balance of power (Sloan & Gray, 1999, p. 1). These theories of geopolitics—along with many others not mentioned here—have themselves come under scrutiny through the lens of critical theory, by writers such as Gearòid Ó Tuathail, to form a school of "critical geopolitics" (Sloan & Gray, 1999, pp. 5-6).

To exhaustively exposit the entire breadth of "geopolitics" as a term and field would require its own undertaking. In order to remain relevant to the four theoretical works dealing with geopolitics and outer space that this thesis will make primary use of, the rest of this section will focus on a few key writers who are relevant to these works. First is Daniel Deudney, who is not only the author of the last of these works, but whose concept of "clusters of geopolitics" also informs Everett Dolman and Nayef Al-Rodhan. Next is Sir Halford Mackinder, whose heartland theory forms a central inspiration in Everett Dolman's *Astropolitik*, helping to inform his much-debated perspective on human space activity. The last is Gearòid Ó Tuathail, whose idea of a critical geopolitics informs both Fraser MacDonald's refutation of *Astropolitik*, and parts of Nayef Al-Rodhan's own *meta-geopolitics* framework.

2.1.2 Daniel Deudney's Clusters of Geopolitics

Text Daniel Deudney's 1997 article Geopolitics and Change attempts to tackle the problem of defining of the term "geopolitics". In doing so, Deudney, identifies five "clusters" of geopolitical thought, gathering together different uses of the term. In brief, these five clusteres are named as: Physiopolitics, *geopolitik*, "realism plus geography,", political geography, and global geopolitics (Deudney, 1997, p. 93).

The first of these, physiopolitics, is in Deudney's estimation the "oldest and most homogenous" of the clusters, denoting the notion that non-human physical nature affects human political affairs (Deudney, 1997, p. 93). In this naturalist view, the constraints and opportunities presented by one's natural surroundings are seen as the primary determining factor in geopolitical outcomes, resulting from the broad adaptation of politics, culture, and economic production to the physical pressures exerted by the natural world (Deudney, 1997, pp. 93-94).

The second cluster, *geopolitik*, refers to the defunct Nazi-German school already mentioned. Deudney characterizes *geopolitik* as an "extreme statist realism cast in Darwinian metaphors" (Deudney, 1997, p. 94). He then gives six core characteristics of *geopolitik*: The view of states as primary political actors; the dependence of states upon territory; the view that states are inherently competitive with one another; the view that states strive towards economic self-sufficiency(autarky); the view that states are "natural" and amoral actors; and the idea that industrialisation expands the "optimum size" of states (Deudney, 1997, p. 95).

Some of these notions repeat ideas found in realist theory, such as the view that the state is the primary political actor, or the view of state actions as amoral. Deudney stresses the use of *geopolitik* in the advocacy of military expansion, particularly in Nazi Germany, and made heavy use of organic, Darwinistic metaphors to justify supremacist ideology. Deudney deems that *geopolitik* is extinct as tradition, as much because of its baggage as due to its lack of scientific value, but nevertheless views it as an "extreme and simplistic" version of realism, once removed of the Darwinistic and supremacist undertones (Deudney, 1997, p. 95).

The third cluster, realism plus geography, refers simply to "geopolitics" being applied as a synonym for realism on its own. Deudney explains that in this particular sense, the term "geopolitics" is used both to refer to realist balance-of-power politics as well as to where such politics intersects with geographical factors. He gives Henry Kissinger as an example of

somebody using the term in this sense. Additionally, Deudney argues that this use of the term "geopolitics" can also be pointing specifically to what he calls "power competition between major states in peripheral areas" (Deudney, 1997, p. 96). Here he provides the example of U.S. Secretary of State George Schulz making official use of the term "geopolitics" in 1984, to denote U.S. concerns with regional conflicts in the Middle East, Central America, and the Persian Gulf (Deudney, 1997, p. 96).

The fourth cluster, political geography, is a branch within the field of geography in which political matters are related to geographical studies. Deudney writes that some advocates have argued that political geography is separate from geopolitics as a more "value-neutral" alternative, or that political geography might denote the "scientific insights contained within the literature of geopolitics" (Deudney, 1997, p. 97). Deudney makes no comment as to these claims, but instead highlights that geographers have generally steered away from attempting to tackle complex questions of world security, and as such have made political geography a "flat and theoretically unfocused enterprise" (Deudney, 1997, p. 97).

The fifth and final cluster is classical global geopolitics – a tradition in which he names writers such as Alfred Thayer Mahan, Sir Halford Mackinder, Friedrich Ratzel, Nicholas Spykman, H. G. Wells, and others. He characterises this form of geopolitics as preoccupied with understanding change, particularly concerned with globalisation as a result of the industrial revolution and the changes it brought about (Deudney, 1997, pp. 97-98). Deudney highlights that this form of geopolitics is often thought of as an entirely realist school of thinking, but argues that there are important differences as well as similarities. The two chief similarities (or "common themes") he identifies are the focus on material power and on security. Beyond this, he points out key differences such as classical global geopolitics not viewing the anarchic, state-centric system as the inevitable state of global politics. Instead, global classical geopolitics often predicted that this system would eventually fall to the creation of a world state. Examples of this are seen in concepts such as Mackinder's "Heartland" theory, in which the control of central Asia is supposed to ultimately lend one power the ability to dominate the entire globe; or in the views of H. G. Wells, who argued that the state-centric system would eventually turn into a more formalised union akin to the United States or Swiss Confederation. Daniel Deudney terms these differences to realism as "liberal strands" within the thinking of classical global geopolitics, and raises the point that "liberal political forms" may be more suited than the realist counterpart to tackling modern material conditions (Deudney, 1997, p. 99).

2.1.3 Heartland Theory

Sir Halford Mackinder's *Heartland* theory forms a central basis for Everett C. Dolman's *Astropolitik*, which is one of the chief theoretical perspectives explored in this thesis. As such, Mackinder's theory will be outlined here. Mackinder reasoned that a historical analysis of states and conflicts in Eurasia may serve to divide what he calls the "World Island"—being the contiguous landmasses of Europe, Asia, and Africa—into concentric regions, or "seats of power". The heartland, or the "pivot area", is the central such region which encompasses most of Inner Asia. Next is the "inner marginal crescent", comprised of continental Europe, Arabia, the Himalayas, the Indian subcontinent, and the mainlands of China and South-East Asia. Beyond this is the "outer or insular crescent", comprising the rest of the world, including islands closer to the inner marginal crescent, such as the British, and Japanese isles (Mackinder, 1904, p. 435; Mackinder, 1919, p. 81).

Mackinder's central thesis is summarised as a dictum: Who rules East Europe commands the Heartland: Who rules the Heartland commands the World-Island: Who rules the World-Island commands the world (Mackinder, 1919, p. 106). In this way, Mackinder argues that world dominance is achievable through seeking control of the "heartland".

2.1.4 Critical Geopolitics

In his Critical Geopolitics, Gearòid Ó Tuathail accuses the very term geopolitics of being a "convenient fiction" (Ó Tuathail, 1996, p. 12). To Ó Tuathail, geopolitics denotes a set of practices with which the societies of great powers seek to explain power, technology, and geography in relation to one another, often in the interest of pursuing militaristic and imperialistic ends. He simultaneously names it an "inconvenient fiction", pointing to Michael Shapiro's assessment on how the state-centric nature of modern geopolitical discourse "silences" important historical struggles concerning peoples and areas rather than states. Here Ó Tuathail concerns himself with the division of geographical space between states, as belong to an "us" and a "them" (Ó Tuathail, 1996, pp. 12-13, 17; Shapiro, 1992, cited in Ó Tuathail, 1996, p. 12).

Ó Tuathail views classical geopolitics as predominantly declarative, for the purpose of then offering "mythical enlightenment" into geographical and political truths (Ó Tuathail, 1996, p. 109; Sloan & Grey, 1999, p. 5). Through promising such insights, geopolitics becomes a means to make declarative statements about how—as Nicholas Spykman puts it—"[geography] just is", as well as making "prophetic" statements about what will be (Ó

Tuathail, 1996, p. 16, 110). It is against this "mythicised" view of geopolitics, and the ways in which it shapes the perception of political issues and identities, that Ó Tuathail couches his critical counter-perspective. He stresses that his "critical geopolitics" is not meant as a normative position on its own, but instead a practice of critically addressing the core interactions which previous theories of geopolitics also attempt to address. He offers that a critical geopolitics must concern itself with what he terms the "problematic of geo-politics" (geo-politics being deliberately distinct from geopolitics), defined as "The general problematic of the scripting of global space by state-society intellectuals and institutions", thus attacking the state-centricity of geopolitics (Ó Tuathail, 1996, p. 51, 55).

2.2 Introduction to Space Geopolitics Theories

This thesis selects four theoretical works concerning the application of geopolitics theories to outer space. The first of these four works is *Astropolitik: Classical Geopolitics in the Space Age* by Everett C. Dolman. *Astropolitik* provides a decidedly realist, classical-geopolitics perspective rooted in writers such as Alfred Thayer Mahan and Sir Halford Mackinder, and attempts to apply classical models to the sphere of outer space, before concluding with recommendations for a policy program in accordance with his perspectives.

Following from this is Fraser MacDonald's *Anti-Astropolitik - Outer Space and the Orbit of Geography*—an article rebuking Dolman's ideas through the lens of critical geopolitics and critical geography. While MacDonald is chiefly a geographer, his article provides a useful basis for a critical perspective on the topics at hand. MacDonald makes use of writers such as Gearòid Ó Tuathail to criticise the notions and assumptions of classical geopolitics, and accuses Dolman in particular of engaging in imperialism. Through this criticism, MacDonald gives his own recommendations for the development of a "critical astropolitics" school of thinking.

The third work is Nayef Al-Rodhan's *Meta-Geopolitics of Outer Space: An Analysis of Spacepower, Security, and Governance*. This work presents the author's own *meta-geopolitics* framework for the analysis of geopolitics as a fusion of classical, liberal, and critical disciplines, which is then applied by Al-Rodhan to outer space. Al-Rodhan also provides a discussion and definition of the term "space power", building on existing geopolitical notions like air-power and sea-power. Al-Rodhan also provides his analysis and predictions on the state of space geopolitics in the modern day, and concludes his work with a

set of policy recommendations in the interest of non-conflictual co-operation and competition in outer space.

The fourth and final work is Daniel Deudney's *Dark Skies*, in which Deudney scrutinises the core assumptions of so-called "space expansionists", and questions whether space activities are at all desirable. Deudney's work is more speculative and deals in imagined futures, hypothetical technologies, and futuristic proposals, but is included here for its value as a skeptical perspective on the notion that space exploration is an inherent good—something which the other perspectives all take as given. Deudney provides his own geopolitical analysis of space exploration and space exploitation, and cautions several ways in which these may be abused to create existential threats to humanity, before concluding with his own recommendations for a drastically different, "Earth-centric" space program.

These four works were selected to give a variety of perspectives representative of general theoretical directions within geopolitics. Everett Dolman's *Astropolitik* presents a a realist model, using classical geopolitics to approach outer space from a perspective that emphasises states as primary actors, and the self-interest of states as primary motivators. Fraser MacDonald's *Anti-Astropolitik* was chosen not only for its counterarguments directed at Dolman, but also as an application Ó Tuathail's conception of a "critical geopolitics" to Dolman's subject matter. Nayef Al-Rodhan and Daniel Deudney, meanwhile, both provide different facets of a liberal or institutionalist perspective. Al-Rodhan employs his own *meta-geopolitics* framework, comprised of different theoretical elements from liberal, as well as realist and critical schools of thought, emphasising both states as actors, and states as the sum of their domestic parts. Daniel Deudney advocates for an international order founded in shared global institutions and cooperation, in place of anarchic state competition. Beyond this, Deudney's work was also chosen to represent a somewhat novel perspective, namely his scrutiny of the basic assumption that space exploration and space "expansion" is an unequivocal good, regardless of outcomes.

2.3 Everett Dolman's *Astropolitik*

Everett C. Dolman's *Astropolitik: Classical Geopolitics in the Space Age* (2002) provides a widely-cited basis for the realist's perspective on space policy. Drawing on the school of classical geopolitics, Dolman lays out a theoretical framework for understanding the history and future of geopolitics in space, or "astropolitics" as he terms it. This term must not be confused with his titular *astropolitik*—which refers specifically to his theoretical framework.

The book's structure first explains the historical and political context of classical geopolitical theory, following from ancient writers such as Thucydides and through to modern theorists like Alfred Thayer Mahan, Sir Halford Mackinder, and Nicholas Spykman. Then, Dolman proceeds to lay out the physical mechanics of outer space; the function of orbits, the nature of space travel according to Newtonian and Keplerian mechanics, and the means by which space can be "mapped". To this, he assigns the terms "astromechanics", and "astrography. Next, he explains the historical and political context of space exploration and the politics thereof, examining the advent of space exploration and its origins, the space race between the USA and the USSR, and the international treaties signed and upheld into the present by spacefaring powers.

Following on from this, Dolman then examines what was the present-day policy landscape at the dawn of the 21st century, and its possible futures. Here he begins to truly show his own theoretical work, and begins to lay out his recommendations for space control. Finally, in the last chapter, Dolman critically examines the notion that state competition is counter-productive to space exploitation, and that a globally unified and co-operative world provides a more ideal basis for humanity's conquest of space. Dolman does not outright reject this notion, but endeavours here to present what he calls a "minimally possible" state-based alternative to space exploitation by way of a unified world-government (Dolman, 2002, p. 8). The theoretical framework of his *Astropolitik* is, he offers, a plan for achieving those conditions.

Dolman begins his explanation of the origins of geopolitics and astropolitics by lamenting the "atrophy" of the term geopolitics. He invokes Daniel Deudney's Geopolitics and Change to supplement this notion, and draws particular attention towards the clusters of physiopolitics, *geopolitik*, and classical world geopolitics as relevant to his *Astropolitik*. Physiopolitics (or geodeterminism, as Dolman re-brands it) for its application of geographical conditions onto the political; *geopolitik* for its troubled history; and, as shall be seen later, classical world geopolitics through drawing on Mackinder's Heartland theory.

Dolman puts special emphasis on *geopolitik* because of its negative association. He is quick to point out that the title of his work, *Astropolitik*, is intended to evoke the school of *Geopolitik*, to serve as a cautionary reminder of the potential consequences of misapplying geopolitical theory to the realm of outer space. Dolman calls *Geopolitik* a "purposeful guide and moral justification" for the Nazi-German "brand of racist militarism" (Dolman, 2002, p. 11), in

which was rationalised an a priori superiority for the Germanic peoples, which would then grant them the right to dominance over Europe (Dolman, 2002, pp. 11-12, p. 42).

Dolman stresses the geodeterministic and Darwinistic overtones in this school of thought. He points to Friedrich Ratzel, credited with inventing the now-infamous term Lebensraum ("Living Space") which was employed by Nazi Germany as part of their *Geopolitik* justifications of conquest. Ratzel, Dolman explains, posited that human culture groups could be understood to act as organisms, attempting to "colonise the space around them" (Dolman, 2002, p. 42). Dolman likens this line of thinking to what he calls a "common perception of humanity's reach for the stars": The idea that human colonisation of outer space is a natural step in the evolution of humanity as the dominant life-form on the planet, whether spurred by monetary interests, a need to escape disaster, as a safety valve for overpopulation, or, as Dolman puts it, a "new interpretation of manifest destiny"(Dolman, 2002, p. 42).

Here, Dolman fully reveals his intention in naming his new theory as he does. He points to how this idea of the "organic state", which in its quest for living space to prevent its own weakening ultimately turns to conquest, was used by the Nazis to justify war and genocide, and the idea of their own racial superiority. Applied to a planetary and inter-planetary scale, this same logic could be used in the attempted formation of a world-state, which spills into outer space as its lebensraum, to expand its dominance, argues Dolman. *Astropolitik* is named as a warning against this line of thinking, to be used explicitly with the awareness that it could easily be perverted, as Dolman puts it, into a justification for authoritarian domination (Dolman, 2002, p. 44).

2.3.1 Dolman's "Astrography"

To continue with his stated purpose of adapting classical geopolitics into the environment of outer space, Dolman goes on to characterise the physical environment (or "terrain") of outer space. Since this aspect is analogous to use of geography in geopolitics, Dolman terms this adaptation "astrography", and further coins the term "astrostrategy" as the corresponding equivalent to geostrategy.

Dolman evokes classical theories of the early 20th century, particularly Sir Halford Mackinder's heartland theory. Dolman takes the idea of Mackinder's core logic—that there is a broad hierarchy of definable "regions", each capable of dominating the next—and applies it to outer space; going so far as to create a dictum of his own. Dolman's dictum is as follows:

Who controls low-Earth orbit controls near-Earth space. Who controls near-Earth space dominates Terra. Who dominates Terra determines the destiny of humankind (Dolman, 2002, pp. 6-7).

This wording makes clear the central thesis of his *astropolitik*: That control of outer space—and particularly, low-Earth orbit—affords the control of the entire Earth (Terra), and humanity's future, be it in outer space or on the Earth itself. Space thus becomes a means for unparalleled (and, perhaps, absolute) force projection (Dolman, 2002, p. 26).

Dolman later defines low-altitude orbits as being those orbits that are between 150 and 800 kilometers above the surface of the Earth. As this pertains to Earth, it can be assumed that this is the exact definition Dolman is pointing to in his dictum where he mentions low-Earth orbit. (This broadly agrees with the European Space Agency's definition, which states that a low-Earth orbit is an orbit between 1000 and 160 kilometers (European Space Agency, 2022). Besides low-altitude orbits, Dolman identifies three other clusters of "currently useful terrestrial orbits": Medium-altitude orbits (between 800 and 35 000 kilometers), high-altitude orbits (above 35 000 kilometers), and highly elliptical orbits (where the orbit's lowest point is as close as 250 kilometers, and it's highest as high as 700 000 kilometers) (Dolman, 2002, pp 56-57).

In addition to classifying orbit types, Dolman also coins four different "regions" of outer space. These are intended to evoke the regions of the world as put forth by Mackinder, to help inform the adaptation of classical geopolitics into outer space. In determining these regions, access to Earth and different vantage points above it is considered, as well as the "resource potential" of the regions themselves. This is meant in the most literal sense: Dolman refers to the vast amount of material resources (mostly in the form of metals) which exists beyond the Earth (Dolman, 2002, p. 59).

Dolman's astropolitical regions are as follows: Terra (being the Earth), Terran space (being the space around the Earth up to and including the altitude of geosynchronous orbits, and the outer reaches of Earth's sphere of influence), Lunar space (the space around the Moon and its orbit), and Solar space (everything beyond the Earth and Moon sphere-of-influence). Hearkening back to his *geopolitik* comparison, Dolman points out that these outer regions would be the equivalent to the Lebensraum, though he specifies that he does consider this view "antequated" (Dolman, 2002, p. 61). Terran space he names his equivalent to

Mackinder's view on eastern Europe, and Solar space as the solar system-scale equivalent to the heartland, being the vast and wealthy expanse which would confer dominance to whosoever could control it all.

Having defined these regions of outer space as analogous to geopolitical regions on the Earth, Dolman moves on to examine how "well-worn paths" emerge, quoting Alfred Thayer Mahan's reference to the emergence of things like roads, sea-routes, and railways. He points, among other things, to how winds and currents shaped the common sailing routes in the Age of Sail, or how land gradient determined the paths of transcontinental railways. In Dolman's view, such paths through space would be defined by gravity wells: The gravitational spheres of influence around celestial bodies which are stronger with proximity, and whose strength and extent is determined by the size of the celestial object itself. Smaller gravity wells may exist inside larger ones, such as the Moon's gravity well within the Earth's, or the Earth's gravity well within the Sun's (Dolman, 2002, p. 61).

Dolman stresses that gravity wells are important to understanding space travel, as gravity wells determine the amount of energy a spacecraft needs to expend in order to travel between two places. The deeper a spacecraft is in a given gravity well, the more energy is needed to escape it. He gives the example that to travel a distance of 35 000 km from the surface of the Earth requires 22 times as much energy as traveling the equivalent distance from the surface of the Moon, because the Earth's gravity well is 22 times "deeper". This exemplifies how space travel can, per Dolman, be understood as non-linear in terms of the resource and energy use involved in traversing a given distance. (Dolman, 2002, pp. 61-63).

The need for spacecraft to travel in circular orbits rather than in straight lines between points implies that the space-based equivalent to lanes of commerce (such as sea routes, railways, and so on) will be the lowest-energy transfer orbits between stable space stations and other points of interest, argues Dolman. This then creates choke-points and "strategic narrows" along these lanes and at their endpoints. The most major such point which Dolman identifies is low-Earth orbit, as his dictum itself implies, because everything going between outer space and the Earth must pass through these orbits. The geostationary "belt" forms another such narrow, particularly because its position is so valuable to various satellite technologies as previously discussed (Dolman, 2002, p. 62-64).

Dolman makes another astrographical consideration meant to align with classical theories of geopolitics. He evokes Alfred Thayer Mahan, and his advocacy for the notion that the US should establish forward bases in strategic locations such as Hawaii and the Philippines, in order to better control and project force over the Pacific. Mahan argued that without such bases, American warships would be severely constrained in their operational range given the need to return to the mainland shores. Dolman takes this logic and applies it to the domain of outer space, supposing that such forward bases and "way stations" could exist in the form of bases which enable resupply, refueling, and repair of spacecraft (Dolman, 2002, p. 67).

Finally, after having mapped many of the notions of classical geopolitics onto the landscape of outer space, Dolman turns back to Earth to highlight some relevant geographical considerations. Having already discussed the significance of energy efficiency in space travel, Dolman points out that different points on the Earth provide vastly differing levels of advantage to launch into specific orbits. This is largely due to the Earth's rotation, which ensures that points nearer the equator move at a higher velocity than points nearer the poles, meaning that a rocket launched from the equator gains a natural energy advantage over one launched near the poles. Conversely, a rocket launched into a 90-degree polar orbit will have an easier time reaching the desired orbital inclination than one launched near or at the equator. This benefit from the Earth's rotation is also why almost all rockets launch west-to-east. Furthermore, it is considered highly favourable for the flight paths of launching rockets to be above water, since ejected stages and the occasional destructive failure could otherwise jeopardise inhabited areas below the flight path. This, Dolman argues, is why the ideal launch sites are coastal locations close to either the equator or one of Earth's poles, with ocean to the east and north (or south). Given their advantages in accessing outer space, such locations are thereby given a high level of strategic importance (Dolman, 2002, pp. 68-69).

2.3.2 Realpolitik and Space Law

Having thus defined the "terrain" of outer space in the geopolitically relevant sense, Dolman moves on to his brief history of spaceflight and the Cold War. In this telling, he makes the case that the competitive realpolitik school of thought is what spurred on the space race and all its advancements towards humanity's "expansion" into outer space. This argument then forms the basis of advocating for the re-establishment of a competitive regime within space exploration, such as there was during the space race, in order to better secure a future in which humanity reaps the benefits of outer space (Dolman, 2002, p. 75).

Dolman connects the dawn of spaceflight technology to the advancement of military technology in the 20th century. He cites an assertion from Walter McDougall, who wrote that all the world's space programs sprung from the invention of four key technologies: Radar, ballistic rockets/missiles, electronic computers, and atomic bombs (McDougall, 1985; cited in Dolman, 2002, p. 77). Ballistic missiles paved the way for orbital launch vehicles; radar and electronic computers enabled precise remote and automated guidance of rockets and spacecraft; and the atomic bomb—though not directly related to space developments—ensured large-scale interest in developing and funding the aforementioned technologies which just so happened to be crucial in the development of spaceflight. Indeed, Dolman points out, many of the technologies and the theoretical principles behind spaceflight had been figured out decades prior, but it was only after the second World War and the advent of nuclear weapons and long-range ballistic missiles that spaceflight received more serious attention (Dolman, 2002, pp. 77-79).

The advent of these technologies now meant that the promises of outer space technology which had hitherto remained theoretical—such as satellite surveillance, communications, and so on—were within reach. Dolman, focusing on the US, emphasises the political effect of the launch of the first ever satellite, the Soviet Sputnik. This entailed the so-called "Sputnik crisis" in which the American government and public grew paranoid that the Soviets had out-paced the US in science technology—particularly missile technology. From this, Dolman appeals to a classical narrative of the "Space Race", wherein the US and USSR went on to compete at outperforming the other in space technology, ultimately culminating in the Apollo lunar landings which are often regarded as testament to the American "victory" in the space race (Dolman, 2002, p. 81).

Dolman uses these points to raise the notion that it was a predominantly realist and realpolitik way of thinking that underpinned the space race. The geopolitical advantages afforded by space technologies, and perhaps even an early recognition of the potential for terrestrial force projection through outer space, meant that the two superpowers needed to stay abreast of each other's technological capacity (Dolman, 2002, p. 83-84). This leads into an assertion Dolman makes about the Outer Space Treaty, which is part of the central premise of his *Astropolitik*. Despite the fiercely competitive environment in Cold War space exploration, the Outer Space Treaty of 1967—which was signed by both the US and Soviet Union—places strict constraints on what can and cannot be done in outer space, including such things as staking national claims on celestial bodies, or placing weapons of mass destruction in orbit of Earth.

The central premise of the Outer Space Treaty is that outer space is rendered the "common heritage of mankind", or *res communis* ("thing for all") as Dolman phrases it (Dolman, 2002, p. 84).

In order to explain how such a treaty fits the realist rationale, Dolman asserts that: "In geopolitical terms, it is recognized as a fundamental dictum that for any critical power factor a state cannot dominate; its highest priority should be to prevent domination of that factor by a potential enemy" (Dolman, 2002, p. 83). Using this logic, he argues that the Cold War powers only agreed to the Outer Space Treaty as a means to mutually assure that the other could not come to dominate something that they themselves weren't yet equipped to dominate—that is, the vast resource wealth and ultimate force projection potential of outer space (Dolman, 2002, pp. 83-86). Dolman here follows with a brief discussion on the idea of *res communis* and the tragedy of the commons: The phenomenon by which independent profit-maximising actors with access to a shared resource deplete or otherwise hamper all access to said resource through uncoordinated and selfish actions. This he does to highlight the importance of whether or not outer space ought to constitute a "commons" (Dolman, 2002, pp. 89-91).

Examining this question further, Dolman looks to historical precedents where international agreements were established around similar "commons", seeking to better define the bounds by which space law is determined. The first, and seemingly most obvious examples, are sea law and air law. Dolman points out that much of existing international space law is already based on formalised sea laws (Dolman, 2002, p. 99), and ties this back in with his earlier invocation of the works of Alfred Thayer Mahan. Dolman highlights four issue classifications that he views as common to international sea, air, and space law. These are: delimitations, sovereignty, registration and liability, and innocent passage (Dolman, 2002, p. 99).

The questions of delimitations and sovereignty—dealing respectively with setting natural and state boundaries to a geographical dimension (the sea; the air)—quickly run into the fundamentally novel nature of outer space. The nature of the Earth's gradually-fading atmosphere makes it hard to determine where space "begins" (Doman, 2001, p. 100) and the nature of orbital mechanics make it impossible to allow for state sovereignty to simply extend "outwards" like it extends upwards in the case of sovereign airspace (Dolman, 2002, p. 119). These questions are largely sidestepped by the *res communis* nature of existing space law whereby states may not make sovereign claims, but Dolman pursues the matter in the interest of underpinning his proposals-to-come for an alternative to the *res communis* outer space

regime. Here he returns to the realist's outlook, affirming that "The only definition of sovereign space that may truly matter is one that incorporates the notion of a region that can be effectively defended" (Dolman, 2002, p. 120).

The question of registration and liability concerns the obligations of states to maintain a registry of ships (in the case of sea law) and aircraft (in the case of air law), independent of individual state policy on other rules and regulations relating to these. This is covered by existing space law, and Dolman highlights that the current rules on registration of man-made space objects are stricter than those for sea law or air law, since outer space is viewed as possessing a greater capacity for environmental harm to the Earth (the same principle by which Dolman asserts his astropolitical dictum), and is as such viewed as a matter of security (Dolman, 2002, pp. 121-122).

Finally, the question of innocent passage concerns the right of a ship or plane to pass through a given country's coastal waters or airspace so long as said passage is not a threat to the peace or security of the country in question. Dolman highlights that unlike the question of registration and liability, innocent passage is less strict at sea than it is in the air. This has historically been exploited, as seemingly innocent seagoing vessels can conceal reconnaissance equipment or aid in infrastructural sabotage. Dolman gives the example of Soviet fishing trawlers with hidden radars to monitor NATO shores, and then likens this to how spacecraft have been used for reconnaissance since their inception—highlighting how innocence of passage is much less strict in outer space than either sea or air (Dolman, 2002, pp. 122-123).

The Antarctic Treaty of 1959 is also used as a point of comparison, since it concerns an international agreement over a neutral territory which is at once rich in resources and inhospitable to regular human life. Unlike outer space under the Outer Space Treaty, the Antarctic is subject to national claims, which have historically received varying levels of recognition. Yet more similarly to the Outer Space Treaty, the Antarctic Treaty does state that Antarctica shall be used for peaceful purposes, in the interest of all mankind (Dolman, 2002, p. 124). This, along with limitations placed on the extraction and exploitation of resources in the Antarctic, constrains the Antarctic's otherwise-significant military potential and limits the degree to which any nation staking a claim to the continent can make practical use of said claim. As such, Dolman argues that the Antarctic Treaty can be seen as a "base model" for the Outer Space Treaty (Dolman, 2002, p. 125).

Following from this, Dolman examines the Outer Space Treaty itself, going over its core stipulations and deriving its base ideological premises. He highlights the treaty's emphasis of a *res communis* outer space regime, and its articles prohibiting national claims to and appropriations of celestial bodies. This regime, Dolman concludes, is one which "has no place for *Astropolitik*" (Dolman, 2002, p. 131). His following assessment of the Outer Space Treaty—and the ensuing tradition of space law which follows the treaty's premises—is that the resulting space regime has created an environment which discourages competition, and which thus perhaps resulted in "draining away the energy" of the space race which may otherwise have continued on an upwards trajectory (Dolman, 2002, p. 137). Dolman acknowledges that such an assertion about counter-factual is difficult to prove, but nevertheless points out that while technology has only improved, space exploration had yet (at time of writing) to return to the heights of the Apollo days. Dolman writes: "The perverse consequence of the OST was the inducement of individually rational behaviour by decisionmakers in the few spacefaring states with the technology and fiscal resources to undertake the development of outer space to not do so" (Dolman, 2002, p. 138).

Dolman thus stamps the state of space law, having followed in the footsteps of similar international regimes set down before it, as stifling to the competition that he believes motivated the space race. He then highlights that the treaty "fortunately" does include several mechanisms by which participating states may alter, amend, or withdraw from the treaty (Dolman, 2002, p. 139). Given this, Dolman argues that realpolitik thus maintains its relevance, as there is nothing truly binding about these laws or the obligation for states to act and be treated as equals under the law—ultimately labelling the notion of such equality as a "useful fiction" (Dolman, 2002, p. 139). States with no ability to stake claims on celestial objects should such a thing become legal, will own "no less" of said objects than they currently do, he argues (Dolman, 2002, p. 140).

2.3.3 Astropolitik as Framework

Here begins Dolman's proposal for an alternative astropolitical regime and his corresponding *astropolitik* framework, on the basis of all his prior observations. This begins by appealing to the criticisms of the Outer Space Treaty as just discussed, and calling for an end to the regime by which states cannot stake territorial claims in space. Doing so, Dolman concludes, would facilitate greater competition for the exploitation of space-based resources such as was seen during the space race. While he remains critical of the *res communis* nature of existing space

law, Dolman stresses that this philosophy need not be done away with, and proposes that provisions could be made to ensure that smaller nations/nations less capable of spaceflight are entitled to benefit from space exploitation nonetheless, or are entitled to claims of their own within certain parameters. Dolman's overall point being that even in the spirit of outer space being the common heritage of mankind, alternative models can be made which do not stifle space exploration, such as he sees it. The ultimate goal of all this, in Dolman's mind, would be to facilitate the eventual expansion of humanity into outer space. (Dolman, 2002, pp. 140-141).

In proposing to apply *astropolitik* to real-world policy, Dolman focuses on the United States, outlining a framework for a "grand strategy" of American *astropolitik* (Dolman, 2002, p. 153). He concentrates on three "critical steps": The withdrawal from the current international space regime and establishment of a free-market principle of sovereignty in space(where nations may claim what they can take and hold); the seizure of military control over low Earth orbit and the deployment of means to deny space access for rival nations; and the establishment of a "national space coordination agency" for the purpose of coordinating commercial, civilian, and military activities in space to maximise efficiency and direct all space efforts to overarching goals (Dolman, 2002, pp. 154-155). Dolman ultimately stresses that while the realpolitik nature of such a policy may see many moral objections, the establishment of a meaningful dominance by a liberal democracy like the US would ideally result in a stable peace where space exploration can thrive and lead to "a new era of peace and prosperity" (Dolman, 2002, p. 161).

In his concluding thoughts, Dolman summarises his view of how varying political schools of thought made their mark on national and international space policy; from realist security dilemmas, to liberal and neo-liberal ideals of common heritage and cooperation (Dolman, 2002, pp. 165-166). Dolman restates his view that the emphasis on cooperation and *res communis* became a tool by which self-interested actors could keep each other down, resulting in a halt to the competitive energies of the space race (Dolman, 2002, pp. 166-168). He again urges that this mentality be set aside in favour of a decidedly realist and capitalist approach, whereby the tragedy of the commons is avoided and the competitive exploitation of resources is allowed—not without regulations where resources "should not" be privatised, but with emphasis on "privatisation where possible". He advocates that the astrographical regions of outer space, such as he himself defines them, could be subdivided and distributed as

separately charted regions, providing a framework for an orderly partition of outer space and of celestial bodies like the Moon (Dolman, 2002, p. 172).

Although he emphasises competition over resources, Dolman recognises that the risk of violence between states must be mitigated. He also posits, however, that violence in space is inevitable just as it has been on the Earth. His proposal being one where space exploration is motivated by profit rather than national honour, Dolman suggests a comparison once again to sea routes, which have historically required peacekeeping naval patrols to ensure their profitability and help keep the oceans peaceful. This way, Dolman sees his ideal system as one where violence is naturally discouraged, as those with the greatest ability to do violence in space would also be those who gain the most from keeping the peace (Dolman, 2002, p. 173). Dolman also assures the reader that the most likely nation to seize upon the potential hegemony of outer space is the United States, which he describes as "preferentially endowed to guide the whole of humanity into space", by virtue of its liberal-democratic, egalitarian values (Dolman, 2002, p. 175).

2.4 Fraser MacDonald's *Anti-Astropolitik*

Writing for Progress in Human Geography, Fraser MacDonald disputes Dolman's arguments and assumptions from the standpoint of critical geography, and critical geopolitics in his article, Anti-*Astropolitik* - Outer Space and the Orbit of Geography. MacDonald also assesses the question of applying geopolitics in outer space through this critical lens, and explores how outer space shapes and changes political geography. This review will focus primarily on the geopolitical aspects of the article.

2.4.1 Outer Space and Geography

MacDonald first sets out to explore the impact of space technology upon social and political geography. His central example is the invention and deployment of the Global Positioning System (GPS) mapping and real-time navigation satellite network, as well as the use of space-enabled communications systems to allow for near-instantaneous communication between any two points on Earth (MacDonald, 2007, p. 594). He laments that geography as a field of inquiry has largely failed to account for the importance of outer space and space-based technologies, which have increasingly enabled the collection and spread of information, and highlights the importance of "knowing" in order to exert control over a political space. These technologies, MacDonald argues, give way to imperialism and the exertion of force in much

the same way early modern explorers enabled the creation of European empires (MacDonald, 2007, p. 595, 600).

While many of these technologies now have civilian uses, MacDonald highlights their origin as primarily military, and argues that the Outer Space Treaty has done relatively little to prevent the militarisation of outer space. The treaty has instead, MacDonald argues, been interpreted as loosely as is convenient, in its attempts to ensure that space is used only for peaceful purposes. Moreover, MacDonald holds that these sentiments are increasingly under threat, and that space warfare may be inevitable as outer space becomes the "next frontier for military-neoliberal hegemony" (MacDonald, 2007, p. 593, 601).

MacDonald points to how satellite technologies have also enabled a greater propensity for states to monitor not only each other, but also their own citizenry. This is achieved both by turning existing military technologies on one's own populace, but also by interweaving these technologies with civilian everyday use. As MacDonald puts it: "In this way, the gadgetry of space-enabled espionage is being woven into interpersonal as well as interstate and citizen-state relations" (MacDonald, 2007, p. 602). MacDonald imagines ways in which these technologies may deepen existing inequalities in the future, both between states and between individuals, and gives numerous examples of how GPS technologies can lead to what he calls "geofencing", whereby given geographical regions are artificially bounded by discouragement enabled through GPS. An example of such being the notion of a technology that warns the user when they are about to enter a "bad neighbourhood" (MacDonald, 2007, p. 602).

He goes on to highlight that at time writing, the market for GPS-enabled technologies and services was valued in billions of dollars, to say nothing of other space-enabled consumer technologies. The fact that these technologies are, per MacDonald's argument, still military at their core, is not forgotten; MacDonald here highlights the US' lack of a guarantee for GPS signal quality in the event that American national security be at risk. MacDonald argues that this is the context in which the European Union decided to pursue its own equivalent to the American GPS, in the form of Galileo, which began operating in 2006 (MacDonald, 2007, p. 604).

2.4.2 Against *Astropolitik*

Moving towards his stated objective of formulating a "critical astropolitics", MacDonald first offers a brief introduction to, and criticism of Everett Dolman's *Astropolitik*. He makes the

central accusation that Dolman is "writing in the service of his empire" (meaning, the United States)—providing what is, MacDonald argues, "a manual for achieving space dominance" (MacDonald, 2007, p. 607). MacDonald criticises Dolman's advocacy for abolishing the *res communis* outer space regime as being in service of American space dominance, justified entirely by a "might-makes-right" line of reasoning. On top of this, he expresses doubt in Dolman's preemptive justification that the US should be permitted to become the dominant power in space on account of it being a liberal democracy. MacDonald writes: "His sunny view that the United States is 'willing to extend legal and political equality to all' sits awkwardly with the current suspension of the rule of law in Guantanamo Bay as well as in various other 'spaces of exception' (see Gregory, 2004; Agamben, 2005)" (MacDonald, 2007, p. 608).

In critiquing Dolman, MacDonald also rejects his classical-geopolitics foundation in the works of Mackinder and Mahan, and calls for a "reappraisal" of astropolitics through a "radical" lens. He then draws on the writings of Gearòid Ó Tuathail to give five brief salient points towards what such a reappraisal may look like. The first of these points is that the way one views geography (or, indeed, astrography) can be used to sustain particular strategic outcomes. MacDonald argues that, through his basis in Mahan and Mackinder, Dolman conceptualises astrography as a politically neutral substratum that, according to Dolman, predicates certain actions and justifications. MacDonald proposes "alertness" to this conception, offering instead Ó Tuathail's view that geography (and by extension, astrography) is not a fixed substratum or set of rules, but must instead be understood as a "highly social form of knowledge" (MacDonald, 2007, pp. 608-609; Gray, 1999, p. 173; Ó Tuathail, 1999, p. 109; cited in MacDonald, 2007, p. 609).

MacDonald puts clear emphasis on the notion that the view which Dolman presents is one that benefits his country, and in the second point calls for a constant scrutiny of the existing power structures in the interest of accountability. The third point attacks the notion that US space dominance must necessarily be seen as inevitable, calling it "imperial logic" to think otherwise. This is then added to in the fourth point, which highlights the apparent ethno-centrism of Dolman's argument for the inherent superiority of the United States as the ideal dominant space power. This is rounded off in the fifth point, calling for a challenge to the "mythic" properties of *astropolitik*. Here, MacDonald again invokes Ó Tuathail, whose argument is that geopolitics is "mythic" in the sense that it purports to grant clear predictions ("prophecy") in complex political systems. Together, these last points paint the picture of

MacDonald's ideal critique of *astropolitik* as one which attacks this central narrative or "myth" of a clear strategic understanding of astropolitics and of an inherent, destined superiority of the United States (MacDonald, 2007, p. 609).

In his conclusion, MacDonald summarises his core argument for the importance of outer space as a relevant dimension to the field of geography, particularly focusing on the "orbital aspects of military supremacy" with concerns to terrestrial warfare, and on the ways in which space-based technologies change and affect individual lives, along with the ways states and people interact. He reaffirms his desire to see an understanding of space through the individual-focused lens of critical geography, rather than through the imperial view of classical geopolitics, such as Dolman proposes. This MacDonald finally terms as giving space "a truly human geography" (MacDonald, 2007, pp. 610-611).

2.5 Nayef Al-Rodhan's *Meta-Geopolitics of Outer Space*

In *Meta-geopolitics* of Outer Space: An Analysis of Spacepower, Security, and Governance, Nayef Al-Rodhan gives yet another view on the application of geopolitical theories to the domain of outer space. He begins by assessing the potential benefits offered by outer space, and the utilisation it already offers to the main space-faring countries. Here he briefly mentions such things as have been brought up in MacDonald (2007) and Dolman (2002): Military reconnaissance spacecaft; satellites for civilian and military communication and navigation; monitoring of Earth's weather and climate; defensive early-warning systems against missile attacks; medical experiments performed aboard the International Space Station, and more. Thus, Al-Rodhan emphasises that the technological developments driven by space exploration often have both direct and indirect impacts on life on Earth (Al-Rodhan, 2012, pp. 2-3).

Similarly, Al-Rodhan identifies the potential dangers and security risks that an increasing human presence in outer space might bring. He calls the weaponisation of space a "serious geostrategic challenge to the international community", stressing that the increasing amount of active "space-faring players" leads to an increasingly complex geopolitical situation which may at any point grow fiercely competitive and result in an arms race in Earth orbit (Al-Rodhan, 2012, p. 3). Al-Rodhan uses these concerns to springboard into some central questions his work goes on to address, looking at how the positive promises of outer space may be maximised while avoiding these dangers; what things future international policy on outer space must account for; whether space collaboration is possible; and whether space

weaponisation is inevitable. To address these questions, Al-Rodhan seeks to provide an underlying framework of analysis for geopolitics in the domain of outer space, in which he will both assess pre-existing theoretical frameworks and provide his own, in the form of "*meta-geopolitics*" (Al-Rodhan, 2012, p. 4).

To lay the groundwork for his proposed framework, Al-Rodhan first gives a brief account of the realist, liberal, and critical perspectives on geopolitics and its application to the domain of outer space. He highlights that writers within all three approaches recognise the potential for militarily controller outer space could enable control of the entire world, but focuses on the difference between the realism of writers like Dolman, who sees this as an opportunity, and the perspectives found in liberal and critical schools which view this observation instead as a threat and a problem (Al-Rodhan, 2012, pp. 5-14). His core criticism for all three approaches is that they "apply Earth-bound assumptions and theories to space" (Al-Rodhan, 2012, p. 15), and that they thus miss out on key differences between the conventional understanding of geopolitics as applied to the terrestrial sphere, and outer space as relevant to geopolitics. Al-Rodhan states that international relations and geopolitics have been "profoundly altered" by the many technologies enabled by space-based technologies, leading to the introduction of actors and dimensions that these "Earth-bound" perspectives do not account for. In Al-Rodhan's words, they "do not pay sufficient attention to the effects of space assets on Earth." It is in the interest of bridging this gap, adding new dimensions to "traditional" theories in order to make them better reflect the relevance of outer space, that Al-Rodhan introduces his own framework of *meta-geopolitics* (Al-Rodhan, 2012, p. 15).

2.5.1 Meta-Geopolitics Framework & Defining "Space Power"

Al-Rodhan's *meta-geopolitics* consists of a combination of theoretical concepts from both classical and critical geopolitics, seeking to combine the analytical realism of the more traditional schools of geopolitics with the critical perspective's focus on perception, representation, and interpretation; as well as providing its own framework for the analysis of geopolitical power. To do this, Al-Rodhan identifies seven capacities, which refer to dimensions of power pertaining to states and state relations. These capacities are: Social and health issues, domestic politics, economics, the environment, science and human potential, military and security issues, and international diplomacy (Al-Rodhan, 2012, p. 19).

The first capacity, social and health issues, Al-Rodhan defines as assessing three related dimensions, being a state's demography, social cohesion, and health. These dimensions

contribute to and affect a state's geopolitical strength, Al-Rodhan argues, through impacting a country's economy, policies, and overall morale. Al-Rodhan points to the relevance of space-based technologies particularly in the case of health issues, as satellite-enabled telemedicine and communication enable more efficient healthcare coverage, which in turn may help prevent social unrest and improve workforce productivity (Al-Rodhan, 2012, pp. 25-28).

This also leads into the second capacity, domestic politics, wherein a state's ability to act in foreign affairs and to utilise its location and resources is deeply affected by the stability of its domestic-political situation. Outer space and space-based technologies affect domestic politics in multiple ways, such as through promoting the national prestige and international status of a space-faring country, serving as a "morale booster" for the nation. Additionally, many non-state actors operate in or make use of the space sector; space launch companies, satellite manufacturers, telecommunications and military industries all work with space technologies, and contribute to shaping domestic politics through lobbying, Al-Rodhan argues. Other non-state actors with a tangible effect on domestic politics, such as media companies or religious institutions, also make indirect use of these technologies through telecommunications and the Internet. With this, Al-Rodhan drives home the central importance of satellite technology in the domestic sphere (Al-Rodhan, 2012, pp. 28-29).

The third capacity, economics, stresses the importance of a state's access to resources, markets, and financial institutions; as well as the strength of its domestic markets, its degree of technological innovation, and energy reliance. Here Al-Rodhan chooses to highlight the degree to which cooperation between states and agencies result in what he terms an "economics of space", responsible for creating and growing jobs, assets, and markets, citing the example of how the space industry was one of few industries that grew its revenue in the year of 2010, despite a "troubled financial climate" (Al-Rodhan, 2012, p. 30, 167). In addition, Al-Rodhan points out that the technological innovation achieved in the name of spaceflight tends to have a "spillover effect" that indirectly benefits other sectors, such as mining and agriculture. Additionally, Al-Rodhan points to the emergence of commercial space actors providing private access to outer space as more evidence of the "promise of emerging space-related markets". This is already being seized upon by state actors such as the United States, he argues, which has begun "externalising" some functions of its space program, such as launching astronauts, to private companies. Al-Rodhan summarises by pointing to a trend of space access becoming cheaper, thereby making space ventures more

lucrative both for state and non-state actors, which in turn may strengthen individual state economies (Al-Rodhan, 2012, pp. 30-31).

The third and fourth capacities—the environment and science and human potential, respectively—both find a relevance in space exploration through a state's capacity to conduct scientific research. Of the environment, Al-Rodhan writes that a state's environmental condition can present a challenge both to security, health, economics, and more besides. Drastic changes to an individual country's environment can drive dramatic demographic change as populations migrate to avoid disasters, and can place ever larger burdens on a country's infrastructure. Additionally, environmental concerns are seldom confined to the borders of a single country, and the cooperation required to better deal with such issues on a global scale can lead to complex outcomes where some states are left strengthened and others diminished (Al-Rodhan, 2012, p. 32). Space-based technologies are thus very relevant to environmental concerns, as satellite technology provides a key function in monitoring and surveying the Earth's climate continuously. Al-Rodhan points out that both NASA and ESA are involved in numerous climate change projects, and that the fledgling space programs of countries like South-Africa, India, and Brazil also engage in extensive environmental surveillance (Al-Rodhan, 2012, p. 33).

Where space technology strongly enables climate science, it is also deeply tied to science in general. Al-Rodhan assesses that a state's capacity to engage in scientific research, innovation, and education forms a key part of its geopolitical strength. He deems that intellectual capital and technology work "as multipliers" of a state's power, "enhancing current capabilities and developing new ones" (Al-Rodhan, 2012, p. 33). This is accomplished both through enabling the development and operation of military technologies which afford a direct benefit to security, and through technologies which generally improve the economic, social, health, and educational conditions on the domestic level. The "spillover" of the space industry is here mentioned again, as an "enormous" benefit to other sectors, as well as the spillover of space science into other sciences (Al-Rodhan, 2012, pp. 33-34).

The sixth capacity, military and security issues, is introduced as being the "traditional" means by which states have been measured against each other; through gauging the strength and ability of military power. Here Al-Rodhan recounts examples of times where space science, space technology, and related fields have contributed directly to the development and

improvement of a country's military capabilities, such as the invention of the nuclear bomb, intercontinental ballistic missiles (ICBMs), and satellite reconnaissance. Al-Rodhan argues that it is likely already the case that conventional warfare is now so dependent on space-based technologies that it cannot be conducted without them (Al-Rodhan, 2012, p. 36). Regardless, he stresses that outer space has become militarised, but not weaponised, and that the weaponisation of outer space presents a "serious challenge to global security" (Al-Rodhan, 2012, p. 37). Al-Rodhan expresses a concern that the increasing complexity of outer space as a political arena may eventually lead to states placing weapons—perhaps nuclear weapons—in Earth orbit, and that this in turn will have a destabilising effect in the form of a "vicious global space arms race" (Al-Rodhan, 2012, p. 37).

The seventh and final capacity, international diplomacy, is given as a state's capabilities to forward their priorities and defend their interests in international arenas and organisations such as the EU, the UN Security Council, etc. Access to space technology can form a significant part of a country's leverage in the area of international diplomacy. The information access enabled by space technologies can, for example, be used through global coordination as a means of monitoring the implementation of international rules, something which affords a deal of negotiating power to the country providing this access. Outer space itself also becomes a topic for international diplomacy, as orbits are without borders and the existing international legislature on outer space still holds to the principle of *res communis*. States with a lot of space assets will also have more at stake where such matters are concerned, and will seek to protect their assets from harm (Al-Rodhan, 2012, pp. 39-41). Here Al-Rodhan stresses what he sees as a need to build a "sustainable security regime on the principles of common interests, cooperation, and justice that enables non-conflictual competition" in order to avoid outer space becoming an arena for hostile competition (Al-Rodhan, 2012, pp. 41-42).

Al-Rodhan uses these seven capacities to give his definition of the term "space power", as "the ability of a state to use space to sustain and enhance its seven state capacities as outlined in the *meta-geopolitics* framework(...)" (Al-Rodhan, 2012, p. 25). Thus, Al-Rodhan argues, his analysis of space power is less "Earth-bound" than previous approaches, for which he criticised Dolman and others. Al-Rodhan uses this to demonstrate the application of space and space power in intertwining areas of politics, beyond the geostrategic concerns of classical geopolitics (Al-Rodhan, 2012, pp. 25-26).

2.5.2 Major Space Players

Al-Rodhan then employs this framework and definition of space power in an analysis of different state and non-state actors in the outer space domain. He highlights the fact that, at time of writing, all "leading" space-faring nations had published new space policies recently, which he uses in tandem with the growing number of space actors and space activities to evidence the conclusion that this is a growing sphere of politics. His *meta-geopolitics* analysis of these leading actors offer insights into each (Al-Rodhan, 2012, p. 101, 173).

The United States is assessed as the decisively dominant force in outer space. Al-Rodhan characters the United States as enjoying "unequaled benefits" in space, and as possessing the means to dominate all other actors in the domain. This, Al-Rodhan argues, places the U.S. in an important place of influence in shaping the environment of spaceflight, all while clearly maintaining its own dominance through an unwillingness to compromise its ability to further its own national interests in space. Al-Rodhan further notes that the United States is heavily reliant on space-based systems, particularly where its economic and military capacities are concerned, rendering the United States the most vulnerable to both intentional and unintentional threats to space assets (Al-Rodhan, 2012, p. 173 and find more??).

Al-Rodhan positions China and Russia the central opposition to U.S. space dominance, writing that both nations cooperate with each other and several other spacefaring nations to advance their own relative positions. For Russia, Al-Rodhan argues that while the dissolution of the Soviet Union saw the Russian space program falling into disrepair and underfunding, recent developments have seen an increase in political drive to expand. This is helped, Al-Rodhan argues, by the extensive history and built-up domestic spaceflight expertise from the Cold War period, when the Soviet space program was an equal competitor to the United States (Al-Rodhan, 2012, pp. 174-175). Al-Rodhan also characterises China as determined "to become a key player in space", pointing to numerous advances in domestic spaceflight capabilities such as satellite launches and crewed spacecraft, as well as having "ambitious plans" for the future of its space program. Al-Rodhan also cautions, however, that the Chinese space agenda may have ulterior motives, citing a controversial anti-satellite weapons test conducted by the Chinese military in 2007, demonstrating the country's ability to disrupt space assets (Al-Rodhan, 2012, p. 175).

Europe is also assessed collectively, given that European space interests tend to be advanced through the European Union, and the European Space Agency (ESA). Al-Rodhan

characterises the European countries as more in line with American space interests, but as nonetheless acting as challengers to the commercial side of U.S. space dominance, providing the example of the Galileo program being a European counter to the American GPS, which Al-Rodhan terms as an attempt to "break the US monopoly" on global navigation systems, become increasingly independent of U.S. space technology. However, Al-Rodhan also emphasises that the European countries are burdened by complications of conflicting geopolitical interests amongst themselves, with consensus on European foreign policy often being slow and difficult to reach (Al-Rodhan, 2012, p. 174).

These four actors—the United States, Russia, China, and Europe—are seen by Al-Rodhan as the "major space players", now to be challenged by the increasing number of state and non-state actors mentioned previously. Private and commercial launch providers are becoming increasingly relevant, Al-Rodhan argues, as evidenced by a trend of increasing revenue in the commercial space sector, with commercial actors now offering services such as satellite construction, launch, and operation (Al-Rodhan, 2012, p. 175). Al-Rodhan also points to the Obama administration's initiative to contract the launch of both cargo and astronauts to private companies, and help develop a commercial launch capability for both uncrewed and crewed spaceflight (Al-Rodhan, 2012, p. 166).

2.5.3 Space Governance and Policy Recommendations

Al-Rodhan then addresses the potential risks and challenges to global security presented by this increasing amount of human activity in outer space. He also goes over the existing legal frameworks and institutions which deal with questions of space governance at the international level, before finally advocating for a set of paradigms that he considers "appropriate" for the present state and course of space politics.

Al-Rodhan identifies five key institutions and cooperation efforts: The International Space Station (ISS) programme; the United Nations General Assembly; the Committee on the Peaceful Uses of Outer Space (COPUOS); the United Nations Office of Outer Space Affairs (UNOOSA, or OOSA), and the Conference on Disarmament. Al-Rodhan also includes a sixth point for "other multilateral space agencies and cooperation initiatives", entailing smaller (but still important) agreements between different space faring countries on things like data sharing or joint use of specific spacecraft (Al-Rodhan, 2012, pp. 178-190).

These efforts all have in common a focus on peaceful use of outer space through cooperation and multilateral communication. The UN General Assembly, COPUOS, and UNOOSA serve specifically to outline and put forward international legislation to this effect, and Al-Rodhan points out examples such as the Outer Space Treaty of 1967 as negotiated in COPUOS in addition to several other treaties; the Principles Declaration of the UN General Assembly in 1961 whereby the principle of peaceful use was first formalised; and the United Nations Programme on Space Applications as carried out by UNOOSA, whereby space technology applications are presented to policymakers (Al-Rodhan, 2012, p. 179, 180, 183). The Conference on Disarmament, while dealing primarily with arms control and non-proliferation, also promoted the peaceful use of outer space through seeking to limit and curtail space weaponisation (Al-Rodhan, 2012, p. 185). The International Space Station programme is put forward by Al-Rodhan as "one of the most encouraging examples of cooperation in outer space", being a cooperative effort of fifteen different nations (Al-Rodhan, 2012, p. 178).

Where these institutions and initiatives all fall short, per Al-Rodhan, is in their failure to account for changes in the political and technological environments. He argues that since the majority of legislature established by these institutions was developed during the Cold War, and were shaped according to the technology at the time, it must be revised in order to tackle the challenges brought on by more recent changes to these environments (Al-Rodhan, 2012, p. 191, 207). One key such failing is in the state-centric nature of the existing major space treaties, Al-Rodhan argues. The increasing amount of space activities being conducted by non-state actors necessitates a means to manage "traffic" in outer space, as Al-Rodhan puts it, to deal with the placements of orbits and the management of debris amongst other issues arising from an increasingly crowded orbital space. Al-Rodhan also criticises the existing legislature for never clearly defining what "peaceful use" is to mean, and that the existing ambiguity to this term allows for a degree of militarisation that, if left unchecked, could spiral into an arms race (Al-Rodhan, 2012, p. 207).

Here, Al-Rodhan ties his argument back to the various ways in which outer space is relevant to his *meta-geopolitics* and the seven state capacities identified therein. He assesses that cooperation in outer space is a crucial tool in global security issues and that coordination in this domain can help facilitate more efficient and mutually beneficial utilisation of outer space in all its forms. He particularly stresses the relevance to the military and economic capacities of countries as these spheres in particular are becoming increasingly reliant on space-based

technologies, but also points to the “spillover” effects previously discussed (Al-Rodhan, 2012, pp. 212-213).

Al-Rodhan concludes his work by putting forth a set of policy recommendations meant to create a governance paradigm which enables “symbiotic non-conflictual competition” in outer space and help ensure the realisation of the potential inherent to outer space for the good of all humanity (Al-Rodhan, 2012, p. 219). These recommendations are as follows:

- Development of “soft law initiatives” such as codes of conduct regarding space activities, aimed at preventing irresponsible and potentially harmful behaviour.
- Addressing the testing, development, and deployment of anti-satellite (ASAT) weaponry, and other offensive capabilities that can threaten space assets.
- Addressing the increased commercial space activity with regards to issues like property and liability, taking account of private manned spaceflight.
- Addressing the issue of space traffic. Al-Rodhan emphasises that the United States is well-positioned to lead international multilateral efforts to track and coordinate space assets.
- Increasing resources for the scientific community to further drive technological advancement and solutions to related issues such as space debris.
- Closer cooperation between existing multilateral bodies such as COPUOS and CD in order to avoid overlap and provide states with a “holistic approach to space issues”.
- Guiding space exploration and space policy according to principles of good global governance: Effective multilateralism, effective multilateral institutions, representative multilateral decision-making structures, dialogue, accountability, transparency, burden-sharing, and stronger partnerships between multilateral organisations and civil society.

(Al-Rodhan, 2012, pp. 219-221)

Al-Rodhan concludes by predicting that space will eventually be weaponised by the three major space powers (the U.S., Russia, and China), and that this may in turn enable the

complete dominance of the Earth through dominance of outer space. Therefore Al-Rodhan argues that a legal instrument aimed at preventing a space arms race is urgently required. He stresses that cooperation cannot be reasonably expected to arise on its own, and must be actively pursued as a counter to individual states' tendencies to act unilaterally. Space, Al-Rodhan concludes, must be considered a global common (Al-Rodhan, 2012, pp. 221-222).

2.6 Daniel Deudney's *Dark Skies*

Across the classical geopolitics of Dolman, the critical geopolitics of MacDonald, and the *meta-geopolitics* of Al-Rodhan, there is a shared principle that space expansion in one form or another is a fundamental good with the potential to tremendously benefit all of humanity (I can cite these?). In Dark Skies, Daniel Deudney presents a critical examination of this principle and the common narrative that views space exploration as a bold and beneficial undertaking. Deudney presents and assesses several risks inherent to space technology that he deems could potentially threaten all of humanity on an existential level, and advocates for a radically different perspective on space exploration to what is offered elsewhere.

2.6.1 Space Expansionism

To make this case, Deudney first presents "space expansionism" as a philosophy and historical narrative. He positions space expansionism within futurism and "technological modernism" (Deudney, 2020, "Storming Heaven", para. 7). Most importantly, he draws a connection between space expansionism and "space futurism", wherein imagined technological futures see humanity enriched and improved through space exploration and expansion. Deudney highlights that space futurism is most prevalent in fiction, but is spread beyond by what he terms "space visionaries", with examples such as Carl Sagan, Stephen Hawking, Freeman Dyson, and Elon Musk (Deudney, 2020, "Space Expansionism and its Critics", para. 3). These "visionaries" influence culture and public discourse, as well as informing pro-space political leaders and movements. Deudney also points out that while space futurists may differ on many topics, they are all space expansionists (Deudney, 2020, "Space Expansionism and its Critics", para. 4).

Deudney characterises the aim of space expansionism as twofold: The expansion of space infrastructure and utilisation of space resources and assets for the betterment and solution of problems on Earth; and the expansion of humanity itself through colonising and industrialising other celestial bodies both in and beyond the solar system. Deudney points to several problems and threats to human civilisation that space expansionists have offered

space-based solutions for, such as climate change, resource and energy scarcity, overpopulation, and more (Deudney, 2020, “Space Expansionism and its Critics”, para. 6-9). Deudney argues that this is “embedded in a larger metanarrative about humanity, Earth, and cosmos, an epic story that connects past, present, and future” (Deudney, 2020, “Space Expansionism and its Critics”, para. 9). Space expansionism offers a view of itself as the inevitable culmination of human progress, promising “limitless expansion” into the ultimate frontier of outer space. Critical of this grand narrative, Deudney terms it a “science-based and technology-dependent religion”, relying on mythic assumptions about human divinity and destiny in order to advocate fantastical pro-space policy and futurist projects, of which Deudney is highly critical both in terms of ideology and feasibility (Deudney, 2020, “Space Expansionism and its Critics”, para. 10-11).

In order to deconstruct and criticise the arguments of space expansionists, Deudney devises a framework for assessing practical arguments in favour of space expansion. Here, Deudney writes that such arguments can be difficult to approach because they cover multiple disciplines, from astronomy and engineering to sociology and economics, and it’s therefore that he focuses on the practicality of such arguments, seeing them as universally attempting to convince the reader that a space expansionist project should be undertaken because it will lead to identifiable consequences that are desirable. This framework thus involves first assessing the feasibility of a given argument according to its technically relevant fields (Deudney cites astronomy, physics, chemistry, materials science, biology, biomedicine, and economics), and then assessing the various assumptions underlying the argument such as making geohistorical parallels (like viewing space as a “frontier”), (Deudney, 2020, “A Framework for Assessment”; “Geographic and Geohistorical Analogies”). Using this assessment framework, Deudney endeavours to analyse common space expansionist claims to the feasibility and desirability of the impact of their proposed projects.

2.6.2 Deudney’s Astrography

Before beginning his critique of space expansionism, Deudney first constructs his own geographical (or astrographical) model of outer space. Like Dolman, his construction centres the Earth and demarcates progressively distant reaches of space as increasingly peripheral, with an understanding that energy requirements imposed by gravity are more important than pure distance (Deudney, 2020, “Orbits, Velocity, and Gravity Wells”, para. 4). Unlike Dolman, however, Deudney extrapolates this model to account for all of space, rather than

just the solar system. His model identifies four regions of "space", moving outwards from the terrestrial Earth: Earth orbital space, including the Moon and all Earth satellites; solar orbital space, including all other planets and asteroids orbiting the Sun; galactic space, which entails all other stars in the Milky Way beyond the Sun; and intergalactic space, in which is included every galaxy in the known universe (Deudney, 2020, "Modern Astronomy and the Expansion of Space", Figure 3.1).

Throughout his exploration of this model, Deudney stresses the differences in scale between these regions of space. He particularly emphasises the difference between Earth orbital space and solar orbital space, and predicts that any future in which humans raise permanent settlements beyond Earth orbital space will create substantially different geopolitics, and suggests that many political arrangements and practices common on Earth will be made "radically different" due to the differing constraints and opportunities presented to them (Deudney, 2020, "From Earth's Astrosphere to the Solar System", para. 4).

2.6.3 "Astro-Archimedeans"

Having laid down his own astrographical model, Deudney then explores the capacity for achieving total dominance of the Earth through supremacy in the Earth orbital space. He details the history of ballistic missiles, anti-satellite weapons, and schemes for "missile interception networks" that could allow one state to deny ballistic missile use to any other terrestrial country (Deudney, 2020, "Ballistic Missile Interception II", para. 5). He continues this exploration into military space expansionist ideas beyond Earth orbital space, presenting existing concepts such as deep-space nuclear weapons basing and weaponising asteroids as kinetic impactors (or "planetoid bombs", as Deudney calls them) (Deudney, 2020, "Deep-Space Nuclear Basing", para. 1, 4).

In presenting the ambitions of the "military" space expansionists, Deudney points back to Everett Dolman's *Astropolitik* dictum as the most "complete" example of the viewpoint that space may be leveraged to give one nation total control over the Earth, which he coins as "astro-Archimedean". (Deudney, 2020, "Deep-Space Nuclear Basing", para. 5, 7). Having acknowledged the capacity for space-based planetary hegemony espoused by the astro-Archimedeans, Deudney nonetheless accuses Dolman of being "utopian" in his belief that the United States will be able and permitted to take charge of this hegemony for the good of all humanity (Deudney, 2020, "Deep-Space Nuclear Basing", para. 7).

Deudney characterises different forms of astro-Archimedean propositions based on their ultimate outcomes for the world order, relation to nuclear weapons, and role of space technology. He identifies four strategies, which he terms "Von Braun strategies" after Werner von Braun, who first advocated the use of space weapons for force projection (Deudney, 2020, "The Von Braun Program and Beyond", para. 7).

These four strategies are, briefly:

- Defense, whereby space-based systems allow complete defense against nuclear weapons technology and the "security foundation" of the state-based world order is secured.
- War-fighting (or war-strategist), whereby space itself is made an extension for terrestrial arenas of war; nuclear war is viewed as "winnable", and the world order is liable to major change through violence.
- Deterrence, whereby space systems ensure a second-strike capability that deters from initiating nuclear war, and the existing world order of states is "frozen" against major wars.
- Dominance, whereby one power consolidates force projection over the whole Earth and becomes a de-facto world government, putting an end to interstate anarchy (Deudney, 2020, "The Von Braun Program and Beyond", Table 5.1).

Deudney makes no attempt to delineate which strategy he considers more feasible or desirable than the others, nor does he condone any one of them, being largely critical of the astro-Archimedeans. He does, however, point out that in all four of the "Von Braun strategies", violence and war are seen as integral and inevitable. Deudney writes: "Despite their profound differences, advocates of the von Braun programs are united in their conviction that war and preparation for war will be an integral part of any expansion of human activity into space" (Deudney, 2020, "The Von Braun Programs and World Order", para. 5).

2.6.4 Closure & "Orbita"

Before offering up his own criticisms of space expansionism as presented, Deudney also presents and discusses various existing criticisms of space expansionist projects and

ambitions. Of these criticisms, Deudney asserts that the most significant examples come from four chief groups: Arms controllers, technology critics, environmentalists, and justice advocates. Space is, according to Deudney, a "minor side issue" within the concerns of these four groups, but are nevertheless influential on space policy. Arms controllers express concerns that space weaponry reduces security and increases the likelihood of nuclear war; environmental critics are skeptical of the ecology of extraterrestrial habitation and argue that space expansion may pose unforeseen environmental risks; technology critics express skepticism that space technology can be fully and predictably controlled; and justice advocates are concerned with potential worsening of economics inequalities brought on by space expansion(Deudney, 2020, "Critics and the Clarke-Sagan Program", para. 2-3).

Deudney points out that these criticisms do not attack the "general vision" of space expanionism and instead choosing to focus on specifics. He argues that they do not amount to a rejection of space activity so much as an advocacy for a "Whole Earth Security program" wherein space technology is employed to protect Earth's habitability (Deudney, 2020, "Critics and the Clarke-Sagan Program", para. 4-5). Deudney highlights that while a Whole Earth Security program would appear to run counter to the aforementioned "von Braun" programs, but is still a form of space expansionism that encourages futurist projects for the sake of Earth's protection. Although, in that some of these technologies also pose a possible threat to Earth security, Deudney points out that some advocates of a Whole Earth Security program have argued that technologies such as asteroid diversion should not be pursued until a reform of world politics to ensure they will not be abused (Deudney, 2020, "Critics and the Clarke-Sagan Program", para. 8).

In his own assessment of the desirability of space activity, Deudney begins by boiling the question of desirability into a question of whether or not space activity or space expansion increases or decreases the likelihood of (nuclear) war, and whether or not it may lead to a single state exerting dominance over the whole of Earth (Deudney, 2020, "Answering Big Questions", para. 1-2). He goes on to explain his view that these aforementioned positive views on space activity and space expansion are founded in misconceptions, geographical errors, misleading geohistorical analogies, and "truncated" geopolitics.

Deudney names ascentionism as one principal geographic error committed by space expansionists. Expansionists assume, per Deudney, "that spatially ascending from the Earth will produce many improvements and that the conduct of human affairs, so frequently

troubled on Earth, will get better in major ways" as a result of space travel and space expansion (Deudney, 2020, "Ascentionism and Disorientations", para. 1). Deudney supposes that the appeal of this ascentionism speaks to culturally pervasive religious constructs that see humanity as "fallen" and the Earth as a realm of corruption, and in which places of higher elevation have often been associated with increased moral value. He views this ascentionism as an error in that such an assumption has no basis in reality, and space expansion may instead serve to exacerbate the things that this ascentionism seeks to escape (Deudney, 2020, "Ascentionism and Disorientations, para. 4-5).

Deudney also criticises the common geohistorical analogies made by space expansionists when describing outer space. He mentions common examples of this, such as the view of space as an "ocean" wherein there are "islands", or the view of spacecraft infrastructure as analogous to railroads, or drawing analogies between space colonisation and human pre-historical migration out of Africa; and between space exploration and activities such as mountain climbing. Deudney points out that such analogies frequently influence other fields and in legislation concerning outer space. The Outer Space Treaty itself is named as an example, given how its makers drew on the provisions of the Antarctic Treaty. Deudney cautions that, while analogies cannot be wholly criticised, these analogies can be misleading—emphasising similarities and obscuring dissimilarities—and he accuses space expansionist analogies of being deliberately such, in the interest of ideological advocacy. This can in turn lead to unrealistic expectations and "underappreciated dangers", Deudney argues (Deudney, 2020, "Geographic and Geohistorical Analogies", para. 1-4). Deudney instead proposes a "corrected geography" of outer space, in which space is understood as practically small due to low effective distances, and in which Earth orbital space is viewed as a part of Earth rather than a separate, expanding realm (Deudney, 2020, "Earth Space Geography, the Astrosphere, and Planetary Closure", para. 2, Figure 9.1).

A significant aspect of Deudney's criticism of space expansionism is the concept of technological closure. This denotes the notion that the technologically-enabled human ability to exploit and understand the Earth has been expanding whilst the Earth itself has remained finite in size, leading human civilisation towards a point where the spatial expansions which have characterised all of prior human history are no longer possible (Deudney, 2020, "The Technological Closure of the Earth and the Outer Space Prospect"). Where space expansionists would argue that space activities may prevent closure by countering the spatial limitation of Earth, Deudney argues the opposite, that through the weaponisation and

militarisation of space it becomes increasingly difficult to make political room for the civil activities that would be conducive to expansion, and that space activities therefore contribute to and "intensify" closure, instead of reducing it (Deudney, 2020, "Earth Space Geography", para. 4).

Next to this, Deudney goes on to stress his view that outer space as a corridor for the deployment of weapons increases the risk of nuclear war. He uses the 1962 Cuban Missile Crisis as an example, arguing that the crisis was enabled largely because of the high speed with which then-recent missile technologies allowed for nuclear weapons to be deployed. Taking the angle that the crisis put humanity on the brink of nuclear war, Deudney argues that this demonstrates the relationship between deployment effectiveness (in terms of potential volume of destruction as well as deployment speeds) and the likelihood of triggering a nuclear war (Deudney, 2020, "Planetary Geopolitics II", para. 1-5).

Additionally, Deudney argues that the increasing speed and accuracy of nuclear payload delivery systems leads to missile silos and bunkers themselves being vulnerable to a pre-emptive nuclear first strike. This, then, incentivises nuclear powers to always keep their nuclear arsenals on high alert and to employ "launch-on-warning" tactics in the interest of securing one's ability to retaliate against a swift nuclear attack. This results in an effective hair trigger, and raises the chance of a nuclear exchange initiating over a misunderstanding or accident. This, Deudney affirms, has its roots in the technological advances which have enabled faster and more precise rockets, and he counts space-related technologies such as rocketry and global positioning satellites as a vital part of this advancement. Finally, Deudney also highlights that the increasing military dependency on satellite systems and the increasing effectiveness of anti-satellite weaponry increases the chance that nuclear war could be triggered over an accidental orbital debris collision, or something similar (Deudney, 2020, "Planetary Geopolitics II", para. 6-7).

Deudney then returns to the notions of Whole Earth Security and Earth-supporting space infrastructure. He agrees that outer space contains a vast amount of untapped material and energy resources that could potentially play a decisive role in alleviating related scarcity/sustainability problems back on Earth. However, he cautions that "sheer quantity alone does not demonstrate that space solutions are superior to terrestrial ones," and that space-based solutions to Earth problems such as global warming tend to overplay the difficulty of the terrestrial solution (such as carbon emission reductions and roof-mounted

solar power) and downplay the difficulty of the space-based solution (such as orbital solar farms or sun-shading)(Deudney, 2020, “Orbita, Earth Rescue, and World Orders”, para. 2).

Even so, Deudney entertains the concept of creating Orbita—a virtual “eighth continent” consisting of Earth-orbit space infrastructure, resource utilisation, and habitation on a grand scale (Deudney, 2020, “The Bernal-O’Neill Program for Urban-Industrial Orbita”, para. 1-3). Creating Orbita would, in Deudney’s estimation, require a robust international peace and cooperative environment, as such an undertaking would be incompatible with significant military activity given its complexity and extreme vulnerability. Deudney argues that Orbita would also further contribute to closure, and create a “Faustian bargain” in which humanity must perpetually maintain the orbital infrastructure on which it now relies, and which creates a whole new level of vulnerabilities in human civilisational infrastructure. Failure to maintain Orbita could also result in the creation of an “orbital rust belt”, Deudney warns (Deudney, 2020, “Orbita, Earth Rescue, and World Orders”, para. 6).

Orbita would also solidify the “planetary high ground”, hearkening back to the idea of outer space as a means of ultimate power projection. Indeed, Deudney echoes Dolman’s reference to Mackinder, stating that “who controls Orbita controls the Earth”, warning that the capability of Orbita to dominate Earth will create a permanent threat of effective world government. This would threaten the existing world order of states as it currently exists on Earth, and would permanently place the potential military dominance of Earth through Orbita as a threat to liberty on Earth. Deudney as such views the prospect of any infrastructure which may contribute to or constitute Orbita as decisively undesirable (Deudney, 2020, “Orbita, Earth Rescue, and World Orders”, para. 7).

2.6.5 The Solar Archipelago

Finally, Deudney examines the longer-term space expansionist “success scenario”, which he terms the “Solar Archipelago”. This entails the successful expansion and colonisation of the whole solar system, starting with Earth-dependent surface habitation on other celestial bodies such as the Moon or Mars, and ending with human settlement of objects as far as the Kuiper Belt and the Oort Cloud, leading to “species radiation” and billions of humans living off-Earth (Deudney, 2020, “The (Improbable) Solar Expansion Success Scenario”, para. 2-6).

Through a geopolitical analysis of this scenario, Deudney argues against its desirability. He predicts that in such a scenario, the vast distances between celestial bodies will outstrip the

high velocities involved with space travel and render an “archipelago” as travel times between settlements remain high, likely measured in weeks and months. Deudney argues that this would be an anarchic, violence-saturated international system similar to current-day Earth, but stresses the added “extreme vulnerabilities” of space settlements and the increased total capacity for violence. This he bases both on the inherent fragility of space settlements and infrastructure due to being placed within environments that are deeply hostile to life, and on the ease with which highly destructive weapons—everything from nuclear bombs to weaponised asteroids—can be utilised in such a scenario (Deudney, 2020, “Solar Geopolitics I”, para. 4-8).

Deudney also predicts that human settlements in such a scenario will, through various means, become increasingly unpredictable as different environments and circumstances, as well as access to different emerging technologies may shape the political actions of off-world humanity in novel ways. This would then make the geopolitics of the solar archipelago increasingly unpredictable, and may in turn lead to Earth eventually being dwarfed by its solar diaspora (Deudney, 2020, “Solar Geopolitics II”, para. 4-7; “Solar Geopolitics III”, para. 1-6). Deudney also predicts that governments within the solar archipelago will trend increasingly authoritarian, due to what Deudney sees as a necessary emphasis on survival resulting from the harsh nature of space environments. The speculation that space colonies will inherently tend towards despotism is also raised as a potential argument against their feasibility, as well as desirability, imagining that colonies ruled through despotism by necessity may still fail to attract colonists. Deudney thus urges those who value individual liberty to be “strong skeptics and opponents” of space expansion (Deudney, 2020, “Solar Geopolitics V”, para. 4-7).

Deudney also rebuffs the notion that this may be solved through political co-operation such as through unions and international federations. Deudney supposes that it will be difficult for Earth to form common institutions with its solar diaspora if interests and ideologies diverge under radically different conditions, even when mutual restraints on violence capacity become vital to achieving security, argues Deudney. Distance and travel times only add to the infeasibility of such projects, he continues, likening their prospects to the failed attempts of the British to create an “Imperial Federation” in the 19th century, in which Britain’s increasingly scattered and disparate holdings would be consolidated in a political union. The fact that no such federation successfully emerged, is offered as evidence by analogy for the

infeasibility of a “solar federation”, and thus the undesirability of a solar archipelago (Deudney, 2020, “Solar Geopolitics VI”, para. 2-4).

The impact of a solar archipelago on Earth is assessed last. Deudney predicts that in this scenario, while many things may depend on who conducts the initial space expansion, the eventual result will be an off-world human diaspora that exerts powerful influence on any political order on Earth. He also predicts that, if Earth is not somehow consolidated before serious space expansion is undertaken, the formation of the solar archipelago will ensure it, ending the anarchic system of sovereign nation-states on Earth for good. Earth’s world government would then proceed to be one of many “world governments”, whose security interests may not align with Earth’s and whose combined power would far surpass that of the consolidated globe. The inherent “high ground” of outer space, as well as the access to highly destructive forms of warfare, means Earth would be at a constant strategic disadvantage towards its highly mobile solar competitors, in Deudney’s view. This argument is brought back to the central point of exploring the solar archipelago space expansionist “success scenario”—that space expansion poses myriad threats to freedom and liberty (Deudney, 2020, “Solar Geopolitics VII”, para. 5-9).

2.6.6 Oasis Earth

In his concluding thoughts, Deudney summarises his core criticisms against the narratives behind space expansionism and his assessment of the potentially disastrous outcomes of space expansionist successes. He stresses that he is not criticising the very idea of space activities, however, and proceeds to lay out several recommendations for measures to be taken in the interest of ensuring an “Earth-oriented space program”, including reversing some existing programs and policies while making concerted efforts to avoid future pitfalls (Deudney, 2020, “Toward an Earth-Centered Space Program”).

His provisions for an Earth-oriented space program are, in brief:

- Relinquish ballistic missiles and orbital weaponry in the interest of reducing the likelihood of nuclear war.

- Relinquish any prospects for large-scale orbital infrastructure to prevent world-dominating hegemony.

- Relinquish any prospects for colonising Mars and asteroids to prevent “catastrophic interworld war and antagonistic species radiation”.
- Relinquish national/corporate asteroidal orbit alteration to prevent military use.
- Form an “international consortium of asteroidal orbit alteration” to provide planetary defense.
- Strengthen the Outer Space Treaty with a focus on arms control and debris mitigation.
- Expand “Earth system science” in the interest of knowledge and sustainability.
- Expand “astronomy from space” in the interest of increasing knowledge of the cosmos (Deudney, 2020, “Toward an Earth-Centered Space Program, Table C.1)

In his closing statement, Deudney underlines that here lies a choice for all of humanity to make, and that sooner or later, the species will have to face the consequences of whichever action is taken. Finding that space expansion is neither desirable nor inevitable, Deudney urges that future space efforts prioritise “Oasis Earth” (Deudney, 2020, “Choices, Destinies, and Inevitabilities, para. 1-3).

2.7 Closing

Having thus laid out these theories in broad detail, the next section of this thesis will lay out the empirical context of contemporary spaceflight and the Artemis program. These four works will then be used as the theoretical basis for the discussion at the end of the thesis, to examine the possible implications of Artemis as emblematic of the United States’ pursuit for space power, and as an overture to aspirations of space expansion.

3 Context

The aim of this section is to broadly lay out the context in which the Artemis program finds itself, and to lay the groundwork for determining both the geopolitical significance of and motives behind this program, and the developments which underpin it. This will entail laying out the broad strokes of U.S. spaceflight history, alongside explaining central concepts that are pertinent to the geopolitics of outer space, namely space militarisation and space law. The

details of the Artemis program itself, as well as the related piece of international legislation titled the “Artemis Accords”, will be saved for the last sections of this part.

3.1 History of U.S. Spaceflight and Space Policy

The fact that an object launched on a trajectory of sufficient height and speed can enter orbit around the Earth has been understood since at least Sir Isaac Newton proposed, as a thought experiment, to launch a cannonball from sufficient altitude to enter orbit. The Russian-Soviet rocket scientist Konstantin Tsiolkovsky, widely considered one of the fathers of modern rocketry, was first to propose the use of multi-stage liquid-fueled rockets to propel artificial satellites into such an orbit, with his treatise Exploring Space Using Jet Propulsion Devices published in 1903. Where Newton’s proposal was only hypothetical, meant to demonstrate certain physical principles, Tsiolkovsky’s proposal was serious, and describes in broad strokes many of the principles by which modern rocketry functions. These same principles would first see use in the construction and deployment of the first long-range ballistic missiles during the second World War. The most infamous of these was the German V-2 missile, which would later go on to be the technical basis of postwar American rocketry (NASA, 2021).

3.1.1 The Sputnik Crisis

On the fourth of October 1957, the Soviet Union successfully launched the first human-made artificial satellite, Sputnik I, into a low-Earth orbit. Today, this is chiefly remembered as a scientific milestone and the dawn of spaceflight, but the social and political reaction to the Sputnik launch—particularly the so-called Sputnik Crisis in the U.S.—had immediate political consequences. The “Sputnik Crisis” denotes the American public’s perception that the Soviet Union had now eclipsed the United States in technological capability, demonstrating the sophistication of Soviet missile technology and instilling a sense of technological inferiority towards the United States’ rival power (Launius, 2005).

The Sputnik Crisis provided political impetus for a response. The first American satellite, Explorer I, was successfully launched into orbit in January of 1958. The same year would also see one of the first major space-related pieces of legislation in the United States, namely the National Aeronautics and Space Act of 1958. This act would see the establishment of the National Aeronautics and Space Administration (NASA), inheriting personnel and assets from the dissolved National Advisory Committee for Aeronautics (NACA), and would be the

formal beginning of the United States' own space program (Suckow, 2009). This marks the U.S. entry into what would soon be called the "Space Race" with the Soviet Union.

3.1.2 The Space Race

The "Space Race" as a historical and political phenomenon has multiple dimensions. On its face, it was a competition between superpowers in achieving technically difficult feats of engineering and scientific advancement in the name of exploration. It is, however, significant that many of these advancements and their resulting technologies bore dire implications in regard to military security and supremacy. Many such implications have been previously mentioned, but within the context of the Cold War, nuclear weapons were a central concern. Multi-stage rockets capable of delivering payloads to orbit would also be able to deliver a nuclear warhead to any place on the planet; and the intelligence-gathering enabled by spy satellites would only make such weapons deadlier (?). The exact considerations made by the U.S. in regard to this military dimension of outer space shall be detailed at length later in this section; suffice it to say here that while the central achievements of the Space Race were overtly civilian in nature, the military applications of space technology remained a driving motivator for both competitors (Davis, n.d).

The Soviet Union went on to launch the first crewed spacecraft into orbit, piloted by Yuri Gagarin, in 1961. This spurred then-president John F. Kennedy to announce a commitment to landing a man on the Moon by "the end of the decade", initially targeting the year 1967. This marked a change from Kennedy's previous political decision on the nation's proposed lunar landing program, which he had opposed as a senator (Madrigal, 2012). In addition to committing to what would become the Apollo Program, Kennedy also lent his support to the ongoing Project Mercury, the United States' own ongoing crewed spacecraft program which had been underway since 1958. Project Mercury would go on to successfully launch astronaut Alan Shepard on a suborbital flight into space in 1961, and astronaut John Glenn into orbit in 1962 (National Aeronautics and Space Administration, 2008).

In 1963 however, as part of an address before the general assembly of the United Nations, President Kennedy signaled another potential turn, when he invited the Soviet Union to join the United States in a joint venture to land humans on the Moon. He pointed out that, since the spacefaring members of the U.N. had all "forsworn any claim to territorial rights in outer space", there seemed to be no reason why the powers could not cooperate, instead of compete. This address was held just over a month after the signing of the Partial Nuclear Test Ban

Treaty, which Kennedy framed as part of a cohesive effort towards achieving "comprehensive disarmament", with a joint Moon program as a means to increase peaceful cooperation (Kennedy, 1963).

Although Kennedy's proposal would be rejected by First Secretary Nikita Khrushchev shortly after Kennedy was assassinated, Khrushchev's son Sergei would later state in a 1997 interview with SpaceCast News Service that his father had strongly considered accepting the proposal, and that he had harboured "second thoughts" in the weeks following the rejection. According to Sergei Khrushchev, the concern among Soviet officials had been that the Americans would exploit such an opportunity to learn more about Soviet rocket technology, to which Nikita Khrushchev seemed unconvinced, thinking rather that it would be more beneficial to the Soviet Union than to the United States in this regard. When the Lyndon B. Johnson administration later suggested a similar proposal, it was also rejected. In the interview, Sergei Khrushchev reasons that this was owed to a Soviet mistrust for the new administration, lacking the same peacebuilding "chemistry" that had been built up between Kennedy and Nikita Khrushchev over the preceding years (Sietzen, 1997).

3.1.3 The United Nations Committee on Peaceful Uses of Outer Space

International discussions about securing a peaceful use of outer space had begun as early as 1958, in the wake of the Sputnik and Explorer probes. In 1959, the United Nations Committee on Peaceful Uses of Outer Space (COPUOS) was formed, first as an ad hoc committee and then formalised as a permanent body within the United Nations. This committee was tasked with reporting to the General Assembly on matters pertaining to the peaceful uses of outer space, and would go on to be a central part in future international legislation concerning outer space (United Nations Office for Outer Space Affairs, n.d.). In 1963, the General Assembly would adopt a resolution banning the use of weapons of mass destruction in outer space, and debate around the issues of outer space and international security would eventually culminate in the signing of the Outer Space Treaty in 1967.

The United Nations Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies—better known as the Outer Space Treaty or OST—will be covered more extensively in section 3.3.3. Briefly summarised, the Outer Space Treaty ensured that all nations should have access to outer space; that their use of outer space shall be peaceful and to the benefit of all humanity; that space and celestial bodies are not subject to territorial claims of sovereignty or appropriation;

and that space objects (such as spacecraft and satellites) remain the jurisdiction and responsibility of the state(s) that launched it (Outer Space Treaty, 1967). Per 2023, the treaty remains in force.

3.1.4 The Apollo Program

When Lyndon B. Johnson assumed the presidency in the wake of Kennedy's assassination, the commitment to land an American man on the surface of the Moon by the end of the decade remained in place. This would become the Apollo Program, the third U.S. manned spaceflight program after Mercury and Gemini. President Johnson was himself an advocate of Apollo, and had been personally in charge of the space program during his term as Vice President under Kennedy (Wasser, 2005). Johnson's time overseeing the Apollo Program soon met with disaster, however, when in January of 1967 a ground test of the Apollo 1 spacecraft suffered an onboard fire caused by an electrical spark, killing all three astronauts inside the command module. Apollo 1 was set to launch only a month after the test, but the disaster meant that the first crewed Apollo flight would not happen until the Earth-orbit test of Apollo 7 in October of 1968. Later that same year, Apollo 8 would launch the first humans to lunar orbit, which also marked the first manned flight of the Saturn V rocket, which was significantly larger and more powerful than previous crewed rocket systems. Such a large rocket was necessary for the task of sending a crewed spacecraft and dedicated lander module all the way to the Moon (Mann, 2020).

The Soviets had meanwhile pursued their own crewed Moon landing program. Having previously claimed both the first hard and soft lunar probe landings (with Luna 2 in 1959, and Luna 9 in 1966 respectively), the Soviets were seemingly well-provisioned to develop their competitor to the Apollo Program, and had been developing the Zond spacecraft during roughly the same timeframe as the early Apollo tests. Several Zond spacecraft made uncrewed flights around the Moon in 1967 and 1968, but proved unreliable due to issues encountered on atmospheric re-entry. The Soviet lunar landing program would be faced with a further setback in 1969, when two test launches of the N-1 rocket—the Soviet competitor to the Saturn V—ended in failure. The second attempt in July saw the rocket explode while still on the launch pad, destroying much of the surrounding launch complex, which would take over a year to repair. Two more uncrewed launch attempts would be made in 1971 and 1972 respectively, both failing in-flight. A fifth launch was planned for August 1974, but was canceled when the Soviet lunar landing program was dismantled that same year (Zak, n.d.a).

In the end, only the Apollo Program would succeed in landing humans on the Moon. Apollo 11 touched down in the Sea of Tranquility on July 20th, 1969, and returned safely to Earth four days later. Apollo 12 would follow in November of the same year, this time demonstrating the ability to land on precisely designated coordinates by landing close to the Surveyor 3 probe which had been flown to the Moon two years prior (Mann, 2020). Having now achieved its largest concrete goal and all but ousted the competition in the process, the U.S. space program would begin to change considerably. Under the Nixon administration, focus was shifted towards low-Earth orbit space stations. The cost of building expendable rockets would become an increasing problem as the post-Apollo NASA budget began scaling down, and this would prompt a further focus on developing reusable launch systems for the purpose of transporting crew and payloads to low-Earth orbit destinations. The Apollo Program would continue through to Apollo 17, which landed on the Moon in December of 1972. Though there would later be several proposed plans for successive lunar landings, lunar space stations, lunar surface bases, and even crewed trips to the planet Mars, Apollo 17 would remain the last time in the 20th century that humans ever flew beyond Earth orbit (Royal Museums Greenwich, n.d).

3.1.5 Space Stations & Space Shuttles

In the wake of Apollo 11, the Soviet Union likewise decided to shift its focus towards space stations and low-Earth orbit crew activities. The Soviet space program went on to launch a number of small Salyut space stations, some of which also doubled as military reconnaissance stations, between 1971 and 1986 (Zak, n.d.b). The U.S. would, in turn, launch its Skylab station in 1973, which would operate until February of the next year (Belew, 1977). It was during this time that President Richard Nixon and Soviet Premier Leonid Brezhnev negotiated a détente in the Cold War, and the resulting ease of tensions between the superpowers would again allow for proposals of space co-operation. This time, efforts to cooperate would yield some success, resulting in the Apollo-Soyuz Test Project, wherein one Apollo and one Soyuz spacecraft would rendezvous in low-Earth orbit, dock “nose-to-nose”, and allow their crews to exchange greetings inside a shared airlock module. The docking occurred on July 17th, 1975, and saw the astronauts and cosmonauts shake hands, receive gifts, and give each other tours of their respective spacecraft (Betz, 2020).

President Nixon also gave his approval for the Space Transportation System program (STS), better known as the Space Shuttle. The program called for a spacecraft which could transport

both crew and cargo to low-Earth orbit destinations (with a particular emphasis on building and maintaining space stations), and which could be re-used for multiple flights in the interest of saving costs (Wall, 2011). The Space Shuttle made its first flight to orbit in 1981. Having learned about the Shuttle program through military reconnaissance early in development, the Soviet Union quickly began pursuing a competitor design. The Soviet government under Brezhnev was particularly concerned that the American space shuttle could be used for military purposes, and set the Soviet Union's Military-Industrial Commission (VPK) to the task of spying on and gathering intelligence about the Space Shuttle program. The eventual result would be the Buran spacecraft, which resembled the Space Shuttle in many ways (Windrem, 2008). Buran became the single most expensive undertaking of the entire Soviet space exploration effort. However, by the time Buran completed its one and only flight to space in 1988, the political situation within the Soviet Union had become unstable, and the program was frozen for lack of funding. The project was ultimately canceled in 1993, two years after the dissolution of the Soviet Union, and the remaining hardware fell into disrepair (Pattle, 2017).

The post-Apollo emphasis on low-Earth orbit space stations continued during this time. While Salyut and Skylab had provided both superpowers with insight and experience, these stations had been relatively limited in size, and in the late 1970s, further plans for larger stations constructed out of multiple modules were laid. Under President Ronald Reagan, the U.S. space effort would pursue the planned construction of Space Station Freedom, to be facilitated by the new Space Shuttle spacecraft, and involving cooperation with international partners in the European Space Agency (ESA), the Canadian Space Agency (CSA), and the National Space Development Agency of Japan (NASDA—forerunner to the present-day JAXA) (National Space and Aeronautics Administration, 2020). During this time, President Reagan would also oversee the Strategic Defense Initiative (SDI)—more infamously known as the Star Wars Program, in which advanced space-based weapons technologies would be developed and deployed (U.S. Dept. of State, n.d). This text will explore the Strategic Defense Initiative more in section 3.2.5.

While the Space Station Freedom project spent several years in a legislative limbo failing to secure sufficient funding from U.S. Congress, the Mir station completed its assembly in low-Earth orbit. The Space Race, such as it was, had all but ended by the time the Soviet Union dissolved, and this would mark a significant shift towards increasing cooperation between the now-Russian space agency and its former rival. This manifested in the Shuttle-Mir program,

running from 1993 to 1998, in which the Mir space station was made a destination for eleven Space Shuttle flights. The program also saw Russian cosmonauts flying on board the American shuttle, and American astronauts flying on board Russian Soyuz rockets. This program allowed American and Russian space efforts to collaborate and coordinate closer than ever, and would combine their expertise for the eventual construction of the International Space Station (ISS), beginning in 1998, shortly after the end of the Mir station program. The ISS design would also incorporate many elements from the Space Station Freedom project, which itself never came to fruition (National Aeronautics and Space Administration, 2020).

The International Space Station consists of modules built and launched by various participating member states. In addition to the United States and Russia, the program also includes Canada and Japan, and the requisite members of the European Space Agency (ESA), being Belgium, Denmark, France, Germany, Italy, The Netherlands, Norway, Spain, Sweden, Switzerland, and the United Kingdom—for a total of fifteen participating countries. When its principal construction had finished, the ISS became history's largest inhabited pressurised volume in outer space, and at time of writing has been continuously occupied by rotating crews since the year 2000, hosting astronauts from twenty different countries (National Aeronautics and Space Administration, 2020; 2023a). At present, the station is scheduled to continue operating until 2031 (Chow, 2022).

3.1.6 The *Columbia* Disaster & the Constellation Program

When the U.S. presidency changed hands from Bill Clinton to George W. Bush, the ISS program was well underway, and the U.S. space shuttles were continually flying both to the station and on separate research missions. However, in 2003 a catastrophic failure of the Space Shuttle would occur when the shuttle Columbia broke up and disintegrated upon re-entering the Earth's atmosphere near the end of its mission, killing the entire crew of seven astronauts. The Space Shuttle program was again grounded as a result, and ISS construction halted for a few years while American crews scheduled to fly the shuttles to the ISS were instead placed on Russian Soyuz flights (Dobrijevic & Howell, 2023). This marked the second lethal failure of the Space Shuttle, with the first being the Challenger disaster of 1986. While the Challenger disaster had eventually been followed by a return to regular operations of the Space Shuttle (albeit with increased safety measures), the Columbia disaster would ultimately lead to the end of the Space Shuttle program.

An accident investigation report was published not long after the disaster, and determined both the cause of the breakup and what measures could be taken to prevent future problems. As a result of this, the Bush administration published the 2004 *Vision For Space Exploration* (VSE), in an attempt to rekindle the public's support for American space technology and chart a course forward from the Columbia disaster. The VSE called for the Shuttles to resume flight and complete the construction of the ISS, and to then retire by the year 2010, to be replaced with new launch vehicles and spacecraft designs that would facilitate plans for crewed exploration of the Moon and Mars in what would come to be named the Constellation program (National Aeronautics and Space Administration, 2004, p. 15). The shuttles resumed flight in 2006, and were ultimately retired in 2011. In 2006 the Bush administration also issued its own updated National Space Policy, replacing the prior one from 1996, repeating many of its points and even strengthening the assertion that the U.S. would reject any attempts to limit or prohibit its access to outer space (White House, 2006).

The Constellation program, which ultimately did away with the idea of reusable spacecraft and space-planes like the STS shuttle in favour of more conventional expendable rockets for the sake of simplicity, would itself meet with a series of delays and cost overruns that ultimately saw it canceled by the Obama administration, shortly after taking over from Bush (Malik, 2010). Certain fixtures of the Constellation program would, however, be spared from cancellation—the most notable being the Orion crew capsule and spacecraft project, which aimed to facilitate crewed exploration beyond low-Earth orbit and aid in crewed lunar exploration (Kolawole, 2011). As such, Orion would go on to be a central part of the Artemis program.

Though ultimately responsible for the cancellation of the Constellation program, the Obama administration was supportive of the goal of again flying humans to the Moon and other deep-space locations, as well as continued support of the International Space Station. In 2009 NASA convened the Review of United States Human Spaceflight Plans Committee, (better known as the Augustine Committee, for its chairman Norman Augustine) to determine the way forward for U.S. human space exploration in the post-Shuttle era (Review of U.S. Human Spaceflight Plans Committee, 2009, p. 7). In its report, the Augustine Committee concluded that "the ultimate goal of human exploration is to chart a path for human expansion into the solar system", and highlighted the possibility of developing space resource utilisation capabilities (so-called in-situ resource utilisation, or ISRU) in the interest of creating a physically and economically sustainable deep space exploration program (Review of U.S.

Human Spaceflight Plans Committee, 2009, p. 22, 39). It was also per the Committee's assessment of the Constellation program overrunning its budget and schedule that the administration removed the program from its 2010 budget request. The Committee's recommendation was to instead rethink the approach to fulfilling the goal of flying humans to the Moon, Mars, and elsewhere (Lawler, 2009). This would form the basis of the lunar exploration program that would later become Artemis.

3.1.7 Commercialising the Space Industry

During the Reagan administration, groundwork was laid for creating a commercial spaceflight industry, hoping to mobilise market competition to create new and more cost-effective launch vehicles and spacecraft. Through directive, Reagan established the Working Group on Commercial Launch Operations, with the aim of streamlining the legal and regulatory process involved with approving and licensing commercial actors to launch and operate spacecraft. This was done with a desire to see the economic potential in outer space realised, and Reagan saw much potential for an "expanded private sector" in space (Kay, 1998, pp. 239-242). In 1984, President Reagan signed the Commercial Space Launch Act, which aimed to give private companies the ability to own and operate their own spacecraft, launch vehicles, and launch sites (Kay, 1998, p. 241).

The latter years of the Bush administration also saw the Commercial Orbital Transportation Services (COTS) program established in 2006 and the related Commercial Resupply Services (CRS) program in 2008, aiming to continue the work that began with the 1984 Commercial Space Launch Act of establishing a private, commercial space launch industry that could assist the nation's space exploration efforts and drive down the cost of spaceflight. These two programs aimed to develop and deploy new vehicles for the transportation of cargo and crew to the ISS. Specifically, COTS would allow NASA to coordinate and assist with the development of these vehicles, while CRS would allow them to operate these vehicles through contracts with the commercial providers. Funding through COTS was awarded through the selection of competing proposals, ultimately winding up with two commercial providers successfully deploying their own launch vehicle and cargo spacecraft (National Aeronautics and Space Administration, 2017).

The cancellation of Constellation and the impending retirement of the Space Shuttle would leave the U.S. with no human-rated rocket or spacecraft system for the foreseeable future. The Orion component of Constellation remained in the cards, but without a suitable launch

vehicle. This meant that the U.S. would now have to rely on Russian Soyuz launches to ferry its astronauts to the ISS (Stromberg, 2014). To help mitigate the U.S. impending lack of a domestic crew-capable launch system, the NASA Authorization Act of 2010 initiated the Commercial Crew Development (CCDev) program. This program would build on the ongoing COTS and CRS commercial spaceflight programs to support the development of new crewed spacecraft systems through commercial vendors. The first operational CRS contracts, flying uncrewed supply missions to the ISS, would begin in 2012, further increasing the confidence in a commercial crewed flight program (NASA, 2019). The SpaceX Crew Dragon later became the first commercial provider to successfully ferry human astronauts to the ISS in 2020 (O'Callaghan, 2020).

To further bolster its commitment to commercialising spaceflight and space exploration, the U.S. Congress also passed the Commercial Space Launch Competitiveness Act in 2015—better known as the SPACE ("Spurring Private Aerospace Competitiveness and Entrepreneurship") Act. Most significantly, the SPACE Act asserts the right for U.S. citizens to "engage in commercial exploration for and commercial recovery of space resources" (U.S. Commercial Space Launch Competitiveness Act, 2015, Sec. 402). However, the final section of the SPACE Act also asserts that this enactment is not an assertion of sovereignty, exclusive rights, jurisdiction, or ownership of any celestial bodies (U.S. Commercial Space Launch Competitiveness Act, 2015, Sec. 403).

3.1.8 The Trump Administration's Space Policy Directives

The Trump administration would continue along the same lines followed by preceding administrations, maintaining support for commercial spaceflight developments, continued operation of the ISS, and the advancement of human deep space exploration programs. To this end, signed a total of four "Space Policy Directives" to further cement many of the goals laid out by the Augustine Committee. The first of these directives (Space Policy Directive-1) was issued in 2017, and cemented the focus on crewed lunar exploration, planning to utilise both the developing commercial spaceflight industry that the U.S. had fostered, as well as the ongoing NASA projects that survived the canceling of Constellation, most prominently the Orion spacecraft (Harrison & Johnson, 2017).

The second directive focused on further bolstering the government's commitment to supporting commercial spaceflight ventures. The directive aimed to streamline some of the legal procedures associated with granting commercial spaceflight licenses, and to minimise the associated regulatory requirements where possible (Memorandum, 2018a). The third directive, issued in 2018, also called on the requisite departments of the U.S. government to begin assessing ways to develop and implement "Space Situational Awareness" (SSA) and "Space Traffic Management" (STM) technologies, expressing a focus on preempting and mitigating potential orbital hazards such as satellite collisions, which could otherwise threaten orbital infrastructure (Memorandum, 2018b).

Also in 2018, President Trump's fourth space policy directive called on the Department of Defense to begin the process of creating a separate space-focused branch of the U.S. armed forces. Until that point, any space-related military activities had been the purview of the United States Air Force (USAF), specifically through the Air Force Space Command (AFSPC) (United States Space Force, n.d.). The notion of forming a dedicated "Space Force" had been gaining momentum for some time within both Congress and the U.S. military, with various attempts being made at forming a "Space Corps" either as a new subdivision of the air force or as its own branch (Bingen et al. 2022). These earlier proposals were shot down, but the notion gained considerable favour when equivalent military branches were established in both the Russian and Chinese armed forces in 2015 (Erwin, 2018). Thus, the Trump administration oversaw the creation of the United States Space Force (USSF) in 2019, signed into law in the National Defense Authorization Act for Fiscal Year 2020 (Bingen et al. 2022).

3.1.9 The Start of Artemis

In 2019, Vice President Mike Pence announced that NASA would now be targeting the year 2024 for a crewed landing on the Moon. This program was officially dubbed the Artemis program later that same year in an announcement from NASA administrator Jim Bridenstine, naming the new Moon landing program after the sister of Apollo from the Greek myth, thereby referencing the old, original Moon landing program (Grush, 2019). In addition to setting the goal of landing humans on the Moon by 2024, NASA also made it clear that human flights to Mars would be the ultimate goal beyond the Moon, seeing the Moon as a "stepping stone" to exploration of Mars. This doctrine is usually referred to as "Moon to Mars" (National Aeronautics and Space Administration, 2023b). In tandem with the Artemis program itself, the Trump administration also drafted new international legislation, named the

"Artemis Accords", aimed at establishing international laws concerning exploration and use of the Moon (Grush, 2020). The Artemis Accords will be explored further in section 3.3.5.

At time of writing, the administration of President Joe Biden still supports the Artemis program, which has already completed its first major flight demonstrating the capabilities of the Orion spacecraft to reach the Moon and return safely, with plans for its first crewed lunar flight in 2024, followed by a landing in 2025 (Harvey & Mann, 2022). The Russian invasion of Ukraine in 2022, and its subsequent political fallout has served to create and deepen a divide between Russia and the U.S. and Europe on space cooperation. Russia now plans to end its long-standing partnership in the International Space Station program, vowing to leave the station after 2024 and begin construction of a new, primarily Russian space station (Associated Press, 2022). In addition to this, the People's Republic of China has in the most recent decade made considerable strides in its own space program, completing the Tiangong space station (Jones, 2021) and announcing plans for a lunar surface base, to which it has invited Russia as a potential partner (Wall, 2022a). As shall be seen in the following sections, these things may play an important part in determining the geopolitical significance of Artemis.

3.2 Militaries in Space

It is hard to ignore the connection between spaceflight and warfare. As previously mentioned, the German V-2 missile, which was used to bomb Allied territory during the second World War, formed the basis for much of early rocketry (Harvey, 2022). Spaceflight technology may serve numerous military purposes, both direct and indirect. Communications and reconnaissance satellites aid military intelligence, allowing for real-time monitoring of the Earth from above. Weapons could also be placed in the Earth's orbit, either for the sake of striking at other space assets (so-called "space-to-space" weapons) or for the sake of striking at targets on the Earth below ("space-to-Earth" weapons). Lastly, space launch vehicles themselves are by nature missile technology, as exemplified in the V-2. Such technology may be used to strike other points on the Earth (as with intercontinental ballistic missiles), or to strike at targets in space ("Earth-to-space" weapons; more commonly termed "anti-satellite" or "ASAT" weapons) (Gleason & Hays, 2020, p. 2).

3.2.1 Rocket-derived Weapons

Perhaps the most commonly evoked connection between spaceflight technology and warfare is the concept of the intercontinental ballistic missile (ICBM). Not only is the V-2 a

forerunner for both ICBMs and space launch vehicles; many 20th century space launch vehicles were themselves also modified ICBM designs—for example, the Mercury-Redstone rocket that carried the first American astronauts into space in 1961 was a modified Redstone missile design (National Aeronautics and Space Administration, 2019). This served as an effective demonstration of the capabilities of such missiles, as the ability to launch a payload into orbit necessarily implies the ability to send an equivalent payload—such as a nuclear warhead—to almost any point on the Earth.

Large anti-satellite weapons work by the same principle of using rocket launch vehicles to deploy warheads against a remote target; but instead targeting hostile space assets such as reconnaissance satellites or weapons platforms. Smaller anti-satellite weapons, which can be launched by high-flying planes such as certain fighter jets, would also eventually be developed. It may be noted here that a significant complication with the use of such weapons is the potential to generate large amounts of orbital debris from a successful satellite strike. Such debris may in turn lead to unintended damage to other satellites, or even a cascade of collisions generating increasing amounts of debris (so-called "Kessler Syndrome"). No such weapons have as yet been deployed in combat, but several live-fire tests have been conducted; each of which received much criticism from the international community for this reason (Smith, 2022).

3.2.2 Space-to-Earth & Space-to-space Weapons

Space-to-Earth weapons seek to take advantage of outer space as the "ultimate high ground". Such weaponry could involve orbital platforms equipped with remote-controlled nuclear missiles, effectively becoming mobile missile silos with potentially much shorter flight times than their terrestrial counterparts (Gleason & Hays, 2020, p. 3). Some proposed orbital weapons systems also opt to make use of orbital velocities in kinetic impactor weapons. Per 2023, international law forbids the placement of weapons of mass destruction in such orbital installations, but does not forbid kinetic impactor weapons explicitly (Gleason & Hays, 2020, p. 2).

Other more unconventional orbital weapons systems have also been studied and proposed at various points, including early concepts for "Sun guns" using orbital mirrors to focus light from the Sun (Time Magazine, 1945), or using high-powered lasers or particle beams to intercept or disrupt weapons systems on the Earth (U.S. Dept. of State, n.d). Such weapon designs have also been proposed (alongside more conventional options) for space-to-space

weaponry, particularly as a means of defending one's own military space assets (Gleason & Hays, 2020, p. 1). While most of these concepts and proposals remain theoretical, at least one space-to-space weapon has historically been deployed: The Soviet Salyut 3 (also known as Almaz 2) was equipped with a 23mm cannon, which was test-fired multiple times (Zak, 2022).

3.2.3 Nuclear Applications

Aside from using space launch technology to facilitate nuclear strike capabilities, different uses for nuclear bombs in the domain of outer space were also considered. A USAF project in 1958 proposed to detonate a nuclear warhead on the surface of the Moon, both as a show of strength and for purposes of studying the resulting crater and debris cloud (Reiffel, 1959). Another proposal in the late 1950s, initially at NASA and later picked up by DARPA and the Air Force, looked at the possibility of using miniaturised nuclear bombs as a means of spacecraft propulsion (Everett & Ulam, 1955; Tackett, 2013).

During this same time period, proposals were also put forth to test nuclear warheads at high altitudes, for the purpose of investigating the electromagnetic pulses which result from such detonations, causing major disruption and damage to various electrical systems. The most notable of these was Starfish Prime, in which a 1.4 megaton nuclear bomb was detonated 400 kilometres above the Pacific Ocean, and still remains the highest-ever detonation of a nuclear bomb. The electromagnetic pulse resulting from this explosion managed to damage electrical equipment 1400 km away from the blast, which exceeded expectations and demonstrated the usefulness of high-altitude nuclear electromagnetic pulse weapons (dubbed "HEMP" weapons) (Wilson, 2008, pp. 6-7). Such tests have not been repeated since the Partial Test Ban Treaty of 1963.

3.2.4 Weaponising the Shuttle

The Space Shuttle program also received its fair share of military appraisal(?). Plans for a militarised space-plane even outdate the Shuttle program entirely, going as far back as to the Second World War, with the German "Silbervogel" project for a rocket-powered sub-orbital bomber. Postwar, the fledgling U.S. space program continued this idea with the Boeing X-20 Dyna-Soar concept. The Dyna-Soar, if completed, would have been a reusable, rocket-launched spaceplane able to carry out tasks such as space reconnaissance, satellite maintenance, and bombing. Dyna-Soar very nearly came to fruition, but was canceled in 1963, just as construction had begun on the first spaceplane (Boeing, n.d).

Many similar tasks were envisioned for the Space Shuttle, which did wind up flying multiple military missions. As has been mentioned, the Soviets also reportedly feared the capacity for the Space Shuttle to be used as a bomber vehicle, though this ultimately proved baseless (See: Sietzen, 1997). The military interest in the Space Shuttles instead focused chiefly on its ability to launch and maintain military communications and reconnaissance equipment. Boeing would also later be responsible for developing the X-37 uncrewed spaceplane, incorporating many elements of the Space Shuttle into a smaller design that could be launched atop conventional rockets. At time of writing, the X-37 is still in active use, flying classified missions for the United States Space Force (United States Space Force, 2022).

3.2.5 The Strategic Defense Initiative & the *Polyus* Project

It was not long after the first test flights of the Space Shuttle that President Ronald Reagan unveiled the plans for his Strategic Defense Initiative (SDI), the derisively-nicknamed Star Wars program. This program would seek to develop primarily defensive weapons systems, both terrestrial and orbital, for the purpose of completely countering the ability of any rival nation (primarily, the Soviet Union) from ever launching a successful nuclear attack on the United States. The program involved research and development of a wide array of different types of weapons, from conventional missiles to futuristic-seeming lasers and beam weapons (U.S. Dept. of State, n.d).

This was met with some criticism at the time, with detractors worrying that a successful Strategic Defense Initiative would only accelerate tensions between the United States and the Soviet Union by sparking an arms race in space. A CIA paper declassified in 2014 purports that the Strategic Defense Initiative was indeed a cause for concern in the Soviet government, and that they took its implications very seriously (Central Intelligence Agency, n.d, p. 22). In 1987, the Soviets constructed the *Polyus* spacecraft—a large weapons platform armed with an onboard laser system intended to destroy SDI satellites. According to Yuri Kornilov, the then-Chief Designer at the Salyut Design Bureau, Premier Mikhail Gorbachev explicitly forbade on-orbit testing of *Polyus*' offensive capabilities, for fear of this being interpreted as an act of aggression by the U.S. The launch, however, was a failure, and no subsequent *Polyus* spacecraft were ever launched (Parke, 2015).

None of the Strategic Defense Initiative's research would ultimately yield finished spacecraft, however (Kennedy, 2019). A report in 1987 by the American Physical Society expressed that some of the proposed technologies—such as directed-energy beam weapons—were a long

way from being possible to actualise as useful military equipment. The report stated that: “We estimate that even in the best of circumstances, a decade or more of intensive research would be required to provide the technical knowledge needed for an informed decision about the potential effectiveness and survivability of directed energy weapon systems. In addition, the important issues of overall system integration and effectiveness depend critically upon information that, to our knowledge, does not yet exist.” (Bloembergen et al., 1987, p. 9). Funding for SDI was subsequently scaled back, until its cancellation in 1993 at the hands of the Clinton administration (Kennedy, 2019).

The concept of space-based missile interceptors was more recently given new life in 2018, with the National Defense Authorization Act calling for the development of such a system, though without specifying exactly what sort of technology is to be used (Reif, 2018). In a 2022 article written for The National Interest by Mike Pompeo, former director of the CIA and former secretary of state under President Trump, this effort is directly and favourably compared to the Strategic Defense Initiative. Pompeo argues that the rise of China, whom he characterises as seeking to challenge the U.S. for world hegemony, poses an unprecedented threat. He calls for a “SDI II” in order to equip the U.S. with the ability to deter and defend against new threats that ground-based ABM systems cannot counter (Pompeo, 2022, p.4).

3.2.6 Global Positioning System

One of the major actively deployed military space technologies is the Global Positioning System (GPS). While not itself a weapon, the GPS network of satellites serves to provide highly accurate geographical positioning and navigation data which may in turn be used to aid military operations, seeing its first widespread military use in the Gulf War from 1990 to 1991 (Pace, et al. 1995). Despite being operated by the Department of Defense and United States Space Force, GPS service is free to the public and may be used by any actor, not limited to the United States. However, the United States government reserves the right to limit access to any one user should it see fit to do so. One example of this occurring was during the Kargil War in 1999 between India and Pakistan, where the Indian military was denied GPS data for the Kargil region (Srivastava, 2014). In order to maintain reliable access to geolocation data, India and others have pursued the development of their own GPS-equivalent systems. The most extensive of these competitors is the Russian *GLONASS*, and other examples include the European Union’s *Galileo* system, and the Chinese *BeiDou* (Westcott, 2020).

3.2.7 Militarising the Moon

In addition to military interests seeking to utilise space technology and near-Earth space, there have also been proposals and investigations into militarising the Moon. As the Moon is much further from the Earth's surface than low-Earth orbital space, these military uses are less focused on leveraging space as a military asset in terrestrial conflicts and instead work on the assumption that the Moon itself is of particular value. At present, the Outer Space Treaty of 1967 forbids territorial claims on the Moon, but in a future scenario where this law is changed or ignored and countries begin seeking to appropriate their own lunar territory, military presences on and around the Moon may become increasingly important.

In the U.S, the possibility of a military outpost on the surface of the Moon was investigated as early as 1959 with the Project Horizon study. This study examined the feasibility and challenges of constructing and operating a "Moon base" that would chiefly facilitate lunar science and exploration, but also military operations if needed. Project Horizon was ultimately canceled by the Eisenhower administration, but the notion of a "Moon base" as a surface outpost with possible military elements would endure (Borch, n.d).

While later Moon base plans in the 20th century fell away with the end of the Apollo program, the Artemis program has breathed some light into these notions. In a 2021 interview with spaceflight news site Space.com, space historian Robert Godwin argues that any future attempts at serious commercial ventures on the Moon or in lunar space will necessitate a U.S. military presence, to "ensure their safety" (David, 2021). Indeed, beyond Artemis itself, the U.S. spaceflight sector has plans for over a hundred different lunar missions by 2030, many of which are commercial in nature (Bender, 2022).

A similar sentiment to that of Robert Godwin was echoed in 2022 when Congress began allocating funds for the development of Space Force projects in lunar space. At $61 million, this sum is not particularly large neither by the standards of civilian spaceflight or U.S. military spending, but clearly marks a newfound interest. Being interviewed by Politico, Space Force Colonel Eric Felt stresses that the Space Force "clearly envisions" that lunar operations will be part of its future (Bender, 2022).

3.3 International Law in Space

As has been referenced already, much international legislation concerning outer space now exists. This part of the section will lay out the existing international legislation concerning

outer space, in the order that they were drafted and signed. There is a total of six major international agreements which govern activities in outer space. In addition to these six, this rundown will also include the "Artemis Accords"—a multilateral agreement put forth by the U.S. in tandem with the Artemis program.

3.3.1 The Partial Test Ban Treaty

The first major international treaty which governs outer space activities is the Partial Test Ban Treaty of 1963—officially titled the Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water. As its official title suggests, this treaty is primarily concerned with nuclear weapons testing across multiple domains, and not just space. A key concern with these tests was that the increasing size and power of nuclear weapons would lead to dangerous amounts of nuclear fallout and damage threatening both human and environmental health. In addition, the Cuban Missile Crisis of 1962 played a large part in driving public and political anxiety surrounding nuclear weapons as a whole, contributing to the desire to have nuclear testing cease (Atomic Heritage Foundation, 2017).

The wording of the Partial Test Ban Treaty makes clear the ultimate intent to achieve nuclear disarmament, and called for a subsequent complete ban of all nuclear testing, such as would later be adopted in 1996 with the Comprehensive Nuclear Test Ban Treaty (which has, at time of writing, not yet entered into force) (United Nations Treaty Collections, 2023). The inclusion of a ban on high-altitude and outer space nuclear weapons testing put an end to any further plans both the United States and Soviet Union may have had for tests akin to Starfish Prime, and represents the first time a major international treaty placed restrictions on what space-faring nations may do in outer space (Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water, 1963).

This matter may appear strictly military upon first glance. After all, it concerns nuclear weapons, and little else. However, the specific wording of the treaty—stating that parties must agree "not to carry out any nuclear weapon test explosion, or any other nuclear explosion"—also forbids any potential peaceful use for nuclear bombs (Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water, 1963). A number of space-related proposals and concepts involve peaceful nuclear explosions, such as using repeated small nuclear explosions to propel large vehicles to and through outer space; or employing nuclear weapons as part of an asteroid-avoidance scheme (World Nuclear Association, 2018). More recently, and perhaps more fantastically, U.S. billionaire Elon Musk

has famously suggested using a barrage of nuclear weapons to melt the polar ice caps of Mars, in aid of making the planet more hospitable to humans (Wall, 2019).

3.3.2 The Outer Space Treaty

Perhaps the most significant international treaty governing outer space is the Outer Space Treaty of 1967—formally the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies. This treaty was the first major piece of international law that made outer space its sole focus, and it forms the basis for all subsequent treaties on the matter.

The Outer Space Treaty establishes a set of principles that space activities are to conform to, and that all future space law is encouraged to follow. Chiefly, these principles are:

- That space is the "province of all mankind", which must be open for all nations to access freely, and which must be used and explored for the benefit and interest of all countries (Article I).

- That outer space and celestial bodies are not subject to any national appropriation by claim, occupation, or any other means (Article II).

- That the exploration and use of outer space must be done in accordance with international law, including the Charter of the United Nations (Article III).

- That nuclear weapons and other weapons of mass destruction will not be placed anywhere in outer space, and that military bases will not be established in outer space (Article IV).

- That space-faring nations are obligated to aid astronauts of other nations in emergencies, including astronauts landing on foreign soil (Article V).

- That each space-faring nation is responsible for its own activities and for any damage caused to the space assets of another, and that each nation retains jurisdiction over any object it launches (Articles VI, VII & VIII).

- That all space activities must be guided with a principle of co-operation, and that any nation whose space activities may interfere with those of another is obligated to alert and consult the international community first (Article IX).

- That parties to the treaty must consider any request by other parties to observe the launch and flight of its spacecraft (Article X).

- That the Secretary General of the United Nations must be informed about any intended space activities, which is then to be disseminated to the other parties and the public (Article XI).

- That all installations (ie. space stations, lunar bases, etc.) and vehicles shall be open to mutual visitation when given reasonable advance notice (Article XII).

(Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, 1967).

As such, the Outer Space Treaty is heavily concerned with ensuring that outer space is used entirely for peaceful purposes, and for the benefit of all humanity irrespective of national belonging. However, while the treaty bans the placement and use of weapons of mass destruction in outer space, it does not prohibit the use of conventional weapons in the same. As mentioned in section 3.2.2, existing plans to place conventional anti-ballistic missile systems and high-velocity kinetic bombardment weapons in outer space would, as such, not be covered by this treaty.

3.3.3 Expansions to the OST

The Outer Space Treaty would be followed by an additional agreement and two conventions expanding upon specific parts of the Outer Space Treaty itself. These are the Rescue Agreement, the Liability Convention, and the Registration Convention.

The Rescue Agreement—officially the *Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space*—was adopted in 1967, the same year as the Outer Space Treaty. It primarily expands upon Article V of the Outer Space Treaty concerning the obligation to render aid in case of a crewed spaceflight emergency. It reaffirms that any country in a position to help in such an emergency is obligated to do so.

This may entail assistance both in space and on Earth after the crew of a spacecraft has returned. The Rescue Agreement also compels its signatories to recover and return any other signatory nation's spacecraft parts that may land inside their territory; the nation to whom the spacecraft belongs must then offer compensation for the recovery (Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, 1967).

The Liability Convention—officially the Convention on International Liability for Damage Caused by Space Objects—was adopted in 1972. This treaty expands on the rules surrounding liability and responsibility established in Outer Space Treaty Articles VI, VII, and VIII. It reasserts that the responsibility and liability of a space object rests on the nation that caused it to be launched, regardless of who launches it. This means, for example, that the U.S. is liable for any damages caused by spacecraft launched by commercial American space agencies. The Liability Convention also states that joint launches, wherein two or more states work together on a space launch, assigns liability equally among the participating countries (Convention on International Liability for Damage Caused by Space Objects, 1972).

The Registration Convention—Convention on Registration of Objects Launched into Outer Space—was adopted in 1974, compelling signatory nations to inform the United Nations about specific details of their active spacecraft. These details include spacecraft type designation, orbit and trajectory data, date and location of launch, and the spacecraft's general function. The intent of the Registration Convention is to enable coordination and mutual observation of space operations, and allow for comprehensive monitoring of decommissioned satellites and space debris (Convention on Registration of Objects Launched into Outer Space, 1974).

3.3.4 The Moon Treaty

The 1979 Agreement Governing the Activities of States on the Moon and Other Celestial Bodies—commonly known as the "Moon Treaty"—attempted to redefine some of the rules and regulations framing space activities on the Moon and other planets. This treaty is often considered a "failed" treaty, since it has not yet been signed by any nation that engages in crewed spaceflight (Listner, 2011).

The Moon Treaty is chiefly concerned with cementing existing prohibitions on territorial claims and resource appropriation, citing the aim of preventing the Moon from becoming an

object of future international conflict. Seeking to only permit the use of the Moon for peaceful purposes, the Moon Treaty lays out a framework for the use of lunar resources under peaceful international cooperation, and reiterates upon the Outer Space Treaty's prohibitions on creating military installations on the surface of the Moon or other planets (Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, 1979).

3.3.5 The Artemis Accords

Presented in relation with the Artemis Program itself, the 2020 Artemis Accords are a recent attempt by the United States to further define a legal framework for space operations on and around the Moon, as well as other celestial bodies. The Accords have been signed by several nations, including some with significant space operations capabilities such as Canada, Japan, Brazil, and the United Kingdom, but lacks participation from other key spacefaring nations; most notably China and Russia. Signing the Artemis Accords was also made a prerequisite for participating as an international partner in the Artemis program itself (National Aeronautics and Space Administration, 2021).

The Accords themselves use the 1967 Outer Space Treaty as a key basis for many of its principles, and explicitly states that its signatories affirm the "importance of compliance" with this treaty. Many of the Accords' sections deal with reaffirming core principles from the Outer Space Treaty and its subsequent treaties, such as reaffirming a commitment to peaceful purposes, a responsibility to render emergency aid in accordance with the Rescue Agreement; a responsibility to register lunar spacecraft in accordance with the Registration Convention, and ensuring open sharing of scientific data. The Accords also include a provision for the mitigation and disposal of space debris (Artemis Accords, 2020).

The most controversial part of the Artemis Accords is found in Section 10, which concerns the use and appropriation of space resources in accordance with Article II of the Outer Space Treaty. Section 10 asserts that the utilisation of space resources may provide sustainability to space operations, and that extraction of such resources "does not inherently constitute national appropriation under Article II of the Outer Space Treaty", effectively establishing an interpretation in which some forms of resource appropriation do not violate Article II. This has been met with some criticism as a faulty interpretation of the intent of the Outer Space Treaty, and accusations that the Artemis Accords is an attempt at paving the way for commercial exploitation of the Moon (Boley & Byers, 2020). The Accords also invited foreign criticisms, such as the then-director of the Russian national space agency Roscosmos

Dmitry Rogozin complaining that the entire Artemis program is “US-centric”, and likening the Accords to an attempt at “lunar invasion” (Grush, 2020).

3.4 The Artemis Program

First established in 2017, the Artemis program itself is the culmination of more than two decades’ work towards replacing the Space Shuttle, and picking up where the Apollo program left off. The program centers on planned human flights to the Moon, supported by many other spaceflight efforts both from other NASA and USSF endeavours; commercial and private actors within the U.S; and international partners. The ultimate goal of the program, as defined by former NASA director Jim Bridenstine, is to return to human exploration of the lunar surface, and to use what is learned on the Moon in preparing for eventual human exploration of the planet Mars (National Aeronautics and Space Administration, 2019b).

3.4.1 Concrete Goals and Timeline

At time of writing, the Artemis program has successfully launched the first of its major spaceflight missions, known as Artemis I. This mission, launched on November 16th 2022, was an uncrewed test flight of the Orion spacecraft and the Space Launch System launch vehicle. The flight took the Orion spacecraft to lunar orbit and back, splashing down off the coast of the Baja California peninsula on December 11th. Artemis I was deemed a success, and NASA is presently preparing for the flight of Artemis II, which is to be the first crewed flight of the program.

When the Artemis program was first announced, its stated goal as defined by President Donald Trump was to land a crewed vehicle on the surface of the Moon in 2024. At time of writing, this timeline has shifted to a lunar landing in 2025 (Harwood, 2021). The core architecture of the program has remained the same, however. Following the uncrewed test flight of Artemis I, Artemis II, now scheduled for 2024, will fly humans on a round-trip to the lunar orbit and back to the Earth without a landing. The subsequent Artemis III, now scheduled for 2025, will fly another crew of astronauts to the Moon and rendezvous with a landing vehicle, which will then take the astronauts to the surface for the first landing of the program, with plans for a landing site somewhere near the lunar south pole (Harvey & Mann, 2022). Subsequent flights will then make additional landings, ensuing construction of an “Artemis base camp” on the lunar surface, as well as completing the assembly of a space station in lunar orbit to help facilitate the human presence on the Moon (National Aeronautics and Space Administration, 2020b). At present, a total of five crewed missions (through to

Artemis VI) have been scheduled, with another subsequent five (through to Artemis XI) proposed as follow-ups. Including these latter proposals, the crewed flights of Artemis are scheduled to run until at least 2031. In addition to these crewed flights, the mission plan also includes numerous uncrewed flights of support equipment and associated payloads (NASA Advisory Council, 2022, p. 3).

3.4.2 Human Landing System Contracts

In order to achieve the lunar landing itself, a lunar lander spacecraft is required. As Orion itself does not have this capability, the crewed lunar landings of the Artemis program require the introduction of a separate lander spacecraft with which to rendezvous in orbit around the Moon. In the past, the Apollo Program's lunar lander spacecraft was launched together with the Apollo spacecraft itself, whereas the Artemis Program instead plans for the lander component to be designed, built, and delivered separately by commercial partners. This is the main goal of the Human Landing System project, which became the basis for a design competition between various commercial partners providing their own human landing system (HLS) design, according to NASA specifications.

The competition ultimately yielded three finalist proposals: One by SpaceX, one by Blue Origin, and one by Dynetics. In April of 2021, NASA ultimately selected the SpaceX proposal (named Starship HLS) for a development contract, intending to utilise their lander for Artemis III (National Aeronautics and Space Administration, 2021b; NASA Advisory Council, 2022, pp. 18-19). NASA would also go on to state that it had wished to award multiple contracts so as to ensure a redundancy in its lunar lander availability, but that initial funding only allowed for one lander. The funding required for an additional lander would later be granted in October of 2021, and a second round of design competition is underway (Wall, 2022b).

3.4.3 Artemis Base Camp

Included as part of the proposed second phase of Artemis landing missions (Artemis VII and onwards) is the concept of an "Artemis Base Camp". This concept involves establishing a permanent surface outpost somewhere on the lunar south pole, to allow for longer stays than what the on-board life support systems of a lander spacecraft may permit. The Artemis Base Camp would also make use of lunar water ice and other minerals to replenish water, oxygen, and other useful resources, through ISRU technology. Elements of the base camp would be designed and delivered by commercial partners, much like other parts of the Artemis

program. The Base Camp concept also includes a “lunar terrain vehicle” (LTV) rover, intended to be a large mobile habitat with a pressurised interior, as opposed to the small and foldable Moon rovers of the Apollo Program (National Aeronautics and Space Administration, 2022b).

3.4.4 Lunar Gateway Station

Though not technically a part of the Artemis program, the Lunar Gateway program also plays a key supporting role in the U.S. plans for crewed lunar exploration. The program, headed by NASA, aims to establish a modular space station in orbit of the Moon to facilitate crewed exploration of the lunar surface, as well as carrying out deep-space experiments and Earth observation, and serving as a staging point for other deep-space operations. When complete, Gateway will be the first crewed space station beyond low-Earth orbit, and is intended to start operating in 2025 for Artemis III. The first module of Gateway is scheduled for launch in 2024 (National Aeronautics and Space Administration, 2021c).

3.4.5 Other Supporting Programs

In addition to Gateway, Artemis is supported by a number of robotic programs intending to support the exploration of the lunar surface and lunar space. These range from other NASA endeavours, to projects by international and commercial partners; and the Artemis Accords themselves, as previously explained in section 3.3.5. Many of these supporting missions are also planned to make use of various launch vehicles, some of which are developed and operated by commercial and international partners.

A central fixture among these supporting programs is the Commercial Lunar Payload Services (CLPS) program, headed by NASA. As the name suggests, this program aims to facilitate the development and deployment of commercial lunar exploration projects through offering contracts and development resources. At present, NASA has awarded payload contracts to five different companies, each intending to deploy different scientific payloads. Many of these payloads are technology demonstrators, intending to aid in preparations for the crewed surface exploration by testing technologies such as in-situ resource utilisation (ISRU) methods and lunar prospecting instruments (National Aeronautics and Space Administration, 2023c).

Another important supporting program is Gateway Logistics Services (GLS), which exists to contract commercial vendors for supply delivery to the Gateway space station, much in the

same manner as the Commercial Resupply Services program does for the International Space Station. NASA opened GLS for potential bidders in 2019, specifying its requirements for the capabilities of the desired logistics spacecraft. At time of writing, the first GLS contract has been awarded to SpaceX's Dragon XL spacecraft, which would launch to the Moon on SpaceX's own Falcon Heavy launch system (Bergin, 2020).

3.4.6 International Partners

International cooperation forms a key part of the Artemis program, both through partnerships with other national space agencies and through contracting of commercial partners from various countries. Chiefly, Artemis partners NASA with the Canadian Space Agency (CSA), the Japanese Aerospace Exploration Agency (JAXA), and the European Space Agency (ESA). In addition, NASA has also cooperated with the Italian Space Agency (ASI), the Israeli Space Agency (ISA), and the German Aerospace Center (DLR) on the flight of Artemis I, where these agencies provided secondary experiments for deployment in lunar orbit (U.S. Dept. of State, 2022). Each participating nation is required to be signatory to the Artemis Accords, which are open for any country to join (National Aeronautics and Space Administration, 2021).

The Canadian Space Agency has a history of cooperating with NASA on ISS operations, both through delivering station payloads and providing astronaut crews. The CSA's involvement in the Artemis Program continues this trend. The agency's main contributions to Artemis are in the form of Gateway components, and a robotic lunar rover scheduled to launch by 2026. The main CSA contribution to Gateway is the planned Canadarm-3 project, which will equip the lunar space station with a robotic articulating "arm" to be used for berthing new modules and spacecraft, as well as inspecting the station's exterior. Similar systems have been provided by the CSA in the past, to serve on the Space Shuttle (Canadarm-1) and on the International Space Station (Canadarm-2). In addition to these contributions, a Canadian astronaut will fly on board Artemis II, the first crewed flight of the program (Wall, 2021).

The European Space Agency has a similar history of cooperation with NASA and the United States in space. The ESA is a major partner in the ISS program, supplying launches, modules, parts and components, as well as astronaut crews to the station (European Space Agency, n.d.a). In a similar vein, the ESA is a key collaborator on the Gateway station project, where it will provide the European System Providing Refueling, Infrastructure and Telecommunications (ESPRIT) module, as well as the International Habitation Module(I-

HAB) in collaboration with JAXA (European Space Agency, n.d.b). For Artemis, ESA is providing the European Large Logistics Lander (also called Argonaut) to help explore the lunar surface and deliver cargo to other surface operations (European Space Agency, n.d.c). In addition to this, the ESA is also a major collaborator on the Orion spacecraft, which forms a key part of Artemis. The ESA provides the European Service Module (ESM), which serves as the spacecraft's main propulsion, power, and support module (European Space Agency, n.d.d).

The Japanese Aerospace Exploration Agency (JAXA) is another major partner with experience from the International Space Station, where it delivered and currently operates the Kibō science module. JAXA is another collaborator on Gateway's I-HAB module, and is in the planning stages of developing an advanced lunar rover for use on later Artemis missions. The rover, currently dubbed Lunar Cruiser, is a collaboration between JAXA and Toyota Motor Corporation, and will be a large mobile habitat with a pressurised cabin, allowing for astronauts to work without the need for space suits, and support expeditions of up to 45 days (National Aeronautics and Space Administration, 2020c; Toyota Motor Corporation, 2020).

In addition to these partners, the Artemis program also receives various supporting efforts from other international partners. A notable example is the flight of Artemis I, which received communications and navigational data from deep-space communications complexes in Spain and Australia, which will continue with future Artemis missions (U.S. Dept. of State, 2022). Other signatories to the Artemis Accords may also join the program in future.

A notable absence in the program is NASA's long-standing partner Roscosmos, the Russian federal space agency. As detailed in section 3.1.5, Russia has played a key part in past space cooperation, and has been the United States' largest partner in the ISS program. In 2017, the two countries initially announced a partnership for future deep-space exploration missions that would include Russian involvement with Gateway and lunar exploration (Weitering, 2017), but Russia would later back out of the partnership, seeking instead to work with China on lunar exploration (Roulette, 2021).

NASA is also prohibited from directly cooperating with any organisation affiliated with the government of China. This prohibition is chiefly upheld by the Wolf Amendment, passed in 2011, which prohibits NASA from any bilateral cooperation with China unless given explicit permission from the FBI. The Wolf Amendment is based on a notion that allowing

cooperation on space exploration would risk giving China insights into U.S. technologies that could be used to improve their own ballistic missile technology. Limited cooperation between the U.S. and China has been permitted in certain instances—such as in 2019 when NASA's Lunar Reconnaissance Orbiter helped to monitor China's Chang'e-4 probe landing on the far side of the Moon—but cooperation between the two countries remains sparse. China has therefore not been invited to sign the Artemis Accords, or to participate in the Artemis Program, Gateway, or any other associated program (Center for Strategic and International Studies, 2019).

4 Discussion

For this discussion, the geopolitical significance of the Artemis program and its related space efforts will now be assessed. This assessment proceeds in three steps: First discussing the geopolitical significance of outer space in a broader sense, touching on space power and space weaponisation; then discussing the geopolitical significance of the Moon itself, as an object of space exploration and expansion, and as an arena on which outer space regimes may be challenged and determined. Finally, the geopolitical significance of the Artemis program itself is discussed, looking at implications and consequences of the aims of the program, its international partnerships, its commercial elements, and the possible motivations behind the program. Following this, a summary and conclusion is presented.

4.1 The Geopolitical Significance of Outer Space

Outer space is increasingly relevant to many aspects of modern life. Immense amounts of information are shared every day through satellite-enabled communications, connecting the entire world with unprecedented speed and scale. Real-time monitoring of the Earth from on high enables accurate weather- and climate modeling, as well as pinpoint global navigation and precise cartography. Space launch technology and satellite information technology also plays an ever-bigger part in the development of offensive and defensive military capabilities. As such, outer space and space technology form important geopolitical assets and resources.

4.1.1 On Space Power

The importance of outer space can be seen reflected in the decision of the United States government to form a dedicated Space Force. The creation process of the United States Space Force mirrors the creation of the United States Air Force many decades prior. Both branches began as organisations within another branch: The United States Space Force as the Air Force

Space Command, and the United States Air Force as the United States Army Air Service, later the Air Corps. When the Air Force was turned into a separate branch of the armed forces, it reflected the growing importance of air power in modern militaries. From this similarity, it can be surmised that the United States now views "space power" as similarly important—enough to warrant a dedicated Space Force.

If the purpose of a navy is to exercise sea power, and the purpose of an air force to exercise air power, then the purpose of a space force must be to exercise space power. Nayef Al-Rodhan gives us a definition for the term "space power", bound up with his framework of *meta-geopolitics* (see section 2.5.1). This definition impresses the usefulness of space-related assets not only in a military context, but in other political contexts that are also relevant to geopolitics. However, as space-based technologies and space assets become broadly important across a range of contexts (such as Al-Rodhan expresses with his seven geopolitical state capacities), the need for security grows commensurately.

Critical points of infrastructure become obvious targets in open war, making their defense a vital interest. As Al-Rodhan writes, space power entails the ability to use space to sustain one's geopolitical capacities, as well as enhancing them. It can therefore be surmised that a major reason for creating a space force is to provide security to space assets, thereby maintaining space power. This is also supported by the various National Space Policies of past U.S. governments asserting the right to deny access to space for any rival, and the importance of preventing such a denial being put on the United States (eg. White House, 2006).

As Al-Rodhan's *meta-geopolitics* also shows, the exercising of space power also affects the domestic and the civilian. The first three of his seven capacities deal with healthcare, social wellbeing, economics, and policy; carrying other effects besides those on military strategy and international relations. The "critical astropolitics" of Fraser MacDonald here serves as a reminder for considering the effect of space power upon private citizens. The assets to which a Space Force provides security—and which may themselves be used in exercising space power abroad—can also be used to exercise space power on the domestic citizenry. Reconnaissance satellites enable surveillance, navigation satellites enable tracking of individuals, and so on. The vulnerability that this reliance on space technology creates also means that a war in space, or any war in which space assets are targeted, can have devastating

effects on a public that requires space technologies to function. Viewed as such, the pursuit of space power presents possible liabilities as well as benefits to the wielder.

4.1.2 On Space Weaponisation

Beyond this emphasis on a chiefly defensive notion of security, there is a looming question of weaponisation. The international community was relatively quick in forbidding the placement of weapons of mass destruction in outer space, but the Outer Space Treaty alone did not stop later attempts to place conventional arms into outer space. From a strategist's perspective, it is surely tantalising to imagine possessing, such as Deudney suggests, a network of orbiting weapons platforms, capable of striking any point on the planet within minutes—much faster than any long-range missile system or high-speed bomber aircraft. Even when limited to conventional arms—no nuclear weapons—there can be no doubt that such a network would be a formidable weapon.

Ronald Reagan's Strategic Defense Initiative imagined space weaponisation chiefly as a nuclear bulwark: A fleet of satellites designed to intercept any attempted nuclear strike upon the United States. This may be seen as a would-be attempt at nullifying nuclear weapons altogether. If you can swat all missiles out of the sky at will, your enemy and their fleet of nuclear warheads suddenly poses no harm. This fits in with one of Daniel Deudney's "von Braun strategies", with the notion of achieving a complete defense against missile attacks. The Strategic Defense Initiative is long since defunct, but the underpinning motive of establishing such a defense remains strategically valid. The growing importance of space assets may even serve to amplify the desire for such systems in the near future, as advocated by Mike Pompeo (see section 3.2.5).

Even if done in the interest of security and deterrence, space weaponisation also gives way to new threats in place of the old. Daniel Deudney highlights that with sufficiently advanced space technology, naturally occurring space resources such as asteroids could also be directly weaponised, with tremendous potential. As such, even if the threat of nuclear war can be eradicated, space weaponisation may yet yield new weapons of mass destruction. Deudney also argues that the attempt at weaponising outer space, even in the interest of strictly defensive security, may itself lead to an arms race in space, creating conflict rather than dissuading it. Wars could conceivably be fought over dominance of low-Earth orbit, and space beyond. With civilian populations down on Earth being increasingly reliant on space infrastructures, such a war would already be threatening on a global scale. The possibility of

Kessler syndrome, wherein a cascade of debris collisions continually generates more debris risking the destruction of multiple satellites and spacecraft orbiting on the same altitude, adds a further risk to the prospect of space war.

Everett Dolman's Mackinder-inspired dictum tells us what might happen if a single state successfully achieves such dominance. "Who dominates Terra determines the destiny of humankind", he writes, himself an advocate that the United States should "dominate Terra". Criticisms of this advocacy are plentiful, from both Fraser MacDonald, Nayef Al-Rodhan, and Daniel Deudney—and others, eg. Duvall & Havercroft, 2009—but all agree on the general principle which Dolman's dictum communicates: Controlling orbital space means controlling the world. Orbital space (and by extension, outer space) thus becomes the "ultimate high ground"—the means by which one state could achieve complete force projection over the entire planet.

Space power and space weaponisation thus present a growing, significant geopolitical concern; one which the United States has evidently begun to realise with increasing clarity. The existence of Space Forces reasserts the military dimension of outer space, and the increasing relevance of outer space in security matters makes it likely that the weaponisation of outer space will continue unless prevented by international agreement.

4.2 The Geopolitical Significance of the Moon

At time of writing, the Moon remains the only other world on which humans have ever set foot. Though the Apollo astronauts did place American flags in the lunar "soil", a gesture sometimes associated with staking a national claim on a territory, no formal territorial claims have, as yet been made of the Moon. Such claims are currently prohibited by the Outer Space Treaty. Since the end of the Space Race and the last of the Apollo missions, there has been little impetus to challenge this notion. In the lead-up to Artemis, however, signs can be seen that such a challenge may be on the horizon, and that the Moon itself will become a geopolitical factor with some significance, indicative of the geopolitical role that outer space may play in the future.

4.2.1 Against *Res Communis*

The current outer space regime (such as Everett Dolman terms it) is that space is *res communis*—the "thing of the community", which is the common ownership of everyone, and therefore can be claimed by no one. As the Outer Space Treaty affirms, outer space is the

"province of all mankind", free for all to access unimpeded. The opposite of *res communis*, in this sense, is *res nullius*—the "thing of nobody". In a *res nullius* outer space regime, states would be free to stake claims on celestial bodies, and perhaps maintain those claims by force if necessary. The question of whether or not outer space ought to remain *res communis* is a major topic in the works covered by the theory section of this thesis, and is pertinent to recent political developments surrounding lunar exploration.

The fact that none of the world's major spacefaring powers ever signed the 1979 Moon Treaty may have been a distant early warning. The provisions of the Moon Treaty are almost entirely focused on solidifying the prohibition against using the Moon for anything other than scientific research, and ensuring that any benefit derived from lunar resources is shared with the entire world as best as possible. The rejection of this treaty, then, could be seen as the rejection of the premise that the Moon and other celestial bodies should forever remain *res communis* in every possible sense. While the Outer Space Treaty also prohibits national appropriation of celestial bodies, it is much less specific about this prohibition, leaving room for subsequent legislation to define a boundary within which lunar exploitation may still be permitted.

The Artemis Accords can be viewed as part of an attempt at doing just this. Section 10 of the Artemis Accords, which concerns the use of space resources, states that signatories are required to conduct any and all use of space resources in accordance with the Outer Space Treaty. However, the same section also states that the signatories to the Accords agree that resource extraction does not inherently constitute national appropriation as defined by the Outer Space Treaty. Taken on its own, Section 10 of the Artemis Accords hardly threatens the existing *res communis* regime—as the Artemis Accords themselves explicitly reaffirm the provisions of the Outer Space Treaty—but it raises more questions when viewed in the context of recent changes made to U.S. space policy, such as the SPACE Act of 2015 claiming the right of private citizens to engage in commercial exploitation of space resources. Some critics (eg. Boley & Byers, 2020) have labeled this as an attempt to move away from outer space being a global commons, towards a US-led, *res nullius*-style regime.

Dolman's *Astropolitik* gives the argument in favour of a *res nullius* outer space regime: That the competition for resources and for strategic control of outer space will accelerate human space exploration. Dolman envisions a future in which humanity can spread beyond the Earth, and in which the vast material wealth of the whole solar system is put to use for human

benefit, both on Earth and off. To support this thinking, Dolman's core example is the original Space Race between the United States and the Soviet Union, which he assesses as the product of competitive incentives between the two superpowers. In his estimation, the rapid progress of human exploration slowed down considerably once the Space Race ended, marked by the last of the Apollo lunar landings, after which no crewed lunar exploration ever followed in the 20th century. The fact that all the world's major powers agreed to making outer space *res communis* was, according to Dolman, just another strategic move—no one state was yet equipped to seriously begin staking claims on the Moon at that time, and so they agreed to a mutual limitation to ensure a level playing field. This shows the realism in Dolman's perspective, seeing the actions of states in the light of their own self-interest and survival strategy above all else.

If Dolman's realist estimation of this motive behind the Outer Space Treaty is correct, then it follows that spacefaring states will increasingly desire a change towards *res nullius* once the ability is in hand to stake and hold a claim on extraterrestrial territory. Dolman's logic holds that states will pursue space expansion when the cost is sufficiently low, and this can be achieved both through reducing the cost of spaceflight, and through the creation of deep space infrastructure to support future missions. As will be argued more extensively in (section), the Artemis program and its related programs like Gateway all seek to achieve these things, rendering the tools to make productive use of a territorial claim more readily available than they were during the Apollo era. As such, recent space developments make *res nullius* more palatable than it was before.

4.2.2 Against *Res Nullius*

Arguments against *res nullius* are numerous. Fraser MacDonald, who rebukes Dolman directly, is highly critical of the imperial undertones he sees as running through the *res nullius* argument. Permitting national claims on celestial bodies is easily comparable to past imperial expansions in the early modern period, and the critical geopolitics framework on which MacDonald draws is inherently scrutinising of the power imbalances which result from imperialism (see Ó Tuathail, 1996). MacDonald's accusation that Dolman "writes in the service of his empire" makes this clear, and he warns that what Dolman advocates would serve to create and reinforce power structures that are difficult to hold accountable. In this view, outer space as *res communis* is an important part in guarding against imperial justifications and unaccountable power.

Nayef Al-Rodhan also argues for an outer space regime centered on established laws and conventions, with emphasis on maintaining the idea of outer space as a global commons. He warns against the danger of creating an arms race in outer space, and recommends pursuing the use of international legal cooperation ("soft law initiatives") to curtail hazardous anti-satellite and space weapons testing. Al-Rodhan recognises the usefulness of competition, but warns against hostility, arguing instead that the principle of *res communis* is compatible with "non-conflictual" competition avoiding the risk of a space arms race, potentially involving nuclear weapons (see Al-Rodhan, 2012, p. 37, 41-42, 219-221). The fact that the United States and the Soviet Union supposedly came very close to cooperating in 1962 on the first Moon landings seems to suggest that there is indeed potential for cooperation, rather than competition, to advance the progress of exploration.

Daniel Deudney echoes many of these sentiments as well, and also advocates for a continuation and a strengthening of the existing outer space regime and its associated international institutions. His Dark Skies is, taken as a whole, a refutation of the very idea that humanity should expand significantly beyond the Earth, which is central to Dolman's *Astropolitik*. Deudney fears not only the near-term dangers posed by arms races and unchecked hostile competition; or the prospect of letting a single state dominate the entire planet through control of near-Earth space, but warns also of a more fundamental long-term risk in allowing humanity to disseminate beyond the Earth—"antagonistic species radiation", as he calls it. To Deudney, a future in the "solar archipelago" is one in which the total capacity for violence is increased, all while geopolitics is unpredictable, and extraterrestrial states likely to lean authoritarian.

In such a future, a comprehensive and peaceful international order may be far more difficult to achieve than it is today, if not outright impossible. *Res nullius* thus runs the risk of creating new dimensions of conflict in both the near and long term, risking the possibility of a future world political system that is more chaotic and unpredictable than the present. Seen this way, *res communis* is not only argued as the better option to achieve near-term goals in space exploration, but also as the best option for avoiding a future that, at least in Daniel Deudney's view, is wholly undesirable. The development of technologies which increasingly enable a possible departure from *res communis* will, as such, have to be addressed by those who fear this outcome, such as both Deudney and Al-Rodhan have already recommended.

4.2.3 Towards the Moon

In light of arguments for and against these two regimes, the Moon can thus be highlighted as the stage on which future developments will be determined. The Artemis Accords have not been signed by certain key spacefaring powers, and while American policy may be accused of attempting to move away from *res communis*, the Outer Space Treaty remains in place. Now that the Artemis Program stands poised to take the U.S. and its space partners back to where humans haven't been since the 1970s, and China and Russia have at the very least stated their intent to do the same, it may be that the question of regimes will soon be put to the international community. What is done (or what isn't done) with the Moon in the coming decade may, as such, determine the path forward, whether that's towards the common good of humanity, or not.

4.3 The Geopolitical Significance of the Artemis Program

Thus, we come to the Artemis program, straddling the confluence of so many factors. The Artemis program contains the efforts of multiple countries, as well as private companies and individuals, to establish a lasting human presence on Earth's next-door neighbour. It combines elements of previous programs such as Constellation, the Space Shuttle, the International Space Station, and more; as well as incorporating a large degree of international cooperation with many long-standing partners such as Europe, Canada, and Japan. Artemis also makes extensive use of the now-thriving commercial space industry in the U.S, and aims to bring that industry along to the surface of the Moon. The potential benefits to the United States and its allies, as well as the potential implications of the program on geopolitics at large, are considerable.

4.3.1 On International Cooperation

The incorporation of extensive international partnerships marks a contrast with the Apollo program, and carries implications for both the United States and each of the respective partner nations. Through the Artemis Accords, and through the various collaborations on individual spacecraft such as Orion or Gateway, the U.S. is tying itself closer to its partners in space, relying on them to deliver certain pieces of the puzzle and thereby permitting its own domestic space effort to focus on a set of key areas—for example, the U.S. did not need to develop its own service module component for the Orion spacecraft, as this role is filled by the European Service Module, effectively outsourcing part of the spacecraft to Europe and allowing domestic resources to be spent elsewhere in the program.

For the United States, this could be seen as a geopolitical double-edged sword. On the one hand, efficiency is increased by collating the resources of multiple countries, and allowing partners to come in and provide key assets to Artemis and other programs. The burden of creating and executing a lunar landing project gets spread across multiple actors. The United States is then able to strengthen its bonds to its partners and allies, tying their space efforts up with its own and compelling them to be invested in the success of U.S. space endeavors. On the other hand, however, it also creates a reliance on foreign actors and foreign technology that cannot necessarily be replaced on short notice with domestic alternatives. This is not a pressing concern so long as relations between the U.S. and a given partner country remain positive and stable, but it creates a vulnerability to the self-sufficiency of the United States, which can be exploited in the event that such relations should begin to turn sour.

An example of this can be seen in the retirement of the Space Shuttles, which created a situation in which the United States possessed no domestic means whatsoever of flying its own astronauts to space between the years of 2011 and 2020 (see section 3.1.7). During this period, it had to rely on Russia for crewed launches. Had this still been the case in 2023, with relations between Russia and the United States having deteriorated significantly over the war in Ukraine, the United States' crewed spaceflight ambitions might have been in serious jeopardy. Relying on international partners for aspects of Artemis runs a similar risk, at least hypothetically.

For the partner nations themselves, the Artemis program is no doubt a tantalising opportunity. While many countries engage in spaceflight, and train astronauts to work on the ISS, very few possess even the means to launch crewed spacecraft of their own, and usually depend on international partnerships with the U.S. and (now less frequently) Russia to fly their astronauts. Likewise, the capability of flying astronauts to the Moon is largely out of reach for most space agencies. To date, only twenty-four humans have been to lunar orbit—all of them American. Artemis thus presents the opportunity for nations with otherwise-smaller space programs to not only work remotely with lunar exploration, but to have their own astronauts visit lunar orbit, and perhaps even the surface of the Moon. Aside from possible scientific benefits, there can be no doubt that a significant amount of national prestige is associated with this idea.

The partner nations must, however, willingly bind themselves to the terms of the Artemis Accords, and will have to rely on the United States for their own lunar ambitions and access

to the Moon. This gives the United States quite a bit of power over its smaller partners, perhaps more so in the grand scheme than the partners have over the United States. There is also the possibility that external competitors such as China may come along with their own proposals for participating in a rival Moon program, on conditions of exclusivity. This in turn would tie in to larger geopolitical and international relations concerns in an increasingly multipolar world.

As space becomes an increasingly relevant part of technological infrastructure (which, as Al-Rodhan shows, affects states in multifaceted ways), so too does it become increasingly important for states to conduct their space policy carefully, especially with regards to large undertakings such as the Artemis program.

4.3.2 On Commercialisation

The commercial component of Artemis seeks both to achieve cost efficiency through utilising domestic market competition among contractors, and to enable access to the Moon for private enterprises looking to deliver their own payloads to lunar space and the lunar surface. Both of these goals have the effect of further strengthening the United States' own capacity to explore and exploit the Moon, but may also carry wider implications that bear some geopolitical relevance.

The utilisation of market competition reflects the belief in competition as a driver for innovation and efficiency. This is reflected throughout the Artemis program and U.S. space policy at large, as seen with the HLS design competitions for Artemis' lander systems, as well as the increasing reliance on commercially developed space launch vehicles and spacecraft. This mentality is itself also reflected in common narratives about the Space Race, as seen in the work of Everett Dolman, who argues that international competition was a central component of the spaceflight innovations made during the Cold War. The goal of reducing cost of access to the Moon through increased commercialisation also mirrors the underlying goal of programs such as COTS, CRS, and the development of commercial launch systems like Falcon-9, which are now driving down the cost of access to low-Earth orbit. If such cost reductions are successful for lunar exploration, the Moon itself becomes more accessible—both to the United States and to its partners, though the United States would benefit the most, as it would hold the proverbial "keys" to the Moon.

Enabling access for private actors to the Moon also enables a greater breadth of scientific undertakings, as private companies might themselves choose to design and deploy new experiments, technologies, and exploratory spacecraft without needing to be part of a NASA space mission. The Commercial Lunar Payload Services (CLPS) program, in which such flights are contracted through NASA, forms the basis for this access, already with several commercial contracts underway.

The flight of commercial payloads to the Moon also constitutes an added dimension of responsibility for the government of the United States. Per existing treaties and agreements—most centrally, the Outer Space Treaty—all these payloads remain the jurisdiction and responsibility of the United States. That means it falls on the United States to ensure that any commercial activity on the Moon is done in accordance with international law. It is notable, then, that the SPACE Act may be interpreted as giving American private actors the go-ahead to commercially exploit lunar resources without legal reprimand. While this does not explicitly or intentionally constitute national appropriation of the Moon, there has been, as previously mentioned, criticism that accuses the U.S. of preparing to abandon the Outer Space Treaty's stance against national appropriation of celestial objects. The Artemis Accords insist that lunar resource exploitation will be done in accordance with Article II of the Outer Space Treaty, but if it should prove profitable enough to abandon this principle, realist logic—such as that of Everett Dolman—would predict a change in outer space regimes, heralded by commercialisation.

4.3.3 On Long-term Implications

Profitable lunar exploitation is unlikely to be viable in the near term, but whosoever makes it viable will most likely do so through laying the groundwork over time. There is no end to the possible ways in which it could be speculated that future space exploitation will (or won't) occur, but what remains certain is that lunar exploitation (and the exploitation of other celestial bodies) is largely a question of infrastructure: It takes launch vehicles, habitable spaces, lunar landers, and other technologies in order to realise any such scheme. The Artemis program represents a considerable investment towards creating that infrastructure, as do many of the associated programs on which Artemis draws, like Gateway, commercial crew, and CLPS. If the Moon is at any point made into a materially profitable venture, Artemis may be poised to provide the United States and its partners with a head start.

Should it prove profitable to commercially exploit the Moon, it can certainly be imagined that other nations will strive to compete for their own slice of the lunar pie. A "scramble for the Moon" could then begin in earnest, and many of the hopes and fears of writers like Dolman and Deudney could then be realised. The Moon could become a political battleground, as states compete over important locations on the lunar surface, and such conflicts could conceivably turn hostile, as laid out by both Al-Rodhan and Deudney. The same infrastructures and technologies would inevitably also enable exploitation of other celestial bodies, such as asteroids, and the planet Mars. If the "Moon to Mars" doctrine is maintained throughout the Artemis program, the program may eventually see the U.S. and its partners given a head start beyond the Moon, as well. New international legislation to support an orderly and peaceful division of lunar and interplanetary resources may be attempted, but the outcomes of such attempts would be difficult to predict from the present.

Successfully capitalising on the resources of outer space would not only directly strengthen any space expansion attempt, but could also grant considerable strategic advantages closer to home. Daniel Deudney gives us his warnings about "planetoid bombs", highlighting the possibility that any state which can control and manipulate natural resources in deep space could also weaponise those resources. A partially or fully self-sustaining presence in outer space could even serve to circumvent hostile attempts at denying access to space, by dispersing military assets beyond just Earth such that counter-attacks may be mounted from space. As Dolman tempts, and as Deudney warns, a country with such control of outer space could then hold the entire planet hostage to its demands.

Futures like this are highly speculative. The Artemis program is certainly not a conscious effort to seize absolute dominion over outer space, nor is it explicitly a gambit to turn the Moon into a profit venture. However, these are real possibilities, with a serious chance of resulting from endeavours such as the Artemis program. If Artemis proceeds as planned, and humanity returns to the Moon "to stay", as NASA administrator Jim Bridenstine put it (National Aeronautics and Space Administration, 2019b), then it becomes only a question of time until these concerns must be addressed in earnest. Whether it is to be a continuation of *res communis* and the restriction of outer space to purely peaceful and scientific uses, or a transition into *res nullius* and unfettered resource competition between spacefaring countries, Artemis is likely to play a key role in asking and answering these questions.

4.3.4 On Motivations

The motivations behind state actions are an important object of theoretical consideration. Historically, we can see that the possible motivations behind establishing and maintaining space programs range from seeking space power and demonstrating one's missile technologies, to a desire for national prestige and boosting domestic morale. Artemis is not an exception to this, nor are its associated programs—but in these recent spaceflight developments there are also some new motivations.

Sustainability and affordability forms a core part of both Artemis and the commercial launch industry in the U.S. This has political benefits, as it may be easier to secure funding for new space projects if the funding required is smaller than before, enabling public space efforts through NASA to achieve more with the same level of budget. It is also a direct strategic benefit to the United States, however—effectively raising the amount of possible space assets the country can operate, without raising the cost of deploying them. Lowering the cost of space access means boosting the nation's space power.

The emphasis on cost and sustainability also fits in with a realist logic: Self-interested states strive to get the most out of their position and their resources, and lowering the cost of spaceflight means exactly this. Dolman's argument that Apollo ended because competition ended proves a useful point of comparison. In this logic, the cost of maintaining a presence on the Moon through the Apollo program outweighed the benefit of—and therefore the interest in—continuing the program. Through its focus on sustainability and cost reduction, Artemis can thus be viewed as an attempt at creating a lunar exploration program that better conforms to realist expectations of state behaviour, seeking to maintain itself as being continually within the self-interest of the United States to maintain.

As has been mentioned, the importance of international partnerships in the Artemis program also carries implications over the self-interest of the United States. Here, realist interpretations may be attempted as well as non-realist ones: The potential benefits of tying its allies close together and outsourcing parts of the program to others are indeed beneficial to the self-interest of the United States; but the possible liability presented by the reliances these ties introduce may also run counter to such a motive. It therefore becomes possible to view Artemis as being motivated, at least in part, by a genuine desire for peaceful, cooperative space exploration. After all, the U.S. is under no obligation to provide other countries with access to the Moon—it is already the world's leading spacefaring power, as well as a military

and economic superpower, and it could well be argued that the Artemis program could have been an entirely domestic undertaking (such as Apollo was) if the U.S. had wanted it to be.

Lastly, and perhaps most interestingly, indications exist that the Artemis program, and the U.S. space program at large, is driven in some part by a desire to facilitate and benefit from space expansion. The final report of the Augustine Committee in 2009, which played a crucial role in creating what became the Artemis program, quite explicitly states its view that the end goal of human space exploration is "to chart a path for human expansion into the solar system" (Review of U.S. Human Spaceflight Plans Committee, 2009, p. 22, 39). The focus on commercialising the space industry may also serve this motive, especially in light of the SPACE Act. The Artemis program already seeks to develop technologies that would be necessary to achieve this, such as ISRU technologies, surface habitats, and so on. It all indicates that the desire for profitable space expansion is a partial motivator behind Artemis, and that Artemis could be planned as a stepping stone to something like Daniel Deudney's Orbita. Indeed, the literature covered in this thesis broadly supports the notion that outer space contains a vast wealth of resources that spacefaring nations could one day tap into, to their own tremendous benefit, and especially so to whoever gets there first. This also supports the previously raised notion that the United States may seek to challenge the notion of *res communis* in the near future.

5 Summary and Conclusion

This thesis has explored the application of theories of geopolitics to the domain of outer space, focusing on the United States' new crewed lunar exploration program, the Artemis program. Four existing works dealing with the geopolitics of outer space have been laid out for use in the analysis, each representing a differing perspective on theories of geopolitics and on their application to outer space. Everett Dolman's *Astropolitik* has been used as the principal example of a realist perspective, rooted in classical theories of geopolitics such as Sir Halford Mackinder's Heartland theory. Fraser MacDonald's Anti-*Astropolitik*, being itself a rebuttal of Dolman's work, has been used to provide a countering perspective from the school of critical geopolitics, based on the works of Gearoid Ó Tuathail. Nayef Al-Rodhan's *Meta-geopolitics* of Outer Space has also been used to provide assessment of the geopolitics of outer space through Al-Rodhan's own *meta-geopolitics* framework, as well to provide a working definition of the term "space power", and assessing the dangers of space weaponisation. Lastly, Daniel Deudney's Dark Skies has been used as a scrutinising

perspective, criticising many of the notions and assumptions that underlie most literature on the subject of space exploration and the use of space resources, and warning against perceived existential risks associated with the expansion of human civilisation into space.

To supplement discussion of the Artemis program, this thesis has also laid out the spaceflight context of present-day U.S. space policy, including the history of American spaceflight during the Cold War and the recent history of new developments such as the commercialisation of the U.S. spaceflight industry. Concepts relating to the militarisation and weaponisation of outer space have also been explained, such as the nature of various kinds of space weapons and military systems in space. International law regarding space exploration and the use of outer space has also been covered, laying out the historical development and current state of space law, which centers on the 1967 Outer Space Treaty. Finally, the Artemis program itself has also been laid out in broad detail, for the purposes of informing its discussion.

The geopolitical significance of the Artemis program has been assessed in distinct facets: Firstly, the geopolitical importance of outer space has been assessed more broadly, to show that space technologies and the exploration of outer space carries an inherent significance to geopolitics, thereby render importance to any large undertaking such as Artemis. This significance is evident in the increasing infrastructural reliance on space technologies, especially communications and navigation satellites, as well as accurate real-time Earth observation. This significance is further evidenced by highlighting the creation of dedicated "space forces" by some of the world's major spacefaring powers, including the United States; it is argued that the creation of space forces signals a significant interest in space security and space power. It is further argued, on the basis of the four theoretical works, that states may desire space power as a means to counter nuclear threats, or to achieve unprecedented levels of force projection.

Secondly, the geopolitical importance of the Earth's Moon—the primary focus of the Artemis program—has been assessed in broad detail, and used to platform a discussion about the potential for material exploitation of space resources and the question of national territorial claims in space. Chiefly, two possible outer space regimes are assessed: That of *res communis*, in which space is deemed the common ownership of humanity and not subject to individual claims of ownership (the regime in which current space law is situated), and that of *res nullius*, in which space is deemed the property of no one and thus made eligible for ownership claims. Arguments for and against either regime are drawn from the four

theoretical works of Dolman, MacDonald, Al-Rodhan, and Deudney; and discussed in relation to the Moon, and the Artemis program as a means to explore and exploit the Moon. This thesis takes no stance on a preferred regime, but argues instead that the Artemis program may in future pose a challenge to the existing regime of *res communis*.

Thirdly, the geopolitical significance of the Artemis program itself is examined and assessed, from the perspective of both the United States and its partner nations in the program. This examination begins by looking at possible geopolitical advantages and disadvantages inherent to participating in the Artemis program. Benefits are highlighted, such as cooperation increasing scale and efficiency for the United States' own ambitions, and providing unprecedented space exploration opportunities to countries that otherwise do not possess the means to send astronauts to the Moon on their own. These benefits are contrasted with potential downsides, such as increased reliance on complex relations that could jeopardise the health of the program if soured. Smaller partner nations may also find themselves at a crossroads between superpowers, in the event of large-scale competition for lunar exploration, inviting complexities in questions of foreign policy, all while outer space technologies grow more important. The increasing utilisation of commercial vendors to develop and provide space technologies is similarly assessed, and used to raise the question of what may happen if commercial exploration and exploitation of the Moon becomes a lucrative business. The possible long-term consequences of enabling profitable exploitation of the Moon and outer space resources is assessed last, arguing that the Artemis program may be the start of a path on which questions about the ownership of outer space may need to be addressed, and on which the imagined hazards of hypothetical futures may threaten to become reality if not addressed.

In conclusion, this thesis finds that the Artemis program, along with associated programs and developments in spaceflight and space exploration, is leading towards a possible challenge to the existing *res communis* nature of outer space in international law. The Artemis program also positions the United States and its space allies to lead the charge in lunar exploration and, perhaps, exploitation. This serves to tie the United States and its allies closer together in space collaboration, and further cements the United States' position as the world's leading spacefaring power—maintaining and increasing its ability to exercise space power and project force through space-based technologies, as well as moving the United States into a position where it could readily benefit from the economic exploitation of the Moon and other space resources, should *res communis* be abandoned for *res nullius*.

The Artemis program represents one of the most ambitious undertakings in all of spaceflight. With half a century gone since the last of the Apollo landings, Artemis looks to take humanity back to the Moon—and this time to stay, if NASA is to be believed. Artemis is also emblematic of a multitude of new developments in spaceflight and in the space policy of the United States. Commercially developed rockets and spacecraft are now driving down the cost of access to space, all while space-based technologies form an increasingly integral part of our modern lives. Brewing international rivalries between spacefaring powers also opens for comparisons to the Cold War and the Space Race, promising a sequel that may utterly surpass the original. Outer space is becoming increasingly significant as an area of geopolitics, and with that significance come many new dangers and opportunities, in equal measure. Artemis may prove a bold attempt to seize the promise of outer space.

The exploration of space will go ahead, whether we join in it or not, and it is one of the great adventures of all time, and no nation which expects to be the leader of other nations can expect to stay behind in this race for space.

-John F. Kennedy, September 12th, 1962.

Works cited

Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, December 5, 1979. https://treaties.un.org/doc/Treaties/1984/07/19840711%2001-51%20AM/Ch_XXIV_02.pdf

Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, December 19, 1967. https://www.unoosa.org/pdf/gares/ARES_22_2345E.pdf

Al-Rodhan, N. (2012). *Meta-geopolitics* of outer space: An analysis of space power, security and governance (1st ed. 2012 ed.). Palgrave Macmillan.

Artemis Accords: Principles For Cooperation in the Civil Exploration and Use of the Moon, Mars, Comets, and Asteroids for Peaceful Purposes, October 13, 2020. https://www.nasa.gov/specials/artemis-accords/img/Artemis-Accords-signed-13Oct2020.pdf

Associated Press, The (2022) *Russia plans to leave International Space Station after 2024.* NPR. https://www.npr.org/2022/07/26/1113683450/space-station-iss-russia-leaving-2024

Atomic Heritage Foundation (2017, April 7) *Nuclear Weapon Test Bans*. https://ahf.nuclearmuseum.org/ahf/history/nuclear-weapon-test-bans/

Belew, L. F. (1977) *Skylab, Our First Space Station*. Scientific and Technical Information Office, National Aeronautics and Space Administration. https://history.nasa.gov/SP-400/ch2.htm

Bender, B. (2022) *Moon battle: New Space Force plans raise fears over militarizing the lunar surface.* Politico. https://www.politico.com/news/2022/03/12/space-force-moon-pentagon-00016818

Bergin, C. (2020) *Dragon XL revealed as NASA ties SpaceX to Lunar Gateway supply contract*. Nasaspaceflight.com. https://www.nasaspaceflight.com/2020/03/dragon-xl-nasa-spacex-lunar-gateway-supply-contract/

Betz, E. (2020) *Apollo-Soyuz Mission: When the Space Race Ended.* Discover Magazine. https://www.discovermagazine.com/the-sciences/apollo-soyuz-mission-when-the-space-race-ended

Bingen, K. A., Johnson, K., Bustillo, J. D., Dean, M. V. (2022) *U.S. Space Force Primer*. Center for Strategic and International Studies. https://aerospace.csis.org/us-space-force-primer/

Bloembergen, N., Patel, C. K., Avizonis, P., Clem, R. G., Hertzberg, A., Johnson, T., Marshall, T., Miller, R. J., Morrow, W. E. M., Salpeter, E. E., Sessler, A. M., Sullivan, J. P., Wyant, J. C., Yariv, A., Zare, R. N., Glass, A. J., Hebel, L. C., Pake, G. E., May, M., . . . York, H. F. (1987). Report to The American Physical Society of the study group on science and technology of directed energy weapons. *Reviews of Modern Physics*, *59*(3), S1–S201. https://doi.org/10.1103/revmodphys.59.s1

Boeing Company (n.d.) *X-20 DYNA-SOAR SPACE VEHICLE*. Retrieved from: https://www.boeing.com/history/products/x-20-dyna-soar.page

Boley, A., Byers, M. (2020) U.S. policy puts the safe development of space at risk. *Science, 370*(6513), 174-175. DOI: 10.1126/science.abd3402

Borch, F. L. (n.d.) *Soldiers on the Moon?!? The Army's Strange but True Plan for a Lunar Outpost.* National Museum of the United States Army. https://armyhistory.org/soldiers-moon-armys-strange-true-plan-lunar-outpost/

Center for Strategic and International Studies (2019) *Bad Idea: The Wolf Amendment (Limiting Collaboration with China in Space)*. https://www.csis.org/analysis/bad-idea-wolf-amendment-limiting-collaboration-china-space

Central Intelligence Agency (n.d.) *Different Times, Same Playbook: Moscow's Response to US Plans for Missile Defense*. CIA Directorate of Intelligence. (21-25). Retrieved from: https://www.cia.gov/readingroom/docs/DOC_0006122438.pdf

Convention on International Liability for Damage Caused by Space Objects, March 29, 1972. https://treaties.un.org/doc/Publication/UNTS/Volume%20961/volume-961-I-13810-English.pdf

Convention on Registration of Objects Launched into Outer Space, November 12, 1974. http://www.unoosa.org/oosa/en/SpaceLaw/gares/html/gares_29_3235.html

Chow, D. (2022) *NASA plans watery end for space station in 2031*. NBC News. https://www.nbcnews.com/science/space/nasa-plans-watery-end-space-station-2031-rcna14576

David, L. (2021) *Military interest in the Moon is ramping up*. Space.com https://www.space.com/military-interest-moon-cislunar-space

Davis, M. (n.d.) *The Space Race*. The Miller Center. https://millercenter.org/the-presidency/educational-resources/space-race

Deudney, D. (1997). Geopolitics and Change. In *New thinking in international relations theory*(M. W. Doyle; G. J. Ikenberry, Ed.) (pp. 91–123). Routledge. Retrieved from: https://millenniumjournal.org/wp-content/uploads/2012/11/geo-geopolitics-and-change-deudney.pdf

Deudney, D. (2000). Geopolitics as Theory:: Historical Security Materialism. *European Journal of International Relations*, *6*(1), 77–107. https://doi.org/10.1177/1354066100006001004.

Deudney, D. (2020). *Dark Skies: Space Expansionism, Planetary Geopolitics, and the Ends of Humanity*. Oxford University Press. (Kindle Cloud Reader version).

Dobrijevic, D. & Howell, E. (2023) *Columbia Disaster: What happened and what NASA learned.* Space.com. https://www.space.com/19436-columbia-disaster.html

Dolman, E. C. (2002). *Astropolitik: Classical Geopolitics in the Space Age*. Routledge.

Duvall, R., Havercroft, J. (2009) "Critical Astropolitics," in Natalie Bormann and Michael Sheehan (ed.) *Securing Outer Space* (Routledge), pp. 42 – 58.

Erwin, S. (2018) *Chairman Rogers: space corps needed more than ever, Air Force 'in denial'.* Spacenews.com. https://spacenews.com/chairman-rogers-space-corps-needed-more-than-ever-air-force-in-denial/

European Space Agency (n.d.a) *About the International Space Station*. European Space Agency (ESA). Retrieved from: https://www.esa.int/Science_Exploration/Human_and_Robotic_Exploration/International_Space_Station/About_the_International_Space_Station

European Space Agency (n.d.b) *Gateway*. European Space Agency (ESA). Retrieved from: https://www.esa.int/Science_Exploration/Human_and_Robotic_Exploration/Exploration/Gateway

European Space Agency (n.d.c) *Argonaut—European Large Logistics Lander*. European Space Agency (ESA). Retrieved from: https://www.esa.int/Science_Exploration/Human_and_Robotic_Exploration/Exploration/Argonaut_European_Large_Logistics_Lander

European Space Agency (n.d.d) *European Service Module*. European Space Agency (ESA). Retrieved from: https://www.esa.int/Science_Exploration/Human_and_Robotic_Exploration/Orion/European_Service_Module

Everett, C. J., Ulam, S. M. (1955) *On a Method of Propulsion of Projectiles by Means of External Nuclear Explosions Part 1.* Los Alamos Scientific Laboratory of the University of California. Retrieved from: https://apps.dtic.mil/sti/pdfs/ADA306631.pdf

Gleason, M. P., Hays, P. L. (2020) *Space Agenda 2021: A Roadmap for Assessing Space Weapons*. Center for Space Policy and Strategy. Retrieved from: https://aerospace.org/sites/default/files/2020-10/Gleason-Hays_SpaceWeapons_20201006_0.pdf

Grush, L. (2019) *NASA administrator on new Moon plan: "We're doing this in a way that's never been done before".* The Verge. https://www.theverge.com/2019/5/17/18627839/nasa-administrator-jim-bridenstine-artemis-moon-program-budget-amendment

Grush, L. (2020) *US and seven other countries sign NASA's Artemis Accords to set rules for exploring the Moon.* The Verge. https://www.theverge.com/2020/10/13/21507204/nasa-artemis-accords-8-countries-moon-outer-space-treaty

Harrison, T., & Johnson, K. (2017) *Back to the Moon? Understanding Trump's Space Policy Directive 1*. Center for Strategic and International Studies. https://www.csis.org/analysis/back-moon-understanding-trumps-space-policy-directive-1

Harvey, A. (2022) *V2 Rocket: Origin, history and spaceflight legacy.* Space.com. https://www.space.com/v2-rocket

Harvey, A., Mann, A. (2022) *NASA's Artemis program: Everything you need to know.* Space.com. https://www.space.com/artemis-program.html

Harwood, W. (2021) *NASA says first Artemis moon landing now expected in 2025.* CBS News. https://www.cbsnews.com/news/nasa-says-first-artemis-moon-landing-slipping-to-2025/

Howell, E. (2022) *Space shuttle Challenger and the disaster that changed NASA forever.* Space.com. https://www.space.com/18084-space-shuttle-challenger.html

H.R.2262 - 114th Congress (2015-2016): U.S. Commercial Space Launch Competitiveness Act. (2015, November 25). https://www.congress.gov/bill/114th-congress/house-bill/2262

Jones, A. (2021) *China's Tiangong space station*. Space.com. https://www.space.com/tiangong-space-station

Kay, W. D. (1998) Space Policy Redefined: The Reagan Administration and the Commercialization of Space. *Business and Economic History*, *27*(1), 237–247. http://www.jstor.org/stable/23703086

Kennedy, J. F. (1963, September 20) *Address Before the 18th General Assembly of the United Nations, September 20, 1963*. John F. Kennedy Presidential Library and Museum. https://www.jfklibrary.org/archives/other-resources/john-f-kennedy-speeches/united-nations-19630920

Kennedy, L. (2019, January 22) *Why Reagan's 'Star Wars' Defense Plan Remained Science Fiction*. History.com. https://www.history.com/news/reagan-star-wars-sdi-missile-defense

Kolawole, E. (2011) *The Orion capsule begins to take shape.* Washington Post. https://www.washingtonpost.com/blogs/innovations/post/the-orion-capsule-begins-to-take-shape/2011/09/11/gIQAzvjGLK_blog.html

Launius, R. D. (2005) *Sputnik and the Origins of the Space Age*. National Aeronautics and Space Administration. https://history.nasa.gov/sputnik/sputorig.html

Lawler, A. (2009) *No to NASA: Augustine Commission wants to more boldly go*. Science.org. https://www.science.org/content/article/no-nasa-augustine-commission-wants-more-boldly-go

Listner, M. (2011) *The Moon Treaty: failed international law or waiting in the shadows?* The Space Review. https://www.thespacereview.com/article/1954/1

MacDonald, F. (2007). Anti-*Astropolitik*—outer space and the orbit of geography. Progress in Human Geography, 31(5), 592–615. https://doi.org/10.1177/0309132507081492

Mackinder, H. J. (1904) The Geographical Pivot of History. *The Geographical Journal*, *23*(4), 421-437. http://www.jstor.org/stable/1775498

Mackinder, H. J. (1919) *Democratic Ideals and Reality*. National Defense University Press.

Madrigal, A. C. (2012) Moondoggle: *The Forgotten Opposition to the Apollo Program*. The Atlantic. https://www.theatlantic.com/technology/archive/2012/09/moondoggle-the-forgotten-opposition-to-the-apollo-program/262254/

Malik, T. (2010) *NASA grieves over canceled program.* NBC News. https://www.nbcnews.com/id/wbna35209628

Mann, A. (2020) *The Apollo Program: How NASA sent astronauts to the Moon.* Space.com. https://www.space.com/apollo-program-overview.html

Memorandum (2018a) *Space Policy Directive-2, Streamlining Regulations on Commercial Use of Space*. Issued on May 24th, 2018. Retrieved from: https://trumpwhitehouse.archives.gov/presidential-actions/space-policy-directive-2-streamlining-regulations-commercial-use-space/

Memorandum (2018b) *Space Policy Directive-3, National Space Traffic Management Policy*. Issued on June 18th, 2018. Retrieved from: https://trumpwhitehouse.archives.gov/presidential-actions/space-policy-directive-3-national-space-traffic-management-policy/

NASA Advisory Council (2022) *ARTEMIS: Artemis I-IV Mission Overview/Status*. (A. Kshatriya; M. Kirasich, Ed.) Retrieved from: https://www.nasa.gov/sites/default/files/atoms/files/nac_october_2022_artemis_final_rev_b.pdf

National Science and Technology Council (1996, September 19) *NATIONAL SPACE POLICY*. Retrieved from: https://www.globalsecurity.org/space/library/policy/national/nstc-8.htm?utm_content=cmp-true

National Aeronautics and Space Administration (2004) *The Vision for Space Exploration*. https://www.nasa.gov/pdf/55583main_vision_space_exploration2.pdf

National Aeronautics and Space Administration. (2008) *In the Beginning: Project Mercury*. https://www.nasa.gov/centers/kennedy/about/history/mercury.html

National Aeronautics and Space Administration (2017, August 4) *Commercial Orbital Transportation Services (COTS)*. (E. Kisliuk, Ed.) https://www.nasa.gov/commercial-orbital-transportation-services-cots

National Aeronautics and Space Administration (2019, March 26) *Mercury-Redstone Launch Vehicle.* (L. Mohon, Ed.) https://www.nasa.gov/centers/marshall/history/mercury-redstone.html

National Aeronautics and Space Administration (2019b, March 26) *NASA Administrator Statement on Return to Moon in Next Five Years*. (B. Inclán; K. Northon, Ed.)

https://www.nasa.gov/press-release/nasa-administrator-statement-on-return-to-moon-in-next-five-years

National Aeronautics and Space Administration (2020, January 23) *Space Station 20th: Historical Origins of the ISS*. (J. Uri, Ed.) https://www.nasa.gov/feature/space-station-20th-historical-origins-of-iss

National Aeronautics and Space Administration (2020b, October 28) *Lunar Living: NASA's Artemis Base Camp Concept*. (C. Warner, Ed.) https://blogs.nasa.gov/artemis/2020/10/28/lunar-living-nasas-artemis-base-camp-concept/

National Aeronautics and Space Administration (2020c, April 2) *NASA Outlines Lunar Surface Sustainability Concept*. (C. Warner, Ed.) https://www.nasa.gov/feature/nasa-outlines-lunar-surface-sustainability-concept

National Aeronautics and Space Administration (2021, January 4) *NASA, International Partners Advance Cooperation with Artemis Accords.* (S. Potter; C. Warner, Ed.) https://www.nasa.gov/press-release/nasa-international-partners-advance-cooperation-with-first-signings-of-artemis-accords

National Aeronautics and Space Administration (2021b, April 16) *As Artemis Moves Forward, NASA Picks SpaceX to Land Next Americans on Moon.* (M. Witt; J. Rowe; K. Brown, Ed.) https://www.nasa.gov/press-release/as-artemis-moves-forward-nasa-picks-spacex-to-land-next-americans-on-moon

National Aeronautics and Space Administration (2021c, July 9) *NASA, Northrop Grumman Finalize Moon Outpost Living Quarters Contract*. (M. Witt; K. Hambleton; I. Reyna; S. Potter, Ed.) https://www.nasa.gov/press-release/nasa-northrop-grumman-finalize-moon-outpost-living-quarters-contract

National Aeronautics and Space Administration (2023a, March 3) *Visitor to the Station by Country*. (M. Garcia, Ed.) https://www.nasa.gov/feature/visitors-to-the-station-by-country/

National Aeronautics and Space Administration (2023b, April 18) *Moon to Mars Architecture*. (E. Mahoney, Ed.) https://www.nasa.gov/MoonToMarsArchitecture

National Aeronautics and Space Administration (2023c, April 20) *Commercial Lunar Payload Services Overview*. (B. Dunbar, Ed.) https://www.nasa.gov/commercial-lunar-payload-services-overview

O'Callaghan, J. (2020) *SpaceX Makes History With First-Ever Human Rocket Launch for NASA.* Forbes. https://www.forbes.com/sites/jonathanocallaghan/2020/05/30/spacex-makes-history-with-first-ever-human-rocket-launch-for-nasa/?sh=2225f12f5321

Pace, S., Frost, G. P., Lachow, I., Frelinger, D. R., Fossum, D., Wassem, D., Pinto, M. M. (1995) *The Global Positioning System: Assessing National Policies*. RAND Corporation. https://doi.org/10.7249/MR614

Parke, N (2015, November 5) *Polyus: the Real Death Star?* Armagh Observatory and Planetarium. Retrieved from: https://armaghplanet.com/*Polyus*-the-real-death-star.html

Pattle, W. (2017) *Buran - the Soviet Space Shuttle*. National Space Centre. https://spacecentre.co.uk/blog-post/buran-soviet-space-shuttle/

Pompeo, M. (2022) *Nuclear Weapons, China, and a Strategic Defense Initiative for this Century.* The National Interest. https://nationalinterest.org/feature/nuclear-weapons-china-and-strategic-defense-initiative-century-199549

Review of U.S. Spaceflight Plans Committee. (2009) *Seeking a Human Spaceflight Program Worthy of a Great Nation*. Retrieved from: https://www.nasa.gov/pdf/617036main_396093main_HSF_Cmte_FinalReport.pdf

Reif, K. (2018) *Congress Calls For Interceptors In Space*. Arms Control Association. https://www.armscontrol.org/act/2018-09/news/congress-calls-interceptors-space

Reiffel, L. (1959) *A Study of Lunar Research Flights, Vol I*. Illinois Institute of Technology Armour Research Foundation. Retrieved from: https://nsarchive2.gwu.edu/NSAEBB/NSAEBB479/docs/EBB-Moon02.pdf

Roulette, J. (2021) *Pivoting from NASA, Russia partners with China for lunar space station.* The Verge. https://www.theverge.com/2021/3/9/22321114/lunar-moon-space-station-russia-china-agreement-nasa

Royal Museums Greenwich (n.d.) *Why did we stop going to the Moon?* https://www.rmg.co.uk/stories/topics/why-did-we-stop-going-moon

Sietzen, F. (1997) *Soviets Planned to Accept JFK's Joint Lunar Mission Offer*. SpaceCast News Service. Retrieved from: https://www.spacedaily.com/news/russia-97h.html

Sloan, G & Gray, C. S. (1999) Why geopolitics?, *The Journal of Strategic Studies*, *22*(2-3), 1-11, DOI: 10.1080/01402399908437751

Smith, M. (2022) *Anti-satellite weapons: History, types and purposes.* Space.com. https://www.space.com/anti-satellite-weapons-asats

Srivastava, I. (2014) *How Kargil spurred India to design its own GPS*. The Times of India. https://timesofindia.indiatimes.com/home/science/How-Kargil-spurred-India-to-design-own-GPS/articleshow/33254691.cms

Stromberg, J. (2014) *How NASA became utterly dependent on Russia for space travel*. Vox. https://www.vox.com/2014/5/5/5674744/how-nasa-became-utterly-dependent-on-russia-for-space-travel

Suckow, E. (2009) *NACA Overview*. National Aeronautics and Space Administration. https://history.nasa.gov/naca/overview.html

Tackett, S. (2013) *Nuclear Pulse Propulsion: Gateway to the Stars.* American Nuclear Society. https://www.ans.org/news/article-1294/nuclear-pulse-propulsion-gateway-to-the-stars/

Time Magazine. (1945) *Science: Sun Gun*. Retrieved from: https://content.time.com/time/subscriber/article/0,33009,852344-1,00.html

Toyota Motor Corporation (2020) *JAXA and Toyota Announce "LUNAR CRUISER" As Nickname for Manned Pressurized Rover*. Retrieved from: https://global.toyota/en/newsroom/corporate/33208872.html

Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water, October 10, 1963. https://treaties.unoda.org/t/test_ban

Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, January 27, 1967. https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/outerspacetreaty.html

Tuathail, G. Ó., & Toal, G. (1996). Critical Geopolitics. Amsterdam University Press.

United Nations Office for Outer Space Affairs. (n.d.) *Committee on the Peaceful Uses of Outer Space*. https://www.unoosa.org/oosa/en/ourwork/copuos/index.html

United Nations Treaty Collections (2023) *Comprehensive Nuclear Test Ban Treaty*. Retrieved from: https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVI-4&chapter=26 (Last visit 02/05/2023)

United States Space Force (n.d.) *What's the Space Force*. Retrieved from: https://www.spaceforce.mil/About-Us/FAQs/Whats-the-Space-Force/

United States Space Force (2022, November 12) *X-37B orbital test vehicle concludes sixth successful mission.* https://www.spaceforce.mil/News/Article/3217077/x-37b-orbital-test-vehicle-concludes-sixth-successful-mission/

U.S. Department of State (n.d.) *Strategic Defense Initiative (SDI), 1983*. 2001-2009 Archive for for the U.S. Department of State. Retrieved from: https://2001-2009.state.gov/r/pa/ho/time/rd/104253.htm

U.S. Department of State (2022) *International Cooperation in NASA's Artemis I Program*. Office of the Spokesperson, United States Department of State. Retrieved from: https://www.state.gov/international-cooperation-in-nasas-artemis-i-program/
Vromen, A. (2018). Qualitative methods. In D. C. Marsh, G. Stoker, & V. Lowndes (Eds.), *Theory and Methods in Political Science*. https://doi.org/10.1057/978-1-137-60353-1

Wall, M. (2011) *How the Space Shuttle Was Born*. Space.com. https://www.space.com/12085-nasa-space-shuttle-history-born.html

Wall, M. (2019) *Elon Musk Floats 'Nuke Mars' Idea Again (He Has T-Shirts)*. Space.com. https://www.space.com/elon-musk-nuke-mars-terraforming.html

Wall, M. (2021) *Canada to launch moon rover by 2026*. Space.com. https://www.space.com/canada-launch-moon-rover-2026

Wall, M. (2022a) *Not just Artemis: China and Russia shooting for the Moon, too.* Space.com. https://www.space.com/china-russia-moon-base-ilrs

Wall, M. (2022b) *NASA wants another moon lander for Artemis astronauts, not just SpaceX's Starship*. Space.com. https://www.space.com/nasa-more-artemis-moon-landers-for-astronauts

Wasser, A. (2005) *LBJ's Space Race: What we didn't know then (part 1)*. The Space Review. https://www.thespacereview.com/article/396/1

Weitering, H. (2017) *NASA and Russia Partner Up for Crewed Deep-Space Missions*. Space.com. https://www.space.com/38287-nasa-russia-deep-space-gateway-partnership.html

Westcott, B. (2020, June 24) *China's GPS rival Beidou is now fully operational after final satellite launched*. CNN Business. https://edition.cnn.com/2020/06/24/tech/china-beidou-satellite-gps-intl-hnk/index.html

White House (2006) *U.S. National Space Policy*. Obama White House Archives. Retrieved from: https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/national-space-policy-2006.pdf

Wilson, C. (2008) *High Altitude Electromagnetic Pulse (HEMP) and High Power Microwave (HPM) Devices: Threat Assessments*. Congressional Research Service. Retrieved from: https://sgp.fas.org/crs/natsec/RL32544.pdf

Windrem, R. (2008) *How the Soviets stole a space shuttle*. NBC News. https://www.nbcnews.com/id/wbna18686090

World Nuclear Association (2018) *Peaceful Nuclear Explosions*. Retrieved from: https://world-nuclear.org/information-library/non-power-nuclear-applications/industry/peaceful-nuclear-explosions.aspx

Zak, A. (n.d.a) *Soviet lunar program*. RussianSpaceWeb. https://www.russianspaceweb.com/spacecraft_manned_lunar.html

Zak, A. (n.d.b) *The Salyut era: First space stations*. RussianSpaceWeb. https://www.russianspaceweb.com/spacecraft_manned_salyut.html

Zak, A. (2022) *That Time the Soviet Union Shot a Secret Space Cannon in Orbit*. Popular Mechanics. https://www.popularmechanics.com/military/weapons/a18187/here-is-the-soviet-unions-secret-space-cannon/