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SPACEPOWER THEORY: LESSONS FROM THE MASTERS

by

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Contents

	<i>Page</i>
DISCLAIMER	ii
PREFACE	iv
ABSTRACT	vi
INTRODUCTION	1
LAND MEDIUM.....	4
Jomini	4
Clausewitz	5
Hart and Fuller.....	7
MARITIME MEDIUM.....	11
Mahan	11
Corbett	13
AIR MEDIUM	17
Douhet	18
Mitchell.....	20
SPACE MEDIUM	25
Lupton.....	26
Oberg	28
Dolman	29
CONCLUSION AND SYNTHESIS.....	32
Lessons on Spacepower Theory	33
APPENDIX A.....	38
APPENDIX B	44
APPENDIX C	47
BIBLIOGRAPHY.....	50

Preface

Space does not yet have the benefit of a Mahan, a Douhet or a Mitchell.

-- Lt Gen Santarelli

Where is the Mahan for Space?

-- Back cover of Oberg's *Space Power Theory*

This research started as “Military Spacemindedness.” It was to explore the intellectual and theoretical origins of military spacepower, recognize the space medium’s unique advantages and inherent limitations, discuss methods of force employment in the medium and visualize the battlespace throughout the spectrum of conflict. However, I found only a limited amount of spacepower theory. To echo General Estes, “There was an obvious vacuum of written theory concerning space that had long since been filled for land, sea and airpower.”¹ Much of the existing written work on spacepower is focused on either organizational or technological concepts (the “who, where and how”) rather than thought (the “what, when and why”). This research looks into the gap and focuses on military theory.

I chose the theorists in this paper because they are recognized experts on warfare in their respective medium. These theorists (with the exception of those on the space medium) have lesson blocks devoted to their principles in Professional Military Education, and regardless whether they are military scholars (e.g. Clausewitz) or advocates (e.g. Mitchell), their influence on military operations continues to this day. This paper captures their original words and applies lessons from these “masters” to the developing body of spacepower theory.

This work is dedicated to the space and missile pioneers, who, in a span of just eight years (1954-1962) developed four complete missile systems (Thor, Atlas, Titan and Minuteman) that remain the foundation of our space launch capability and nuclear deterrence. In that same timeframe, they developed infrared and optical imaging satellites that were able to take 30-foot resolution pictures of Soviet missile fields by 1960. Their heroic efforts and technical prowess built the foundation of spacepower.

I'd like to thank my faculty research advisor, Maj Edd Allard, for his patient review of numerous drafts. I also wish to thank Col Jim Forsyth and Dr. Ken Feldman for their expertise and advice that re-scoped and refined this research. The '05 Space at the Operational Level of War Research Seminar, particularly Majors Lane "Snapper" Humphreys, Jonathan "Mad Dog" Davis, and Rob "Huck" Huckleberry, provided much needed peer reviews. I am also greatly indebted to General Lance Lord for the opportunity to serve as his speechwriter and observe many spacepower "coaching moments" first-hand. Thanks to his efforts, space superiority now "rolls off our tongues" as easily as air, land and sea superiority. His influence will continue to increase the combat power of our Air Force and our nation for many years to come.

Finally, I'm grateful for being blessed with a wonderful family—Jennifer, Jeff and Jake deserve more thanks than I can give for their patience, understanding and support.

¹ James E. Oberg et al., *Space Power Theory* (Colorado Springs: US Air Force Academy; Distributed by US Government Printing Office, 1999), ix.

Abstract

Spacepower, analogous to airpower and sea power, is the ability to use the space medium to project military power. Since the end of the Cold War, the contributions of spacepower to national security and military operations have become increasingly visible in the open press, leading to an increased stated need for a comprehensive spacepower theory. This research is focused toward that need. It explores the central themes and specific points of the “theoretical masters” of land, sea and air, in order to draw analogies to the emerging presence of military spacepower.

Space will continue to aid combat in other mediums as it offers persistence, range, and near instantaneous speed—enabling a global presence that is unmatched by capabilities in any other medium. However, for spacepower to emerge as a fully competent component of the future joint force, or simply to mature as a combat arm within the US Air Force, a body of serious thought must be given to why we need spacepower and what we intend it to do.

Through this analysis, five lessons emerge for spacepower theory: 1) Spacepower must control space lines of communication; 2) Decisive points are key to space control; 3) Spacepower requires superior observation capabilities and the ability to take offensive action; 4) Robust spacepower could lead to enemy paralysis; and 5) Spacepower requires masters of the space medium.

Introduction

You may not be interested in war ... but war is interested in you.

-- Trotsky

In military activities, the question of the utilization of the armed forces is the most critical and the most vital that confronts a nation.

-- Mahan

Theory should cast a steady light on all phenomena so that we can more easily recognize and eliminate the weeds that always spring from ignorance.

-- Clausewitz

No study is possible on the battlefield; one does there simply what one can in order to apply what one knows. Therefore, in order to do even a little, one has to already know a great deal, and to know it well.

-- Foch

When asked to comment about the earth environment and its respective mediums, I picture two images: 1) The Earth as seen by the crew of Apollo 17 on December 7th, 1972, during their trip to the Moon;² and 2) The earthrise over the moon's horizon, first taken by Apollo 8 astronauts in December, 1968.³ Both photos serve to illustrate the vibrant earth against the stark blackness of space, while the former clearly illustrates four distinct media—land, sea, air and space—with the African continent, the Antarctic ice cap, white cloud masses suspended in air and a significant amount of dark blue water clearly in view. These images serve to unite land, sea, air and space into one symbiotic system. Navy Captain and veteran astronaut Donald Williams said:

For those who have seen the Earth from space, and for the hundreds and perhaps thousands more who will, the experience most certainly changes your perspective. The things that we share in our world are far more valuable than those which divide us.⁴

Divisiveness and conflict, however, are inherent to human nature. The Clausewitzian maxim of war as “politics by other means” rings in our ears and defines the need for the military instrument of national power, while also illustrating the motivation for conflict throughout human history.⁵ As explained by Art and Waltz, “Military Power plays a crucial role in international politics because states coexist in a condition of anarchy... [it] helps make and enforce the rules of the game.”⁶ The United States spells out its commitment to military power in the National Security Strategy (NSS) by stating, “Defending our Nation against its enemies is the first and fundamental commitment of the Federal Government.”⁷ The NSS goes on to say, “It is time to reaffirm the essential role of American military strength. We must build and maintain our defenses beyond challenge.”⁸

The US uses its military instrument of national power to accomplish four national security objectives outlined by the 2004 National Defense Strategy: “Secure the United States from direct attack; Secure strategic access and maintain global freedom of action; Establish security conditions conducive to a favorable international order; and Strengthen alliances and partnerships to contend with common challenges.”⁹ Further, “The [Defense] Department must work to secure strategic access to key regions, lines of communication and the “global commons” of international waters, airspace, space and cyberspace.”¹⁰

To accomplish these tasks, US forces must integrate land, sea, air and space forces and be “born joint.” However, each service must also be masters of their respective medium(s) to achieve decisive effects within that medium and enable the Joint Force to

conduct “sequential, parallel or simultaneous operations throughout the physical and information domains of the global battlespace.”¹¹

This paper presents benchmark theories of warfare in the land, sea, air and space mediums and concludes with five lessons drawn from the “theoretical masters” for spacepower. Each master theorist’s main themes and central points are outlined in Appendix A, along with of how their themes/points could be applied to spacepower. Appendix B then and reduces these points into five main categories, forming the synthesis of this research. These lessons from the theoretical masters will hopefully add to the current body of spacepower theory, based largely on Oberg’s 13 Truths and Beliefs on Spacepower, summarized at Appendix C.

² Photo is NASA Image #: AS17-148-22727 taken on 7 December 1972, and is available (in multiple resolutions) from <http://grin.hq.nasa.gov/ABSTRACTS/GPN-2000-001138.html>.

³ Photo is NASA Image #: 68-HC-870 taken on 29 December 1968, and is available (in multiple resolutions) from <http://grin.hq.nasa.gov/ABSTRACTS/GPN-2001-000009.html>.

⁴ Kevin W. Kelley, *The Home Planet* (Reading, Mass.: Addison-Wesley, 1988).

⁵ Carl von Clausewitz, *On War*, ed. Michael Eliot Howard and Peter Paret, Rev. ed. (Princeton, N.J.: Princeton University Press, 1984), 87. Clausewitz’ actual words (translated) are, “We see, therefore, that war is not merely an act of policy but a true political instrument, a continuation of political intercourse, carried on with other means.” Echevarria (<http://www.carlisle.army.mil/ssi/pubs/display.cfm?pubID=374&CFID=348108&CFTOKEN=80423277>), however, explains how Americans consider war an alternative to bargaining, rather than part of an ongoing bargaining process, as in the Clausewitzian view.

⁶ Robert J. Art, and Kenneth N. Waltz, *The Use of Force: Military Power and International Politics*, 5th ed. (Lanham, Md.: Rowman & Littlefield, 1999).

⁷ George W. Bush, “The National Security Strategy of the United States of America,” (Washington, D.C.: Government Printing Office, 2002), iii.

⁸ *Ibid.*, 29.

⁹ United States Joint Chiefs of Staff, *National Military Strategy of the United States of America* (Washington, DC: US Government Printing Office, 2004), 1.

¹⁰ *Ibid.*

¹¹ *Ibid.*, 13.

Land Medium

Documented land warfare dates to the duel between David and Goliath. The concept of the battle “field” dominates our thought still today, based on thousands of years of ritualized wars, wars with limited objectives, conventional wars of conquest, mass wars, or wars without quarter.¹² Land warfare is described in one of the oldest books of the bible—Deuteronomy—with the oldest known concepts on the *art of war* written by Sun Tzu in the 4th Century B.C. He said, “The art of war is of vital importance to the state. It is a matter of life and death, a road either to safety or to ruin. Hence under no circumstances can it be neglected.”¹³

With credit to the Romans, the Carthaginians, the Spartans and others, military theory languished until the era of the post-Westphalian nation-state, and the modern standing army came to fruition. Napoleon’s military prowess changed the character of warfare forever, and military theorists clamored to explain his success on the battlefield and ensure the state could out-think its opponent—essential for survival in the era of modern, total warfare.

Jomini

The most direct interpreter of Napoleon’s domination of the land medium was Antoine Henri de Jomini. Jomini was promoted to colonel by Napoleon and fought at Jena, Elau and the Peninsular War. He left the French army, but was recalled by Napoleon and became a brigadier at the age of twenty-eight.¹⁴ Jomini devoted his life to addressing how Napoleon led his army to greatness. Although he has been criticized for

proposing rules from Napoleon's success and selecting only the evidence to support his claims, he remains "one of the outstanding strategists of Western military history."¹⁵

First written in *Traité de Grande Tactique* in 1803, Jomini's central treaties were:

That strategy is the key to warfare,
That all strategy is controlled by invariable scientific principles; and
That these principles prescribe *offensive action to mass forces* against weaker enemy forces at some *decisive point* if strategy is to lead to victory.¹⁶

Jomini added to these principles in his later work *Précis de l'art de la guerre* (Summary of the Art of War) by stating: "To so arrange that these masses shall not only be thrown the decisive point, but that they shall engage at the proper times and with energy."¹⁷ Expanding on this point, he said, "The system of rapid and continuous marches multiplies the effect of an army and at the same time neutralizes a great part of that of the enemies...but its effect will be quintupled if the marches be skillfully directed upon the decisive strategic points."¹⁸ Understanding that this recommendation may be obvious, Jomini clarified that "the difficulty lies in recognizing those points."¹⁹

Clausewitz

Like Jomini, Carl von Clausewitz was present at Jena, but served in the Prussian army—which suffered a disastrous defeat at the hands of the Napoleon. As a result, Clausewitz was a prisoner of war from 1806-1809 and worked for the rest of his life, mostly at the Berlin Military School writing his theories of warfare, to reform the Prussian army based on the lessons he learned "the hard way."²⁰ Many military strategists, theorists and historians today regard Clausewitz as the preeminent ground combat theorist and military strategist, as he connects warfare (with the goal of

annihilation of the fielded force) to politics, and also accounts for natural human reactions that occur during warfare (fog and friction).

Clausewitz said, “War is nothing but a duel on a larger scale;” with the purpose “to compel our enemy to do our will...and there is no logical limit to the application of that force.”²¹ In that duel, the purpose of warfare is, according to Clausewitz, “... always and solely to be to overcome the enemy and disarm him.”²² He amplified this by stating,

The fighting forces must be *destroyed*: that is, they must be *put in such a condition that they can no longer carry on the fight...* The country must be occupied; otherwise the enemy could raise fresh military forces; [and] the enemy’s *will* must be broken—the enemy government and its allies have been driven to ask for peace or the population made to submit.²³

Clausewitz proposed that defeat of the enemy is not due to general causes:

What the theorist has to say here is this: one must keep the dominant characteristics of both belligerents in mind. Out of these characteristics a certain center of gravity develops, the hub of all power and movement, on which everything depends. That is the point against which all our energies should be directed.²⁴

In addition to defining the center of gravity concept, which remains critical to modern warfare, Clausewitz distinguished actual combat from “war on paper.” In what is frequently described as the fog of war, Clausewitz said, “War is the realm of uncertainty; three quarters of the factors on which action in war is based are wrapped in a fog of greater or lesser uncertainty.”²⁵ He went on to say:

In short, most intelligence is false, and the effect of fear is to multiply lies and inaccuracies...This difficulty of accurate recognition constitutes one of the most serious sources of friction in war, by making things appear entirely different from what one had expected.²⁶

While Clausewitz’s concept of fog relates to faulty, missing or altered intelligence during the fight, his concept of friction is analogous to a “Murphy’s law” during combat: “Friction, as we choose to call it, is the force that makes the apparently easy so

difficult.”²⁷ Overcoming wartime fog and friction requires a level of military genius with has two factors: an intellect and education that, even during the most pressing and worst combat conditions, “retains some glimmerings of the inner light which leads to truth;” and the “courage to follow this faint light wherever it may lead.”²⁸ Clausewitz called the former attribute *coup d’oeil*, or an inward eye, that can maintain its focus on the principles of warfare during the heat of combat, and the latter a determination or *courage d’esprit* that can accept responsibilities and make decisions under pressure.

It was Clausewitz who connected and defined strategy and tactics and related their purpose in combat. He said,

The whole of military activity must therefore relate directly or indirectly to the engagement. The end for which a soldier is recruited, clothed, armed and trained, the whole object of his sleeping, eating, drinking and marching *is simply that he should fight at the right place and the right time*. It follows that the destruction of the enemy’s forces is always the means by which the purpose of the engagement is achieved.²⁹

Clausewitz’s detractors used this preoccupation with the battle/engagement and his lack in mentioning maneuver warfare, to blame him for the WWI ‘force on force’ catastrophe. They also said that he was too parochial (land power) and did not mention the significance of sea power in the Napoleonic wars.³⁰

Hart and Fuller

One of the most prolific critics of Clausewitz was Captain B.H. Liddell Hart, who stated that “Fighting power is but one of the instruments of grand strategy...” and introduced the use other instruments of national power to military strategists.³¹ “Furthermore,” he said, “while the horizon of strategy is bounded by the war, grand strategy looks beyond the war to the subsequent peace.”³² Hart added to Clausewitzian

military strategy, which focused primarily on engagement, with the idea that strategy should “bring about this battle under the most advantageous circumstances” and to “diminish the possibility of resistance” through “movement and surprise.”³³ The perfect strategy would produce a military decision without “any serious fighting,” and “not so much to seek battle as to seek a strategic situation so advantageous that if it does not of itself produce the decision, the continuation by a battle is sure to achieve this.”³⁴

This was the basis of his *indirect approach* that would cause strategic and psychological location that would leave the enemy with a sense of being trapped—by “paralyzing some of its vital organs instead of having to destroy it physically.”³⁵ Rather than a concentrated advance, Hart advocating using a combined effect of air and land motor power to *distribute and disperse forces* as much as possible against either one objective, successive objectives or a number of objectives simultaneously. Striking at enemy “communications and command centres which form its nerve system” and directly against a “nation’s nerve system of industry” are two ways he proposed that would deprive enemy freedom of action.³⁶

British Major General John Frederick Charles Fuller also advocated enemy paralysis over physical destruction of the enemy as a way to overcome the butcherous trench warfare of WWI. He said, “If a battle can be won without suffering loss, surely this is the most economical, if not the most traditional, way of gaining the strategical object.”³⁷ Fuller charged all commanders with their first, and primary duty, “to understand the anatomy of battle”—comparing the army to the human body, the brain (commander and his staff) controls the body (the enemy soldiers and fighting capacity).³⁸ Fuller described wearing down the enemy through body warfare and engaging enemy soldiers to get the

enemy to “bleed to death” would not be as effective as a “shot through the brain and a second shot through the stomach (dislocating the enemy supply lines) using a combined arms approach of the airplane and the tank to overcome obstacles and paralyze the enemy through surprise, mobility, security, speed and range.³⁹ “It is not difficult to forecast,” Fuller said, “what the doubling, tripling and quadruplicating of the speed and radius of action of the present day machines will mean to the art of war in the future.”⁴⁰

¹² Gérard Chaliand, *The Art of War in World History: From Antiquity to the Nuclear Age* (Berkeley: University of California Press, 1994), 7.

¹³ Sun Tzu (Sunzi bing fa), *The Art of War*, ed. James Clavell (New York: Delta, 1988), 9.

¹⁴ Chaliand, *The Art of War in World History: From Antiquity to the Nuclear Age*, 724.

¹⁵ Ibid.

¹⁶ John Shy, “Jomini,” in *Makers of Modern Strategy: From Machiavelli to the Nuclear Age*, ed. Peter Paret (Princeton, N.J.: Princeton University Press, 1986), 146.

¹⁷ Chaliand, *The Art of War in World History: From Antiquity to the Nuclear Age*, 739.

¹⁸ Ibid., 743.

¹⁹ Ibid., 739.

²⁰ Ibid., 671.

²¹ Clausewitz, *On War*, 75, 77.

²² Ibid., 90.

²³ Ibid. The third portion of this quote was paraphrased, as it was changed from a double negative “cannot be...so long ... has not” in favor of a more direct approach.

²⁴ Ibid., 595-6.

²⁵ Ibid., 101.

²⁶ Ibid., 117.

²⁷ Ibid., 121.

²⁸ Ibid., 102.

²⁹ Ibid., 95.

³⁰ Ibid., 36.

³¹ Basil Henry Liddell Hart, “Strategy,” in *ACSC Strategy and War Coursebook* (Maxwell AFB, AL: Air University Press, 2004; reprint, with permission, from *Strategy* (1954), Chapter 19), 314, 16.

³² Ibid., 314.

³³ Ibid., 315.

³⁴ Ibid., 316.

³⁵ Ibid., 325.

³⁶ Ibid., 327.

³⁷ J. F. C. Fuller, “Strategical Paralysis as the Object of the Decisive Attack,” in *ACSC Strategy and War Coursebook* (Maxwell AFB, AL: Air University Press, 2004; reprint, with permission, from *On Future Warfare* (1928), Chapter 4), 305.

³⁸ *Ibid.*

³⁹ *Ibid.*, 308.

⁴⁰ *Ibid.*, 307.

Maritime Medium

Estimates vary, but somewhere between 70 and 75 percent of the Earth's surface is covered by water, mostly by Oceans (97%) with a volume of 317,000,000 cubic miles.⁴¹ If all of the world's water was poured on the United States, it would cover the land to a depth of 90 miles.⁴² However, until the 1880s, no serious literature existed for naval warfare. Up to that time, naval leaders developed their strategy in terms of common sense and practical experience and it seemed there was no need for naval theory, as the changing political landscape and rapidly changing technology (wood to iron, sail to steam, shot to shells, etc.) seemed to "sweep all previous thinking away."⁴³

Mahan

In 1885, Alfred Thayer Mahan was promoted to Captain and became an instructor at the newly established Naval War College, where he began his work on sea power theory and published *The Influence of Sea Power on History* in 1890. His works were well-received almost as they were written, as Mahan commented in 1892:

The cordial reception [of my work] is virtually an admission that, in the race for material and mechanical development, sea officers as a class have allowed their attention to be unduly diverted from the systematic study of the Conduct of War, which is their peculiar and main concern.⁴⁴

Mahan distinguished the difference in naval power from land power largely due to the fact the sea cannot be occupied, but it remains important to international commerce and national wealth. He defined the need for sea lines of communication: "A nation...cannot live indefinitely off itself, and the easiest way by which it can

communicate with other peoples and renew its own strength is the sea.”⁴⁵ He expanded on this when he wrote:

The first and most obvious light in which the sea presents itself from the political and social point of view is that of a great highway; or better, perhaps of a wide common, over which men may pass in all directions, but on which some well-worn paths show that controlling reasons have led them to choose certain lines of travel rather than others. These lines of travel are called trade routes; and the reasons which have determined them are to be sought in the history of the world.⁴⁶

Controlling these sea lines of communication is essential to national survival in the modern era. Mahan identified how these strategic lines pass through “useful strategic points” that must be controlled through “command of the sea.” Mahan explained:

These national and international functions can be discharged, certainly, only by command of the sea. The Pacific, the Atlantic, and the Caribbean, with the great controlling stations [of] Porto Rico (sic), Guantanamo, The Canal Zone, and Hawaii...in which ships and stations are interdependent factors. To place the conclusion concretely, and succinctly, the question of command of the sea is one of annual increase of the navy. The question is not ‘naval,’ in the restricted sense of the word. It is one of national policy, national security, and national obligation.⁴⁷

How he proposed controlling the sea was by establishing positions, as outlined above, through forward naval bases, ideally positioned to project naval power “from which [the navy] can exert its strength” and through naval vessels that could simultaneously serve in an offensive and defensive capacity.⁴⁸ Mahan outlined this concept in the July 1902 edition of *National Review* when he wrote:

War is a business of positions. Its position, suitably chosen, by supporting the cruiser force, covers the approaches of national commerce, and also maintains both the commercial blockade and the close watch of the military ports. It may be noted that the commercial blockade is offensive in design, to insure the enemy and compel him to fight, while the other specified functions of the vessels are defensive.⁴⁹

Many credit Mahan’s writings for transforming the United States from a regional power to a world power. Students of Mahan included President Theodore Roosevelt and

his cousin, Franklin Delano Roosevelt, who each served as Assistant Secretary of the Navy—both were reportedly avid readers of Mahan, with the former holding the position during the Spanish American War.⁵⁰ It was the Spanish American War, incidentally, that won the Spanish colonies of Cuba, Puerto Rico, Guam, and the Philippines, as well as the formerly independent nation of Hawaii—and Mahan’s theoretical “controlling stations” became real American possessions. The country of Panama (with the Panama Canal project) and a greatly expanded navy both came to fruition under Theodore Roosevelt’s presidency.

Corbett

While Mahan is credited for the ascendancy of American naval power, Sir Julian Stafford Corbett is regarded, on the coattails of Mahan, as Britain’s greatest maritime strategist.⁵¹ Where Mahan advocated naval supremacy as an enabling end in itself, Corbett saw maritime strategy as merely one component of an overall national strategy aimed at the Clausewitzian view of ‘policy by other means.’ “For it scarcely needs saying,” said Corbett, “that it is almost impossible that a war can be decided by naval action alone.”⁵² Corbett amplified Mahan when he said, “The object of naval warfare is the control of communications, and not, as in land warfare, the conquest of territory. The difference is fundamental.”⁵³

Corbett defined maritime communications as the “wider communications which are part of the life of the nation...which connect the points of distribution.”⁵⁴ He went on to describe the interdependence between land and sea operations and addressed commercial communications at sea (or commercial shipping):

By occupying her maritime communications and closing the points of distribution in which they terminate, we destroy the national life afloat, and thereby check the vitality of that life ashore so far as the one is dependent on the other. Thus we see that so long as we retain the power and right to stop maritime communications, the analogy between command of the sea and the conquest of territory is in this aspect very close...It is obvious that if the object and end of naval 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 upon the sea. Now the only means we have of enforcing such commercial communications at sea is in the last resort the capture or destruction of sea-borne property.⁵⁵

If the ultimate aim of naval warfare is to control maritime communications, Corbett clarified, “In order to exercise that control effectively we must have a numerous class of vessels specially adapted for pursuit ... (with the) power of preventing their operations being interfered with by the enemy.”⁵⁶ In land warfare, lines of operation exist, and limits can be placed on enemy movement. At sea, however,

“...there is practically nothing to limit the freedom of his movement except the exigencies fuel...[and] the liability to miss him is much greater at sea than on land and the chances of being eluded by the enemy whom we are seeking to bring to battle becomes...a check upon our offensive action.”⁵⁷

Therefore, the pursuit battle units, according to Corbett, must have scouting power: “The battle-fleet must have eyes. Now, vessels adapted for control of communications are also well adapted for ‘eyes.’”⁵⁸ These eyes will help secure command of the sea by understanding how and when to seize the initiative and strike before the enemy’s mobilization is complete.

The other method of securing command of the sea is by blockade—“either to prevent an enemy’s armed force leaving port, or to make certain it shall be brought to action before it can carry out the ulterior purpose for which it puts to sea.”⁵⁹ Corbett called the former a “closed” blockade which “prevents the enemy’s fleet acting in a certain area and for a certain purpose” and was not in favor of it, as it passes the element of surprise to the

enemy, who will act to break the blockade.⁶⁰ An “open blockade,” however, closes commercial lines of communication to draw the enemy fleet to sea and bring him to action in a decisive battle before he is ready for combat—in a method which is “least exhausting to our fleet, and which will best preserve its battle fitness.”⁶¹

It does not take a large fleet to achieve command of the sea—“a Power too weak to win command by offensive operations may succeed in holding the command in dispute by assuming a general defensive attitude” or a “fleet in being.”⁶² The idea was to dispute control by “harassing operations, to exercise control at any place or at any moment as we saw a chance, and to prevent the enemy exercising control in spite of his superiority by continually occupying his attention;” and “keeping the fleet actively in being—not merely in existence, but in active and vigorous life.”⁶³

⁴¹ U.S. Geological Survey, *Earth’s Water Distribution* [Internet] (Aug 22, 2003 [cited 27 February 2005]); available from <http://ga.water.usgs.gov/edu/waterdistribution.html>.

⁴² U.S. Geological Survey, *How Much Water Is There on (and in) the Earth?* [Internet] (Mar 18, 2004 [cited 27 February 2005]); available from <http://ga.water.usgs.gov/edu/earthhowmuch.html>.

⁴³ A. T. Mahan and John B. Hattendorf, *Mahan on Naval Strategy: Selections from the Writings of Rear Admiral Alfred Thayer Mahan, Classics of Sea Power* (Annapolis, Md.: Naval Institute Press, 1991), xvii.

⁴⁴ *Ibid.*, xiv.

⁴⁵ A. T. Mahan, *The Influence of Sea Power Upon History, 1660-1783* (New York: Dover Publications, 1987), 200.

⁴⁶ *Ibid.*, 25.

⁴⁷ Mahan and Hattendorf, *Mahan on Naval Strategy: Selections from the Writings of Rear Admiral Alfred Thayer Mahan*, xx.

⁴⁸ *Ibid.*

⁴⁹ *Ibid.*, 313.

⁵⁰ Edward J. Renehan, Jr., *TR and the Navy: Speech Delivered at the 80th Annual Dinner of the Theodore Roosevelt Association* [Internet] (29 October 1999 [cited 27 February 2005]); available from <http://www.theodoreroosevelt.org/life/TRandNavy.htm>.

⁵¹ John Klein, J., “Corbett in Orbit,” *Naval War College Review* 57, no. 1 (2004).

⁵² Julian Stafford Corbett, *Some Principles of Maritime Strategy* (New York: AMS Press, 1972), 13.

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- ⁵³ Ibid., 90.
⁵⁴ Ibid.
⁵⁵ Ibid., 91. *Emphasis added.*
⁵⁶ Ibid., 116.
⁵⁷ Ibid., 161.
⁵⁸ Ibid., 116.
⁵⁹ Ibid., 185.
⁶⁰ Ibid., 188, 205.
⁶¹ Ibid., 189.
⁶² Ibid., 211.
⁶³ Ibid., 213-4.

Air Medium

Most aircraft fly from the surface of the earth through two levels of the Earth's atmosphere—the troposphere, which begins at the Earth's surface and extends to an altitude of approximately 10 miles (lower at the poles, higher at the equator), and the stratosphere, found between approximately 10 miles and 30 miles above sea level.⁶⁴ The highest known flight of a propeller driven aircraft was 96,500 ft (18.3 miles) by NASA's unmanned, solar-powered Helios on August 13, 2001, and the highest airplane flight of a non-rocket powered aircraft was 123,523.58 feet (23.4 miles), set on Aug. 31, 1977, by a MIG-25.^{65,66}

Aircraft provided the ability for mankind to reach into the sky and travel great distances with increased speed since the first balloon flight in 1783 and the first airplane flight in 1903. After man's first journey into the sky, military aircraft nearly immediately followed—in 1794 the French government established an army reconnaissance balloon unit; and the aircraft became integral to the war between Italy and Turkey within a decade of its invention.⁶⁷ The term “air power” itself can be traced back “at least as far as H.G. Wells's work (1908), *War in the Air*.”⁶⁸ Upon analysis, however, MacIsaac stated, “There has been no lack of theorists, but they have had only limited influence in a field where the effects of technology and the deeds of practitioners have from the beginning played greater roles than have ideas.”⁶⁹

Douhet

Giulio Douhet started as a practitioner and became one of airpower's greatest theorists. He was the commander of the first Italian air unit in World War I and was court-martialed and jailed for a year after openly criticizing the Italian military leadership's conduct of the war.⁷⁰ He was exonerated in 1920, published *Command of the Air* in 1921 (the same year he was promoted to general officer), and he subsequently retired from the service. Douhet spent much of the rest of his life communicating his ideas on airpower.⁷¹ He said, "The form of any war—and it is the form which is of primary interest to men of war—depends upon the technical means of war available."⁷² After observing the failed defensive trench warfare in the Great War, he remarked, "Wars can be won only by offensive action;" and "Because of its independence of surface limitation and its superior speed—superior to any other known means of transportation—the airplane is the offensive weapon par excellence."⁷³

This offensive weapon must be employed to command the air medium. Douhet's primary tenet was simply, "To have command of the air means to be in a position to prevent the enemy from flying while retaining the ability to fly oneself."⁷⁴ He amplified this when he said:

To have command of the air means to be in a position to wield offensive power so great it defies human imagination. It means to be able to cut an enemy's army and navy off from their bases of operation and nullify their chances of winning the war. It means complete protection of one's own country, the efficient operation of one's army and navy, and peace of mind to live and work in safety. In short, it means to be in a position to win.⁷⁵

This included all "technical means" available to shorten the war, as he said, "Air power makes it possible to not only make high-explosive bombing raids over any sector of the enemy's territory, but also to ravage his whole country by chemical and bacteriological

warfare.”⁷⁶ To adequately organize, train, equip and conduct operations leading to command of the air, Douhet advocated an organizational need for an independent air force:

In such a case, an air force should logically be accorded equal importance with the army and navy and bear the same relation to them as they now bear to each other. Obviously, both the army and the navy, each in its own field, must operate toward the same objective—i.e., to win the war. They must act accordingly, but independently of each other. To make one dependent on the other would restrict the freedom of action of one or the other, and thus diminish their total effectiveness. Similarly, an air force should at all times co-operate with the army and the navy; but it must be independent of them both.⁷⁷

“Equal importance” was significant, as Douhet perceived the large expenditures on the army and navy should be divided equally with an air arm for increased national security. Douhet explained, “The resources which even the richest nation can put at the disposal of national defenses are not limitless. With a given quantity of resources it is possible to secure a national defense just as efficient as the correct proportioning of the three factors.”⁷⁸

Douhet pushed investments in two classes of aircraft—a “battleplane” suitable for both combat and bombing, with “armament, armor protection, speed, and radius of action” and reconnaissance planes with superior speed that can “see, understand and report.”⁷⁹ Aircraft capabilities were projected by Douhet to command the air, but he anticipated it would be contested at every step. He said, “In order to observe the enemy in war, it is necessary first to spot him; and ...it is equally important for him not to be observed.”⁸⁰ Once observed, Douhet compared destroying an air force to attacking nests and eggs rather than birds in flight: “Similarly, destroying an enemy’s airplanes by seeking them out in the air is, while not entirely useless, the least effective method. A much better way is to destroy his airports, supply bases, and centers of production.”⁸¹

This effort would achieve command of the air, and then enable war-winning capabilities.

These abilities were unheard of just a few years prior to Douhet's writing, and was a true paradigm shift of Douhet's time—as Douhet explained,

In the days before the World War the opinion was current in military circles that combat in the air was an impossibility, and, except in rare instances, the first planes used in the war were provided with no armament suitable for combat. But aerial combat is a reality and is here to stay. Any aerial action on the part of the foe is bound to be to his advantage, and our disadvantage, and we must contest it. During the World War it was considered poor policy to admit that our reconnaissance planes could do practically nothing to prevent enemy planes from carrying out their observations over our lines, and vice versa. But aerial combat developed spontaneously, in the natural course of events.⁸²

Douhet then prophetically penned the words that have guided the continued transformation of armed forces and warned of the danger of being caught in dogma without the benefit of fresh military thought:

In the preparations for national defense we have to follow an entirely new course because the character of future wars is going to be entirely different from the character of past wars. I say: The World War was only a point on the graph curve showing the evolution of the character of war; at that point the graph curve makes a sharp swerve showing the influence of entirely new factors. For this reason clinging to the past will teach us nothing useful for the future, for that future will be radically different from anything that has gone before.⁸³

Mitchell

Brigadier General William “Billy” Mitchell espoused many of Douhet's ideas and, through his consistent advocacy for a separate aeronautical service, is considered by many to be the father of the United States Air Force. Mitchell was the first to use mass air attacks in combat during World War I and envisioned airpower as a potent and decisive weapon in future battles. He conceived and led the St. Mihiel offensive, the largest aviation attack in history to that point, “with two attack brigades of 400 planes

each” that attacked the German army in the rear and led to the surrender of 16,000 Germans in two days.⁸⁴ Despite his demonstrated importance of airpower to the fight, Mitchell’s greatest achievement may have been the world headlines made during his demonstration of what was then termed as frail, incompetent airpower against formidable navy sea power in 1921 by sinking captured German warships: the submarine U-117, the destroyer G-102, the cruiser *Frankfurt* and the battleship *Ostfriesland*—an “unsinkable ship” in the opinion of naval experts with a triple hull, 85 watertight compartments and hardened steel.⁸⁵

Mitchell was the first pronounced advocate of American military airpower. His books, articles and remarks served to ignite passions for airmindedness and military aviation. He wrote, “The time has come when aviation must be developed for aviation’s sake and not as an auxiliary to other existing branches. Unless the progressive elements that enter into our makeup are availed of, we will fall behind in the world’s development.”⁸⁶ “The world stands on the threshold of the ‘aeronautical era’” Mitchell wrote, and “During this epoch the destinies of all people will be controlled through the air.”⁸⁷ In Mitchell’s definition, “Air power is the ability to something in or through the air, and, as the air covers the whole world, aircraft are able to go anywhere on the planet” with no obstacles and, “in case of war, one place is just as exposed to attack as another place.”⁸⁸ “Air power in the future,” Mitchell wrote, “will be a determining factor in international competitions, both military and civil.”⁸⁹ Mitchell examined the developing air forces of England, France, Italy, Germany, Japan, Russia (and others) and stated, “America still hesitates to consolidate her aeronautical activities but the question is

becoming more important every day and the more it is investigated, the more apparent is its necessity.”⁹⁰

The decidedly different medium of air brings the unique ability for prompt global strike and the power of the offensive and forcing an air battle. Mitchell stated, “Armies may dig trenches, live in them, or sit around in them waiting for an enemy to attack them. This cannot be done in the air.”⁹¹ He further explained, “The country that is ready with its air force and jumps on its opponent at once will bring about a speedy and lasting victory.”⁹² According to Mitchell,

Aircraft move hundreds of miles in an incredibly short space of time, so...there is no telling where they are going to go to strike. Wherever an object can be seen from the air, aircraft are able to hit it with their guns, bombs, and other weapons. Cities and towns, railway lines and canals cannot be hidden. Not only is this the case on land, it is even more the case on water.⁹³

Further commenting on the unique ability to operate in the air medium with global reach and power, Mitchell said,

The advent of air power has made every country and the world smaller. We do not measure distances by the unit of miles, but by the unit of hours. . . . Should a nation, therefore attain complete control of the air, it could more nearly master the earth than has ever been the case in the past. Just as power can be exerted through the air, so can good be done, because there is no place on the earth’s surface that air power cannot reach and carry with it the elements of civilization and good that comes from rapid communications.⁹⁴

However, to master this medium required a break from tradition, according to Mitchell. “Already,” said Mitchell, “we have an entirely new class of people that we may call ‘the air-going people’ as distinguished from the ‘land-going people’ and the ‘sea-going people’...with a spirit, language, and customs of their own.”⁹⁵ Correspondingly, Mitchell writes, “A new set of rules will have to be devised and a whole new set of ideas of strategy learned by those charged with the conduct of war.”⁹⁶ But in this early phase

of airpower, there was no bank of historical data to draw lessons or deduce theoretical principles from (as available to Mahan in discussing sea power, for example). The traditional armed services of a nation “build on a foundation that they are certain of rather than to take any chances for making a mistake...they always look back to find a precedent for everything that is done.”⁹⁷ “In the development of air power,” Mitchell wrote,

one has to look ahead and not backward and figure out what is going to happen, not too much of what has happened. That is why the older services have been psychologically unfit to develop this new arm to the fullest extent practicable with the methods and means at hand.⁹⁸

⁶⁴ Dan Johnston, *The Atmosphere* [Internet] (U.S. Centennial of Flight Commission Essays, 2003 [cited 28 February 2005]); available from http://www.centennialofflight.gov/essay/Theories_of_Flight/atmosphere/TH1.htm.

⁶⁵ Guinness World Records, *Highest Flying Propeller-Driven Aircraft* (Guinness World Records, 2005 [cited 28 February 2005]); available from http://www.guinnessworldrecords.com/gwr5/content_pages/record.asp?recordid=56393.

⁶⁶ Pearson Education, *Absolute World Records: Altitude* [Internet] (Information Please Database, 28 Feb 05 2005 [cited 28 February 2005]); available from <http://www.infoplease.com/ipa/A0004565.html>.

⁶⁷ Giulio Douhet, *The Command of the Air* (Washington, D.C.: Office of Air Force History (USAF Warrior Studies), 1983), vii.

⁶⁸ David MacIsaac, “Voices from the Central Blue: The Air Power Theorists,” in *Makers of Modern Strategy: From Machiavelli to the Nuclear Age*, ed. Peter Paret (Princeton, N.J.: Princeton University Press, 1986), 627.

⁶⁹ *Ibid.*, 624.

⁷⁰ Chaliand, *The Art of War in World History: From Antiquity to the Nuclear Age*, 891.

⁷¹ Douhet, *The Command of the Air*, viii.

⁷² *Ibid.*, 6.

⁷³ *Ibid.*, 15.

⁷⁴ *Ibid.*, 24.

⁷⁵ *Ibid.*, 23.

⁷⁶ *Ibid.*, 6,7.

⁷⁷ *Ibid.*, 5.

⁷⁸ *Ibid.*, 70.

⁷⁹ *Ibid.*, 114,20.

⁸⁰ *Ibid.*, 134.

⁸¹ *Ibid.*, 34.

⁸² *Ibid.*, 41.

⁸³ Ibid., 27.

⁸⁴ Roger Burlingame, *General Billy Mitchell, Champion of Air Defense* (Westport, Conn.: Greenwood Press, 1978), 99,100.

⁸⁵ Ibid., v.

⁸⁶ William Mitchell, *Winged Defense: The Development and Possibilities of Modern Air Power, Economic and Military* (New York: Dover, 1988), x.

⁸⁷ Ibid., 3.

⁸⁸ Ibid., 3-4.

⁸⁹ Ibid.

⁹⁰ Ibid., 116.

⁹¹ Ibid., 10.

⁹² Ibid.

⁹³ Ibid., 3.

⁹⁴ Ibid., 26.

⁹⁵ Ibid., 6.

⁹⁶ Ibid.

⁹⁷ Ibid., 20.

⁹⁸ Ibid., 20-1.

Space Medium

Earth is the cradle of humanity, but one cannot live in a cradle forever.

Konstantin E. Tsiolkovski

If we do not expend the thought, the effort, and the money required, then another and more progressive nation will. It will dominate space and it will dominate the world.

Lt Gen James H. Doolittle

Air Force space-based assets have become essential to the success of operations conducted by all elements of America's joint forces.

General Ron Fogleman

For the first time in Air Force history, space has become an equal partner with air-breathing assets.

Dr. James G. Roche

There is no specific demarcation line that separates air and space. Theodore von Karman (in 1957) proposed what has come to be known as the “Karman primary jurisdiction line” where an object traveling 25,000 feet per second loses its aerodynamic lift and centrifugal force takes over, at about 53 miles above sea level.⁹⁹ This demarcation line is purposely kept in doubt to maintain political and legal flexibility regarding spacecraft overflight of another state’s national space. Oduntan proposed a staggered demarcation regime in international law to regulate jurisdiction over spatial territories, with maximum airspace altitude of 55 miles, a “buffer zone for the next 45 miles, which should be recognized as an area of innocent passage for all states,” and a space demarcation line at 100 miles.¹⁰⁰

At altitudes between 100 and 500 miles above sea level, low-earth orbiting (LEO) spacecraft conduct earth sensing, weather, and other missions. The space shuttle typically operates in this region, up to 250 miles. The earth medium-earth orbit (MEO) regime is approximately 11,000 nautical miles above sea level, where navigation satellites provide precision navigation and timing (PNT) signals. Geosynchronous orbit (GEO), at approximately 22,300 nautical miles above the Earth's surface, is prime space "real estate" over the equator for communication and missile warning satellites. Spacecraft in this orbit exhibit limited motion relative to the earth's rotation (zero motion for geostationary) and appear to remain in a fixed position over the equator. Earth stations can therefore position transmit/receive antennae in a stationary position, leading to inexpensive equipment such as "DirecTV" dishes. An illustration of these distances is typically done to a rough scale using a 12" globe, a sheet of copy paper and a ruler.¹⁰¹

This globe has a 12" diameter. To relate this scale to air and space operations, a typical airliner that flies at 35,000 feet would be 1/100" (1/4 mm, or the width of the sheet of paper) off the surface of the globe. LEO—the space shuttle orbit—would be 1/4" (9 mm) away; MEO—the GPS orbit—would be 19" (48 cm) out; and GEO, where the DSP satellites are "parked," would be 33" (85 cm) from the surface.

Lupton

In 1988, in the midst of the Cold War—where spacepower was very much a player, Lt Col David E. Lupton wrote, "Phrases such as *space power* and *space forces* cause intense, unfavorable reaction in the United States."¹⁰² Clouded in secrecy to protect the technological investment on both sides, military spacepower evolved "in the black" until photoreconnaissance satellites were first acknowledged by President Carter in 1978 and the existence of the National Reconnaissance Office became a public fact in 1992.¹⁰³

Lupton was the first to identify four schools of thought, or approaches to the military use of space: the sanctuary doctrine (space is a war-free zone to guarantee overflight, observation, treaty verification and to limit escalation), the survivability doctrine (retaliation to fragile space systems with attacks in-kind, emphasizing redundancy), the high-ground doctrine (global-presence coupled with high velocity/directed energy weapons that have the ability to dominate terrestrial operations) and the control school (control the space environment when and where needed to ensure friendly forces benefit from it and “enemy forces are denied those benefits”).¹⁰⁴

Lupton then identified issues pro and con for each school, leading to the conclusion that “The United States must have the ability to control space if it is to use that medium to fulfill national objectives in situations where our objectives come in conflict with those of other nations.”¹⁰⁵ His “five pillars of a space control doctrine” includes: 1) a logistical structure “required to make the American presence in space seem as ubiquitous as that of the British seaman in earlier centuries;” 2) the human being or man in space—beyond satellites/machines to overcome the fog and friction of war; 3) a space-based space surveillance system; 4) space control weapons, to include directed energy from space, ground and air platforms and projectile weapons; and 5) an improved organizational structure that can adequately lead space forces both in the operational arena (maneuvering, deploying decoys, employing electronic countermeasures or emission control) and the “bureaucratic organization that sees “combat” in the arenas where the budget dollar is divided.”¹⁰⁶ Lupton concluded by arguing that the “organizational neglect of the last 25 years [in 1988] brought on by the sanctuary doctrine’s antimilitary tenets” will require many years of repair, and the “lack of experienced personnel capable

of making the term *spaceman* as legitimate as the terms *airman* or *seaman* could gravely hinder Space Command's efforts."¹⁰⁷

Oberg

James Oberg was a career space engineer (NASA shuttle rendezvous), he has written ten books and a thousand magazine and newspaper articles on all aspects of space flight, and remains widely regarded as a world authority on the Russian space program.¹⁰⁸ His book *Space Power Theory* was "an incomplete attempt to match the vision of General Howell M. Estes, III, US Air Force (Retired)."¹⁰⁹ General Estes explained,

I was directed by the secretary of Defense to draft military space policy for space warfare. During our attempts to craft this policy, we often discussed the need for a national philosophy or strategic theory about space to guide our efforts. There was an obvious vacuum of written theory concerning space that had long since been filled for land, sea and airpower...While this book does a credible job of starting the debate about space power theory, it is only the beginning.¹¹⁰

Colin Gray also added that while technical manuals exist, "texts on space power have been notable for their rarity" and "to date our military space literature has yet to record a major publication."¹¹¹

While Oberg discussed the impact of space upon citizens, the nature of space power, impediments to the exercise of space power and space power in a national context, the heart of his work was his *Theory of Space Power*, centered around thirteen "truths and beliefs" in Appendix C. Oberg summarized the exercise of space power for national security when he said:

If the United States, or any other spacefaring nation, wishes to retain its national space power, it must necessarily protect its interests in space. The term most commonly used for expressing this need is space control, derived from Mahan's notion of sea power and sea control. This notion—

no matter its designation—is the primary principle of the exercise of space power.¹¹²

Correspondingly, Oberg stated that, “A basic tenet of space control is a requirement that all elements of space power, whether orbital or terrestrial, be protected...this will come to include a large number of commercial...[and] international friends and allies.”¹¹³ He continued to expand on this concept by stating the primary importance and necessity of quality real time space surveillance:

Surveillance of space emerges as the key element of space control, enabling the other facets of protection and denial. This is, in actuality, a declaration that controlling one’s destiny in space hinges upon an ability to detect what is happening in real time, as it happens. Until the point when we can truly watch over our satellites, we must place our faith in the good intentions of others.¹¹⁴

Dolman

Dr. Everett Dolman, Associate Professor of Comparative Military Studies at the School of Advanced Air and Space Studies (SAASS), took “strategy into outer space in a way that has not even been attempted before” in his 2002 *Astropolitik*—a book that was praised by Colin Gray as “...a true milestone on the road to holistic strategic understanding of the space environment.”¹¹⁵ Dolman stated, “In an age that has gone beyond sail and steam [with reference to Mahan’s “command of the sea” concepts] to one that is predicated on technology, communications, and innovation, exploitation of outer space is one modern route to prosperity and affluence.”¹¹⁶ His thesis, essentially, was a realist approach to “maximize space exploration and exploitation” for the gain of “all Earth’s people” and “reverse the current international malaise” with space exploration.¹¹⁷

Dolman’s *Astropolitik* strategy involves a three step process: 1) The United States should eliminate the Outer Space Treaty and establish, as the leading spacefaring nation,

a principle of free-market sovereignty in space by “permitting spacefaring states to claim covering ownership of territory on celestial bodies and other geo/astrographic positions while affording non-spacefaring states some opportunity to benefit;”¹¹⁸ 2) The US should seize military control of low-Earth orbit and prevent other states from deploying military spacecraft, while providing a “safe operating environment to enhance trade and exploration...” by implementing “a police blockade of all current spaceports, monitoring and controlling all traffic both in and out;”¹¹⁹ and 3) The US should establish a “national space coordination agency... to define, separate, and coordinate the efforts of commercial, civilian and military space projects.”¹²⁰

Dolman’s increased space militarization approach avoids what some view as a coming space-weapons race by discouraging military space competition through “a military space force that maintained effective control of space...perceived as tough, non-arbitrary, and efficient.”¹²¹ Increased military space programs and advancements, according to Dolman, would continue to be the backbone of many civilian space operations (robust space launch capacity, for example) with economic advantages comparable to current “spin-off” capabilities in areas of “telecommunications navigation, earth-sensing, and weather satellites.”¹²² Dolman’s work, though perhaps controversial, paints a vision for a national and international future that advances into the space medium. It overcomes “current US space strategy [that] is focused on technological capabilities, and to a lesser extent on developing military and commercial capabilities.”¹²³ The current US space strategy is “not decisive, guiding or illuminating,” according to Dolman, and is not “*strategic*.”¹²⁴

⁹⁹ Dr. Gbenga Oduntan, *The Never Ending Dispute: Legal Theories on the Spatial Demarcation Boundary Plane between Airspace and Outer Space* (The Centre for International Law, University of Hertfordshire, Autumn 2003 [cited 9 March 2005]); available from http://perseus.herts.ac.uk/uhinfo/library/i89918_3.pdf.

¹⁰⁰ *Ibid.* ([cited]).

¹⁰¹ Script from AFSPC Command Briefing, circa 2004.

¹⁰² David E. Lupton, *On Space Warfare: A Space Power Doctrine* (Maxwell Air Force Base, Ala.: Air University Press, 1988), 1.

¹⁰³ *Ibid.*, 13. President Carter said, "Photo-reconnaissance satellites have become an important stabilizing factor in world affairs in the monitoring of arms control agreements. They make an immense contribution to the security of all nations." Many other details became public at the SAFSP Holiday Party, held 6 Dec 97, through NRO Director Keith Hall's remarks: <http://www.fas.org/irp/nro/hall3.htm>

¹⁰⁴ *Ibid.*, 38-9.

¹⁰⁵ *Ibid.*, 125-6.

¹⁰⁶ *Ibid.*, 142-3.

¹⁰⁷ *Ibid.*, 144.

¹⁰⁸ James Oberg, *Profile* [Internet] (2005 [cited 7 March 2005]); available from <http://jamesoberg.com/profile.html>.

¹⁰⁹ Oberg et al., *Space Power Theory*, v.

¹¹⁰ *Ibid.*, ix, xi.

¹¹¹ *Ibid.*, xv.

¹¹² *Ibid.*, 137.

¹¹³ *Ibid.*, 138.

¹¹⁴ *Ibid.*, 140.

¹¹⁵ Everett C. Dolman, *Astropolitik: Classical Geopolitics in the Space Age* (London; Portland, OR: Frank Cass, 2002), xi, xii.

¹¹⁶ *Ibid.*, 183.

¹¹⁷ *Ibid.*

¹¹⁸ *Ibid.*, 141.

¹¹⁹ *Ibid.*, 157.

¹²⁰ *Ibid.*

¹²¹ *Ibid.*, 159.

¹²² *Ibid.*, 162.

¹²³ *Ibid.*, 155.

¹²⁴ *Ibid.*, 156.

Conclusion and Synthesis

Each theorist represented above presented something of value toward advancing the profession of war by presenting a framework to better utilize each earth medium to conduct combat operations. Combat occurred in each medium before a theoretical framework emerged to further develop the ability to control that medium (land, air, and sea) when needed and influence combat in other mediums. Space is no exception. The ability to guide weapons with precision is a recent and growing competency of the US military, and it is enabled by spacepower. This competency has already been challenged by adversaries (Iraqi jamming of the GPS signal in 2003 during Operation IRAQI FREEDOM) and counteracted through US action (elimination of six jamming sites through airstrikes).¹²⁵

Space will continue to aid combat in other mediums as it offers persistence, range, and near instantaneous speed—enabling a global presence that is unmatched by capabilities in any other medium. However, for spacepower to emerge as a fully competent component of the future joint force, or simply to mature as a combat arm within the US Air Force, a body of serious thought must be given to why we need spacepower and what we intend it to do. The work of Lupton, Oberg and Dohlman (among others) forms the existing theoretical baseline, but to what standard do we compare contemporary spacepower theory? Further, what does spacepower provide the future joint force, beyond the ability to control the space medium?

Examining the preeminent theorists of war in other mediums gives us a framework to examine current spacepower theory and guide further development. Appendix A presents

a summary of the central themes of each “Master” theorist of land, sea and air, along with their specific points, and suggests how their thoughts could be applied to spacepower. This helps us to avoid attaching ourselves “early” to a specific theorist who we assume would be most applicable and discarding salient points of others before examining their relevance in the search of a better model. Through this analysis, as shown in Appendix B, some common themes are evident.

Lessons on Spacepower Theory

1. Control Space Lines of Communication

Mahan introduced the concept of sea lines of communication and explained the importance of controlling “well worn paths,” or trade routes, to command the sea. Corbett echoed this point when he emphasized retaining the power to stop maritime communications and equated that capability to occupying territory on land. The concept of *space* lines of communication (LOCs) is just as, and perhaps more, critical to modern national survival as controlling trade routes in the nineteenth century.

While material goods are not transported through space as they are over the oceans, commercial use of spacecraft is “changing the way business and commerce are conducted” both intrastate and worldwide.¹²⁶ Some examples include \$97 Billion in 2003 worldwide space revenues generated through: Financial transactions (credit card payments, ATM machines, private financial networks), Entertainment (programming content distribution, live access to news & sports, direct access television & radio), Global Markets (telephony & wireless network backup, video conferencing, private data networks), Humanitarian Efforts (telemedicine, environmental monitoring, weather forecasting), Education (distance education, employee training), Business Data

(logistics, remotely tracking assets, remotely monitoring systems, data interchange), and many other government, public and private uses.¹²⁷ Military uses of space continue to increase, beyond communications and weapons guidance, to flying actual weapons platforms (such as the Predator) from across the globe using satellite data links.¹²⁸

The importance of controlling space LOCs continues to escalate, with significant diplomatic, informational, military and economic implications. Use of the space medium is increasingly essential to national survival, as the volume of critical decisions reliant on instantaneous information, observation and communications transmission continues to rise. Ensuring friendly space LOCs, and denying space LOCs to an adversary during conflict, is a vital national need—and spacepower must develop to address this need.

2. Decisive Points are Key to Space Control

A corollary to controlling space LOCs is controlling decisive points. Each theorist emphasized the importance of controlling these points: Mahan identified how sea lines of communication pass through useful strategic points that must be controlled to command the sea, Corbett discussed closing the points of distribution in which maritime communications terminate, and Jomini stated that friendly forces should be massed at the decisive point at the proper times. Further, Clausewitz related that the purpose of a soldier is to fight at the right place at the right time, Hart and Fuller described decisive points to paralyze the enemy, Douhet conveyed the importance of destroying an air force before it takes flight, and Mitchell stated strategic points cannot be hidden from the air.

Potential decisive points that could influence the control of space LOCs include geostationary spacecraft used for communication or telemetry relay, ground centers for spacecraft command and control (C2), launch sites and spaceports, mission/data

processing sites, ground data downlink and relay stations and key research and development facilities. The more redundant, dispersed and mobile these decisive points are (aircraft launch systems such as the Pegasus, mobile C2 centers, and redundant, multiple, or crosslinked orbital relay spacecraft for example), the more difficult it would be to control space lines of communication and ultimately influence enemy operations.

3. Required Capabilities: Observation and Action

Douhet emphasized the importance of observing the enemy with reconnaissance planes of superior speed that can observe, understand and report enemy action and stated that the enemy will do everything possible to deny this observation. Corbett also said that the battle-fleet must have eyes to understand when to strike. Oberg discussed the corollary for space when he stated that surveillance of space was the key element of space control, enabling the other facets and how “...one’s destiny in space hinges upon an ability to detect what is happening in real time.”¹²⁹ However, the speed of action in space and the ability to conduct rapid ground-to-space or space-to-space attacks without observation requires more than just space surveillance—it involves in-depth intelligence preparation of the battlespace that provides an analysis of what *could* be harmful to spacecraft (e.g. adversary spacecraft with requisite delta-V to affect friendly orbits), ground sites or data links *before* an actual attack takes place.

Required capabilities would therefore involve sensors located both on the ground and in-space to provide “scouting power” beyond observation and also retaining a capability to conduct offensive and defensive operations before enemy space “fleets” can be mobilized, similar to the concepts of Douhet and Corbett. The space “cruiser” or

“battleplane” must be capable of large delta-V operations to transit various orbits and affect decisive points.

4. Space Superiority Should Lead to Enemy Paralysis

Mitchell stated that no obstacles prevent attack from the air, and once the air battle is won, cities, towns, railways, etc. are all subject to attack, similar to Douhet’s “command of the air” where the airplane’s superior speed and independence of the surface could cut off and rout an enemy’s army and navy. The corollary to space is obvious—airpower was superior because of range, speed and independence of surface forces measured in *hours*. Spacepower offers infinitely greater options through its continuous presence measured in *years*. As current airpower technology enables attacking the enemy with stealth and precision—and no warning, so future capabilities should enable persistent precision strikes against future adversaries through the surprise, mobility, security, speed and range that spacepower offers. Following Hart and Fuller, well placed spacepower shots to the “brain” and “stomach” of a future adversary could be decisive in a future conflict.

5. Spacepower Requires Masters of the Space Medium

Clausewitz described the level of military genius required to overcome wartime fog and friction when he discussed *coup d’oeil* and *courage d’esprit*. The intellect and education required of military space operations must take into account the unique attributes of spacepower and create experts that can understand (orbital mechanics, space communications, etc.) and strategize ways to best operate in and from the medium *before* being faced with a combat situation. The short timelines for weapons in/from space and even shorter timelines for directed energy weapons will be disastrous for the ill-prepared.

To borrow from Mitchell, we already have an entirely new class of people that we may call ‘the space-going people’ as distinguished from the ‘air-going people,’ the ‘land-going people’ and the ‘sea-going people.’ Military spacecraft are not autonomous—they are crewed by space professionals for operations 24/7/365, and the many military capabilities enabled by spacepower are directly attributable to their successes. However, space professionals must understand that they are not simply “manning a post,” and must learn how to preserve, protect and defend their capabilities that increasingly mean success or failure of other military operations and life or death to their brothers and sisters-in-arms.

In closing, the unchallenged observation and the ability of US spacecraft to find, fix, target, track, engage and assess will increasingly be contested, and space combat may develop along the lines of air combat as Douhet stated: “...spontaneously, in the natural course of events.”¹³⁰ When it does, the requisite thought, technology and organizational structures must be in-place to emerge victorious. This research provides a framework of spacepower thought for future Masters of Space.

¹²⁵ Jim Garamone, *CENTCOM Charts Operation Iraqi Freedom Progress* [Internet] (American Forces Information Service, March 25 2003 [cited 27 March 2005]); available from http://www.defenselink.mil/news/Mar2003/n03252003_200303254.html.

¹²⁶ International Space Business Council, “2004 State of the Space Industry,” (Bethesda, MD: Space Publications LLC, 2004), 7.

¹²⁷ *Ibid.*

¹²⁸ Air Force Fact Sheet, *MQ-1 Predator Unmanned Aerial Vehicle* [Internet] (March 2005 [cited 27 March 2005]); available from <http://www.af.mil/factsheets/factsheet.asp?fsID=122>.

¹²⁹ Oberg et al., *Space Power Theory*, 140.

¹³⁰ Douhet, *The Command of the Air*, 41.

Appendix A

Applying the Theoretical Masters to Spacepower

Theorist	Central Theme	Specific Point	Application to Spacepower
Jomini	<ul style="list-style-type: none"> • Strategy is the key to warfare • Strategy is controlled by invariable scientific principles 	<ul style="list-style-type: none"> • Offensive action to mass forces against weaker enemy forces at some decisive point • Difficulty lies in recognizing these points 	<ul style="list-style-type: none"> • Enemy should be engaged at decisive points but the difficulty lies in recognizing the decisive points for spacepower • Potential decisive points include: Spaceports, command & control centers, data relay spacecraft (particularly geostationary relays), spacecraft / launch vehicle manufacturing sites, key research & development facilities
Clausewitz	<ul style="list-style-type: none"> • War is an extension of politics • Human factors in warfare • Warfare is a duel with the goal of annihilation of the fielded force • Defeat of the enemy results by attacking their center(s) of gravity 	<ul style="list-style-type: none"> • Center(s) of gravity are the hub of all power and movement, on which everything depends • Friction in warfare • Fog of war • Fight at right place & right time 	<ul style="list-style-type: none"> • Protect friendly centers of gravity through redundancy (Ground to Space C2 Systems, spacecraft on-board redundancy, physical security, greater space situational awareness) • Develop and maintain <i>coup d'oeil</i> and <i>courage d'esprit</i> to overcome friction through intensive training and education on the space medium, potential adversary actions and combat related TTPs • Induce fog into adversary's decision-making processes (launch countdown computers, altered commands to spacecraft, altered spacecraft state of health). Complicate enemy attempts to gather friendly spacecraft constellation data & order(s) of battle • Engage key points that affect enemy centers of gravity at the right time and right place

Theorist	Central Theme	Specific Point	Application to Spacepower
Hart	<ul style="list-style-type: none"> • Look beyond war to the peace • Enemy paralysis 	<ul style="list-style-type: none"> • Bring battle under the most advantageous circumstances through movement and surprise • Indirect approach to dislocate the enemy and paralyze its vital organs without destroying it physically • Utilize the combined effect of air and land motor power to distribute and disperse forces, enabling simultaneous strike • Target enemy “nerve systems” of C2 and industry 	<ul style="list-style-type: none"> • Bring battle under the most advantageous circumstances through movement and surprise • Employ the persistence of spacepower to dislocate and paralyze the enemy and incapacitate their ability to control and utilize space capabilities. Ensure adversary can use key assets after conflict by employing reversible actions • Utilize the combined effect of spacepower, land motor power, airpower and information power to distribute and disperse forces, enabling simultaneous strike • Strike key military command and control sites and industrial centers to eliminate adversary’s ability to generate and mobilize forces
Fuller	<ul style="list-style-type: none"> • Enemy paralysis 	<ul style="list-style-type: none"> • Surprise, mobility, security, speed and range • Shot to the brain— leadership targets • Shot to the stomach— enemy supply lines 	<ul style="list-style-type: none"> • Space provides the greatest leverage in terms of surprise, mobility, security, speed and range • Leverage spacepower advantages to strike enemy leadership targets directly. Employ space-based force application for maximum effect • Interdict enemy supply lines, distribution centers, and sources of supplies with space-based force application

Theorist	Central Theme	Specific Point	Application to Spacepower
<p>Mahan</p>	<ul style="list-style-type: none"> • Command of the sea 	<ul style="list-style-type: none"> • Control sea lines of communication (trade routes) by controlling specific points • Naval vessels (cruisers) that simultaneously serve in an offensive and defensive capacity • Forward naval bases to project power and the ability to conduct commercial blockades • The sea cannot be occupied, but it remains important to international commerce and national wealth. • The question of command of the sea is one of annual increase of the navy. The question is not ‘naval,’ in the restricted sense of the word. It is one of national policy, national security, and national obligation. • Sea officers cannot allow their attention to be unduly diverted from the systematic study of the Conduct of War, which is their peculiar and main concern 	<ul style="list-style-type: none"> • Control space lines of communication (trade routes) by controlling specific points • Space vessels (cruisers) that simultaneously serve in an offensive and defensive capacity and have the requisite delta-V to transit multiple orbits • Spacepower must include the capability to block information and/or physical traffic to & from space • Space cannot be occupied, but it remains important to international commerce and national wealth • The question of command of space is one of annual increase. The question is not ‘military space,’ in the restricted sense of the word. It is one of national policy, national security, and national obligation • Space professionals cannot allow their attention to be unduly diverted from the systematic study of the Conduct of War, which is their peculiar and main concern

Theorist	Central Theme	Specific Point	Application to Spacepower
<p>Corbett</p>	<ul style="list-style-type: none"> • Control & occupy maritime communications 	<ul style="list-style-type: none"> • Naval power is just one component of national strategy • Analogy between command of the sea / maritime communications and occupying territory— forbid public & private property passage • Capture/destruction of sea-borne property as last resort • Fleet scouting power required—”eyes” of the fleet—as liability to miss the enemy is much greater than on land & enemy can elude our offensive action • Attack before enemy fleet mobilization • Closed or open blockade of enemy ports to draw enemy fleet to sea • “Fleet in being” concept for weaker naval powers to level field through harassment ops 	<ul style="list-style-type: none"> • Spacepower is just one component of national strategy • Analogies can be drawn between command of space and global communications to occupying territory—public & private communications can be denied passage • Capture/destruction of space-borne property as last resort—mitigate space debris and ensure freedom of operation once hostilities cease • Space scouting power required—”eyes” of the fleet—as liability to miss the enemy is much greater than on land, sea and air, and enemy can elude our offensive action by changing orbital parameters • Attack before enemy can launch spacecraft or deploy space control measures (e.g. directed energy weapons) • Closed blockade to keep enemy fleets on the ground or open blockade of enemy ports to draw enemy fleet to space • “Fleet in being” concept for weaker space powers to level field through harassment operations using laser weapons to frustrate imagery, jamming spacecraft uplink or downlink signals (e.g. command and control or mission signals), or deploying explosive charges on maneuverable spacecraft

Theorist	Central Theme	Specific Point	Application to Spacepower
Douhet	<ul style="list-style-type: none"> • Command of the air • The form of war depends on the technical means available 	<ul style="list-style-type: none"> • Wars can be won only by offensive action and, because of its independence of surface limitations and its superior speed, the airplane is the ultimate offensive weapon • Prevent the enemy from flying while retaining the ability to fly oneself and be able to cut an enemy's army and navy off from their bases of operation • Advocate for an independent air force, accorded equal importance with the army and navy • Required capabilities: battleplanes & reconnaissance planes • Importance of observation—enemy will deny it • Destroy air force before it takes flight • Combat has & will develop from reconnaissance beginnings 	<ul style="list-style-type: none"> • Because of its independence surface limitations, superior speed and persistence over multiple targets, the spacecraft is the ultimate offensive weapon • Prevent the enemy from launching and attaining orbit while retaining the ability to orbit oneself and be able to cut an enemy's army and navy and air force off from their bases of operation • Advocate for an independent space force, accorded equal importance with the army, navy and air force • Required capabilities include advanced/robust space and ground based surveillance, along with the ability to engage targets in space or in other mediums from space • Importance of observation—enemy will deny it • Destroy adversary spacecraft before they take flight • Combat has & will develop from reconnaissance beginnings

Theorist	Central Theme	Specific Point	Application to Spacepower
<p>Mitchell</p>	<ul style="list-style-type: none"> • Command of the air leads to global reach and global strike • Advocate of American military aviation 	<ul style="list-style-type: none"> • Destinies of all people controlled through the air—rapid communications • No obstacles preventing attack from the air, as strategic points (cities, railways, canals, ports, ships) cannot be hidden • Readily available offensive airpower will decide warfare outcome(s) • Distinctive class of people—airmen—with unique spirit, language & customs • Airpower requires new rules and ideas of strategy • No precedent for airpower strategy or theoretical principles—must look ahead and anticipate what will happen vice examining what has happened • Older services “psychologically unfit” to fully develop air arm 	<ul style="list-style-type: none"> • Destinies of all people now controlled through space. Spacepower enables instantaneous global communications • No physical obstacles preventing attack from space. Strategic points cannot be hidden, through ability to overcome concealment/camouflage/deception with multiple detection bands (visible, infrared, multi-spectral or hyper-spectral imagery) • Readily available (on-orbit or rapid launch) offensive spacepower will decide warfare outcome(s) • Distinctive class of people—spacemen—with unique spirit, language & customs • Spacepower requires new rules and ideas of strategy • No precedent for spacepower strategy or theoretical principles—must look ahead and anticipate what will happen vice examining what has happened • We have yet to develop this new arm to the fullest extent practicable with the methods and means at hand

Appendix B

Synthesis: Five Lessons on Spacepower Theory

Category	Application to Spacepower
<p>Control Space Lines of Communication</p>	<ul style="list-style-type: none"> • Mahan: Space cannot be occupied, but it remains important to international commerce and national wealth • Mahan: The question of command of space is one of annual increase. The question is not ‘military space,’ in the restricted sense of the word. It is one of national policy, national security, and national obligation • Mahan: Spacepower must include the capability to block information and/or physical traffic to & from space • Corbett: Analogies can be drawn between command of space and global communications to occupying territory—public & private communications can be denied passage • Corbett: Capture/destruction of space-borne property as last resort—mitigate space debris and ensure freedom of operation once hostilities cease • Mitchell: Destinies of all people now controlled through space. Spacepower enables instantaneous global communications
<p>Decisive Points are Key to Space Control</p>	<ul style="list-style-type: none"> • Clausewitz: Protect friendly Centers of Gravity through redundancy (Ground to Space C2 Systems, spacecraft on-board redundancy, physical security, greater space situational awareness). Engage key points that affect enemy centers of gravity at the right time and right place • Jomini: Enemy should be engaged at decisive points. Potential decisive points include: Spaceports, command & control centers, data relay spacecraft (particularly geostationary relays), spacecraft / launch vehicle manufacturing sites, key research & development facilities • Mahan: Control space lines of communication (trade routes) by controlling specific points • Corbett: Closed blockade to keep enemy fleets on the ground or open blockade of enemy ports to draw enemy fleet to space for destruction • Douhet: Prevent the enemy from launching and attaining orbit while retaining the ability to orbit oneself and be able to cut an enemy’s army and navy and air force off

Category	Application to Spacepower
	<p>from their bases of operation</p> <ul style="list-style-type: none"> • Mitchell: No physical obstacles preventing attack from space. Strategic points cannot be hidden from space
<p>Robust Observation and Action Capabilities Required</p>	<ul style="list-style-type: none"> • Mahan: Space vessels (cruisers) that simultaneously serve in an offensive and defensive capacity and have the requisite delta-V to transit multiple orbits • Hart: Ensure adversary can use key assets after conflict by employing reversible actions • Corbett: Space scouting power required—“eyes” of the fleet—as liability to miss the enemy is much greater than on land, sea and air, and enemy can elude our offensive action by changing orbital parameters • Corbett: Attack before enemy can launch spacecraft or deploy space control measures (e.g. directed energy weapons) • Corbett: “Fleet in being” concept for weaker space powers to level field through harassment operations using laser weapons to frustrate imagery, jamming spacecraft uplink or downlink signals (e.g. command and control or mission signals), or deploying explosive charges on maneuverable spacecraft • Douhet: Because of its independence surface limitations, superior speed and persistence over multiple targets, the spacecraft is the ultimate offensive weapon • Douhet: Space and ground based surveillance and the ability to engage targets in space or in other mediums from space • Douhet: Importance of observation—enemy will deny it • Douhet: Destroy adversary spacecraft before they take flight • Mitchell: Readily available (on-orbit or rapid launch) offensive spacepower will decide warfare outcome(s)

Category	Application to Spacepower
Space Superiority Should Lead to Enemy Paralysis	<ul style="list-style-type: none"> • Clausewitz: Induce fog into adversary’s decision-making processes (launch countdown computers, altered commands to spacecraft, altered spacecraft state of health) • Clausewitz: Complicate enemy attempts to gather friendly spacecraft constellation data & order(s) of battle • Hart: Employ the persistence of spacepower to dislocate and paralyze the enemy and incapacitate their ability to control and utilize space capabilities • Hart: Utilize the combined effect of spacepower, land motor power, airpower and information power to distribute and disperse forces, enabling simultaneous strike • Hart: Strike key military command and control sites and industrial centers to eliminate adversary’s ability to generate and mobilize forces • Fuller: Leverage the surprise, mobility, security, speed and range of spacepower to strike enemy leadership targets directly • Fuller: Interdict enemy supply lines, distribution centers, and sources of supplies with space-based force application
Spacepower Requires Masters of the Space Medium	<ul style="list-style-type: none"> • Clausewitz: Develop and maintain <i>coup d’oeil</i> and <i>courage d’esprit</i> through intensive training and education on the space medium, potential adversary actions and combat related TTPs • Mahan: Space professionals cannot allow their attention to be unduly diverted from the systematic study of the Conduct of War, which is their peculiar and main concern • Douhet: Combat has & will develop from reconnaissance beginnings • Mitchell: Distinctive class of people—<i>spacemen</i>—with unique spirit, language & customs • Mitchell: Spacepower requires new rules and ideas of strategy • Mitchell: No precedent for spacepower strategy or theoretical principles—must look ahead and anticipate what will happen vice examining what has happened • Mitchell: We have yet to develop this new arm to the fullest extent practicable with the methods and means at hand

Appendix C

Oberg's 13 Truths and Beliefs on Spacepower

1. *The primary attribute of current space systems lies in their extensive view of the Earth.* While all other forms of power are effectively regional, space power allows worldwide access in time spans measured in minutes as opposed to hours and days.¹³¹
2. *A corollary to this attribute is that a space vehicle is in sight of vast areas of Earth's surface.* This means that electromagnetic radiation—signals, beacons, or high-energy beamed attacks—can access the vehicle.¹³²
3. *Space exists as a distinct medium.* The unique attributes of space operations clearly differentiate space power from other mediums of national [military] power, but can only do so if we cease clinging to notions influenced by earthbound prejudices. The basis of space power is an understanding and use of astrophysics [and astronautics] not aeronautics.¹³³
4. *Space power, alone, is insufficient to control the outcome of terrestrial conflict or ensure the attainment of terrestrial political objectives.* Space power must be combined with its emerging sibling, information power, and the older, purely terrestrial, expressions of national power such as air, sea, and land power to successfully influence the actions of competing nations.¹³⁴
5. *Space power has developed, for the most part, without human presence in space, making it unique among other forms of national power.* Technology has substituted for a human crew in space, providing instead, a virtual presence through a connection to terrestrial control sites.¹³⁵
6. *Technological competence is required to become a space power, and conversely, technological benefits are derived from being a space power.* A strong space industry and a strong educational and laboratory system is required to form a vanguard civil space program and powerful military space capability.¹³⁶

7. *As with earthbound media, the weaponization of space is inevitable, though the manner and timing are not at all predictable. At some point in the future...the international system of sovereign states and the nature of mankind will combine to cause a state to put a weapon into orbit.*¹³⁷
8. *At some time in the future, the physical presence of humans in space will be necessary to provide greater situational awareness. Humans have and will continue to possess a keener ability to sense, evaluate, and adapt to unexpected phenomena than machinery.*¹³⁸
9. *Situational awareness in space is a key to successful application of space power. This means knowing not just where everything is in space and where they are going, but also knowing where they could go if desired, what they are doing, what they are seeing, and what they are relaying to their operators.*¹³⁹
10. *Control of space is the linchpin upon which a nation's space power depends. Assured access to space, space-based services, and space-derived products will become of critical import to the US public and policy makers. Control of space and access to space, as a result, will be a non-negotiable issue.*¹⁴⁰
11. *Space operations have been and continue to be extremely capital intensive. Exploration of our planet, the land, the sea, and aerial flight, was often conducted within the means of individual or group wealth... Space has required the wealth of nations—and large nations with large budgets, at that. There is speculation that technologies to more efficiently access space may yet reduce the high cost of doing business there in the near future. It may not.*¹⁴¹
12. *Scientific research and exploration pays off. Exploration and research have proven themselves to be the engine of technological advances, even breakthroughs. They enhance both national industrial capabilities and cultural attitudes toward space.*¹⁴²
13. *There will be wild cards. Minds must be sufficiently flexible to detect, recognize, and move quickly to exploit or counteract these [scientific] surprises.*¹⁴³

¹³¹ Oberg et al., *Space Power Theory*, 124.

¹³² Ibid.

¹³³ Ibid., 126.

¹³⁴ Ibid., 127.

¹³⁵ Ibid.

¹³⁶ Ibid., 128.

¹³⁷ Ibid., 129.

¹³⁸ Ibid.

¹³⁹ Ibid., 130.

¹⁴⁰ Ibid.

¹⁴¹ Ibid., 130-31.

¹⁴² Ibid., 131.

¹⁴³ Ibid.

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