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**PROPOSED TENETS OF SPACEPOWER:
SIX ENDURING TRUTHS**

by

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Preface

I wrote this paper because I believe we are at the leading edge of a revolution in how we think about space. Previously much of the discussion about weaponizing space, fighting in space, space as a separate service, etc. was primarily confined to space professionals and academics. I believe we are now only a few years away from applying force against targets in, to and from space, having to contend for space superiority, and no longer being able to take space superiority for granted. Our doctrine is not well prepared for this; it still views space as a supporting extension of airpower. The foundation of doctrine, except for the Principles of War, is tenets about how to employ whatever power is being discussed. It is now time to capture the enduring truths about how to employ spacepower. Even if it is not 100 percent correct, getting it 85 percent right and changing it as we learn is better than where we are now, with spacepower seen as nothing but a force enhancer.

Writing this paper would not have been possible without the assistance of many space professionals around the Air Force who lent valuable time to comment on the draft tenets of spacepower. To all of them I say, thank you. I promised I would not quote or identify any by position without their permission, but their thoughts and experience were invaluable. I especially want to thank Maj Eric Dorminey at the Space Division of the USAF Weapons School for putting thought into this work, making suggestions on improvements and taking time to discuss it at length. A last word of thanks goes to an unnamed F-15 driver for all his help providing a pilot's perspective on these thoughts.

Abstract

The United States Air Force has a policy of using space as the high ground. It calls for capabilities to use spacepower in every conceivable way in conflict including missile defense, space control and creating significant terrestrial effects. Air Force Space Command has funded programs that will bring responsive launch vehicles and an ability to apply force directly from space while continuing to improve all the things they currently do in, to and from space. However, there are no tenets about how to best employ spacepower. This paper concludes now is the time to write these tenets. This will help guide the development of new programs and tactics, techniques & procedures (TTP). Without guiding, enduring truths there is no foundation to build upon, and the Air Forces risks building systems and developing TTP that do not ensure the most efficient and effective use of spacepower.

The six proposed tenets of spacepower are:

1. Space operators should understand the advantages and limitations of operating in, to and, from space.
2. Spacepower should be prioritized and coordinated by a space professional with a global perspective.
3. Spacepower in a theater should be centrally controlled by a space professional.
4. Spacepower is flexible and versatile.
5. Spacepower is best used to achieve effects in, to and from space that capitalize on its unique advantages.
6. Spacepower can support or be supported by terrestrial operations or operate independently.

Chapter 1

Introduction

But if we limit our efforts only to applying space technologies to existing modes of war fighting, we have undershot...It is no different than all the ways our armed forces once found for airpower to support ground operations—and do no more.

—Hon. Peter B. Teets
Air & Space Power Journal, Spring 2003

This paper proposes six tenets of spacepower for the reader’s consideration. The purpose for suggesting these tenets is to further the development of doctrine for conducting military operations in space. Maj M. V. Smith’s “Ten Propositions Regarding Spacepower” published in 2002¹ concisely articulated the nature of spacepower. He conclusively showed spacepower is a unique form of military power and is not an extension of airpower. If, as Smith demonstrated, spacepower is unique, then there must be enduring truths about the employment of that power. This paper proposes six such truths with the hope they will be examined, discussed and incorporated into Air Force doctrine.

Overview

The introductory chapter of this work sets the stage for introduction of the tenets of space power. It shows that “*spacepower*” is an accurate term and defines it. Then it demonstrates why introduction of tenets is appropriate at this time because of the wealth of experience and writing

about spacepower. It wraps up with a brief discussion of the methodology used to develop this project.

The second chapter demonstrates current Air Force doctrine does not adequately address spacepower's unique contributions to military power, its unique guiding truths or its potential to do much more than just enhance other operations. It then shows that Air Force and joint policy call for spacepower capabilities to use space as the high ground, not only to provide force enhancement effects but also to produce effects on space, terrestrial and transient targets.

The third chapter is the heart of the work. It answers the central question: "What are the enduring truths about the employment of spacepower that are universally true and independent of particular platforms or operational concepts?" It articulates six proposed tenets and provides evidence they are enduring truths about the employing spacepower.

The fourth chapter draws conclusions about how adoption of the proposed tenets might influence space operations, Air Force organization and what it means for the joint force commander's organization and effectiveness. After all, the ultimate test of the utility of spacepower is how it contributes to a joint force commander accomplishing his mission.

“Spacepower” is an Accurate Term

Spacepower is often an ill-defined term. Lt Col Peter Hays said it is a “cosmic concept that is complex, indeterminate, and intangible.... Confusion swirls on the semantic level because there is no commonly accepted definition or accepted wording for this concept.”² Maj M. V. Smith said that spacepower is “the ability to use spacecraft to create military and political effects.”³ This paper will focus on military spacepower and define that as a nation's ability to use military space assets, either ground or space-based, to create desired effects in, to and from space. It also includes systems from the intelligence, civil and commercial space sectors when

they are supporting the military instrument of national power. The *Space Commission Report* provided a very good summary of the sectors of spacepower; it is contained in Appendix A.

While acknowledging Brian Sullivan's assertion that use of the term spacepower is either absurd or arrogant because we currently operate in very small portion of space compared to the nearly infinite vastness of the universe,⁴ his conclusion is disputed because control of Earth orbit does constitute spacepower, not just Earth power as he suggests. Given that the inhabitants of Earth are the only known life in the universe, controlling access to space, a part of spacepower, is an effective way of controlling space. This is the same as the Navy controlling the oceans, not by having ships everywhere, but by controlling an adversary's ability to sortie from its harbors.

Therefore, use of the term spacepower is appropriate and precise. It includes creating desired effects in, to and from space and controlling access to Earth orbits and the vast, and still undeveloped, potential of space beyond the Moon.

Tenets Are Appropriate At This Time

There has been legitimate discussion about the appropriateness of developing tenets of spacepower at this time. Many believe until spacepower can directly apply force its primary mission is force enhancement. They say it is sufficiently guided by the tenets of airpower because it should be integrated as closely as possible with air operations.

However, what is needed is a foundation in doctrine to guide the development and employment of space forces with missions much broader than only force enhancement. Because, as the next chapter will show, the Air Force now has policy and programs calling for spacepower to do much more than force enhancement. Also, there is now sufficient experience and academic writing to form a basis for articulating the tenets of spacepower in doctrine.

Air Force Basic Doctrine defines a tenet as a *fundamental guiding truth of air and space power employment*.⁵ M. V. Smith pointed out that tenets rise to the level of institutionalized doctrine and deliberately chose to write his 10 propositions about spacepower as just that—propositions, not doctrine.⁶ This paper will build on that and focus on truths about employment, as we now understand them, and suggest their inclusion into doctrine. This does not mean as spacepower matures the tenets of spacepower will not also evolve. That is expected, according to Air Force Doctrine Document (AFDD) 1 doctrine is meant to codify accumulated wisdom based on analysis of experience and theory. It goes on to point out that doctrine development is never complete but doctrine continues to evolve as new wisdom is gained.⁷

There are now 46 years of experience of operating in space.⁸ The National Reconnaissance Office was created in 1960,⁹ there has been an Air Force major command responsible for space forces for 21 years¹⁰ and a unified command responsible for war fighting with space forces for 18 years.¹¹ The nearly half-century of experience includes major space power utilization in the Viet Nam war, the Cold War, Operations DESERT STORM, ALLIED FORCE, ENDURING FREEDOM and now the ongoing IRAQI FREEDOM. After nearly five decades operating in space, the notion there is not enough experience to write tenets about spacepower is baseless.

In addition to experience that spans a timeframe longer than that between the Wright brothers' first flight until Chuck Yeager broke the sound barrier,¹² there has been a plethora of academic writing about spacepower and some doctrine development. Recent major works include: David Spires' *Beyond Horizons: A Half Century of Air Force Space Leadership* and *Spacepower for a New Millennium: Space and U.S. National Security* edited by Peter Hays et al. In addition, there have been a many academic papers published recently including Michael Mantz's "The New Sword; A Theory of Space Combat Power," M. V. Smith's work referenced

above and Brigadier General Simon Worden and Maj John Shaw's "Whither Space Power? Forging a Strategy for the New Century." Joint Publication 3-14 *Joint Doctrine for Space Operations* was published in August 2002 and Air Force doctrine was updated in November 2001 as AFDD 2-2: *Space Operations*. These are just a few examples of the large body of professional, academic and theoretical thought on spacepower.

Given the lengthy experience base, the a deep pool of written thought on spacepower, and policy and programs for spacepower to apply force in, to and from space; it is not only appropriate, but necessary to codify the tenets of spacepower in doctrine.

Methodology

The genesis of this project began several years ago as informal discussions with officers conducting space control operations. Over time it evolved into an incomplete list of ideas about the need for an overarching theory of space control. Again through informal discussion and personal experience in space control operations, that list became ideas about tenets of space power. The formal aspect of this project started with a review of existing literature and doctrine to help refine the ideas into more concisely written tenets based on the experience and expertise captured in those writings. The draft tenets were then formally discussed with a group of space operators from a variety of backgrounds attending the Air Force's Air Command and Staff College and further refined. Finally these final draft tenets were distributed to 18 senior officers (mostly O-6s and a few flag officers) in a wide variety of space positions including officers at the Headquarters Air Force, Air Force Space Command, the National Reconnaissance Office, the Space and Missile System Center and various space wings in both 14th and 20th Air Forces for comment and reflection on their validity. The review group included graduates of the Air Force Weapons School and the School of Advanced Airpower and Space Studies. Additionally, the

final draft tenets were distributed to instructors in the space division of the Air Force Weapons School for their comments. In all, nine individuals responded with written comments and an F-15 pilot offered additional insightful comments. The inputs were synthesized and used to put theoretical writings into perspective. Then it all was consolidated into the list as it appears here.

There are some obvious limitations to this project. First and most importantly, most space missions currently being executed are force enhancement missions. Therefore, discussion of what spacepower may be able to do in the future, especially in terms of force application, remains educated speculation. Second, in spite of the nearly 50 year history of space operations, what is known about operating in space is probably a very small portion of what will be learned in the next 50 years. So, even though the speculation is an educated guess, it is still a guess. What seems to be an enduring truth today may not look so enduring in 15 years. Finally, much of the research is based on opinion and expertise. Since no one is omniscient, bias and limited perspectives influenced inputs to the study. The impact of this was minimized by soliciting inputs from operators with varied backgrounds.

Notes

¹ Maj M. V. Smith, *Ten Propositions Regarding Spacepower* (Maxwell AFB, AL.: Air University Press, October 2002).

² Lt Col Peter L. Hays, *United States Military Space: Into the Twenty-First Century* (Maxwell AFB, AL.: Air University Press), part I, 5.

³ Smith, 7.

⁴ Brian R. Sullivan, "Spacepower and America's Future," in *Spacepower for a new Millennium: space and U.S. National Security*, ed. Peter L. Hays et al. (New York, NY.: McGraw-Hill, 2000), 259.

⁵ Air Force Doctrine Document (AFDD) 1, *Air Force Basic Doctrine*, 1 September 1997, 22.

⁶ Smith, 3.

⁷ AFDD 1, 1-2.

⁸ The first artificial, earth orbiting satellite, Sputnik I, was launched on Oct 4, 1957.

Notes

⁹ Lt Col Peter L. Hays et al., “Spacepower for a New Millennium: Examining Current U.S. Capabilities and Policies,” in *Spacepower for a New Millennium: Space and U.S. National Security*, ed. Peter L Hays et al. (New York, NY.: McGraw-Hill, 2000), 8.

¹⁰ Air Force Space Command was created on September 1, 1982.

¹¹ United States Space Command was formed in September 1985.

¹² The Wright brothers first flew on Dec 17, 1903 and Chuck Yeager broke the sound barrier on Oct 14, 1947, a time span of almost 44 years.

Chapter 2

What of Current Doctrine and Policy?

National safety would be endangered by an Air Force whose doctrines and techniques are tied solely on the equipment and process of the moment. Present equipment is but a stop in progress, and any Air Force which does not keep its doctrine ahead of its equipment, and its vision far into the future, can only delude the nation into a false sense of security.

Gen H. H. “Hap” Arnold, 1945

Air and Space Doctrine

Current Air Force doctrine claims to articulate the tenets of spacepower, but this seems to be the result of an attempt to include space in air operations rather than an honest assessment of spacepower doctrine in its own right. This is problematic because, as Lt Col Hays observed, few concepts of sea power theory directly translated to airpower theory. Since space is as unique as sea or air, there is no reason to assume either sea power or airpower theory should directly translate into spacepower theory.¹

Air Force doctrine is still driven by the idea of an *aerospace* force, even if the term has fallen out of favor. Lt Col Hays and Dr. Karl Mueller point out, “Air Force Chief of Staff Gen Thomas D. White first used the word *aerospace* in 1958, and the concept that air and space form a seamless operational medium has been the foundational component of Air Force thinking about space ever since.”² The revision of AFDD 2-2 made significant steps towards maturing space

doctrine by pointing out space is a physical environment like land, sea and air³ but this has not been incorporated in other Air Force doctrine.

Current Air Force doctrine does not consider tenets of spacepower other than as they may be captured in the tenets of air and space power as articulated in AFDD 1.⁴ This list was created by substituting “air and space power” for “air power.” In fact, figure 2.2 of AFDD 1 remains the “Tenets of Air Power.” The draft version 3 dated 15 Jan 03 of the revised AFDD 1 contains the same basic tenets of air and space power.

The latest revision of AFDD 2-2 attempts to draw some distinction between air and space power saying, “Airmen, however, should not assume airpower and spacepower are interchangeable. Applying the operational art of war requires an understanding of the similarities and unique qualities of each...”⁵ AFDD 2-2 was a significant departure from previous Air Force doctrine and went as far as to rename the Joint Force Air Component Commander the Joint Force Air and Space Component Commander (JFASCC); however, this new name has not been accepted throughout the Air Force or the joint community.

AFDD 2-2 also stated, “A JFASCC may require a space officer dedicated to carry out the detailed responsibilities associated with the [space forces] coordination role.”⁶ This senior space officer concept has been used by Central Air Forces in Operations ENDURING FREEDOM and IRAQI FREEDOM, seemingly with good success incorporating space into air operations. AFDD 2-2 identifies how to integrate space into air operations but it does not identify how to employ space forces as military power that can either be supporting or supported.

Some have argued the push by spacepower advocates to change the focus of Air Force spacepower doctrine from force enhancement towards a more complete force package, including force application, is misplaced. Maj John Grenier went as far as to say, “The essence of

(offensive counter space) and (defensive counter space) has less to do with force application and more to do with supporting, enabling and enhancing other air and space operations.”⁷ He, along with others, believes that until technology is fielded allowing space to apply force the Air Force should continue to focus on using spacepower as a force enhancer.

If this same argument were applied to airpower prior to World War II, then the work of the Air Corps Tactical School developing the theory (and what was in effect doctrine at the time) of high altitude precision daylight bombing before there were high performance bombers⁸ was completely misguided. They should have waited until after the B-17 and B-24 bombers were operational to develop doctrine about how to use them.⁹ Had they done that, the U.S. may never have had a four-engine heavy bomber capable of bombing Germany or Japan. The fallacy of this “wait for the capability” argument is that without the development of doctrine there is nothing to guide the requirements for new systems or their tactics, techniques & procedures (TTP). Technology is not what limits the development of spacepower today; it is the lack of doctrine that results in ill-defined, incomplete spacepower requirements.

Maj Grenier pointed out the high classification of many space systems and the lack of integration of counterspace plans are substantial hurdles to helping the air breathing part of the Air Force understand what space brings to the fight. However, he said those are just excuses for the “inability of space operators, space weapons officers, and space experts to tell in-theater aviators what counterspace brings to the fight.”¹⁰ While counterspace is only one portion of spacepower, if his argument is correct, it is actually a failing of doctrine to articulate what counterspace contributes to the fight. That failing is partially a result of the lack of tenets of spacepower to be a foundation for the building blocks of doctrine on applying spacepower.

As shown above there are small steps towards spacepower being recognized as coequal with airpower, but current Air Force doctrine views spacepower as an extension of airpower with a primary mission of force enhancement; disappointingly, many believe it should stay that way.

Space as the High Ground

In his 1988 work *On Space Warfare: A Space Power Doctrine*, David E. Lupton proposed four schools of thought, which are actually four doctrinal approaches, for military activity in space.¹¹ These have been widely referenced and discussed by authors since their introduction so there is no need to repeat that work here. Table 1 is adapted from M. V. Smith's *Ten Propositions* and does an excellent job of summarizing the four schools of thought.

The United States Air Force is now part of the “space as the high ground” school of thought. This was a significant departure from history as recent as Operation DESERT STORM when the U.S. was moving towards a survivability doctrine from a sanctuary doctrine.¹² The movement to the high ground position began with the publication of the United States Space Command Long Range Plan and continued with the publication of the *Space Commission Report*. The election of President George W. Bush and installation of his realist administration including Secretary of Defense Rumsfeld and Under Secretary of the Air Force Peter Teets continued the movement. Most recently, Air Force Space Command began openly applying resources to implement a high ground doctrine.

Space as the high ground is clearly the driving view of the United States Space Command's Long Range Plan. By 2020, the plan envisions “a robust fully integrated suite of space and terrestrial capabilities provides dominate battlespace awareness enabling **on-demand** targeting and engagement of all ballistic and cruise missiles; and if directed by the NCA, the ability to identify, track and hold at risk designated high value terrestrial targets.”¹³

Table 1, Military Space Doctrines

Doctrine	Primary Purpose of Space Forces	Employment Strategy	Wartime Mission of Space Forces	Preferred Organization
Sanctuary:	Strategic Stability Arms Control	Optimize for NTMV* Vulnerable Orbits Limited numbers Fragile Systems	Limited	
Survivability:	Above Functions Plus: Force Enhancement	Hardening Crosslinks, Less Vulnerable Orbits On Orbit Spares Reconstitution Capability Defense Convoy Maneuver Stealth Redundancy	Force Enhancement Degrade Gracefully	Unified Command or Major Command
Control:	Space Control Significant Force Enhancement		Space Control Counterspace Capability Surveillance Significant Force Enhancement	Space Force or Unified Command
High Ground:	Above Functions Plus: Ballistic Missile Defense Decisive Impact on Terrestrial Conflict		Above Functions Plus: Ballistic Missile Defense Decisive Space-to-Space and Space-to Earth Force Application	Space Force

*NTMV—national technical means of verification

Source: M. V. Smith, *Ten Propositions Regarding Spacepower* (Maxwell AFB, AL: Air University Press, October 2002), 22.

The *Space Commission Report* clearly sees space as the high ground. It states, “Finally, space offers advantages for basing systems intended to affect air, land and sea operations. Many think of space only as a place for passive collection of images or signals or a switchboard that can quickly pass information back and forth over long distances. It is also possible to project

power through and from space in response to events anywhere in the world. Unlike weapons from aircraft, land forces or ships, space missions initiated from earth or space could be carried out with little transit, information or weather delay. Having this capability would give the U.S. a much stronger deterrent and, in a conflict, an extraordinary military advantage.”¹⁴ The Space Commission also warns of satellite vulnerability to attack and the need to have the capability to negate enemy spacecraft.¹⁵ This ability to deliver significant effects against targets from space and the need for space control is clearly in the high ground doctrine of space. The recommendations of the report have been accepted by the Department of Defense; therefore, military policy is clearly in line with the high ground school of thought.

The Honorable Peter Teets, Undersecretary of the Air Force, is also clearly a member of the high ground school of thought. He recently said, “I intend to exert every effort in my duties to fulfill the Air Force’s responsibility as the Department of Defense’s executive agent for space—to do whatever it takes to ensure that our nation’s space capabilities can perform every conceivable mission needed to conduct effective war fighting.”¹⁶

Air Force Space Command is now applying financial resources to implement parts of a high ground doctrine. On March 1, 2003, they launched an \$8 million Analysis of Alternatives for Operationally Responsive Spacelift. The requirements for that program are based on a Joint Requirements Oversight Council validated Mission Needs Statement. The program is projected for initial operational capability in 2014. Projected payloads include the common aero vehicle, a munition that can be delivered from or through space, along with counterspace payloads.¹⁷

Additionally, the Space and Missile System Center is working on programs through the Space-Based Laser Project Management Office. Although the details of the program are beyond the scope of this paper, the Space-Based Laser-Integrated Flight Experiment program began in

1999 and anticipates launch of their first satellite in 2012 and demonstration of an ability to shoot down a ballistic missile in 2013.¹⁸

It was forecast a missile defense system using Brilliant Pebbles, the most mature of the Strategic Defense Initiative program technologies, and space-based laser could be operational before the Theater High Altitude Area Defense and the National Missile Defense system, would cost less than those two systems and be more effective.¹⁹ Although not currently active, it is possible the Brilliant Pebbles program could see new life again someday.

An Air Force Weapons School graduate responding as part of the research for this project said there are written requirements from a sister service to have a capability to deliver small ground units into denied territory using sub-orbital space vehicles and then extract them with the same vehicle. While this may sound futuristic, it again shows U.S. spacepower is clearly in the high ground school in spite of some assertions to the contrary.

As shown by the unified combatant command's long range plan, Department of Defense leadership, and Air Force belief that space should be exploited for space control, missile defense, and to create significant effects in conflicts; also considering Air Force Space Command is funding programs that would implement a high ground doctrine, the Air Force is responsible for a high ground school type spacepower—even if its current doctrine does not yet reflect that.

Notes

¹ Lt Col Peter L. Hays, *United States Military Space: Into the Twenty-First Century* (Maxwell AFB, AL.: Air University Press), part I, 25 - 26.

² Lt Col Peter Hays and Dr Karl Mueller, "Boldly Going—Where? Aerospace Integration, The Space Commission, and the Air Force's Vision for Space," *Aerospace Power Journal* XV no. 1, (Spring 2001): 36.

³ AFDD 2-2, 4.

⁴ Air Force Doctrine Document (AFDD) 1, *Air Force Basic Doctrine*, 1 September 1997, 21 - 22.

⁵ Air Force Doctrine Document (AFDD) 2-2, *Space Operations*, 27 November 2001, 8.

⁶ AFDD 2-2, 31.

Notes

⁷ Maj John Grenier, “A New Construct for Air Force Counterspace Doctrine,” *Air & Space Power Journal* XVI no. 3, (Fall 2002): 21.

⁸ Brig Gen Haywood S. Hansell, “The Development of United States Concept of Bombardment Operations, in *Airpower Studies: Academic Year 2003* (Maxwell AFB, AL.: Air Command and Staff College, November 2002), 56.

⁹ Lt Col Michael Mantz, *The New Sword: A Theory of Space Combat Power* (Maxwell AFB AL.: Air University Press, May 1995), 60.

¹⁰ Maj John Grenier, “A New Construct for Air Force Counterspace Doctrine,” *Air & Space Power Journal* XVI no. 3, (Fall 2002): 19.

¹¹ David E. Lupton, *On Space Warfare: A Space Power Doctrine* (Maxwell AFB, AL.: Air University Press, June 1998).

¹² Maj M. V. Smith, *Ten Propositions Regarding Spacepower* (Maxwell AFB, AL.: Air University Press, October 2002), 22 – 25.

¹³ *Long Range Plan: Implementing USSPACECOM Vision for 2020*, (Peterson AFB CO.: U. S. Space Command, Director of Plans, March 1998), 8.

¹⁴ *Report of the Commission to Assess United States National Security Space Management and Organization*, (Washington D.C.: The [Space] Commission, January 11, 2001), 33.

¹⁵ *Report of the Commission to Assess United States National Security Space Management and Organization*, (Washington D.C.: The [Space] Commission, January 11, 2001), 27.

¹⁶ Honorable Peter B. Teets, “Developing Space Power: Building on the Airpower Legacy,” *Air and Space Power Journal* 17, no. 1 (Spring 2003): 15.

¹⁷ William B. Scott, “Rapid Response,” *Aviation Week & Space Technology*, April 7, 2003, 67.

¹⁸ “Space-Based Laser Team Defines Requirements for Experimental Missile Defense System,” April 4, 2001, n.p., on-line, Internet, April 9 2003, available from <http://www.spacedaily.com/news/laser-01d.html>.

¹⁹ Henry F. Cooper, “Space Defense: An Idea Whose Time Has Come?” in *Spacepower for a new Millennium: space and U.S. National Security*, ed. Peter L. Hays et al. (New York, NY.: McGraw-Hill, 2000), 136.

Chapter 3

Tenets of Spacepower

Clearly, the 21st century will be the century in which power, prosperity, and security will belong to those who understand, exploit, and expand the medium of space.

—Gen Ronald Fogleman

Spacepower for a New Millennium: Space and U.S. National Security

Few concepts from sea power theory translate directly into airpower theory—why should we expect either sea power or airpower theory to apply directly for the distinct medium of space?

—Lt Col Peter Hays

United States Military Space: Into the Twenty-First Century

As shown in chapter 2, Air Force policy views space as the high ground and calls for capabilities to use spacepower in every way in conflicts—including controlling space, missile defense and producing significant terrestrial effects. Air Force Space Command has programs to implement this policy, but the Air Force has no guiding fundamental truths about how to employ spacepower. The following six proposed tenets of spacepower attempt to represent enduring truths about the employment of spacepower. They are written here for discussion and suggested for inclusion in Air Force doctrine. This chapter will explain each one and provide evidence of their veracity. There is not universal agreement on these tenets and the discussion of each will attempt to represent opposing views and convincingly show they should be included in a list of tenets. While in some cases these tenets may be “lead-turning” existent capabilities, without

doctrine to help shape requirements, how will the Air Force ensure programs and TTP are developed in ways that ensure the most efficient and effective use of spacepower?

The six proposed Tenets of Spacepower are:

- 1. Space operators should understand the advantages and limitations of operating in, to and from space.**
- 2. Spacepower should be prioritized and coordinated by a space professional with a global perspective.**
- 3. Spacepower in a theater should be centrally controlled by a space professional.**
- 4. Spacepower is flexible and versatile.**
- 5. Spacepower is best used to achieve effects in, to and from space that capitalize on its unique advantages.**
- 6. Spacepower can support or be supported by terrestrial operations or operate independently.**

If, as Tenet #1 stipulates, space is a unique medium, it is reasonable to state there are unique truths about employing forces in, to and from that medium.

Tenet #1

Space Operators Should Understand the Advantages and Limitations of Operating In, To and From Space

Space is a distinct medium, both physically and politically. Like land, sea and air, there are advantages and disadvantages operating in, to and from this medium. Space operators should understand the advantages and limitations of operating in, to and from space. This is included as a tenet of spacepower because understanding the advantages and limitations of space is critical to understanding how to employ space forces.

Space operations are often thought of as being similar to air operations, but operating in space is as unique as operating in any of the other three mediums.¹ Space is unique because of the physical differences.² Although it is true there is no universally accepted dividing line between air and space, there is a boundary layer between them nearly 65 miles wide. The highest altitude obtainable by an air-breathing aircraft is about 28 miles. The lowest altitude of a

sustainable satellite orbit is 93 miles.³ In between the two mediums is a region 65 miles wide in which flight cannot be sustained without tremendous expenditures of fuel.⁴

The boundary layer divides two dissimilar environments. Air is a medium of substance and space is a vacuum. The relative density of the atmosphere at 1,243 miles (the “hard vacuum of space”) is one particle per cubic centimeter compared to the 10^{18} particles per square centimeter at sea level.⁵ (For additional information about the changing density of the atmosphere as altitude increases see Appendix B.) Somewhere around 62 miles altitude aerodynamic flight is no longer possible, even if there was some form of sustainable propulsion. Below 93 miles altitude spacecraft cannot orbit. Because of this, the laws of physics that govern how to operate in air and space differ. Flight is ruled by principles of aerodynamics described by Bernoulli and Newton; orbits are governed by principles described by Kepler and Newton.

As shown above, when AFDD 2-2 quoted General Thomas White saying, “There is no division...between air and space. Air and Space are an indivisible field of operations”⁶ both the USAF and General White were wrong.

A synergy of effects between forces operating in different mediums does not mean one of those forces is an extension of the other. For example, it is inconceivable to claim a C-17 delivering Army troops is ground power, because airpower operates in a different medium and can do more than just deliver Army troops. Likewise, when spacepower delivers effects that benefit other forces, it is not an extension of those forces any more than C-17s are an extension of ground forces, because spacepower operates in a different medium and can do more than just force enhancement missions.

The value of knowing air and space are different mediums is not the physics lesson but understanding how the different mediums affect operations. Some of the differences are in the

operation of vehicles, such as how to dissipate heat in space or what the effect of a change in velocity will have on the ground trace of a spacecraft's orbit. Other differences have to do with the effect of phenomena in the medium when operating in it, such as storms in the atmosphere compared to electromagnetic energy storms in space. Another major difference is debris, which can cause foreign object damage. In space the foreign objects are traveling between 30,000 and 160,000 MPH.⁷

The most important differences are what the physical differences allow. For example, spacecraft travel at very high speed (about 7,790 meters per second in low Earth orbit), which allows them to cover the distance between two points very quickly or have a tremendous amount of kinetic energy. Conversely, space is very big and there is a lot of distance to cover. Changing direction at orbital speeds is very difficult or impossible with the very limited fuel supplies available. Also, orbiting at a very high altitude allows a wide field of view and, at a geosynchronous altitude, a continuous presence over an area. However, electromagnetic energy and physical objects are affected in many ways as they pass through the entire depth of the atmosphere. These are just a few of the advantages and limitations of operating in space; there are many more and it takes operational expertise to understand how to use them for military advantage.

Space is also different from land, sea or air politically. Unlike operating in any other medium, there are no political boundaries in space. Much like a ship in international waters, spacecraft can go anywhere, anytime; but unlike the oceans, in space there are no shores to impede a course. The unopposed orbits of the first Sputnik established the right of spacecraft to unimpeded orbits over any country.⁸ After the precedent was established, it was later codified in

the *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, 1967* (The Outer Space Treaty of 1967).⁹

Related to the right of unrestricted orbits is the idea of vehicular sovereignty. That is, sovereignty resides with the vehicle, not the position it is in. This is also similar to ships operating in international waters. The disadvantage of vehicular sovereignty is there are no safe sanctuaries in which to seek refuge for refit or re-supply. Once hostilities towards a spacecraft commence, it cannot (except for transatmospheric vehicles) seek protection by returning to friendly territory.¹⁰

Like other mediums there are treaties that limit some activities in space, but what is limited is unique to space. In very broad terms, there are treaties against placing weapons of mass destruction in orbit or on the Moon, establishing military bases on celestial bodies, or interfering with arms control treaty verification from space. There is also prohibition against causing long-lasting environmental effects.¹¹ What is most important about these political limitations is that almost everything is permissible except for a few specific cases.¹² So in this sense, space is like other mediums; there are agreed upon political limitations on some activities, but what is limited is relatively limited and unique to space.¹³

Given the differences in the physical and political environments it is reasonable to conclude space is a unique medium. Because space is a unique medium, a requirement to understand what advantages and limitations are inherent in operating in, to and from that environment is the first tenet of employing space forces.

Tenet #2

Spacepower Should be Prioritized and Coordinated by a Space Professional With a Global Perspective

Spaceforces, because of their global impact, tremendous capabilities, very high cost, difficulties of operating in space and extreme sensitivity to technology advances, may be the ultimate low density/high demand asset and require prioritization by a commander with a global perspective.

Because of the speed and altitudes of orbits, space forces almost always have the potential to produce effects in multiple theaters, often simultaneously. For example, a communications satellite may be providing support to EUCOM and CENTCOM at the same time or an imaging satellite may image targets in multiple theaters within a few minutes of each other. Similarly, terrestrial forces executing space control missions would almost always produce effects on systems an adversary uses in multiple theaters.

Being a good operator in any one environment is difficult. Becoming expert on how to employ the military instruments at the operational or strategic level of war in any medium takes a career of learning.¹⁴ Space is no different; professionals with a deep pool of experience in space operations should command space forces.

Therefore, allocation of military spacepower assets between theaters should be made by a senior space professional with a global perspective. One combatant commander with a global perspective should have combatant command (command authority) of all military spaceforces. Additionally, the space forces needed to execute any major regional contingency operations plan will require significant commercial and intelligence augmentation.¹⁵ The combatant commander should have the ability to obtain and coordinate additional forces from the civil, commercial and intelligence space sectors.

In this organizational scheme tactical control (TACON), and sometimes operational control (OPCON) of assets would be allocated to a theater. However, the theater commander would never be given control over a satellite, only mission payloads. The time and scope of control a theater would have over an asset would be clearly defined in a deployment order or space tasking order. This could be a complete dedication of a satellite to a theater, such as a communications satellite that was supporting only that theater or it could be continuous dedication of a certain number of transponders on a communications satellite. In the case of low earth orbit satellites, it could be certain windows of time for each mission payload based on when resources would be useful to that theater.

The space commander in theater should have direct liaison authority with whatever organization controls the payload. This would allow him to coordinate as necessary to ensure the operations crews fully understand what effects the theater needs for the time the resources are allocated to them. In effect, the satellite and payload operations crews would be working for that theater commander during those times. This should also be true for terrestrial space forces. Even though tactical control passes to the theater, combatant command should reside with a commander with a global perspective because of their ability to regularly create effects in multiple theaters.

In this scheme, that theater commander will always be the commander to make plans to use the spacepower made available to the theater. However, that theater will never “own” the satellite or be allowed to affect its orbital parameters. Space forces not allocated to a theater would remain under the OPCON and TACON of the space combatant commander even if they affect a theater. The space combatant commander must always be fully aware of the theater commander’s needs and requirements to ensure space forces are responsive to the supported

commander's requirements. The orders from the theater commander and combatant commander would be transmitted to the executing forces through a single Space Tasking Order process.

The theater commander would have authority to “pull the trigger” on systems that only affect his theater. However, for missions that would create effects in multiple theaters, execution authority would remain with the combatant commander. Clearly defining the extent of this authority for each system allocated to a theater, either space or terrestrial based, will be extremely important to avoid confusion and maintain unity of command and unity of effort.

Future systems present challenges to this system, but will make it even more important. For example, should a micro-satellite “space predator” constellation launched solely to support a single theater be under theater combatant command? In this scheme the answer is “no” because even though the constellation may be optimized to provide imagery coverage to cover specific gaps in one theater, it would still have value to other theaters. The same is true for theater missile defense from space. Those missiles may or may not impact in the theater they were launched from, so a commander with a global perspective should be the one to “pull the trigger” for those systems. Processes, including training and exercising, that ensure close coordination between theater space staffs and the space combatant commander's staff should be adopted to ensure space remains integrated with the theaters' campaign plans.

Tenet #3

Spacepower in a Theater Should be Centrally Controlled by a Space Professional

Spacepower in a theater is a very limited resource and a space commander with a theater-wide perspective should control its allocation within that theater. Failing to do this runs the risk of repeating the mistakes made in the early years of airpower—forces being spent inefficiently in “penny packets”. A Joint Force Space Component Commander (JFSCC) should fill this role.

This, along with the preceding tenet, were the most criticized of the tenets proposed during research; they were also the most strongly defended proposed tenets. The most often voiced concern was that spacepower has done a largely good job becoming relevant to the fight through force enhancement, especially force enhancement for the Air Force, and is well integrated into Air Operations Centers. Many leaders felt strongly this should not be reversed and spacepower should avoid becoming segregated and risk being marginalized. This tenet in no way suggests reversing any of those advancements in the utilization of spacepower.

In April 2000 Maj Larry Price raised this same concern. He concluded a JFSCC was a viable option, but did not make sense at that time because of the risk of damage to the effort to integrate space into the Air Operations Center. He went on to say the transition to a JFSCC is inevitable, “the only question is...will [it] occur soon enough to ensure space forces are effectively and efficiently employed...?”¹⁶ Since that writing the Air Force has gained three years and two major wars of experience integrating space into air operations. The relationship between spacepower and airpower is not so fragile that spacepower should not continue to mature out of fear of jeopardizing their relationship.

This tenet does not suggest space weapons officers or other space operators should be removed from the Air Operations Center, although they may need to be re-named. Their primary function is now and should remain to help optimize space support for air operations and ensure the Joint Force Air Component Commander has experts who are a part of his staff that can ensure airpower uses space to its fullest advantage. They also sometimes help other services integrate spacepower into their operations. That is spacepower being used to enhance military power and should continue; however, spacepower can also do much more.

The JFSCC would be responsible for planning the employment of the space forces allocated to the theater by the space combatant command. He would do this as a co-equal with the other component commanders and would be responsible to the joint force commander for the employment of spacepower to accomplish effects for the campaign plan either as the main effort or in support of the main effort as directed. Currently, no one is tasked to think about how to use space in this way. As long as the senior space operator is a part of the joint force air component commander's staff it is unlikely the focus will shift away from providing support to air operations.

Today's situation is similar to the early days of airpower when General Carl Spaatz said in exasperation that soldiers and sailors talked about the years of experience that went into training a surface commander, which made it impossible for outsiders to understand their calling. Yet, they all felt capable of running an air force.¹⁷ Today's equivalent to General Spaatz's comments would be: Pilots speak in awe of the complexities of running eight ship formations, designing strategic air campaigns and coordinated precision bombing, insisting the required skills can only be mastered by years in the cockpit and commanding air forces. Yet the Air Force feels pilots are almost instantly capable of mastering the intricacies of optimizing spacepower¹⁸ (See Appendix C for additional information from the Rumsfeld Commission about this issue.) That is presented not to belittle pilots but to emphasize that learning how to use spacepower in a fight, like using any other form of military power, is complex and difficult and takes a years of learning to master.

Although it was not considering spacepower at the time it was written, Joint Publication 3-0: *Doctrine for Joint Operations* points out "any dimension of combat power can be dominant – and even decisive – in certain aspects of an operation or phase of campaign and each force can support or be supported by other forces."¹⁹ While it is true spacepower would be hard pressed to

demonstrate decisive effects today, as was shown in chapter 2, it is less than 10 years away from being able to do so (tenet #6 will amplify this point).

Decisive or not, a JFSCC should command all the space forces in a theater. Fully integrating spacepower's full potential into the joint force commander's plan, while continuing to provide support to other forces is a very complex task. It is a mission for a JFSCC—a commander with enough experience in space operations to make those judgments, the staff to ensure spacepower is employed to its fullest advantage and holding equal position on the joint force commander's staff.

Tenet #4 Spacepower is Flexible and Versatile

Spacepower, much like airpower, is flexible and versatile. Although this is not unique to spacepower, it is equally valid as a tenet of spacepower. Flexibility means spacepower can shift from one campaign objective to another very quickly.²⁰ For example, a photoreconnaissance satellite may image targets on two different fronts of a campaign within a very short period of time. Today's legacy satellite systems are not easily reconfigured or maneuvered;²¹ however, they can shift between different objectives within the limits of the platform. In this they are like all weapon systems, space-based or terrestrial, they must operate within their limitations.

Future systems may provide much more flexibility in the form of responsive launch systems using common micro satellite buses. Additional flexibility may be gained from a "space predator"—a small, cheap expendable satellite with limited life launched for a single purpose. Also flexibility may be gained from on-orbit refueling capabilities. That will reduce the mission-limiting impact of deciding to maneuver a satellite.²² Some critics say space systems will never be cheap enough to make short-lived satellites like "space predator" practical. Considering a

Tomahawk cruise missile costs \$600 thousand²³ and is completely expended in a single mission; micro satellites costing \$1.1 Million launched for a single mission but providing a few months of useful life seem reasonable.²⁴

Spacepower is versatile in that it can be equally effective at the strategic, operational and tactical levels of war—sometimes simultaneously. For example, a Defense Support Program satellite can be watching for strategic missile launches while also looking for much shorter-range theater missiles. The future common aero vehicle or space-based lasers mentioned in chapter 2 will be able to attack targets across the spectrum of war nearly simultaneously. Counter space systems will be able to attack space systems the enemy is using to achieve tactical and strategic effects.

Some critics may charge this tenet is talking about future systems that may not ever be developed into weapon systems. That is the point of writing tenets now, to help guide the development of those systems, which are actual programs—not just vaporware, and their TTP. If flexibility and versatility are not designed into systems, they will not have it.

Tenet #5

Spacepower is Best Used to Achieve Effects In, To and From Space That Capitalize on Its Unique Advantages

Space, as a unique operating environment, provides advantages that should be capitalized on and limitations that should be minimized. That means the best use of spacepower requires choices about what mission to do in, to and from space. Just like it makes more sense to do some missions from a tank rather than an airplane, it makes more sense to do some things from ships or airplanes than space. Conversely, it makes more sense to do some missions from space than with terrestrial forces. As the often-repeated mantra of the space integration school of thought says, some airpower missions will migrate to space when it becomes reasonable; however, in

addition to migrating some missions to space there are probably entirely new sets of missions that are better accomplished from space.²⁵

What then are the most important characteristics of spacepower? First is the “global” nature of spacepower. In this case “global” means not only the ability to reach any place on Earth in much less time than any other system, it also means access to all locations on Earth simultaneously with relatively few assets compared to any other form of military power.²⁶

Second is the persistence of spacepower. Not only can spacepower reach all spots on Earth with great speed and/or simultaneously, it can continue to provide access to those areas for as long as required. Together, **global access and global presence are the essence of spacepower.**²⁷

Third, spacepower is unobtrusive. It is not always apparent when some aspects of spacepower are able to create effects over an area. Although true today, as launch systems become more responsive and satellites require less on-orbit checkout prior to becoming operational, it will become increasingly true. There are fewer political and public opinion considerations when deploying space-based forces than deploying strike aircraft or UAVs. As was stated above, even when the presence of spacepower is well known, there are no legal restrictions on its ability to conduct operations over any spot on Earth.

Finally, space is for most practical purposes a vacuum, which allows some weapons to travel very long distances with no disruption by atmospheric conditions. Although this idea is mostly applicable in space-to-space engagements, it is what makes space-based missile defense and space-based counter space missions practical.

These four attributes: global access, global presence, unobtrusiveness and the vacuum of space are unique advantages that spacepower missions should capitalize on. If a mission does

not require any of these attributes maybe it could be done better by some other form of military power. If it does require any of these attributes it is a good candidate for consideration to be accomplished in, to and from space.

Space power will never replace airpower and airpower will never do everything spacepower can do, the two are unique and complimentary. As M. V. Smith said, “Airpower should continue to provide theater-focused forces; spacepower provides globally focused forces. The two compliment each other as joint partners with land and sea forces.”²⁸

Tenet #6

Spacepower Can Support or be Supported By Terrestrial Operations or Operate Independently

Spacepower, like all other forms of military power, can support other forces, be supported by other forces or act independently. Today, space assets are the first forces over a theater and remain after conflict is terminated. Much of the history of spacepower is supporting terrestrial forces. Experience and the volumes written forecasting how space power will support forces in the future speak for themselves and do not need to be repeated here.

One case however, is worth discussion. The Air Force’s Global Strike Task Force (GSTF) will rely on space for traditional support²⁹ but spacepower may also play a major role in helping “kick down the door.” Force application from space may soon be possible against targets deep in enemy territory or very deep or very well defended targets. General Jumper did not present spacepower force application as part of the GSTF, even though other not yet existent capabilities were presented. As soon as space demonstrates an attack capability they should be included in the GSTF. Space assets can reach the theater faster, strike with greater impunity and remain over the area longer than other forces. That is not to say they will ever replace the cost effectiveness

or mission flexibility of aircraft, only to point out there are some specialized missions the GSTF will execute that can take advantage of the unique characteristics of space forces.

Terrestrial forces can also support spacepower. The most obvious examples are when terrestrial forces strike ground segments of an adversary's space systems.³⁰ Other less obvious support may include efforts to mask the actual capabilities of some space forces, designating targets for munitions delivered from space, transporting space forces to forward locations and providing security for terrestrial-based space forces—to name just a few of the many ways space forces may need support.

Additionally, space and terrestrial forces should be able to create synergistic effects. For example, terrestrial forces may force an adversary to shift their communications from a fiber-optic network to a space-based system. Space forces may then be able to deny the use of that system. The two forces working together would thus create an effect neither was capable of producing independently. Spacepower should never think of itself as operating in the vacuum of space and should always be integrated in the joint force commander's plan to create effects in whatever way is required. Also, as one research responder noted, space forces should be flexible enough and sufficiently integrated into joint war fighting to be able to support other forces, even if it is not an ideal space mission. In turn space forces may need assistance from other forces to cover their shortfalls.

Spacepower can also act independently of terrestrial forces. It would take a very specific set of circumstances for spacepower to be decisive today, but as new systems become available those circumstances will expand. That is not to say, spacepower should ever be considered an answer to every problem or even be useful in every circumstance. Just like every other form of military power, in the right circumstances, when an adversary has a critical vulnerability in a

center of gravity that can be affected by spacepower, then spacepower can be decisive. Maj Smith said, “Force application from space will take many forms; but it seems likely space-based weapons will fill specific niches, ideal for a handful of missions during certain phases of operations. No claim is made that spacepower by itself can be decisive in conventional warfare, but it may help set the conditions for victory by friendly forces in certain circumstances.... There may be certain forms of limited warfare wherein information gleaned from space or strikes delivered from space may achieve the political and military aims of an operations.”³¹

James Oberg argued that spacepower alone, at least for the next several decades, “is insufficient to control the outcome of terrestrial conflict or ensure the attainment of terrestrial political objectives.”³² In doing so he failed to consider that some national centers of gravity might have a vulnerability that can be affected by spacepower. As Smith said, these would probably be in limited warfare with limited objectives and only in unique circumstances. Just because it is not common however, does not make it out of the realm of possibility. For example, spacepower may be able to coerce some leaders by holding high value, well defended targets at risk from a space-based attack that does not include risking a pilot and does not require over flight permissions from any other country.

Even if spacepower is not decisive it may still take action independent of other forces. This could include signaling U.S. intent by temporarily preventing some satellite-based services in a country or striking a high value, well defended target. Many other attack options may be independent of terrestrial forces, even if they produce synergistic effects with those forces to create a decisive outcome. Although some of these capabilities are not yet fielded, they should be available during the careers of space operators on duty today.

Nothing written in this chapter should be construed to suggest spacepower would ever be decisive in all, or even many, situations or will ever replace airpower. However, spacepower should always be well integrated into a joint force commander's plan including its ability to operate in support of other forces, supported by other forces, or independently to produce whatever effects the commander requires.

Notes

¹ Joint Publication (JP) 3-14: *Joint Doctrine for Space Operations*, 9 August 2002, I-2.

² It is possible information is also a unique medium but the discussion of information as a medium is both beyond the scope of this work and beyond the author's research and expertise.

³ Maj M. V. Smith, *Ten Propositions Regarding Spacepower* (Maxwell AFB, AL.: Air University Press, October 2002), 38.

⁴ Maj M. V. Smith, *Ten Propositions Regarding Spacepower* (Maxwell AFB, AL.: Air University Press, October 2002), 38.

⁵ Maj Bruce M. DeBlois, "Ascendant Realms: Characteristics of Airpower and Space Power," in *The Paths of Heaven: The Evolution of Airpower Theory*, ed. Col Phillip S. Meilinger (Maxwell AFB, AL.: Air university Press, 1997), 551.

⁶ Air Force Doctrine Document (AFDD) 2, *Space Operations*, 27 November 2001, 1.

⁷ Maj Bruce M. DeBlois, "Ascendant Realms: Characteristics of Airpower and Space Power," in *The Paths of Heaven: The Evolution of Airpower Theory*, ed. Col Phillip S. Meilinger (Maxwell AFB, AL.: Air university Press, 1997), 552.

⁸ David N. Spiers, *Beyond Horizons: A Half Century of Air Force Space Leadership*, revised ed. (Maxwell AFB, AL.: Air Force Space Command in association with Air university Press, 1998), 52.

⁹ Maj Bruce M. DeBlois, "Ascendant Realms: Characteristics of Airpower and Space Power," in *The Paths of Heaven: The Evolution of Airpower Theory*, ed. Col Phillip S. Meilinger (Maxwell AFB, AL.: Air university Press, 1997), 547.

¹⁰ David E. Lupton, *On Space Warfare: A Space Power Doctrine* (Maxwell AFB, AL.: Air University Press, June 1998) 15.

¹¹ Maj M. V. Smith, *Ten Propositions Regarding Spacepower* (Maxwell AFB, AL.: Air University Press, October 2002), 43.

¹² Joint Publication (JP) 3-14: *Joint Doctrine for Space Operations*, 9 August 2002, I-4.

¹³ Brig Gen Simon P. Worden and Maj John E. Shaw, *Whither Space Power? Forging a Strategy for the New Century* (Maxwell AFB, AL., Air University Press, September 2002), 130-132.

¹⁴ Air Force Doctrine Document (AFDD) 1, *Air Force Basic Doctrine*, September 1997, 22.

¹⁵ Air Force Doctrine Document (AFDD) 2, *Space Operations*, 27 November 2001, 48. AFDD 2-2 pints out augmentation using commercial assets began in the Viet Nam war and have

Notes

continued ever since. In Operation ALLIED FORCE 60 percent of satellite communication was over commercial satellites and the requirements are increasing.

¹⁶ Maj Larry G. Price, "Space Operations in the Joint Warfighting Arena: The Viability of a Joint Force Space Component Commander," Research report no. 144/2000-04 (Maxwell AFB, AL.: Air Command and Staff College, April 2000), 26 – 27.

¹⁷ Col Phillip S. Meilinger, *Ten Propositions Regarding Air Power* (Air Force History and Museums Program, 1995), 49 – 50.

¹⁸ *Report of the Commission to Assess United States National Security Space Management and Organization*, (Washington D.C.: The [Space] Commission, January 11, 2001), 43 - 44.

¹⁹ Joint Publication 3-0: *Doctrine for Joint Operations*, 10 September 2001, III-10.

²⁰ Air Force Doctrine Document (AFDD) 1, *Air Force Basic Doctrine*, September 1997, 23.

²¹ Air Force Doctrine Document (AFDD) 2, *Space Operations*, 27 November 2001, 9.

²² William B. Scott, "Space Shell Game," *Aviation Week & Space Technology*, April 7, 2003, 74 - 75.

²³ "United States Navy Fact File: Tomahawk Cruise Missile," (United States Navy, 9 April 2003), on-line, Internet, 11 April 2003, available from <http://www.chinfo.navy.mil/navpalib/factfile/missiles/wep-toma.html>.

²⁴ Based on a 10-meter resolution micro satellite built and launched by Surrey Satellite Technology Ltd. They have demonstrated this with an actual on-orbit system using a 6.5 kg bus and Russian launch vehicles. This includes the cost of a ground station. Multi-spectral and 2-meter monochromatic imaging could be achieved for an additional \$2 million. SOURCE: Maj Timothy Lawrence, USAF, who was assigned as a researcher at Surrey.

²⁵ Maj M. V. Smith, *Ten Propositions Regarding Spacepower* (Maxwell AFB, AL.: Air University Press, October 2002), 104 - 105.

²⁶ Maj M. V. Smith, *Ten Propositions Regarding Spacepower* (Maxwell AFB, AL.: Air University Press, October 2002), 92.

²⁷ Maj M. V. Smith, *Ten Propositions Regarding Spacepower* (Maxwell AFB, AL.: Air University Press, October 2002), 48.

²⁸ Maj M. V. Smith, *Ten Propositions Regarding Spacepower* (Maxwell AFB, AL.: Air University Press, October 2002), 97.

²⁹ General John P. Jumper, "Global Strike Task Force: A Transforming Concept, Forged by Experience," *Aerospace Power Journal* XV, no. 1 (Spring 2001): 29 – 32.

³⁰ Air Force Doctrine Document (AFDD) 1, *Air Force Basic Doctrine*, 1 September 1997, 47-48.

³¹ Maj M. V. Smith, *Ten Propositions Regarding Spacepower* (Maxwell AFB, AL.: Air University Press, October 2002), 106.

³² James E. Oberg, *Space Power Theory* (U.S. Air Force Academy Department of Astronautics, CO; Government Printing Office, March 1999), 127.

Chapter 4

Conclusions

The purpose of military spacepower is to provide capabilities to assist in achieving political and military objectives.

—M. V. Smith
Ten Propositions Regarding Spacepower

This paper showed space is a unique medium with its own physical and political attributes. Because of that uniqueness it has its own operational characteristics—with the corresponding advantages and limitations. Therefore, there must be enduring truths about how to employ spacepower.

The Air force has policies that require spacepower to be able to create effects in, to and from space and Air Force Space Command has funded programs to enact that policy. However, there are no enduring truths about how to employ spacepower in Air Force doctrine to guide the development of programs or TTP. This paper proposed six tenets of spacepower and showed each is a valid tenet.

Acceptance of these tenets in doctrine and, more importantly, by members across the services will put to rest discussion about whether space should be “weaponized”. That argument is long over and the answer is that space is already being weaponized. It will also help change the paradigm many people use to view space. They will begin to see space as a co-equal component of a joint force capable of supporting other forces, being supported by other forces or taking independent action.

To incorporate these tenets would require some organizational changes. Creation of a Joint Force Space Component Commander will require additional expertise in joint war fighting and how space can contribute directly to a joint force commander's plan. Deciding whether or not to collocate this staff with Air Operations Centers will require considerable thought and discussion. The processes, training and exercising for these space staffs will be critical. All the lessons learned about the process of incorporating space into air operations can be applied to incorporating space into the joint force campaign plan, but the process will still take considerable time. The Space Division at the Air Force Weapons School may have to break into multiple sections, one focusing on support to air operations and another on creating direct effects.

Most importantly incorporating these tenets means spacepower will be presented to joint force commanders as a power in its own right and not just a supporting function of airpower. Just as few people envisioned how GPS applications would eventually permeate society, it is probably impossible to predict the many ways space operators will think of to use spacepower to create effects for the joint campaign plan.

Above all, this paper presented an attempt to capture truths about spacepower that have yet to be codified. Regardless of a reader's stance on these specific tenets, few could argue that tenets are not required. Spacepower is bursting on to the stage as a force able to stand on its own. If the Air Force does not codify enduring truths about how to effectively fight with this power, its maturation will be a long and painful process. The next step is for these tenets to be discussed, modified if necessary, captured in doctrine and applied throughout the Air Force.

Appendix A

Space Sectors

The Rumsfeld Space Commission summarizes the four space sectors as follows.

There are four sectors of space activity: civil, commercial, defense and intelligence.

Civil Space Sector

The civil space sector is approaching a long-standing goal of a permanent manned presence in space with the deployment of astronauts to the International Space Station. The U.S. has shouldered the largest share of development and funding for this effort. Because it is an international program, however, its benefits for scientific research, experimentation and commercial processes will be widely shared. The number of countries able to participate in manned space flight has grown substantially. In addition to the U.S. and the USSR (now the Russian Federation), 21 other countries have sent astronauts into orbit in U.S. and Russian spacecraft. The People's Republic of China has announced its intention to become the third nation to place human beings in orbit and return them safely to earth.

Other research and experiments in the civil sector have many applications to human activity. For example, civil space missions to understand the effects of the sun on the earth, other planets and the space between them, such as those conducted by the Solar Terrestrial Probe missions, will help in the development of more advanced means to predict weather on earth.

Commercial Space Sector

Unlike the earlier space era, in which governments drove activity in space, in this new era certain space applications, such as communications, are being driven by the commercial sector. An international space industry has developed, with revenues exceeding \$80 billion in 2000. Industry forecasts project revenues will more than triple in the next decade. Whereas satellite system the growth of the space industry today, and its hallmark in the future, will be space-based services.

The space industry is marked by stiff competition among commercial firms to secure orbital locations for satellites and to secure the use of radio frequencies to exploit a global market for goods and services provided by those satellites. International consortia are pursuing many space enterprises, so ascertaining the national identity of a firm is increasingly complex. The calculations of financial investors in the industry and consumer buying habits are dominated by time to market, cost and price, quantity and quality. It is a volatile market. Nevertheless, as a result of the competition in goods and services, new applications for space-based systems continue to be developed, the use of those products is increasing and their market value is growing. Space-based technology is revolutionizing major aspects of commercial and social activity and will continue to do so as the capacity and capabilities of satellites increase through emerging technologies. Space enters homes, businesses, schools, hospitals and government offices through its applications for transportation, health, the environment, telecommunications, education, commerce, agriculture and energy.

Space-based technologies and services permit people to communicate, companies to do business, civic groups to serve the public and scientists to conduct research. Much like highways and airways, water lines and electric grids, services supplied from space are already an important part of the U.S. and global infrastructures.

The most telling feature of the new space age is that the commercial revolution in space has eliminated the exclusive control of space once enjoyed by national defense, intelligence and government agencies. For only a few thousand dollars, a customer today can purchase a photograph of an area on earth equal in quality to those formerly available only to the superpowers during the Cold War. Commercial providers can complement the photographic images with data that identify the location and type of foliage in an area and provide evidence of recent activity there. They can produce radar-generated maps with terrain elevations, transmit this information around the globe and combine all of it into formats most useful to the customer. This service is of increasing value to farmers and ranchers, fisherman and miners, city planners and scientists.

Defense Space Sector

Space-related capabilities help national leaders to implement American foreign policy and, when necessary, to use military power in ways never before possible. Today, information gathered from and transmitted through space is an integral component of American military strategy and operations. Space-based capabilities enable military forces to be warned of missile attacks, to communicate instantaneously, to obtain near real-time information that can be transmitted rapidly from satellite to attack platform, to navigate to a conflict area while avoiding hostile defenses along the way, and to identify and strike targets from air, land or sea with precise and devastating effect. This permits U.S. leaders to manage even distant crises with fewer forces because those forces can respond quickly and operate effectively over longer ranges. Because of space capabilities,

the U.S. is better able to sustain and extend deterrence to its allies and friends in our highly complex international environment.

Space is not simply a place from which information is acquired and transmitted or through which objects pass. It is a medium much the same as air, land or sea. In the coming period, the U.S. will conduct operations to, from, in and through space in support of its national interests both on earth and in space. As with national capabilities in the air, on land and at sea, the U.S. must have the capabilities to defend its space assets against hostile acts and to negate the hostile use of space against U.S. interests.

Intelligence Space Sector

Intelligence collected from space remains essential to the mission of the Intelligence Community, as it has been since the early 1960s. Then the need to gain access to a hostile, denied area, the USSR, drove the development of space-based intelligence collection. The need for access to denied areas persists. In addition, the U.S. Intelligence Community is required to collect information on a wide variety of subjects in support of U.S. global security policy.

The Intelligence Community and the Department of Defense deploy satellites to provide global communications capabilities; verify treaties through “national technical means”; conduct photoreconnaissance; collect mapping, charting, geodetic, scientific and environmental data; and gather information on natural or man-made disasters. The U.S. also collects signals intelligence and measurement and signature intelligence from space. This intelligence is essential to the formulation of foreign and defense policies, the capacity of the President to manage crises and conflicts, the conduct of military operations and the development of military capabilities to assure the attainment of U.S. objectives.¹

Notes

¹ *Report of the Commission to Assess United States National Security Space Management and Organization* (Washington D.C.: The [Space] Commission, January 11, 2001), 10 – 14.

Appendix B

Changing Atmospheric Density

Table 2, The Changing Atmospheric Medium

Altitude (km)	Density (d)/Density at Sea Level (d ₀)
0	d ₀ = 10 ¹⁸ particles/cm ³
5	d = .492 x d ₀ (one-half of Earth's atmosphere is below this)
10	d = .242 x d ₀ (supplemental oxygen required for respiration)
15	d = .119 x d ₀ (supplemental pressure oxygen required for respiration)
24	d = .033 x d ₀ (compressing external air is no longer economical; humans require self-contained environments)
32	d = .011 x d ₀ (operating limit of turbojet engines)
45	d = .002 x d ₀ (operating limit of ramjet engines)
100	d = 10 ¹² particles / cm ³ (aerodynamic effects become insignificant)
1,000	d = 10 ⁵ particles / cm ³
2,000	d = one particle / cm ³ (the "hard vacuum" of space)

Density = $\exp(-mgz/kT)$, where z is altitude, m is the molecular weight in kg of air, g is the local acceleration of gravity, k is Boltzmann's constant, and T is temperature (degrees Kelvin).

Source: Maj Bruce M. DeBlois, "Ascendant Realms: Characteristics of Airpower and Space Power," in *The Paths of Heaven: The Evolution of Airpower Theory*, ed. Col Phillip S. Meilinger (Maxwell AFB, Al.: Air university Press, 1997), 551.

Appendix C

Senior Leadership Space Experience Issues

The Rumsfeld Space Commission said:

In contrast, military leaders with little or no previous experience or expertise in space technology or operations often lead space organizations. A review by the Commission of over 150 personnel currently serving in key operational space leadership positions showed that fewer than 20 percent of the flag officers in key space jobs come from space career backgrounds (Figure 18). The remaining officers, drawn from pilot, air defense artillery and Intercontinental Ballistic Missile (ICBM) career fields, on average had spent 8 percent, or 2.5 years, of their careers in space or space related positions. Officers commanding space wings, groups and squadrons fare only slightly better; about one-third of the officers have extensive space experience, while the remaining two-thirds averaged less than 4.5 years in space-related positions

This lack of experience in leadership positions is a result of several factors. The space force is young and small, but it has been around long enough for a few to reach four-star rank and the number of personnel is growing. There has been an infusion of personnel from the ICBM force into space organizations in an effort to broaden career opportunities for the missile launch officers. Over time, this will create a larger cadre of space professionals, but in the short term it has had an impact on the overall level of experience of space personnel. Military officers with space training are in high demand in the commercial world. As a result, there has been a drain of space talent as evidenced by the low retention of first term space engineers and operators. Finally, there is a lack of focused career development in the space community.

Space leadership in the military will require highly trained and experienced personnel at the very senior positions and throughout all echelons of command. These leaders must provide the vision, the technological expertise and doctrine, concepts and tactics to generate and operate spaceforces in this new era of space and to generate the cadre of space professionals future military operations will require. New space personnel management policies and new career paths are needed to develop leaders with greater depth and breath of experience in the space career field.¹

Notes

¹ *Report of the Commission to Assess United States National Security Space Management and Organization* (Washington D.C.: The [Space] Commission, January 11, 2001), 43 – 44.

Glossary

AFDD	Air Force Doctrine Document
CENTCOM	United States Central Command
EUCOM	United States European Command
GPS	Global Positioning System
GSTF	Global Strike Task Force
JFACC	Joint Force Air Component Commander
JFASCC	Joint Force Air and Space Component Commander
JFSCC	Joint Force Space Component Commander
JP	Joint Publication
OPCON	Operational control
TACON	Tactical control
TTP	Tactics, techniques and procedures
UAV	Unmanned Aerial Vehicle
USAF	United States Air Force

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