THE BETTER MIND OF SPACE

Matthew L. Lohmeier, Major, USAF

Wright Flyer Papers

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Foreword

It is my great pleasure to present another issue of The Wright Flyer Papers. Through this series, Air Command and Staff College presents a sampling of exemplary research produced by our resident and distance-learning students. This series has long showcased the kind of visionary thinking that drove the aspirations and activities of the earliest aviation pioneers. This year's selection of essays admirably extends that tradition. As the series title indicates, these papers aim to present cutting-edge, actionable knowledge—research that addresses some of the most complex security and defense challenges facing us today.

Recently, The Wright Flyer Papers transitioned to an exclusively electronic publication format. It is our hope that our migration from print editions to an electronic-only format will foster even greater intellectual debate among Airmen and fellow members of the profession of arms as the series reaches a growing global audience. By publishing these papers via the Air University Press website, ACSC hopes not only to reach more readers, but also to support Air Force–wide efforts to conserve resources. In this spirit, we invite you to peruse past and current issues of The Wright Flyer Papers at https://www.airuniversity.af.edu/AUPress/Wright-Flyers/.

Thank you for supporting The Wright Flyer Papers and our efforts to disseminate outstanding ACSC student research for the benefit of our Air Force and war fighters everywhere. We trust that what follows will stimulate thinking, invite debate, and further encourage today's air, space, and cyber war fighters in their continuing search for innovative and improved ways to defend our nation and way of life.

EVAN L. PETTUS
Brigadier General, USAF
Commandant

Acknowledgments

First, I must say thank you to my classmates in the Schriever Scholars Program. Your combined experience and insight have been incredibly valuable to me this year at school. But what will remain more important to me than your professional expertise is that you have become my friends. I look forward to serving with you and coming back to you for counsel and advice.

I, of course, would be remiss if I did not also acknowledge and thank the faculty of the Schriever Scholars program. You have challenged my thinking, opened my eyes to many important issues in national security space, and introduced me to some of the most influential men and women in the community. Thank you for introducing me to *the Better Mind of Space*.

Last, and most importantly, I owe a debt of gratitude to my family. *I can no other answer make, but thanks, and thanks, and ever thanks*.

Preface

Culture, at a fundamental level, is comprised of shared values and assumptions about reality. It has to do with what is in the mind. Perhaps it is easier to analyze existing culture than it is to figure out how to change it. Yet that is the problem I would like to address in this paper. Specifically, how do you improve military space culture?

Admittedly, the question is ambiguous, but it is one I have been asked many times. Implicit in the question is the assumption that military space culture needs improvement. I do not challenge that assumption here, rather I accept it as something deserving of our time and effort. Of course, there are a myriad of ways to address any topic, but the idea of culture seems to be among the more elusive and subjective topics of research pertaining to space and space power. What follows is one more meager attempt to transform the elusive and subjective into something within reach.

Introduction

It is necessary to call into council the views of our predecessors in order that we may profit by whatever is sound in their views and avoid their errors.

—Aristotle

Consider two minds of space. These minds are emblematic of two competing cultures. They are not equal in merit, nor equally prevalent. One is rare while the other is common. One is more capable of advancing space power and the other less capable. After considering the merits and limitations of each, the psychological dilemma encountered should prompt those who possess the common mind to abandon it in favor of the rarer mind.[1]

My intent is to compare these two minds of space. The picture that emerges should help space professionals understand the complex tapestry in which polarized disagreements about a number of space-related issues is rooted.[2] Since its creation, the Air Force has maintained what we will call the traditional mind of space and is responsible for current military space culture. Like the waning moon, the traditional mind of space is diminishing in vigor, power, and influence. There is a better mind of space emerging that is much larger than the Air Force. The emergent mind of space is like the waxing moon—its illuminated area is increasing, and the clarity and power of its influence is growing.

This paper is presented using a framework consisting of three related parts that correlate to three facts of meaning common to mind agreed upon in Western philosophy.[3] These three facts of meaning are thought, purpose, and knowledge.[4] Part one analyzes how we think about space as a fact of mind and will juxtapose the traditional and emergent minds of space. Parts two and three similarly analyze our purpose in and our knowledge of space respectively to draw contrasts between the two minds.

There is a way to measure improvement to military space culture, but it requires the kind of intellectual scrutiny of one's own biases that causes discomfort for the undetermined mind.[5] A better understanding of military space culture requires a richer vocabulary than our overused airmindedness and its parallel, and equally uninteresting, spacemindedness. Thinking stops when we encounter words familiar to us.[6] The utility in presenting this new three-part philosophical framework lies in the hope that it furthers dialog about military space culture and leads to better understanding of what space is and the role of the military in that realm.

Mind in the Western Philosophical Tradition

The first fact of meaning common to Western philosophical tradition is thought. Thought serves organizational culture as the mechanism of reason that sifts through available data to help determine what is relevant. Thought is shaped by experience, and differences in experience frame differences in thought.[7] Thought manifested by the traditional mind of space is different than thought manifested by the emergent mind. Different data assume greater or lesser degrees of relevance because the way each of these minds think about the space domain are fundamentally different.

The second fact of meaning is purpose or intention. It is the direction of conduct to future ends. Purpose is the part of the mind that plans a course of action with foreknowledge of its goal and is manifested as working in some way toward a desired and foreseen objective. Purposiveness is sometimes called the faculty of will and can be regarded as the very essence of mentality, or mindset.[8] In military parlance, purposiveness equates to vision or mission.[9] For an organization to be effective, its purpose of mind must be unified and meaningful. The traditional and emergent minds of space, however, believe in different purposes for space. The mutual divergence of thought about, and purpose in space provides a biased lens through which each mind assesses and weighs the importance of data about space.[10]

The third fact of meaning common to mind is knowledge or knowing. Knowledge is a critical aspect of mind because its utility rests in truth and reality. These realities manifest themselves in the space domain as both facts of physics and facts of activity. Therefore, knowledge represents the nexus of the traditional and emergent minds, and the point from which they develop in different directions and project themselves into opposing spheres of influence.[11] A separate discussion of each of these three facts of meaning common to mind helps us to understand a holistic picture of the traditional and emergent minds of space. The military space professional is then confronted with a decision about the relevance and comparative advantage of each of these minds.

While the mind is not a distinctly human possession, the concept can also be attributed to entire organizations by virtue of its members sharing the same goals and working toward the same missions.[12] The Air Force has its own mind, and smaller organizations within the Air Force such as Air Combat Command, or for our purposes, Air Force Space Command (AFSPC), have their own minds. The analysis of the traditional and emergent minds of space presented here reveals differences that could rightly be referred to as cultural distinctions.[13] I assert that changes or shifts in the organizational

culture are necessarily characterized by the changes or shifts in the mindset of the persons who compose the greater organizational whole.[14]

Just as psychologist Dr. Daniel Kahneman's now famous "System 1" and "System 2" of the brain are notional, so are the two opposing minds of space, and there are people who can identify with either.[15] The comparison of these two minds is not intended to imply there are necessarily only two, but serves as a model. These minds may appropriately be viewed as forming two ends of a spectrum. In time, a different or better mind of space may emerge against which any prevailing mind might be juxtaposed for the purpose of analysis. This comparison serves its purpose by allowing us to clearly examine and question the views of predecessors.

Part One: Thought About Space

> *Airmen think spatially, from the surface to geosynchronous orbit.*
>
> —Air Force Basic Doctrine

> *Operating in a seamless medium, there are no natural boundaries to constrain air, space, and cyberspace operations.*
>
> —The Foundations of Airpower
> Air Force Basic Doctrine

In order to analyze thought about space as a fact of mind, we must juxtapose the traditional mind of space with an emergent one. The traditional mind thinks the air and space domains are an indivisible continuum. It tends to view military space operations as occurring in one or more of several orbits out to, and including, geosynchronous Earth orbit (GEO), but not beyond. Analysis of the traditional mind requires us to consider how military space professionals came to this belief, and so we turn to airmindedness.[16] Understanding how airmindedness translates to space provides a context for the way the traditional mind forms ideas about space, and from which it reasons about the purposes of space. That mind will then be contrasted with an emergent mind that thinks about a military space operating area composed of all cislunar[17] space and beyond, and that comprehends an expansive astropolitical model.

The Traditional Mind: Thought

The traditional mind of space thinks about space from the ground up, extending out to GEO. Earth is the only vantage humanity has ever known, and

this mind has been conditioned to think about space as an inseparable continuation of the air domain.

Dr. M.V. "Coyote" Smith noted the first documented use of the term airmindedness occurred in a *London Times* article published on 26 February 1927. At that time, its definition was limited and meant interest or enthusiasm "for the use and development of aircraft." By the mid-1930s, US Army Airmen such as Henry "Hap" Arnold, Carl "Tooey" Spaatz, and Jimmy Doolittle cultivated an aviation environment that would naturally enlarge the meaning of airmindedness. As Dr. Smith explained, "[airmindedness] included not only the aircraft and the Airmen who flew them, but the entire community of scientists, engineers, politicians, lawyers, regulators, manufacturers, and educators . . . who helped build even the tiniest elements of aviation." The growing understanding of what was meant by airmindedness was a necessary precursor to the establishment of an independent Air Force which, they argued, was able to offer a unique contribution to national security. [18]

The definition of airmindedness did not stop evolving. In September 1945, Gen Henry H. Arnold, then Commander of the US Army Air Forces, expanded the definition further. Airmindedness was no longer just about military, civil, and private aircraft and aviation, but about airpower. He wanted all Americans to be airminded and to understand the relevance of airpower. This change in focus, though seemingly subtle, was important. The new focus was "not only on using and developing aircraft, but on what else could be developed to enable airpower to reach its full potential."[19]

As the Cold War ensued, the space race emerged. In addition to the creation of new aircraft, the United States developed capabilities that enhanced airpower's potential. New developments in atomic weapons and intercontinental missile delivery systems enhanced and supported the Air Force's manned bomber force. Satellites, too, became operational and began the earliest space-based intelligence gathering missions. These efforts did not just enhance the effectiveness of airpower, though they did that quite well. By integrating these developments into the narrative of airpower, the Air Force demonstrated just how vital airpower was to the joint fight. Space was thus used to enhance airpower and airpower's narrative.[20] At the end of the Cold War, Operation Desert Storm gave the United States a historic opportunity to demonstrate how lethal airpower had become as a result of space-based enhancement. Around-the-clock sorties that delivered precision munitions were proof of the supremacy of American airpower.[21]

Demonstrations of airpower, however, were not the only reason space became an indispensable piece of the Air Force narrative. Ownership of space was also debated on the political front during the Cold War, and senior Air

Force leaders helped further that narrative as well. In 1958, Air Force Chief of Staff, Gen Thomas D. White argued that space was a natural extension of the air domain. He did so in an attempt to secure the rights of ownership for space capabilities from the other military services.[22] Though the other services rejected this bureaucratic grab by the Air Force, as well as the idea that air and space were a continuum called "aerospace," the narrative stuck. Eventually, Air Force doctrine defined aerospace as "pertaining to the total expanse beyond the Earth's surface."[23]

Since then, the term aerospace has gone in and out of vogue among Air Force senior leaders.[24] While not every leader has insisted on the indivisibility of the air and space domains, the spirit of that idea has lingered. As late as September 2018, amid arguments over the organizational future of national security space, the Air Force Association (AFA) strongly opposed the creation of a separate space force on the grounds that not only were air and space indivisible, but the "*effects* from air and space have been integrated and are indivisible." Stating that a separate space force would do more harm than good, the AFA proposed the US Air Force be renamed the "US Aerospace Force" and continue its longstanding stewardship of both the air and space domains. To strengthen its argument, the AFA cited General White's ideas about aerospace from 1958.[25]

The annexation of space to enrich the narrative of airpower resulted in an expanding definition of airmindedness and the continued cycle of thought that insists air and space are an inseparable continuum. Those who have embraced and defended this narrative of indivisibility appear to be bound to view space from an Earth-centric, ground-to-GEO perspective. While there may be a growing number of military space professionals who reject the assertions of the AFA, the prevalence of this viewpoint constitutes the way the traditional mind of space thinks about the domain.

The Emergent Mind: Thought

The emergent mind of space thinks about the domain not only from the ground up and out to GEO, but beyond GEO as well. Retired Air Force Brig Gen S. Peter Worden aptly captured the way the emergent mind thinks about space:

> The Air Force needs to focus on true "strategic" objectives in space. These are objectives for the coming Century. . . . True space operations will spread across the solar system in the decades ahead and the nation that controls them will dominate the planet. Focusing on low Earth orbit (LEO) is akin to having a Navy that never leaves sight of the shore. The US military needs to focus on "blue-water" space operations—GEO and above. US military space operations need to be in deep space, initially all of cislunar

> space, with an eye upon the entire inner solar system. To operate in deep space one needs to use the resources there, starting with fuel from asteroids. Once this is recognized, the military-economic imperative of identifying and protecting these assets becomes clear. The focus . . . should be to be sure on low-cost access to real outer space—with "space" beginning at GEO. New means of moving around in space are more important than just getting off the ground.[26]

While Brigadier General Worden touched upon both thought about and purpose in space, the focus is on his remarks as they pertain to thought about the domain. He explained the irrationality of a perpetual near-Earth focus through a Naval analogy, and argued that US military space operations should be focused on deep space beyond GEO.

Brigadier General Worden is not alone in asserting that thought about the space domain must not be limited to our near-Earth orbits. In his classic and debated work, *Astropolitik*, Dr. Everett Dolman suggested a model that comprehends space beyond GEO. It is a view from the distinct vantage of space where Earth exists in one of four interconnected regions relevant to military space professionals. In his work, he posited the resurrection of geopolitics with an application in the space domain may be a useful goal, but that it would require "at a minimum continuing political relevance." That political relevance comes, in part, from understanding that we live in an era of the re-emergence of great powers, and that we are transitioning from a world in which the United States is the sole superpower to a multipolar world. As classical geopolitical theory has tended to amplify the centrality of national and regional rivalries, our world of multipolar peer competition should consider what Dr. Dolman termed the astropolitical space landscape.[27]

Just as the interactions of distinct regions and domains on Earth have defined the course of global history, it is likely that future interactions within certain regions of space will have bearing upon the destiny of humankind.[28] There are four regions of space that are of interest to military space professionals described in Dr. Dolman's model. They are:

1. *Terra* or *Earth*, including the atmosphere stretching from the surface to just below the lowest altitude capable of supporting unpowered orbit. . . . [The inclusion of a terrestrial region is a critical concept for Dolman's model, and is a proper setting for space activities.] It is on the surface of the Earth (*Terra*) that all current space launches, command and control, tracking, data downlink, research and development . . . and storage operations are performed. Terra is the only region or model that is concerned with traditional topography in the classic geopolitical sense, and is the transition region between geopolitics and astropolitics.

2. *Terran* or *Earth Space*, from the lowest viable orbit to just beyond geostationary altitude (about 36,000 km). Earth space is the operating medium for the military's most advanced reconnaissance and navigation satellites, and all current and planned space-based weaponry. At its lower limit, Earth space is the region of post-thrust medium– and long–range ballistic missile flight, also called [LEO]. At its opposite end, Earth space includes the tremendously valuable geostationary belt, populated mostly by communications and weather satellites.

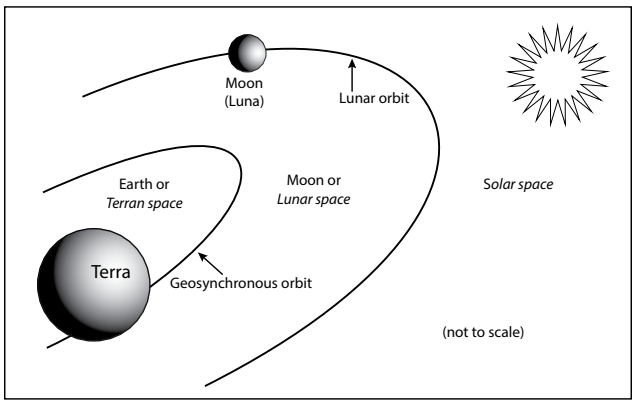

Figure 1. Four Regions of Space.[29]

3. *Lunar* or *Moon Space* is the region just beyond [GEO] to just beyond lunar orbit. The Earth's moon is the only *visible* physical feature evident in the region, but it is only one of several strategic positions located there. Earth and lunar space encompass the four types of orbits [used by the preponderance of artificial satellites], with the exception of the highly elliptical orbit with apogees beyond the orbit of the moon, currently used exclusively for scientific missions.
4. *Solar Space* consists of everything in the solar system (that is, within the gravity well of the Sun) beyond the orbit of the Moon. . . . the exploration of solar space is the next major goal for manned missions and eventual permanent human colonization.[30] The near planets (Mars and Venus), the Jovian and Saturnian moons, and the many large asteroids in the asteroid belt undoubtedly contain the raw materials sufficient to ignite a neo-industrial age. From an antiquated *geopolitik* point of view, it also contains the *lebensraum* for a burgeoning population on Earth.[31]

The traditional mind of space has focused only on the first two regions of Dr. Dolman's astropolitical model. However, if Brigadier General Worden's

view of space is correct then we have merely been parked near Earth's proverbial shores. The emergent mind believes all four regions of space have importance, but that Dr. Dolman's third region specifically has great significance to the military space professional. His lunar space, or what is commonly called cislunar space, is home to many strategic positions. Those strategic positions include, but are not necessarily limited to:

1. the lunar surface, especially the water-ice covered poles,[32]
2. lunar peaks of 24-hour continuous solar exposure,
3. lunar orbit, from which deep space maneuver is greatly enabled,[33]
4. Earth-moon Lagrange points outside of the gravity wells of the earth and moon,[34] and
5. near-Earth asteroids, which are rich in platinum group metals.[35]

Those strategic positions might be termed key terrain, since their exploitation affords a marked advantage to the state that successfully stages there.[36] In addition to strategic security advantages, these staging points also have the potential to enable a cislunar economy. There are an increasing number of private and commercial space companies that have plans to expand into cislunar space, exploiting its resources to meet Earth's growing energy demands, boosting US economic strength, and propelling space industrialization in a way that is not possible by utilizing Earth's resources alone.[37]

Proponents of US space power who think about space in this manner are not the only strategists who think about the space operating environment beyond GEO. It appears the emergent mind of space is shared by China, which also has strategists who view the moon and other fourth region solar space planets as strategically significant. The head of China's lunar exploration program, Ye Peijian, said, "The universe is an ocean, the Moon is the Diaoyu (Senkaku) Islands, Mars is Huangyan Island (Scarborough Shoal)."[38] This public position is evidence that America's leading space competitor thinks about space differently than Western military space professionals have traditionally perceived the domain.

The traditional mind therefore has an indivisible aerospace continuum, and the emergent mind has its four regions. To the former, its eyes are fixed upon orbits out to GEO, and what lies beyond GEO is the realm of the National Aeronautics and Space Administration (NASA) and the scientist. To the latter, space can be modeled as an astropolitical environment in which there are different regions that are each important to the military space professional—regions that may define the future of humanity. Rejecting the idea that geo-

graphic, topographic, and positional nuance is a matter of mere analogy, but realities to which the principles of classical geopolitics may be applied for advantage, the emergent mind of space is capable of strategizing and planning in the domain in ways the traditional mind of space does not and cannot.[39]

Part Two: Purpose in Space

> *We must assume future war on Earth will extend into Space. We will need to 'fight through' attacks on our space assets and capabilities and continue to provide the space support our warfighters need and have come to expect.*
>
> —Deputy Secretary of Defense Robert O. Work

The fact of meaning common called purpose is the why, or to what end of space and space power. In military parlance, purpose, or intention, is captured in an organization's mission and vision, and so we shall survey the current mission and vision of Air Force military space professionals. Vision is aspirational, and "refers to a picture of the future with some implicit or explicit commentary on *why* people should strive to create that future." It clarifies the general direction for change and transformation, motivates people to take action in that direction, and creates a unity of effort in a remarkably fast and efficient way. Mission is also related to purpose because, notionally, it explains who is involved in what, when, and where, as well as why. Purpose is therefore important because it is simultaneously aspirational and practical.[40]

The traditional and emergent minds have distinct purposes in space. The traditional mind emphasizes support but does not necessarily think dominance is an unworthy aim. The emergent mind, on the other hand, emphasizes its purpose to dominate, but understands space will always enable and enhance the joint fight. The former articulates the importance of space power by an appeal to airpower's narrative. The latter characterizes space power's importance as an increasingly independent narrative.

These contrasting purposes have recently been on display in the arguments for and against an independent space force. Those with the traditional mind of space tend to be critics of independence for space. They believe space forces as components of airpower provide adequate support for joint warfighters, and that independence might damage joint integration. The emergent mind tends to advocate for an independent space force, believing space dominance is more likely to be achieved, and America's role as leaders in space more cer-

tain to be secured, if dominance of the domain is sought by a military service whose sole responsibility is just that.

The Traditional Mind: Purpose

Shortly after President Trump directed the stand up of an independent space force in 2018, many in the defense establishment began reiterating their reasons why it was a bad idea. Among the most common arguments: the new space force would be too expensive, it would create too much bureaucracy, it would hurt joint integration, and the timing was not yet right.[41] One journalist even suggested that a new military service for space would make the United States weaker.[42] Retired Air Force Lt Gen David Deptula argued that while a space force was the right decision, the timing was off, and that vital prerequisite conditions had to be met before creation of an independent force.[43] Though he acknowledged some of the conditions were met, he believed the United States should not yet establish the space force as an independent service because the US has thus far been unable to develop a general space power theory, and has not developed the capability to produce direct combat power in or from space as a "co-equal contributor" to joint multi-domain operations.[44]

He claimed these conditions were vital to the success of the future space force. However, if the traditional purpose in space has always been support to the joint warfighter and enhancement of joint warfighting capabilities, how could space power ever have been given the priority required for it to become a co-equal contributor? The essential prerequisites Lieutenant General Deptula argued were missing, and which he offered as a critique of the idea of independence for space, were unwittingly just as appropriately a critique of the Air Force, which has been the longstanding steward of military space. If development of a general space power theory and the capability to produce direct combat power in or from space are essential requirements in the advancement of US space power, then why has the Air Force done neither?[45]

The answer may be that the Air Force has not believed those things were necessary. The defense establishment has asserted that the space domain was benign until recently.[46] Beyond that, space power has been understood as merely one facet of airpower.[47] The traditional mind has thought about space as the continuation of the air domain and views its purpose as providing support to terrestrial warfighters. Air Force warfighters produce fires in and from the air domain, and space forces and capabilities support and enhance those effects. Doctrinally, space enables information collection and sharing. Its assets are viewed as "a *nonintrusive* method of providing up-to-the-minute warning and information" for enabling the terrestrial/air fight.[48] The Air Force

has therefore traditionally developed space power to play a support role enabling and enhancing joint operations. The traditional mind is not only satisfied keeping space under the stewardship of the Air Force but seeks to ensure it remains there.

A military organization's mission and vision reflect purpose. With that in mind, consider the mission of AFSPC, which is to "provide resilient, defendable and affordable space capabilities for the Air Force, Joint Force and the Nation."[49]

Do military space professionals believe their purpose in space is to provide defendable space capabilities to the Air Force? Is their purpose to ensure those capabilities are affordable?[50] The answer to both is no. It is likely military space professionals better identify with the missions of the units to which they belong than they do with the mission of AFSPC. This presents a challenge for young military space professionals and their military leadership at the lower levels. They may have purpose of mission locally, but only with difficulty understand how their local mission is linked to the larger purposes of the United States in space. They understand that they support and enable joint warfighting—so to this they aspire. What happens when military space professionals are told they are now warfighters? There is an internal inconsistency that arises when what your leaders say you are is not in alignment with what your mission says you are.[51] The rhetoric is ambiguous at best, and misleading at worst.[52]

The traditional mind is focused on the support mission. It is stove-piped and narrow, unaware of the vastness of the national security and economic space enterprise, and unsure of who it ultimately supports. Military space culture has understood its purpose in space to be support for the joint warfighter. It is a noble purpose of itself, and each of the military services plays a support role in the joint fight. Air Force leaders have emphasized this purpose for military space forces for decades. Military space has grown during the life of the Air Force, and benign space capabilities were never quite so powerful when compared to air breathing machines that deliver destruction and ensure domination of the skies.

The Emergent Mind: Purpose

The emergent mind of space understands its purpose in space is directly tied to national security, because unfettered access to and freedom of action in space are vital national interests.[53] Space is a necessary part of our national security efforts and strategy, and there is a military-economic imperative to provide security in the domain. For that reason, the emergent mind seeks to dominate the domain by developing and fielding space capabilities to exercise

all the joint functions including generating combat power if necessary.[54] Individuals and groups who share this mind likely pursue independence for space forces as the best means of furthering space power.

In their classic work, *Spacepower: What It Means to You*, Donald Cox and Michael Stoiko listed a number of reasons to explore and exploit space, including economic, psychological, political, military, scientific, and moral reasons.[55] All six of these are tied to the major instruments of national power.[56] Success in diplomacy, for instance, is cast by the moral authority, psychological influence, and political prestige of being a leader in the space domain, and few can argue the scientific benefits of space have not drastically improved the ability to collect and disseminate information. While military space plays a specific role, the association of space and each of these reasons to national security is a connection all military professionals must make.

Unfortunately, the conditions required to accelerate US space power have been largely absent since the end of the Cold War. The environment of competition tangibly linked to national security that was familiar to Americans for decades has faded. Recently, however, as China has demonstrated the ability to destroy space-based assets, government and military leaders have become more concerned about space.[57] This concern is reflected in the US National Security Strategy (NSS). It says the United States seeks to "preserve peace through strength." This is true in space as it is in any other warfighting domain. The US must ensure its military "remains preeminent, deters [its] adversaries, and if necessary, is able to fight and win" in space. Accordingly, it must "maintain [its] leadership and freedom of action in space." The NSS continues by explaining that the entire network of assets critical to the American way of war and way of life is enabled by space: "Communications and financial networks, military and intelligence systems, weather monitoring, navigation, and more have components in the space domain." Lastly, it emphasizes increased US dependence upon and vulnerability in space at a time when there is increased global access to space and space-based capabilities:

> As US dependence on space has increased, other actors have gained access to space-based systems and information. Governments and private sector firms have the ability to launch satellites into space at increasingly lower costs. The fusion of data from imagery, communications, and geolocation services allows motivated actors to access previously unavailable information.[58]

The crux of the matter is that space is critical to US national security. More expressly, access to and freedom of action in space directly impacts US military operations and its "ability to prevail in conflict."[59] The criticality of US dominance in space was articulated by a senior military leader during his visit

with the Schriever Space Scholars at Air University when he said, "If we don't win in space, we don't win."[60]

The National Space Council, chaired by Vice President Pence, unanimously adopted recommendations to send to President Trump pertaining to human spaceflight endeavors. They intend to return American astronauts to the lunar south pole by 2024 and establish a sustainable presence there by 2028. United States presence on the moon will focus on science, resource utilization, and risk reduction for future missions to Mars. It will also "unleash American industry," including public-private partnerships and "other mechanisms" to generate innovation and sustainability of activities from LEO to the moon and beyond.[61] In a 2018 interview, the vice president explained that it was clear to the administration that the United States needed to remain "dominant in space, from a national security perspective, as we are on Earth."[62] Despite the purpose in space embraced by the current administration, there are many who remain unconvinced of the military's role in space, saying the military provision of security for other human space endeavors is "dangerous rhetoric."[63]

It would be easy to think these recommendations were only about human space exploration and would fall under the purview of NASA and the Department of Commerce. The notes released by the council reveal their recommendations stemmed from discussions centered within the context of foreign adversaries and competitors, who are mentioned multiple times, and the NSS.[64] It is clear the council agrees about the purpose of space, as well as thought about space. They think of the air and space domains as an indivisible continuum just like they view the national security space operational environment as consisting of the volume of space from the ground-to-GEO.

The people advocating these national policies inside the DC Beltway are the same people advocating for the creation of an independent space force. They view military space forces as necessary to ensure security for the commercialization and industrialization of cislunar space, as well as human exploration of the moon and beyond. Other competitor and adversary nations have demonstrated the capability to degrade and deny the United States access and freedom of action in space. Military space forces have an important role to play, and the emergent mind counsels them to seek dominance of the domain if needed.

To secure the ability to prevail in conflict in and from the space domain, national political and defense leaders have decided to stand up a warfighting command for space. The commander of the US Space Command (USSPACECOM) will be obligated and authorized to integrate joint forces and execute all the joint functions outlined in doctrine.[65] Those joint functions are Command and Control (C2), Intelligence, Fires, Movement and Maneuver, Pro-

tection, Sustainment, and Information.[66] The fulfillment of these obligations will be contingent on successful integration of joint forces trained to execute these functions, and the fielding of space assets with capabilities suitable to those tasks. Currently, Air Force space forces enable and greatly enhance the fight through these joint functions, except for one. Just as Lieutenant General Deptula argued that there were vital prerequisites that needed to be met, space joint doctrine draws a blank when it comes to fires. It reads, in part:

> Space operations support air, land, maritime, and cyberspace fires through intelligence, PNT [positioning, navigation, and timing], and communications capabilities. Use of space-based PNT capabilities significantly reduces collateral damage and friendly fire, as many types of guided munitions and FFT [friendly forces tracking] devices use space-based PNT. SATCOM [satellite communications] provides data flow to and from widely geographically dispersed forces conducting fires in austere environments.[67]

The emergent mind of space seeks to field and deploy space-based weapons systems that can produce fires in and from the space domain, producing both lethal and nonlethal effects. It also seeks to leverage commercial, industrial, and allied space capabilities.[68] Possession of such a space-based arsenal could prove more effective in countering air and missile threats than any of our air-based capabilities. In fact, the ability to produce fires via a mature space-based military architecture could provide improved precision, lethality, and speed, while reducing collateral damage in the unfortunate event of conflict.

Just as in other warfighting domains, the purpose of the emergent mind of space is to seek dominance in the domain.[69] Purpose in space includes support for the joint warfighter but is farther reaching. While the mission of the US military in space is unique, as are the missions of other space sectors and organizations within the space enterprise, there could (and perhaps should) be a new unifying national purpose of American space power to which all space professionals might aspire. The new vision would have to be appropriately composed to wed all actors across the US national security and economic space enterprise in a common cause.

Such a sweeping vision of American space dominance could be agreed upon by proponents of US space power. It is not literal in the sense that cislunar space can be seized by the United States as its own territory any more than the ocean can, but the purpose, or intent is clear. The cultural influence in military space alone could be substantial, but beyond the military, such a vision has the potential to transform even the fabric of American society into the world's preeminent spacefaring nation. Just as space forces in the Intelligence Community and NASA would each have a distinct mission or role in space, military space forces would likewise have a unique purpose in space for the accomplishment of that unifying national vision.

If space is a warfighting domain, nothing less than dominance of the domain is an acceptable ambition of military space forces. Space support efforts remain essential to a larger joint warfighting construct, though support is not the primary purpose of space forces, just as support is not the primary purpose for any of the other services, though each plays a support role in the joint fight.

Part Three: Knowledge of Space

Because of [China's and Russia's] actions, space is no longer a sanctuary. It is now a warfighting domain. This is not a future or theoretical threat. This is today's threat.

—Acting Secretary of Defense, Patrick M. Shanahan

[Space] will be a human domain and it will be under control by some piece of human society.

—Dr. Mike Griffin

If we do not seize the opportunity to control the ultimate high ground, someone else will, and we will then forfeit our role of global leadership in space.

—Gen (Ret.) John Piotrowski

When discussing the knowledge of space, there is not just divergence between the two minds of space, as there was with thought and purpose, but also overlap and convergence. Knowledge of space is different because it is rooted in objective truth and reality, both in facts of physics and in activity. Individuals or organizations who disagree over the way they think about space agree on the physical realities of the domain. They can also agree upon orders of battle while disagreeing about the purposes of space and space power. The two minds might share the same knowledge of space, but disagree about its meaning and importance, particularly when it comes to knowledge about the activities of US competitors in space.

Facts of Physics

The air domain exists in the lowest reaches of the earth's atmosphere, and military and commercial activities in that realm exist primarily in the troposphere, the first of five primary layers of the earth's atmosphere.[70] The air do-

main, therefore, lives in a volume of air that is less than one percent of the earth's radius in height.[71] As a result, the force of gravity remains relatively constant in the air domain while varying greatly beyond it.[72]

From the vantage of space, the most important features of celestial bodies (including Earth) within the four regions of space are mass, orbit, and relation to other space phenomena. Mass is directly related to gravity, the most important feature in understanding and traversing space topography.[73] Mass causes "unseen undulations" called gravity wells that are analogous to the hills and valleys of Earth, and not only have potential geopolitical importance but determine tactical limitations and opportunities for military forces. The intentional placement and operation of artificial bodies in space must therefore be done with careful consideration of the varied gravitational influences imposed by both fixed and transitory celestial bodies.

The atmosphere of the air domain is a dense substance through which an airfoil travels to generate lift, and which a jet engine consumes for continued combustion in the production of thrust. It is largely protected from cosmic radiation and, while vast, is finite. Space, however, is void of atmosphere, immersed in radiation, and infinite.[74] Satellites in space therefore have no need for ailerons, rudders, and elevators, and rocket engines operate by burning a different kind of fuel. Physical realities present as natural a boundary between the air and space domains as they do between the sea and air, or the land and sea. There is no "seamless" transition between the air and space domains. The movie *Apollo 13* and every shooting star we see in the night sky prove it.[75]

Getting our satellites from the surface of the earth to space, and designing propulsion systems for deep space movement and maneuver, relies on mathematical calculations that rest upon the physics given us, in part, by Newton.[76] The world's best scientists have sent humans from the earth to the moon and back by building upon the work given us by yet other scientific fore-bearers, from the more renowned, such as Kepler and Einstein, to the more obscure, including Goddard, Von Braun, and Tsiolkovsky.[77] Each of these people have contributed to our understanding of the facts and physics of space.

Knowledge of these facts of physics, including the items just covered as well as our current understanding of the moon, sun, stars, and other astronomical objects, is the element of mind that is shared, or upon which convergence is manifest. Practically speaking, individuals and organizations possess only a limited amount of all available knowledge, but the data are all available to be gathered and processed. In our philosophical framework, knowledge possesses all the relevant data, information, or reality pertinent to space. But

facts of physics are not the only reality in space about which military space professionals must be aware.

Facts of Activity

There is also knowledge about space over which the two minds again diverge. Knowledge about events and activities in the space domain represent to the military space professional realities requiring interpretative consideration. For example, in 2007 China destroyed one of its defunct weather satellites with a ballistic missile-based weapon.[78] India demonstrated in 2012 with the launch of the Agni V missile that it, too, had the capability to shoot down satellites in LEO. As of 2019, four nations, including the US, have proven antisatellite weapons and have used them to destroy targets in LEO.[79] The fact these events have happened is incontrovertible, however, the weight of their importance is a matter of interpretation between both minds of space.

China's rapidly maturing space capabilities are of concern. In December 2018, it launched its Chang'e-4 lunar spacecraft on a Long March 3B rocket from Xichang Satellite Launch Center.[80] China's space program includes exploration of the far side of the moon, an effort that is complicated because of the inability of spacecraft to maintain radio contact with the earth. To remedy that difficulty, China parked a communications relay satellite at the earth-moon libration, or EML-2 Lagrange point, months before the launch of Chang'e-4. In the beginning of 2019, Chang'e-4 made a successful landing on the lunar surface and China now has an established presence at the lunar south pole.[81] Its ambitions on the moon include a Chinese research base, a permanent human presence, and resource extraction activities.[82]

In addition to China's activities on and near the moon, it is also pursuing space-based solar power (SBSP). Prototypes of these satellites have been in development for years, and small and medium-sized models will be deployed into the stratosphere between 2021 and 2025. A mega-watt level satellite will be launched by 2030. The solar arrays ultimately required for this solar power project—ranging from football-field-sized to kilometers-wide—are much larger than what is currently built upon Earth, and so China must improve its on-orbit manufacturing capabilities and look to use resources mined from the moon or asteroids. The advantages of SBSP are numerous, but there are drawbacks as well—chief among them is the prohibitive cost to develop and field it.[83]

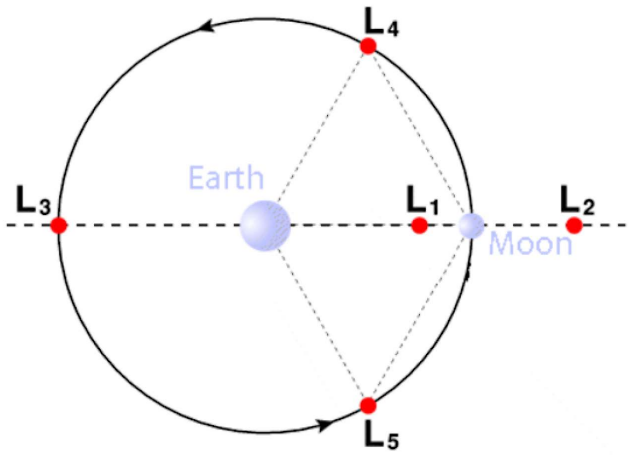

Figure 2. Earth-moon Lagrange points.

Two Minds Juxtaposed[84]

Because the traditional mind of space thinks about space from the ground up to GEO, China's lunar activities fall outside of its operational environment (OE). It does not judge China's activities on the moon to be of concern for the military space professional. The traditional mind neither perceives these activities to be a potential threat to US national security (either immediately or eventually), nor does it think these activities inhibit space support to the joint fight. Since the traditional mind prefers to measure threats in distance rather than delta-v, the moon seems too far away to consider. Likewise, it interprets China's SBSP developments to be of little or no immediate interest to the military. SBSP is the realm of the scientist, after all, and not the military professional. Because the military's primary purpose in space is support, SBSP is weighed against the requirement to perform that role and assessed for its utility to that end. The knowledge of these activities is weighed and found to be lacking strategic importance. Unfortunately, the traditional mind's assessment is a misunderstanding of China's aims in space.

The reasons for this nonstrategic assessment are to be found in the other facts of meaning comprising the traditional mind of space. Thought and purpose are biased lenses, consciously and unconsciously shaping perceptions of the information available to mind. In Von Braunian style, the traditional mind still points to the United States' 1969 moon landings and current Mars expeditions as evidence it is far ahead of China.[85] The traditional mind, impressed by the distance of its own endeavors, dismisses China's seemingly

less-intrepid feats. There is bitter irony in the hubris that characterizes American accomplishments in space, however, because the perceived need to defend the primacy of its image may eventually cost it primacy in reality. Since the military professionals who possess the traditional mind of space view their OE as extending out to GEO, they strategize within the confines of that space. They naturally project the same ambitions, intentions, and purpose onto their adversaries.

This is unfortunately natural and happens subconsciously. It is a psychological phenomenon casually but accurately termed what-you-see-is-all-there-is (WYSIATI).[86] If the United States has no national security interests beyond GEO, then neither does China.[87]

The emergent mind of space pays close attention to China's activities on and near the moon and takes seriously its ambitions to develop SBSP. China's lunar activities are all happening within critical regions of space.[88] Military professionals who possess the emergent mind take notice when China's activities could have astropolitical or geopolitical implications. They are forced to examine the ways that China's activities on the moon put US military forces at a disadvantage, whether in cislunar space, or in near-Earth orbits. The emergent mind should consider how China might gain economic advantage from lunar and SBSP pursuits. Outside of the economic incentives, this mind should also consider what other uses of SBSP might be exploited by an adversary in the event of military conflict.

While it is possible the traditional mind will be confronted by the same thoughts at some point, it is more likely the emergent mind will possess the strategic foresight to ask about them. The emergent mind perceives these activities as potentially threatening to the future of US national security. Knowledge of these activities is weighed in a different balance than that of the traditional mind, and their importance against a different standard.

The same WYSIATI phenomenon that leads the traditional mind of space to project its intentions and purpose on its adversaries also exists in the emergent mind. Our biases allow us to make sense out of the complex world despite having only pieces of the puzzle.[89] Because the emergent mind thinks of space as a separate domain from the other warfighting domains, and considers all cislunar space its OE, it believes China's activities on the moon could potentially limit US freedom of action in the environment either immediately or eventually. The moon, it believes, is NASA's realm only as it pertains to human space exploration and scientific endeavors. The emergent mind understands the military has a unique role in connection with the moon that is distinct from NASA and that role must be better articulated in national policy and across the entire space enterprise via strategic dialog.

Finally, the emergent mind knows that if geo-determinism has any merit, then China's geographic expansion into and throughout the space domain, including at Lagrange points and key lunar terrain, means it will also attempt to gain a global advantage over all other spacefaring nations.[90] It is this belief that urged the US National Space Council to direct NASA to return astronauts to the moon by 2024 to establish a lunar base.[91] This sudden shift in national policy leaps beyond previous human endeavors on the moon a half-century ago, demonstrates US intentions to remain global leaders in space, and serves as a political statement that it is watching closely what China has been doing and will not allow it to gain space dominance.[92]

Summary

The two minds of space are contrasted using a three-part framework built upon facts of meaning common to mind in Western philosophy—thought, purpose, and knowledge. Based upon this comparison of the two minds, the traditional mind of space has been relatively limited.

One space age has come and gone. The dawning of yet another race in space with improved technology, a greater commitment of global capital, an increasing number of international players, and renewed ambition and competition demands a better mind of space, one more suited to today's challenges and better qualified to advance US space power.

Table 1. Summary of the two minds of space.

Facts of Meaning Common to Mind	The Traditional Mind	The Emergent Mind
Thought	• Earth's surface to GEO • Indivisible continuum of air and space domains • Space is part of the definition of airpower	• Four regions of space and an astropolitical modeling of the space domain • Distinct, separate air and space domains
Purpose	• Emphasis on the support role (understands we must maintain leadership in the domain) • Importance derived from airpower's narrative • Ambiguous organizational vision and disconnected purpose	• Emphasis on dominance of the domain (understands space will always enhance and support the joint fight) • Increasingly seeks independence of narrative • Seeks new unifying vision for US spacepower
Knowledge	Convergence: *Facts of physics*	
	Divergence: Weight of importance of *facts of activity*	
	• China's Lunar activities outside military OW • Not a threat to national security • No impact to space support role	• China's activities all occur in regions of space important to the military • Astropolitical/geopolitical implications • Economic/military advantages available in cislunar space

The traditional mind thinks about space from the earth's surface to GEO, as an extension of the air domain. It is dominated by the belief that the primary purpose of military space forces is support to the joint warfighter. It has a propensity, therefore, to be blind to strategic possibilities in the domain and to the intentions of adversaries because of the relatively low weight of importance it gives their activities beyond GEO.

The emergent mind of space thinks about space not only from the earth to GEO, but also contemplates the astropolitical modeling of and strategic possibilities in all cislunar space. The purpose of the emergent mind of space is domination of the domain. It is aware of commercial ambitions throughout cislunar space and thinks strategically about military implications and applications of those endeavors, and plans ways to provide security there. It seeks strategic advantage by exploitation of all key terrain in space and watches closely the moves of military adversaries in space.

Conclusion: The Better Mind of Space

We have considered the two distinct and competing minds of space. After examining and analyzing the evidence, it is clear that only one of these minds is capable of advancing space power. I have possessed each mind—the traditional one before, and the emergent now. I hope this examination of these two minds may be of some benefit to a military space professional somewhere and will help improve military space culture. This work also documents one instance of personal evolution—a true manifestation of measured improvement to military space culture and the abandonment of the logically spurious but psychologically reassuring status quo.[93]

The mind can evolve. Military space culture will not change quickly. The rapid organizational changes to national security space will hopefully prove beneficial to military space culture. But meaningful change, the kind of change that lasts and transforms organizations begins with the individual minds of the professionals who serve us all.

Notes

(All notes appear in shortened form. For full details, see the appropriate entry in the bibliography.)

1. Kuhn, *The Structure of Scientific Revolutions*, 77–78. The word used by Kuhn was not *dilemma*, but *crisis*. "The act of judgment that leads [a person] to reject a previously accepted theory is always based upon more than a comparison of that theory with the world. The decision to reject one paradigm is always simultaneously

the decision to accept another, and the judgment leading to that decision involves the comparison of both paradigms with nature *and* with each other."

2. From the ongoing dialogue over an independent Space Force to the weaponization of space, or as an explanation for why there has been such difficulty settling upon an overarching space power theory.

3. I adopt an ontology originally articulated by Mortimer J. Adler in his assessment of mind in an essay he wrote for inclusion in *A Syntopicon: An Index to The Great Ideas,* volume 3.

4. There is variance in the philosophical meanings of *thought*, *purpose*, and *knowledge*, or in other words, differences in approach to the explication of each. Those differences are unimportant for this paper. Despite nuance, there is agreement that these three elements comprise what is meant by mind. Lest I am charged with misappropriation of the terms, I will say here that I have simplified the definitions and applications of these terms so they might be used for the purpose of practical comparison.

5. Steven Pinker, *The Better Angels of Our Nature: Why Violence Has Declined*, 477.

6. Kahneman, *Thinking Fast and Slow*, 3–4. Kahneman said, "To be a good diagnostician, a physician needs to acquire a *large set of labels* for diseases, each of which binds an idea of the illness and its symptoms, possible antecedents and causes, possible developments and consequences, and possible interventions to cure or mitigate the illness. Learning medicine consists in part of *learning the language of* medicine. A deeper understanding of judgments and choices also *requires a richer vocabulary* than is available in everyday language" (emphasis mine).

7. This is also captured well in John Boyd's OODA loop [observe, orient, decide, act —Ed]. In his model, orientation shapes the way we observe, decide, and act. Persons or organizations with different orientations process and interpret the same realities differently.

8. Adler, *A Syntopicon*, 123–131.

9. The importance of purpose of mind is particularly evident in military culture. Today's military leaders often talk about warrior *ethos*, a Greek word meaning character. Discussion about ethos is intended to convey something of importance about the guiding beliefs or ideals of the warrior. Additionally, each service has core values, and every organization has a vision and mission.

10. A note here on Ulric Neisser's perceptual cycle model (1976) may further support the point. The model hypothesizes that decision-making and perception is cyclical, and that top-down processing and bottom-up processing influence each other. Hence it is neither likely perceptions are purely data-driven, nor theoretical. Rather, active schemata establish a context for perceptive activity.

11. Varied schemata generate nuanced affordances, or utility. In other words, different ends seek different means. See also note 10.

12. Col John A. Warden, "The Enemy as a System," 48. This is also an assumption that appears to have been made by Air Force Colonel John Warden. In an article he wrote in 1995, he attributed mind to the entirety of a command structure. He asserted that the object of war was to influence the mind of that command structure.

13. Stuart R. Levine, "Outperform With a Growth Mindset Culture." Culture is comprised of the espoused values, formal philosophy, shared meanings, and habits of thinking of the individuals in an organization. Edgar H. Schein, *Organizational Culture and Leadership*, 14–15. Mind, then, it may be argued is the very essence of culture. Most organizations suffer from a fixed culture (or mindset).

14. There are other aspects of organizational culture, such as heritage, traditions, and habits of behavior that will not be the focus of this paper. To one degree or another, other papers have already attempted to address the topic of military space culture by examining those elements of culture. Maj Jeremy Phillips, "Engendering Cyber-mindedness in the United States Air Force Cyber Officer Corps." Phillips includes a section about the organizational culture of military space. Maj Steven L. Kwast, "Convergence or Divergence: The Relationship Between Space Doctrine and Air Force Doctrine."

15. Kahneman, *Thinking Fast*, 29. Kahneman said, "System 1 and System 2 are so central to the story I tell in this book that I must make it absolutely clear that they are fictitious characters. Systems 1 and 2 are not systems in the standard sense of entities with interacting aspects or parts. And there is no one part of the brain that either of the systems would call home. You may well ask: What is the point of introducing fictitious characters with ugly names into a serious book? The answer is that the characters are useful because of some quirks of our minds, yours and mine. A sentence is understood more easily if it describes what an agent (System 2) does than if it describes what something is, what properties it has. In other words, "System 2" is a better subject for a sentence than "mental arithmetic." The mind—especially System 1—appears to have a special aptitude for the construction and interpretation of stories about active agents, who have personalities, habits, and abilities."

16. The discussion about airmindedness in Part One is also useful context for the discussion about the traditional mind of space in Parts Two and Three. It is therefore necessary to spend some time on it here at the beginning.

17. Cislunar is defined as the area between the earth and the moon, including the moon's orbit. —Ed.

18. Smith, "Air-mindedness Approaches Infinity," 1–2.

19. Smith, "Air-mindedness," 3–4.

20. This is not an accusation, but a matter of historical fact. One could scarcely imagine the Air Force *not* exploiting the advantages of space power the way it did.

21. Smith, "Air-mindedness," 4.

22. Smith, "Air-mindedness," 6; White, "Air and Space Are Indivisible."

23. Smith, "Air-mindedness," 4, 6.

24. Gen John Jumper, who became the Air Force Chief of Staff in September 2001, neither found the term aerospace useful, nor an accurate description of the two domains. In 2018, Air Force Chief of Staff Gen David Goldfein used the term to describe his understanding of the connectedness of the two domains in a meeting with the Schriever Scholars at Air University. Despite Gen Jumper's abandonment of the term

nearly two decades ago, the military space culture inherited by Gen Goldfein included the understanding that air and space are an inseparable continuum.

25. Sandra Erwin, "Air Force Association Opposes Establishment of a Space Force, Says Air and Space are Indivisible" (emphasis mine). Using the same logic, one could argue a separate Air Force is not necessary since the same *effects* are produced by the A-10 and artillery.

26. Majors Brian E. Hans, Christopher D. Jefferson, and Joshua M. Wehrle, "Movement and Maneuver in Deep Space: A Framework to Leverage Advanced Propulsion," 3.

27. Dolman, *Astropolitik*, 52, 60; Office of the President, *National Security Strategy*, 27.

28. Dolman, *Astropolotik*, 59. Dolman refers to Halford Mackinder's 1904 article, "The Geographical Pivot of History," and his later (1919) postulation that he who controls the "Heartland commands the World-island" and hence the earth.

29. Dolman, *Astropolitik*, 69.

30. Mike Wall, "US to Return Astronauts to the Moon by 2024, VP Pence Says." As for the private space sector, the vision of SpaceX's Elon Musk is colonization of Mars. Additionally, there appears to be a whole of government approach in swing, or what Vice President Mike Pence called an "all-hands-on-deck" approach, as the current administration has directed NASA to return to the Moon by 2024 and to establish a sustainable presence there by 2028. The Vice President cited the expansion of human presence to Mars as one of the reasons a sustainable lunar presence was required.

31. Dolman, *Astropolitik*, 69–70. Dolman's ideas about the four major regions of space are informed, at least in part, by the following sources, which he references in his work: B. Smernoff, "A Bold, Two-Track Strategy for Space," in U. Ra'anan and R. Pfaltzgraf (eds), *International Security Dimensions of Space*, 17–31; P. Stares, *Space and National Security*, pp. 13-18; H. Herwig, "Geopolitik: Haushofer, Hitler, and Lebensraum," in Gray and Sloan (eds), *Geopolitics*, 218–41.

32. Jeff Foust, "Lunar Base and Gateway Part of Sustainable Long-term Human Exploration Plan." The Moon's poles are covered in water ice, a suspicion that was confirmed only in 2018. NASA Administrator Jim Bridenstine recently spoke at the Space Foundation's 2019 National Space Symposium in Colorado Springs and made reference to NASA's intentions to exploit the water ice resources at the Moon's south pole for production of rocket propellant and breathable air.

33. The delta-v budget (km/s) required to reach LEO from lunar orbit is roughly 1/3 of the energy required to get to LEO from the surface of the earth. Comparisons can be made by referencing a delta-v budget table such as the ones found at https://en.wikipedia.org/wiki/Delta-v_budget.

34. Dennis Wingo, *Moonrush: Improving Life on Earth with the Moon's Resources*, 16. Earth-moon Lagrange point 1 (EML–1), for example, has been proposed as an ideal way-station, or gateway outpost, for a cislunar economy where in-space assembly and on-orbit refueling could be accomplished.

35. Wingo, *Moonrush*, 83–88.

36. Joint Chiefs of Staff, *DOD Dictionary*, 135.

37. Wingo, *Moonrush*, 16; John Lewis, *Mining the Sky: Untold Riches from the Asteroids, Comets, and Planets*, 5.

38. Nicole Kobie, "The Epic Tale of China's Out of This World Plan for Space Domination."

39. Dolman, *Astropolitik*, 60.

40. John P. Kotter, *Leading Change*, 69–70; Joint Chiefs of Staff, *Joint Publication 3-0*, GL-12. Joint Doctrine defines mission as: "1. The task, together with the purpose, that clearly indicates the action to be taken and the reason therefore. (JP 3-0) 2. In common usage, especially when applied to lower military units, a duty assigned to an individual or unit; a task (JP 3-0)."

41. Lt Gen David A. Deptula and Lt Col Michael Martindale, "Organizing Spacepower: Conditions for Creating a US Space Force," 1; Erwin, "Wilson: $13 Billion Space Force Cost Estimate is 'Conservative.'"

42. Loren Thompson, "Ten Ways a Space Force will Make America Weaker."

43. Deptula and Martindale, "Organizing Spacepower," 1. The vital prerequisites were those used as the basis for the creation of an independent Air Force. The assumption was that the same prerequisite conditions must be met.

44. Jeff Schogol, "The Truth about the Space Force is Out There." Deptula also said, "Can we stop an Intercontinental Ballistic Missile in boost phase from space today? The answer is no. Should we be able to? Yes. When are we going to be able to do that?"

45. Valerie Insinna, "Air Force Leaders on Space Deterrence." Air Force Chief of Staff General David Goldfein recently acknowledged the Air Force has not yet developed space as a co-equal contributor when he said: "It's not enough to step into the ring and just bob and weave, block and parry, and absorb punches. At some point, we've got to hit back…*So we'll rapidly develop and field the technology needed to counter adversary systems* from any domain at the time, place and manner of our choosing" (emphasis mine). The context was a reference to our inability to counter adversary systems in space.

46. Insinna, "Air Force Leaders on Space Deterrence." At the first air chiefs conference focused on space issues, which was held in Colorado Springs, Colorado, in conjunction with the 2019 National Space Symposium, Air Force Chief of Staff General David Goldfein explained the transition from a benign space domain to a contested one: "One of the things I shared with this set of chiefs is that we just happen to be here at the birth, we're here at the creation of the transition from a benign environment to a more contested environment." Gathered at this inaugural air chiefs conference on space were leaders from Australia, Canada, Denmark, France, Germany, Italy, Japan, the Netherlands, New Zealand, Norway, the United Kingdom, and the United States.

47. US Air Force, *Basic Doctrine*, 25. Airpower is defined as "the ability to project military power or influence through the control and exploitation of air, space, and cyberspace to achieve strategic, operational, and tactical objectives." Also, airpower creates effects "from and within. . . space."

48. US Air Force, *Basic Doctrine*, 30 (emphasis mine).

49. This statement was from the original AFSPC website. Since the writing of this work, the AFSPC has been officially redesignated as the US Space Force, and the mission statement has been updated. —Ed.

50. Those obligations may belong to leaders at HQ AFSPC, but not to the majority of military space professionals.

51. It is likely one could critically assess the same cognitive disconnect in military space professionals in relation to the AFSPC Vision, which is: "Innovate, accelerate, dominate."

52. If a vision is aspirational by nature, then in what way(s) are military space professionals expected to be innovative? How or what are they supposed to accelerate? How or what are they aspiring to dominate? Are these references to our need to improve our acquisition processes?

53. Office of the President, *National Security Strategy*, 31.

54. US Air Force, *Joint Publication 1*, I-18.

55. Donald Cox and Michael Stoiko, *Spacepower: What it Means to You*, 3.

56. The instruments of national power being diplomacy, information, military, and economy (DIME).

57. In 2007, China demonstrated antisatellite weapons capability. This is discussed further in Part Three.

58. Office of the President, 4, 31.

59. Office of the President, 31.

60. This same sentiment was shared no fewer than three times by this officer. He spoke freely in a nonattributional environment during a one-hour meeting. Later in the same meeting he said it differently: "If we don't dominate and win [in space], the joint force doesn't win."

61. Marcia Smith, "Space Council Adopts Recommendations at its March 26, 2019 Meeting,"

62. Erwin, "Space Force Discussions Increasingly Blur the Line Between Military and Civilian Space."

63. Peter Juul, "Trump's Space Force Gets the Final Frontier All Wrong."

64. Worden and Shaw, *Whither Space Power? Forging a Strategy for the New Century*, 4. The author recognizes that NASA was established as a civil space exploration agency as a direct result of national security concerns early in the Cold War, and that our subsequent urgency for manned lunar missions was likewise a result of security concerns. From Worden and Shaw: "There is little doubt that the Apollo program was a national security effort, as indeed most space exploration for the past 40 years has been. It was designed to respond to technical, political, and even ideological challenges from the Soviet Union, which was seeking to detach Europe from the United States and win over the rest of the world by demonstrating the superiority of its space capability (and therefore its ideology)."

65. Erwin, "Trump Nominates Raymond to Be Commander of US Space Command." US Space Command, later redesignated the US Space Force stood up in the summer of 2019. Gen John Raymond is the commander.

66. Joint Chiefs of Staff, *Joint Publication 3–0*, xiii.

67. Joint Chiefs of Staff, *Joint Publication 3–14*, II–13.

68. Joint Chiefs of Staff, *Joint Publication 3–0*, III–30. In Joint Doctrine, fires "typically produce destructive effects;" William Brissett, "Raymond Says Partnerships are Driving Progress in Space." An exploration of the military advantages of dual-use space assets lying *in potentia* deserves a separate paper. The importance of partnerships with commercial space has fortunately been increasingly emphasized by AFSPC in the past several years.

69. Joint Doctrine's notional phases of conflict traditionally included a *domination* phase, and military space must be capable and ready to dominate in and from the space domain just as we do in each of the other warfighting domains.

70. From nearest to furthest, the five layers are the troposphere, stratosphere, mesosphere, thermosphere, and exosphere. The dynamic boundaries separating these layers are successively greater in distance in relation to each other, while the layers themselves consist of exponentially greater volumes of space the further from Earth they are.

71. The tropopause, the border between the Troposphere and Stratosphere, can be as high as 20km above the equator. From there, moving latitudinally to the poles, the height of the tropopause varies, and is lower, due to sun activity.

72. Sir Isaac Newton, *Mathematical Principles on Natural Philosophy*, in *The Great Books of the Western World*, vol. 34, 284.

73. Dolman, *Astropolitik*, 71.

74. Col Michael C. Whittington, "A Separate Space Force: An 80-Year-Old Argument," 7.

75. The precision of approach angle required upon re-entering the earth's atmosphere is emphasized in the movie. Likewise, the visible display we call a "shooting star" results from the burning matter of a meteorite that has splashed down in Earth's atmosphere—an impossible phenomenon if air and space were a seamless continuum.

76. Newton, *Mathematical Principles*, 14. The genius of Newton's axioms, or laws of motion, which we all experience and yet hardly any of us can articulate read thus: "Law 1: Every body continues in its state of rest, or of uniform motion in a right line, unless it is compelled to change that state by forces impressed upon it; Law 2: The change of motion is proportional to the motive force impressed; and is made in the direction of the right line in which that force is impressed (more readily recognized or commonly discussed as F=ma); and Law 3: To every action there is always opposed an equal reaction: or, the mutual actions of two bodies upon each other are always equal, and directed to contrary parts."

77. From Tsiolkovsky, for example, we have the classical rocket equation, of which there are many derivations. This mathematical contribution to rocketry is important because Newton's second law is valid for constant-mass systems only.

78. Carin Zissis, "China's Anti-satellite Test."

79. Sriram Iyer, "India Enters an Elite Space Club After Scientists Shoot Down a Low Orbit Satellite 300km Away in Space, says Prime Minister Modi."

80. Namrata Goswami, "The Moon's Far Side and China's Space Strategy."

81. NASA, "Apollo 11 Technical Air-to-Ground Voice Transcription." The name of China's lunar lander, *Chang'e*, is an invocation of China's Moon Goddess. According to ancient Chinese myth, she has lived there for thousands of years. It was for that reason the Houston capsule communicator told Michael Collins of the Apollo 11 crew to keep his eye out for "a lovely girl with a big rabbit" shortly before they landed on the Moon.

82. Goswami, "The Moon's Far Side."

83. Mark R. Whittington, "First the Moon, Now China Plans to Launch Space-Based Solar Power Satellite;" Peter Garretson, "Better Than Paris: Space Solar Power;" John Mankins, *The Case for Space Solar Power*; Daniel Wood, "Space Based Solar Power." Of course, the costs of any complex project are more nuanced than simple, but SBSP will cost tens of billions of dollars to field.

84. Kahneman, *Thinking Fast and Slow*, 86–87. This section is intentionally presented as a stiff assessment of each mind. It is nearly jumping to conclusions based upon limited evidence, which the mind does so intuitively. The assessment uses the *thought* and *purpose* of each mind as the lens through which knowledge of China's activities in space is viewed and as the standard against which importance is weighed.

85. Erin Dunne, "No, We Don't Need to Land on the Moon (Again)." Dunne says, "The US already won that race more than five decades ago."

86. Kahneman, *Thinking Fast and Slow*, 85. The vignette shared by Kahneman to introduce the subject is related to our discussion of the way the traditional mind interprets China's activities in Space. He said, "The measure of success for System 1 is the coherence of the story it manages to create. *The amount and quality of the data on which the story is based are largely irrelevant*. When information is scarce, which is a common occurrence, System 1 operates as a machine for jumping to conclusions. Consider the following: 'Will Mindik be a good leader? She is intelligent and strong . . .' An answer quickly came to your mind, and it was yes. You picked the best answer based on the very limited information available, but you jumped the gun. What if the next two adjectives were *corrupt* and *cruel*?" (emphasis mine).

87. China's activities in cislunar space appear to have not been discussed openly by Air Force senior leaders, or senior military leaders from other services for that matter. It is difficult to assess the degree to which current Air Force leadership believes it is an important issue. The author assumes if China's lunar activities were considered to have strategic importance by Air Force senior leaders they would discuss those activities openly. There is at least one office in the Pentagon of which the author is aware, that is thinking through the strategic implications of China's posturing in cislunar space. That office is not part of the Air Force.

88. See Part One, where the four regions of space important to military space professionals is discussed.

89. Kahneman, *Thinking Fast and Slow*, 87.

90. Dolman, *Astropolitik*, 13. Geo-determinism is "the tenet that geographic location . . .ultimately decides the character of a population and the type of government and military forces that emerge . . .Ideally, geostrategists attempt to gain a global

advantage over competing states. If they are unable to accomplish dominance for themselves, they invoke geostrategy to deny the geographically advantaged state's potential domination through their own maximization of scarce geo-positional resources."

91. Wall, "US to Return Astronauts."

92. President Trump directed NASA to return astronauts to the Moon by 2028 in December 2017. Vice President Pence's announcement to return by 2024 has dramatically changed the timeline.

93. Pinker, *The Better Angels of Our Nature*, 545.

Abbreviations

AFA	Air Force Association
AFSPC	Air Force Space Command
FFT	friendly forces tracking
GEO	Geosynchronous Earth orbit
LEO	low earth orbit
NASA	National Aeronautics and Space Administration
NSS	National Security Strategy
OE	pperational environment
PNT	positioning, navigation, and timing
SBSP	space-based solar power
WYSIATI	what-you-see-is-all-there-is

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