

NOVEMBER 2016



# FROM BLUE TO BLACK

Applying the Concepts of Sea Power to the Ocean of Space

Dr. Jerry Hendrix and Michelle Shevin-Coetzee



## About the Authors



**JERRY HENDRIX** is the Senior Fellow and Director of the Defense Strategies and Assessments Program at the Center for a New American Security. A retired Captain in the United States Navy, his staff assignments included tours with the Chief of Naval Operations Executive Panel (NOOK), the Office of the Under Secretary of Defense, and the Office of Net Assessment. He retired as the Director of Naval History.



**MICHELLE SHEVIN-COETZEE** is a former Researcher with the Center for a New American Security now working as a Research Assistant at the Center for Strategic and Budgetary Assessments. At CNAS, she worked with both the Defense Strategies and Assessments and Strategy and Statecraft programs. Her work focuses on U.S. defense policy and strategy, European security, and wargaming.

## Acknowledgements

The authors would like to thank Shawn Brimley for his thoughtful feedback and helpful comments. They would also like to thank Maura McCarthy for managing the paper the publications process, and Melody Cook and Erin Rothback for their creativity in design and layout. This paper would not have been possible without the support of the Center for a New American Security.

## Introduction

The space environment is of great importance to the United States. However, space remains just unfamiliar enough to decision makers so as to introduce hesitation in those charged with strategic decisions. One useful way of addressing the strategic oddity of space is to examine it anew through the familiar lens of sea power theory. In particular, studying the works of Alfred Thayer Mahan and Julian Corbett can provide essential guidance, informing the strategic, commercial, and military aspects of space. President John F. Kennedy turned to such an analogy in 1962 when he outlined his vision for why the United States should undertake manned exploration of the moon. “We set sail on this new sea,” he declared, suggesting that pioneering efforts in space could be understood within the more familiar context of nautical achievement.<sup>1</sup> President Kennedy understood the importance of space power, and so must defense policymakers today. To do so, they would be well advised to review the theories of sea power as a means of developing a framework for space.

## The Importance of Space and Its Resemblance to the Sea

No environment is more important for long-term U.S. national security interests than space. From a strategic point of view, it is especially crucial for three key reasons: It serves as the frontier of future exploration, resources, and growth. However, in many ways space is not unlike air, land, and sea areas of responsibility, all representing vital territory where national interests must be protected.

Beyond the intrigue of space that captivates our minds, tangible reasons for considering the environment strategically encompass both the realms of security and economic competition. For the military, troops across the world rely on space. Without the use of, and access to, U.S. space assets, military services would be unable to conduct their operations and missions. As just a few examples, consider early warning; intelligence, surveillance, and reconnaissance; positioning, navigation, and timing; communications; and command and control. Likewise, the commercial sector has great interest in space, particularly given recent advances that promise to make access cheaper and more reliable. Seemingly mundane items in our homes rely on space, including satellite televisions and phones, as do exciting services that we might consider in the future, such as space tourism.

Innovative companies such as Space Exploration Technologies Corporation (SpaceX) and Blue Origin are thriving.

For all these reasons, strategists are turning their attention to space, hinting that it will become a center for competition between nations much like the surface of the ocean, its underwater component, and the skies.<sup>2</sup> In the past, such a realization opened new arenas of conflict beyond mankind’s natural home on land, and, in fact, serves as an important reminder today that space is not the first “new frontier,” or the first new medium of competition between states. Much has been considered and written about past eras of exploration and conflict in new domains.

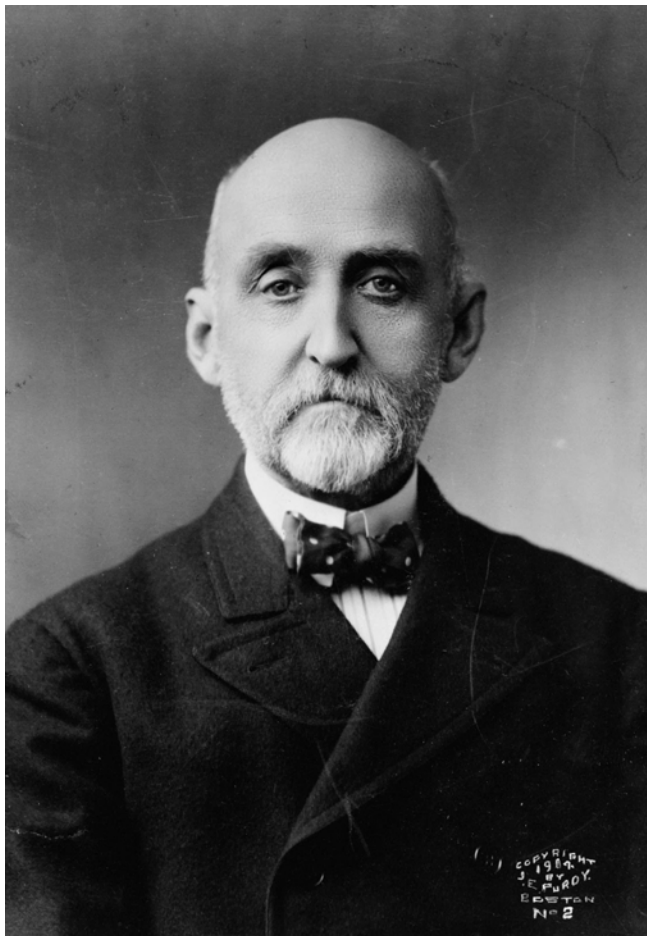


*The Earth, a largely water planet, surrounded by the black ocean of space. (NASA)*

The open ocean – the dark, deep blue domain beyond a nation’s territorial waters and extended economic zone – is perhaps the most analogous realm to consider because of its strategic similarities.<sup>3</sup> Both environments seem vast and trackless, often lacking obvious territorial attributes or frontiers, and both are insusceptible to ownership. Likewise, the sea and space are viewed as symbolically

significant, with the potential to evoke nationalistic sentiment. Consider the importance of dreadnought battleships before World War I or of the “space race” to the moon during the Cold War. These achievements were a source of prestige, affording a quick and readily grasped means of comparing the relative strengths of great powers. Finally, both environments are exploited or controlled most effectively by diverse elements of national power, rather than by single weapons or platforms. Effective command and control, for example, benefits from communications, early warning indicators, and radars on land, at sea, and in space. These similarities suggest that policymakers seeking a framework to understand space can draw upon the well-developed theories of sea power.

Captain Alfred Thayer Mahan (left) and Sir Julian Corbett (right), masters of maritime strategy.



## The Utility of Naval Theorists

To guide the discussion of space today, it is important to consider the contributions of historical strategic theorists on the topic of the sea. Doing so can inform today’s decision makers as they confront the looming struggle, in both economic and military terms, in the vastness stretching out from the thin atmospheric barrier that surrounds our world. In particular, policymakers should consider the wisdom of two preeminent naval theorists: Captain Alfred Thayer Mahan (1840–1914) and Sir Julian Corbett (1854–1922).

Mahan, an American naval officer and educator, is hailed as “the father of modern naval history.”<sup>4</sup> His seminal work, *The Influence of Sea Power upon History* (1890), explores Britain’s conflicts with France from the 1660s to the Napoleonic Wars in order to illustrate the broader impact of “sea power upon the course of history and the prosperity of nations.”<sup>5</sup> Seemingly over-matched nautical Britain withstood and ultimately prevailed against continental France because it achieved maritime dominance, and it grew richer as it sustained that



supremacy. Britain's command of the sea, Mahan argues, rested on its instruments of war, including military bases, maritime commerce, and colonial territories, enabling the Royal Navy to seek and win decisive battles.

Mahan distills lessons from the British experience that would have a broader application, identifying six elements that shape a country's ability to project naval power: "geographical position; physical conformation; extent of territory; size of population; national character; and character of government."<sup>6</sup> Britain's natural endowment satisfies the first three of Mahan's criteria – an island nation with navigable harbors did not require London to divert resources for extensive land fortifications or standing armies – but his framework allows for the influence of other factors in the development of sea power. Together, they determine the strength of a country's navy and its ability to project power, no matter the place or time.

In contrast to Mahan, Corbett, a British-born civilian, was trained as a barrister. Writing in an era of escalating tensions before World War I, Corbett returns to Mahan's theme of the effectiveness of British sea power against a dominant continental rival – although his focus at the time was most likely Germany, not France or Russia. Corbett's greatest work, *Some Principles of Maritime Strategy* (1911), breaks new ground in multiple ways. First, he distinguishes between different levels of the topic: between major strategy (addressing the higher purpose of war) and minor strategy (the administrative and operational concerns of the services). Second, Corbett presents a much-needed distinction between naval and maritime strategy. Whereas naval strategy concerns "what part of it which determines the movements of the fleet," maritime strategy determines the "part the fleet must play in relation to the action of the land forces."<sup>7</sup>

Corbett's work is viewed as a corrective to navalists who had previously thought in terms of a fleet's capacities alone and, by implication, to those who failed to grasp the limitations of unsupported sea power. "It scarcely needs saying," Corbett concludes, "that it is almost impossible that a war can be decided by naval action alone."<sup>8</sup> His work also highlights skepticism regarding Mahan's insistence on the importance of fleet concentration, instead proclaiming that command of the sea lies in securing control of the dispersed network of maritime communications. Denial of access, not destruction, therefore, defines the use of sea power and allows for the combination or synchronization of operations that could secure a conclusive victory.

## Mahan and the Application of Sea Power to the Space Environment

Recent articles dismiss Mahan's tenets as "questionable"<sup>9</sup> or outdated.<sup>10</sup> Some suggest that sea power no longer occupies the pivotal place in the competition among nations that it once did due to advancements in armament, specifically nuclear weapons and precision strike, reconnaissance, stealth and communication technologies. The implication is that technology has advanced to the point where history's lessons are now overtaken by the pace of our modern age.

Yet Mahan's *The Influence of Sea Power upon History* distills certain elements that, if understood and applied properly, could illuminate strategic lessons for today's military competitions. He does not suggest, as so many of his contemporary and current critics claim, that the historical experiences of sailing ship captains be directly

**The history of spacing nations has been less determined by the shrewdness and foresight of governments than by conditions of position, extent, configuration, number and character of their people – by what are called, in a word, natural condition.**

—Mahan, 1890 <sup>11</sup>

applied to the naval vessels of the 1890s or the 2090s. Instead, he promotes broad concepts that are applicable to any age. Lifting Mahan's guiding elements and principles from their natural maritime environment and applying them to a more futuristic setting in space may stretch their original meaning, but they also help to provide a strategic context to an environment that is presently well beyond many policymakers as well as entertainment to those who find value in leveraging history to inform current decisions.

*Note - Throughout this paper the authors use statements made by Captain Alfred Thayer Mahan and Sir Julian Corbett on the subject of sea power, and alter them to make their work applicable to the space environment. Words that appear in bold are space related terms that have been substituted for sea related terms in Mahan and Corbett's original works.*

## The Elements of Space Power

### Geographical Position

Reduced to practical terms, the closer a launch site is to the equator, the greater the push the vehicle receives from the Earth, and, thus, the greater a cargo load it can carry.<sup>12</sup> Geographic position will be an important factor in the exploration of space, determining the ease and cost of accessibility to the new frontier. Although other nations can achieve the ability to launch satellites into orbit, it will come at greater costs in fuel and complexity.



### Physical Conformation

Mahan’s musings on the influence of physical conformation in the determination of a nation’s aptitude for expansion have applications in space, specifically this observation that nations lacking either markets or resources will push outward.<sup>13</sup> The implication is that nations possessing an abundance of natural resources within their borders have little need to look beyond them, and thus are consigned to, at best, second rate

economic status on the international level if they do not find some impetus to push outward. Access to fuel of both solid and liquid varieties, as well as the rare earth metals required for some specialized forms of rocket and electronic construction, are critical to a space power’s success. What was true for the sea shall hold for space.

### Extent of Territory

Weakness emanates from the size of the largely undefended space frontier. Land is defended by armies, the seas by navies, and the air by air forces, but, aside from radar installations, few assets are now devoted to the defense of a nation’s space frontier. For instance, one explosion of a nuclear device (10 to 20 megatons) 180 miles above Kansas could generate an electromagnetic pulse capable of knocking out 90 percent of all unprotected electronic services in the United States: phone lines, power stations, and computers included.<sup>14</sup> These would be disrupted and remain so for a prolonged period of time.

### Size of Population

This is a critical factor in a nation’s pursuit of power. A large population can be a benefit, providing a sizable production base and a corresponding tax base from which programs may be funded.<sup>15</sup> Citizens who are literate, well-educated, and skilled in space-related sciences, technologies, and industries will support a nation’s natural expansion into space.

### National Character

The desire that will draw nations into space on a scale equivalent to the wave of European expansion onto the American continents and into Asia will be the pursuit of profit.<sup>16</sup> Nations driven by the laws of supply and demand seek resources in space that can be acquired more cheaply than from mines or markets on Earth. Samples returned from the moon by the Apollo astronauts show it to be abundant in iron, titanium, aluminum, and manganese, the basic components needed for construction on Earth or in space. Oxygen, a central component of water, air, and propulsion fuel, exists in large quantities in the lunar soil.<sup>17</sup> Helium 3, expected to be the preferred fuel for fusion reactors currently under development, exists only in minute quantities on Earth but is abundant on the lunar surface.<sup>18</sup> It will be relatively easy, using current mining techniques, to gain access to these materials.

### Character of Government

Continuing to apply Mahan’s concepts to today’s world, the role of government in establishing a comprehensive



## 02 Extent of Territory

As with its maritime and land borders, a nation must be concerned with the security of the space border high above its territory as an avenue of attack.

space policy must be simultaneously a leading and following presence. It should lead by providing the mechanisms for legal claims on space resources and follow by providing the necessary constabulary presence in the settled territories to establish rule of law and protect the claims of citizens.<sup>19</sup> If a government seeks participation in the development of space, then Mahan suggests:

“The influence of the government will be felt . . . in maintaining an armed **space force** of a size commensurate . . . of the interests connected with it. . . . Undoubtedly . . . the maintenance of suitable space stations in those distant parts of space to which armed shipping must follow peaceful vessels of commerce.”<sup>20</sup>

In this manner, the government will participate in the expansion into space in its most legitimate form, as a force established to stabilize and protect the rights of its citizens and the sovereignty of its national assets.

With these elements in mind, it is possible that Mahan’s ruminations on the influence of sea power still hold meaning today, particularly the application of his three guiding principles – setting, position, and strength – to strategic, military, and commercial contexts.

## Setting

If history’s lessons are to be applied correctly, mankind must recognize appropriate parallels and first consider strategic setting. Human expansion into space has been relatively limited, charting the confines of (the near-sea) low Earth orbit extensively and sending small manned expeditions to the nearest island, the moon. Unmanned expeditions have journeyed the length and breadth of the solar system, transmitting evidence of rich resources. Seeking a historical period that most resembles the current environment might lead to well before both Mahan and Corbett, to the latter half of the city-state period in ancient Greece. Then, as now, old divisions between competing states had broken down,

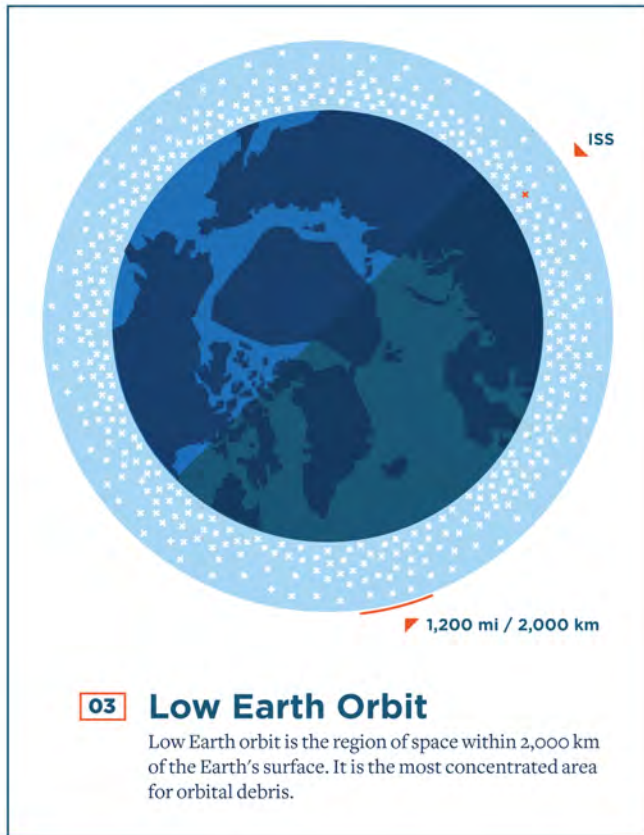
opening the path for Greek unification under the leadership of predominant cities. Exploration and utilization of the Mediterranean Sea progressed to the point where primitive sea power began to exert an influence on the political power structure.

Modern nation-states prefer a cooperative, multi-lateral approach to governing under the leadership of predominant nations. Countries with advanced economies and technological bases now look outward.

Drawing on the maritime analogy, today several nations are poised at the edge of the sea of space, looking out at the figurative Mediterranean of low Earth orbit, and beyond to the first great island, the moon.

**Circumstances have caused the Mediterranean Sea to play a greater part in the history of the world, both in a commercial and a military point of view, than any other sheet of water of the same size.**

—Mahan, 1890 <sup>21</sup>



**Communications dominate war; broadly considered, they are the most important single element in strategy, political or military.**

—Mahan, 1900<sup>24</sup>

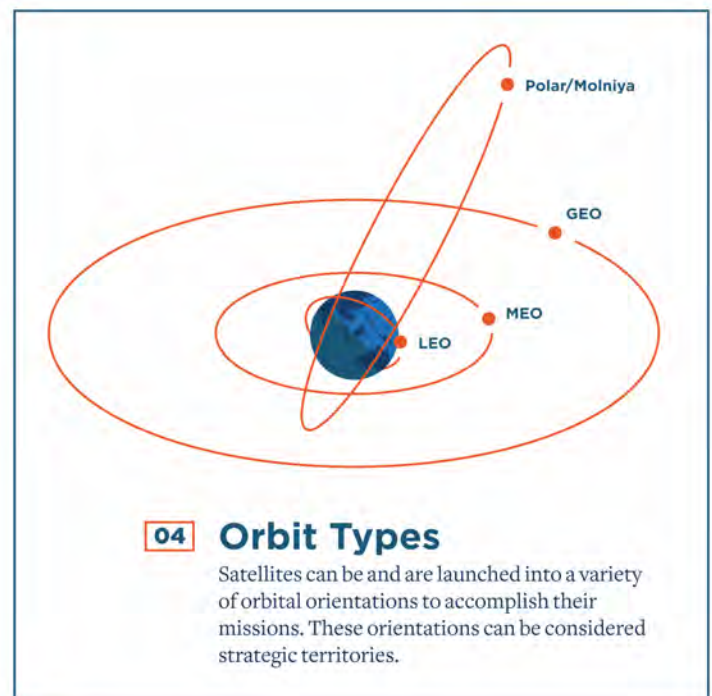
provided General Norman Schwarzkopf's strategic planners with a bird's eye view of the enemy's position, strength, and mobility. As this real-time intelligence illuminated the weakness of the opponent's flank, communications satellites relayed the necessary orders to coalition ground commanders as they sped across the desert. Tanks and other small units made use of the newly emerging space based Global Positioning System to guide them across the featureless desert terrain. Weather satellites provided predictions of falling visibility, and the Defense Support Program early warning satellites alerted commanders to falling Scuds.<sup>25</sup> Without these resources, it is doubtful that the Storm campaign would have gone as smoothly or successfully. The same would hold if both sides of the desert conflict had possessed equal access to space based systems.

Space based communications and reconnaissance systems, along with rocket-launched weapons, have been cited by analysts such as Colin Gray and Barry Watts as reasons for the shrinking utility and influence of terrestrial based systems, including sea power.<sup>26</sup>

## Position

After considering its strategic setting, a nation must recognize its position, a key element of military operations. Low Earth orbit (the near sea in Mahanian terms), like the Mediterranean in Greek and Roman times, is dotted with routes of trade and communication. Thousands of man-made satellites whirl above us, relaying communications, monitoring critical developments, and mapping the Earth's surface.<sup>23</sup> Each of these electronic sentinels provides a service, mostly commercial, but others are critical to the security of their owners. A nation's first goal should be to maintain access to the vital routes of low Earth orbit as well as the polar, Molniya, sun-synchronous, semi-synchronous, and geo-synchronous orbits, followed closely by the protection of assets already present. It logically follows that the state must also prepare the means to deny access to these routes to enemies or potential enemies. By satisfying these conditions, a nation protects its position on this near-sea and establishes itself as a space power.

Consider the role that space plays in conflict. The 1990–91 Desert Shield–Desert Storm campaign, for example, heralded the growing importance of space based systems in modern warfare. Surveillance satellites





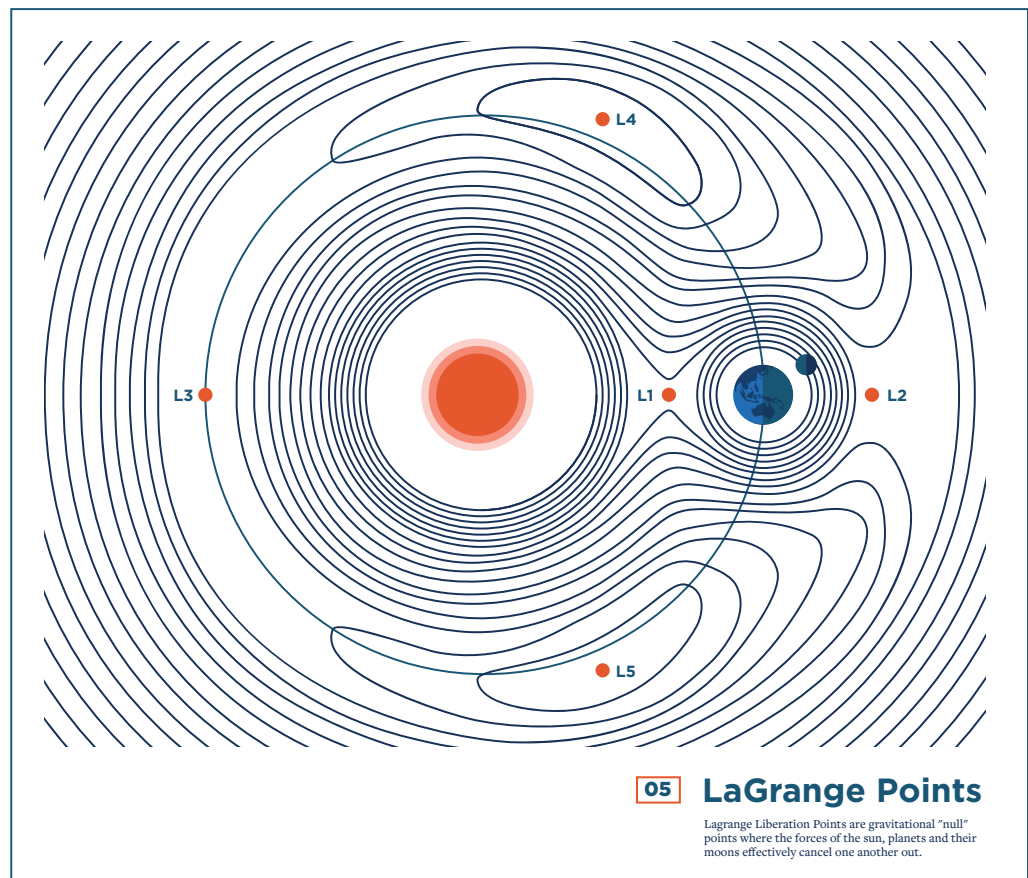
By extension, these statements suggest that space has emerged as a position of influence. At the present time, fewer than ten nations have demonstrated the capability to launch satellites into Earth orbit, and the lessons of Desert Storm have not been ignored. Other countries now orbit satellites, either with their own boosters or launch services purchased elsewhere, which possess both defensive and offensive capabilities. Three nations, in addition to the United States, have a rudimentary precision strike complex comprised of space based reconnaissance assets, an orbiting positioning system, and precision strike weapons. Antisatellite offensive technologies and techniques, capable of knocking out large segments of the United States' space based defense network, have been, or are being, developed.<sup>27</sup>

Certainly the United States has an interest in developing the capabilities to protect its national interests in Earth orbit and the ability to deny to potential enemies the opportunity to deploy space based assets against it in a future conflict. But in other areas, U.S. strategic thinking in this regard falls short.

Defense of routes to space (through the Earth's atmosphere) and protection from space based threats have largely fallen under the aegis of national air forces. Arrays of land and space based radar installations track and catalog the numerous objects orbiting overhead.<sup>29</sup> Should an object prove threatening, the U.S. Department of Defense could confront it with a system such as the Patriot Missile, the Theater High Altitude Area Defense system, or the Navy's Aegis Ashore system. These technologies have matured over the past generation and are now used by the United States and its allies. Other options stem from the antisatellite (ASAT) systems developed in the United States under the Star Wars defense program of the 1980s. An ASAT missile could be launched from ground based systems or ships at sea,

or it could be carried aloft by a fighter to intercept the offending satellite as it passed overhead.<sup>30</sup> These systems, while effective in repelling ballistic threats, are not useful tools for establishing decisive control of space. Their weakness lies in the vast expanse of space, the speed of orbiting satellites, and the limited time that these platforms remain over any given nation. Combined, these elements render attacks on orbiting installations difficult at best. Positions overlooking travel routes are more important than those in the great void, because it is less possible to avoid them.<sup>31</sup>

Although space based threats to terrestrial installations could be met from space stations orbiting in the same plane as the menace, this type of defense entails the expenditure of large amounts of fuel to intercept threats operating in different orbital configurations. A more pragmatic choice is a series of defensive systems in geostationary orbits, remaining constant over the same Earth coordinates and possessing the ability to look down on, and shoot down, threatening satellites as they fly past below. Future defense planners can also look toward the gravitationally stable Lagrange liberation points between the Earth, moon, and sun. These positions exist as gravitational "null" points where the forces of the three bodies effectively cancel one another out.





**06 Geosynchronous Orbit**

This graphic shows concentrations of objects in low earth orbit and in the geosynchronous region.

## Strength

An additional point of strategic advantage is the moon itself, which represents the most defensively sound position for militarized bases.<sup>33</sup> Moreover, a nation will not be able to establish itself as a preeminent space power until it recognizes the inherent strength and importance of a lunar base, particularly for commercial purposes. In the future, history will probably look upon the moon as we might today envision a hybrid combination of Gibraltar and the Hawaiian Islands. Its resemblance to Gibraltar lies in its equal access to both the vast outer expanses of interplanetary space and the inner Earth-moon system. Control of the moon will be the determining factor in the control of space and, once an adversary is entrenched on its surface, the natural defensive strengths of the moon will render his removal difficult, if not impossible.

**The moon, in the general scheme of space, is a strategic point of singular importance. It is a great center of movement, and invaluable half-way house, an advanced position of great natural power of offense as a base of operations and for supply and repair.**

—Mahan, 1911<sup>32</sup>

By **space** strategy we mean the principles which govern a war in which space is a substantial factor. **Space** strategy is but that part of it which determines the movements of the fleet when **space** strategy has determined what part the fleet must play in relation to the action of the land forces; for it scarcely needs saying that it is almost impossible that a war can be decided by **space** action alone.

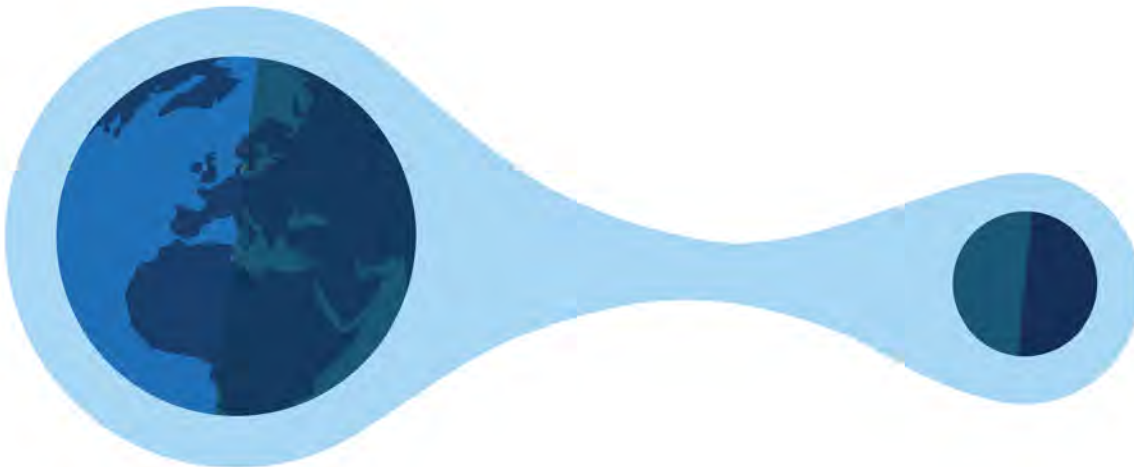
—Corbett, 1911 <sup>35</sup>

Although it will not be necessary for all outgoing or returning space vehicles to stop by the moon, it will be convenient. Like the Hawaiian Islands, the moon will serve as a terminus for both outward bound explorers and returning commercial vessels, their holds filled with mineral resources destined for Earth and lunar orbiting factories. With low gravity, the moon could become a staging center, launching its many resources into space with greater ease and lower costs than Earth-built components. Low gravity and abundant resources make the moon the logical construction site for the great interplanetary ships of the future. Once built, these vessels will return to the lunar orbit for overhaul and repair at the great space docking facilities constructed for them.

## Corbett and the Application of Sea Power to the Space Environment

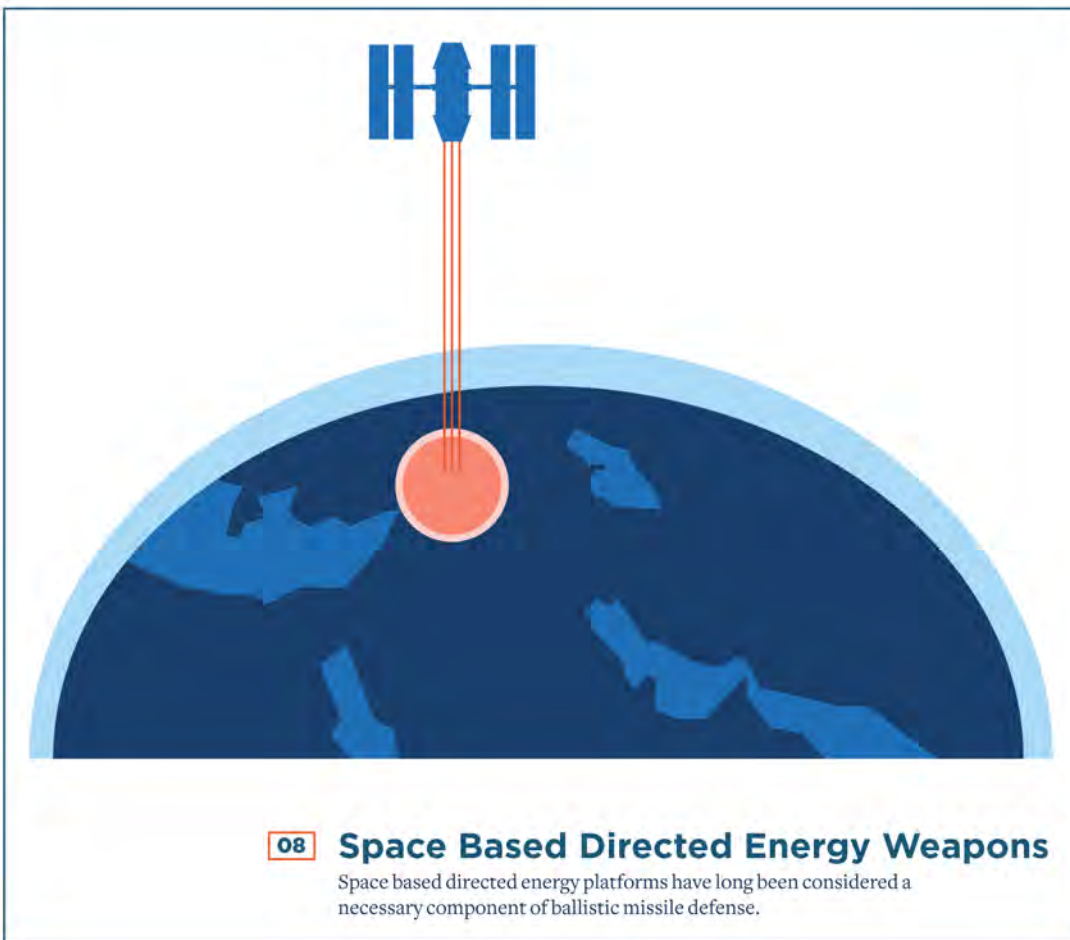
The writings of the great British naval strategist Sir Julian Corbett are also applicable to space. Like Mahan's, Corbett's contributions can be divided into three primary categories: strategic, commercial, and military.

For Corbett, the strategic purpose of naval forces is to facilitate the government's broader policy objectives. Aside from pressuring the enemy, naval forces aid a nation's army, diplomats, and allies. Sea power, therefore, comprises only one of the elements of a country's military. In much the same manner, current strategists should view space based assets or capabilities that can touch space as a component of a country's overall



### 07 Cislunar Space

The moon represents the first “near island” for Earth based defenses and the economic and strategic jumping off point to develop the resources of the solar system.



The military application of Corbett’s ideas extends further. Appropriate posture and presence of naval forces ensure that an enemy cannot disrupt a nation’s trade and operations. International commerce passes through straits and oceans as part of the freedom of navigation underwritten by naval power. The commercialization of space must be supported with similar protection. As Corbett suggests with regard to naval units and sea lines of communication, military assets on the ground or in low Earth orbits can at best protect only a portion of the space based lines of communication, and only for a limited period of time. However, units based in geosynchronous positions, at Lagrange points or on the moon, much like the

satellites of all types — communications and intelligence-surveillance-reconnaissance — have become integral to military operations and critical to U.S. military success in battle. The 2011 raid by elements of the Navy’s elite SEAL teams on a compound in Abbottabad, Pakistan, that resulted in Osama bin Laden’s death was enabled by a constellation of satellites. They collected imagery and signals intelligence from the area to confirm bin Laden’s presence, and then they aided in the coordination of the raiding force.<sup>36</sup> Such an ability to manage widely dispersed forces now represents the “normal” mode of operation. The American Global Positioning System, for example, is the key enabler of the state’s precision strike complex, which represents the U.S. military’s key technological advantage following the Second Offset when it chose to invest in capabilities and accept a huge reduction in the size of its force. To lose what have become crucial systems would represent the degradation of a significant U.S. military advantage and possible defeat in battle.

British base at Gibraltar, could provide broader coverage of the planet, especially if the platform employed directed energy and speed of light systems. It is critical that a nation so dependent on space as an aspect of its economic life should ensure access to it. Of equal importance is to maintain the ability to deny others access to those advantages.

**It is obvious that if the object and end of space warfare is the control of communications it must carry with it the right to forbid, if we can, the passage of both public and private property thru space.**

—Corbett, 1911 <sup>37</sup>

**Command of space, therefore, means nothing but the control of space communications, whether for commercial or military purposes. The object of space warfare is the control of communications, and not, as in land warfare, the conquest of territory.**

—Corbett, 1911 <sup>38</sup>

Finally, Corbett posits that naval forces also possess a commercial purpose. Command of the sea, including lines of communication, ensures the passage of both public and private shipping. Although a blockade of ports, for example, could provide this control temporarily, such authority over an area could not be guaranteed indefinitely. It is no easier to safeguard sections of space in the long term. With information services, finance and insurance industries, and nearly 10 percent of the United States' \$18 trillion economy passing through space, the resilience and protection of these systems are a rising concern for all aspects of government. The challenge is that critical satellites orbit at vastly different speeds, altitudes, and inclinations. Low Earth orbit platforms sweep by overhead many times a day. Geosynchronous satellites remain over the same spot constantly, but do so at an altitude of 23,500 miles. Satellites in polar orbits cross from the North to the South Poles, often in highly elliptical flight paths. Protecting all of these from attack from either Earth based or space based systems is difficult to impossible under current conditions. The development and testing of anti-satellite technologies by Russia and China during the past decade has exposed an existing threat to the United States' space-dependent economy. According to Corbett, a great power must defend its vulnerable commercial assets. A nation that takes such steps both protects itself and strengthens its position as a space power.

## Implications for Great Power Competition

Looking beyond current comparisons of the sea and space, the exploration, exploitation, and militarization of the Earth-moon system might seem distant. However the

Earth is crowded, and, while ecologists are not claiming that we are approaching a crisis point with regard to natural resource depletion, it must be understood that our planet has a finite supply of critical elements.<sup>39</sup> Soon nations will have no choice but to expand outward, searching for living space and resources, and, despite humankind's best intentions, the military competition between countries will follow.<sup>40</sup> The question becomes who will lead the race into space. The United States and the former Soviet Union blazed the trail during the 1960s, but both lost their desire after the United States won the moon race in 1969. Beyond the theoretical framework that Mahan, in particular, can provide, his work also highlights important historical parallels that can demonstrate who might serve as the dominant space power in the next century.

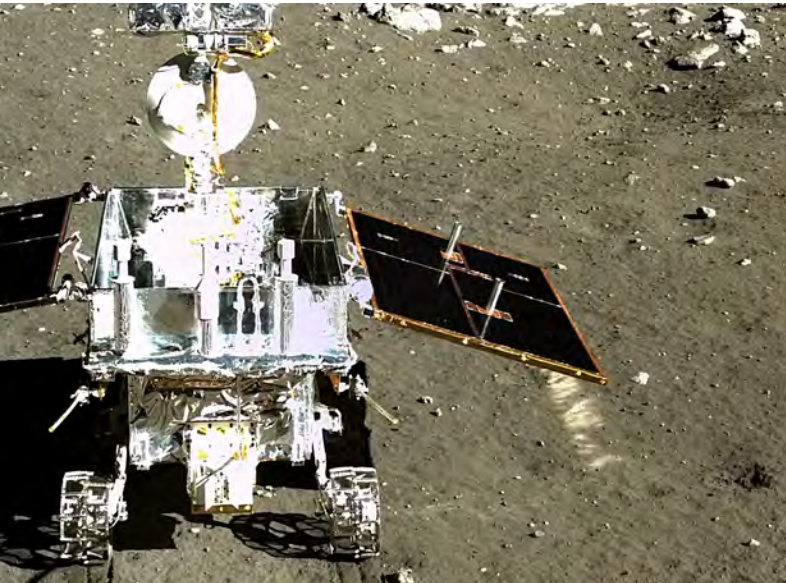
As far the U.S. geographic position goes, history has proven that its location on the globe is not injurious to its ambitions in the exploration of space. Although it is true that American launch sites in California and Florida are not able to take full advantage of the Earth's rotational speed, which is faster nearer the equator than at its poles,



*Astronaut Buzz Aldrin, the Apollo 11 Lunar Module Pilot, photographed on the moon 20 July 1969. (NASA Image)*

new technologies have overcome this handicap by developing powerful delivery vehicles, comfortably placing some of the world's heaviest payloads in orbit.

This comfortable technological and economic position may be eroding, however. Like the French at the center of Mahan's writings, Americans abide in a vast, "pleasant land" that contains abundant mineral and agricultural resources. In fact, if it were to choose to ignore its trade and alliance agreements, the United States would be capable of supplying most of its current needs from internal resources. It therefore has few economic reasons, at the present time, to initiate a large scale exploitation of the resources of space.



*China National Space Administration (CNSA) Chang'e-3 landed on the moon on 14 December 2013. It deployed the Yutu moon rover to explore the surface a few days later.*

China, on the other hand, greatly resembles historic England, a nation almost wholly dependent on outside suppliers for raw materials. Foreign buyers of Chinese manufactured products are the lifeblood of the economy. With almost all of Earth's resources already claimed, Beijing is turning its attention to space as a possible source of material independence. Recent unmanned orbiters around the moon have found extensive supplies of base ores as well as rare earth metals and mapped their locations.<sup>41</sup> China is realizing that claiming such minerals would guarantee not only its independence from outside economic coercion on Earth, but also, at least initially, its dominance as mankind stretches outward across the solar system.<sup>42</sup>

The United States, abiding in its "pleasant land," may find itself eclipsed in the very technological fields in which it has led for the past 30 years. Other, more "hungry," nations with a clearer vision of the future may set themselves upon the seas of space, discovering, claiming, and profiting from the abundant resources that exist there. The United States must recognize that "the space above a country is one of its frontiers"<sup>43</sup> and move to claim it. The size of that frontier may well be the element that will ring the alarm bell of the U.S. conscience.

Furthermore, the United States, a nation that stretches across an entire continent, is proportionally more vulnerable to threats from space than its smaller contemporaries in, for example, England, Panama, or Japan. This is not to say that the United States does not recognize this potential vulnerability; Washington has invested billions of dollars into the development of defensive systems capable of repelling attacks from space. Electromagnetic railguns, lasers, and missile launched kinetic kill weapons are just a few examples of alternative means of defending the U.S. space frontier from ballistic missile attacks.<sup>44</sup> These technologies demonstrate promising ability to protect U.S. territories, but what about other national assets at sea, abroad, and in space?

The United States owns thousands of satellites, some of which are unimportant, but most of which are critical to the business, science, and defense sectors of the state. Relatively few of these satellites occupy stable positions over U.S. territory; most spin about the Earth in low, fast moving orbits that leave them vulnerable to attacks in space from any number of nations. The United States does not possess the ability to defend these possessions from ground based installations. The best opportunity to both secure the space frontier and protect sovereign possessions in orbit lies with a space based defense system.

U.S. competitors in the international arena, are not so shortsighted. In China, for example, increased public funding for science and mathematics programs in public schools might provide the intellectual springboard to vault Beijing into stronger positions in space. If this happens, the United States will be placed in the expensive position of playing catchup. The window of U.S. vulnerability is defined by the amount of time it takes to educate and train a new generation of engineers, scientists, and technicians, and by how willing the country is to spend funds to attract talent from other countries. Industries will have to be retooled, and the costs will be great.

U.S. expansion beyond this planet will be neither smooth nor without incident. Other nations, promoting their own interests, will challenge the American position in space. The United States must be prepared to meet this challenge with an established space force that is capable of protecting its national interests on the new frontier. To develop a more robust space architecture, the United States must consider Mahan's and Corbett's lessons as they apply to space power.

## Conclusion

Nobel laureate Steven Weinberg bluntly states that the exploration of space is cost prohibitive, and British Astronomer Royal Martin Rees posits that with advances in robotics, there is no reason to send humans into space at all.<sup>45</sup> These individuals are short-sighted and lack vision for the future of mankind. Space will only become more important as Earth's resources are depleted and economic scarcity drives mankind beyond the planet. The only relevant question is who will lead us there and with what tools.

China has demonstrated a growing interest in space. Having arrived late on the chessboard of international competition, it is working to position itself strongly. Beijing is improving its heavy lift capability, launching vehicles with the (unintentional) assistance of key U.S. aerospace corporations and the federal government,<sup>46</sup> and securing the rights to several geosynchronous orbital parking spots previously claimed by neighboring Asian countries. These positions, if occupied by Chinese satellites, will provide commanding presence over East Asia and the entire Pacific Ocean.

As Mahan might suggest, one stimulus behind China's recent sojourns into space is the unique pressures of its citizenry. The country possesses the largest single population on the planet and has been constrained by a lack of raw resources within its own natural borders. Beijing's initial explorations in Africa, Asia, and most recently the South China Sea have been met with mixed results and increasingly negative press. Although its initial steps into space seem to be driven by a quest for national prestige, China, with its expanding population and limited natural resources, can no longer ignore the cornucopia of resources beyond Earth's atmosphere.

Nonetheless, it is unclear who will emerge on top in the next era of space exploration and competition. During the 1950s, the United States and the former Soviet Union began the competition through government supported agencies, but those organizations have

grown to become large, bureaucratically bloated, and increasingly ineffective. Today, in contrast, commercial entities such as SpaceX and Blue Origin are stepping into the fray with exciting new rocket designs that could upend the space race. SpaceX founder Elon Musk has established the goal of sending a commercial rocket of his own design to Mars. A historical parallel could be considered is the Dutch East India Company, chartered in 1602 by the Dutch government and granted an exclusive monopoly over the spice trade from Southeast Asia. The East India Company was first to issue stock as a means of raising capital to cover its expenses, a move that revolutionized the world economy. SpaceX's innovative, low cost, competitive approach to spaceflight, including the improvement of landing and reusing first stage boosters, promises to change mankind's approach to space exploration.

Today the challenge posed by the mining of minerals from the moon and the asteroid belt requires economic innovations of the current generation. Certainly such actions are coming into the realm of the possible from both technological and economic perspectives, but whither goes trade, so goes national competition. Low Earth orbit, geosynchronous orbit, Lagrange points, and the Moon each represent key strategic positions that might trigger rivalries to control them. Adapting the writings of Mahan and Corbett as a starting point for future conversations regarding a strategic approach offers firm ground upon which to build. Although the future remains uncertain and the vastness of space offers ambiguity, the lessons of the past can chart a good course forward.



*The Dutch East India Company issuance of stocks to raise funds to explore the southwestern Pacific Ocean finds parallels with SpaceX's innovative tech-startup approaches to spaceflight. (Wikimedia Commons and SpaceX)*

## Endnotes

1. John F. Kennedy, "Address at Rice University on the Nation's Space Effort" (Rice Stadium, Houston, September 12, 1962).
2. Ashley Tellis, "China's Military Space Strategy," *Survival*, 49 no. 3, 41–72, <http://dx.doi.org/10.1080/00396330701564752>. Jeff Kueter and John Sheldon, "An Investment Strategy for National Security Space," Special Report No. 129 (Heritage Foundation, February 20, 2013), <http://www.heritage.org/research/reports/2013/02/an-investment-strategy-for-national-security-space>.
3. John Klein, "Corbett in Orbit: a Maritime Model for Strategic Space Theory," *Naval War College Review*, 57, no.1 (winter 2004).
4. Milan Vego, "Naval Classical Thinkers and Operational Art" (Naval War College, Joint Military Operations Department, 2009), <https://www.usnwc.edu/getattachment/85c-80b3a-5665-42cd-9b1e-72c40d6d3153/NWC-1005-NAVAL-CLASSICAL-THINKERS-AND-OPERATIONAL-.aspx>.
5. Alfred Thayer Mahan, *The Influence of Sea Power upon History, 1660–1783* (Boston: Little, Brown, and Company, 1890), v–vi.
6. *Ibid.*, 29.
7. Julian S. Corbett, *Some Principles of Maritime Strategy* (London and New York: Longmans, Green, and Company, 1911), 15.
8. *Ibid.*
9. Christopher J. Fettweis, "A Critique of Classical Geopolitics," *Classics of Strategy and Diplomacy*, March 24, 2015, <http://www.classicsofstrategy.com/2015/03/a-critique-of-classical-geopolitics-christopher-j-fettweis.html>; and William D. Needham, "Mahan?" U.S. Naval Institute *Proceedings*, 119 no. 1/1,079 (January 1993) 44.
10. David Ignatius, "Transforming U.S. Military Might into 21st Century Weapons," *The Washington Post*, January 2, 2011, <http://www.washingtonpost.com/wp-dyn/content/article/2010/12/31/AR2010123101858.html>; and Jan S. Breemer, "The End of Naval Strategy," *Strategic Review*, 22 no. 2 (1994), 40–42.
11. Mahan, *The Influence of Sea Power Upon History*, 28.
12. Lyn Dutton et al, *Military Space* (McLean, VA: Brassey's, 1990), 15–16.
13. Mahan, *The Influence of Sea Power Upon History*, 32.
14. John M. Collins, *Military Space Forces* (New York: Pergamon-Brassey's, 1989), 29–31. For more recent analysis please also see, Clay Wilson, CRS Report to Congress: High Altitude Electromagnetic Pulse (HEMP) and High Power Microwave (HPM) Devices: Threat Assessments (Washington DC: July 21, 2008); Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack (April 2008); William Graham, Statement Before the House Armed Services Committee: Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack (July 10, 2008); and Peter Huessy, Electronic Doomsday for the US? The Electromagnetic Pulse (EMP) (January 13, 2016).
15. Mahan, *The Influence of Sea Power upon History*, 39.
16. *Ibid.*, 46.
17. Collins, *Military Space Forces*, 21.
18. Lawrence E. Joseph, "Who Will Mine the Moon?" *The New York Times*, January 19, 1995, A23.
19. Mahan, *The Influence of Sea Power upon History*, 51.
20. *Ibid.*
21. Mahan, *The Influence of Sea Power upon History*, 29.
22. Alfred Thayer Mahan, *Naval Strategy Compared and Contrasted with the Principles and Practice of Military Operations on Land: Lectures Delivered at U.S. Naval War College, Newport, R.I., Between the Years 1887 and 1911* (Boston: Little, Brown, and Company, 1911), 134.
23. Dutton et al., *Military Space*, 95–113.
24. Alfred Thayer Mahan, *The Problem of Asia and Its Effect upon International Policies* (Boston: Little, Brown, and Company, 1900), 125.
25. William A. Dougherty, "Storm from Space," U.S. Naval Institute *Proceedings*, 18, no. 8 (August 1992) 48–51.
26. Colin S. Gray, "Vision for Naval Space Strategy," U.S. Naval Institute *Proceedings*, 120, no. 1 (January 1994), 65; Barry D. Watts, "The Military Use of Space: A Diagnostic Assessment" (Center for Strategic and Budgetary Assessments, 2001), 121–26, <http://csbaonline.org/publications/2001/02/the-military-use-of-space-a-diagnostic-assessment/>.
27. Zachary Keck, "China's New Super Weapon Revealed: Satellite Destroyers," *The National Interest*, April 15, 2015, <http://nationalinterest.org/blog/the-buzz/>



- chinas-next-superweapon-revealed-satellite-destructors-12640.
28. Mahan, *Naval Strategy*, 151.
29. Dutton et. al., *Military Space*, 147–53.
30. Thomas Karas, *The New High Ground: Systems and Weapons of Space Age War* (New York: Simon and Schuster, 1983), 153–54.
31. Alfred Thayer Mahan, *Mahan on Naval Warfare: Selections from the Writing of Rear Admiral Alfred T. Mahan* (Boston: Little, Brown, and Company, 1918), 70.
32. Mahan, *Naval Strategy*, 138.
33. Collins, *Military Space Forces*, 24–25.
34. Mahan, *Naval Strategy*, 163.
35. Corbett, *Some Principles of Maritime Strategy*, 15.
36. Craig Whitlock and Barton Gellman, “To Hunt Osama bin Laden, Satellites Watched over Abbottabad, Pakistan, and Navy SEALs,” *The Washington Post*, August 29, 2013, [https://www.washingtonpost.com/world/national-security/to-hunt-osama-bin-laden-satellites-watched-over-abbottabad-pakistan-and-navy-seals/2013/08/29/8d-32c1d6-10d5-11e3-b4cb-fd7ce041d814\\_story.html](https://www.washingtonpost.com/world/national-security/to-hunt-osama-bin-laden-satellites-watched-over-abbottabad-pakistan-and-navy-seals/2013/08/29/8d-32c1d6-10d5-11e3-b4cb-fd7ce041d814_story.html).
37. Corbett, *Some Principles of Maritime Strategy*, 95.
38. *Ibid.*, 94.
39. Jolene Creighton, “Why Asteroid Mining Could Dictate Our Entire Future in Space,” *Science Alert*, July 1, 2016, <http://www.sciencealert.com/how-asteroid-mining-might-dictate-our-future-in-space>.
40. Capt. Alfred Skolnick, “The Navy’s New Frontier,” U.S. Naval Institute *Proceedings*, 115, no. 1 (Jan., 1989), 30–31.
41. Leonard David, “Is Mining Rare Minerals on the Moon Vital to National Security?” *Space.com*, October 4, 2010, <http://www.space.com/9250-mining-rare-minerals-moon-vital-national-security.html>.
42. Jeff Kueter, “China’s Space Ambitions—And Ours,” *The New Atlantis*, no. 16 (spring 2007), <http://www.thenewatlantis.com/publications/chinas-space-ambitions-and-ours>.
43. Mahan, *The Influence of Sea Power upon History*, 30.
44. Dutton et al., *Military Space*, 156–69.
45. Amitai Etzioni, “Mars Can Wait. Oceans Can’t,” *CNN*, August 17, 2012, <http://www.cnn.com/2012/04/09/opinion/etzioni-space-oceans/>.
46. James R. Asker and Joseph C. Anselmo, “U.S. Broadens Probes of China Tech Transfer,” *Aviation Week and Space Technology*, June 29, 1998, 24–26.

## **About the Center for a New American Security**

The mission of the Center for a New American Security (CNAS) is to develop strong, pragmatic and principled national security and defense policies. Building on the expertise and experience of its staff and advisors, CNAS engages policymakers, experts and the public with innovative, fact-based research, ideas and analysis to shape and elevate the national security debate. A key part of our mission is to inform and prepare the national security leaders of today and tomorrow.

CNAS is located in Washington, and was established in February 2007 by co-founders Kurt M. Campbell and Michèle A. Flournoy.

CNAS is a 501(c)3 tax-exempt nonprofit organization. Its research is independent and non-partisan. CNAS does not take institutional positions on policy issues. Accordingly, all views, positions, and conclusions expressed in this publication should be understood to be solely those of the authors.

© 2016 Center for a New American Security.

All rights reserved.



**Bold. Innovative. Bipartisan.**