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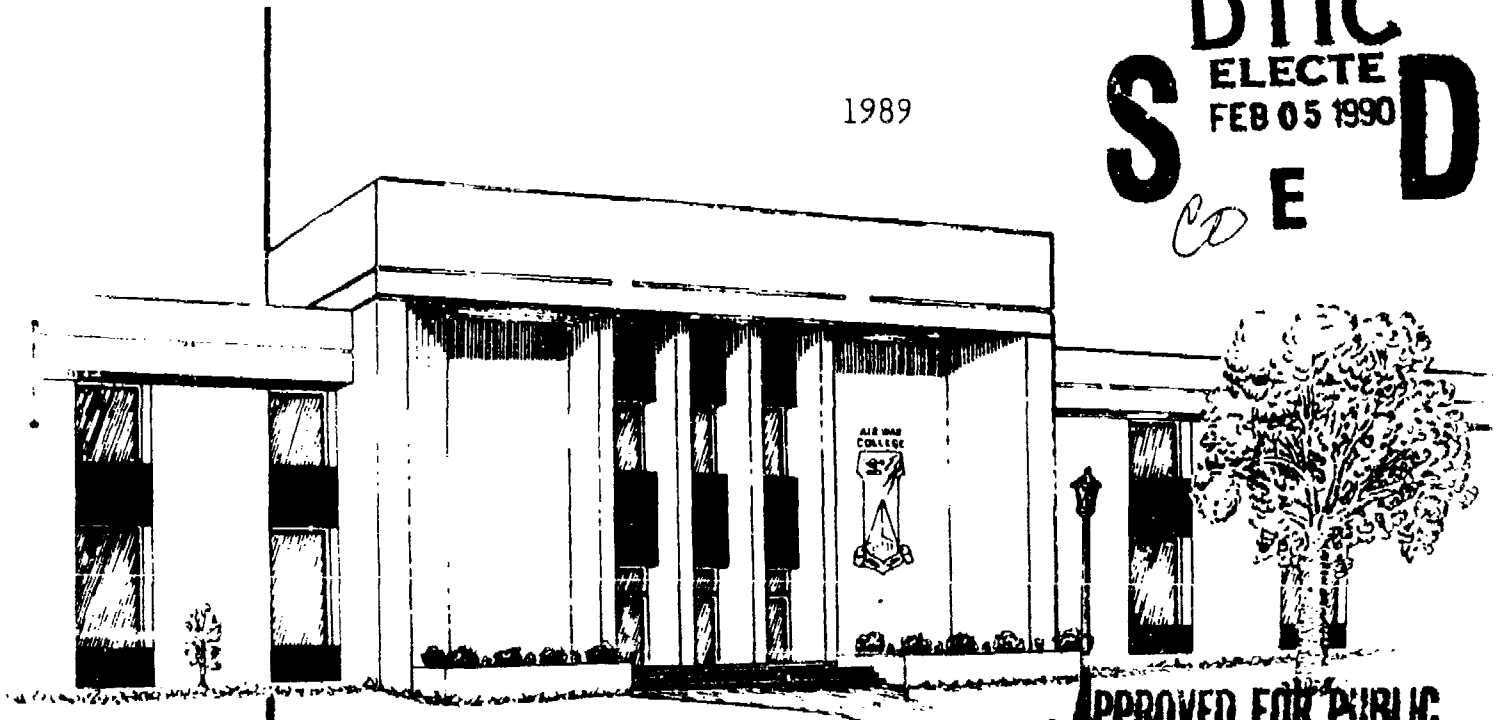
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THE ESSENCE OF SPACEPOWER: IMPORTANT INFLUENCES
ON THE EVOLUTION OF NATIONAL SPACEPOWER

LIEUTENANT COLONEL CRAIG P. WESTON

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AIR UNIVERSITY
UNITED STATES AIR FORCE
MAXWELL AIR FORCE BASE, ALABAMA

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THE ESSENCE OF SPACEPOWER:
IMPORTANT INFLUENCES ON THE EVOLUTION OF NATIONAL SPACEPOWER

by

Craig P. Weston
Lieutenant Colonel, USAF

A DEFENSE ANALYTICAL STUDY SUBMITTED TO THE FACULTY
IN
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Advisor: Colonel Ted Schroeder

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EXECUTIVE SUMMARY

TITLE: The Essence of Spacepower: Important Influences on the Evolution of National Spacepower

AUTHOR: Craig P. Weston, Lieutenant Colonel, USAF

This paper scopes the concept of spacepower, identifies the arenas in which it must be forged, and outlines the factors that strongly influence its evolution. These insights are drawn from the history of land, sea, and air power. Broad parallels in the formation of national power in these mediums suggest that spacepower is composed of three components and will evolve in five separate but interdependent arenas. Within each of these arenas there appear to be several factors that are key to the evolution of national power in any medium. One obvious conclusion of this study is that a number of nations could become spacepowers. Another conclusion is that the United States must come to grips with several shortfalls if it is to remain a preeminent spacepower for the long term.

The reader with limited time may wish to focus on Chapter II, the Integration of Arenas section in Chapter IV, and Chapter VI. They comprise a more detailed executive summary.

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BIOGRAPHICAL SKETCH

Lieutenant Colonel Craig P. Weston (B.S., United States Air Force Academy; M.S., Air Force Institute of Technology) has served in research, development, and flight test positions associated with air launched munitions and high energy lasers. Most recently assigned to Space Division at Onizuka Air Force Base, California; he contributed to the development of the lead satellite in a new satellite program and directed satellite operations as the Mission Director for another satellite system. He is a graduate of the Air War College- Class of 1989.

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CHAPTER I

CHALLENGE

History, by apprising men of the past, will enable them to judge the future.

Thomas Jefferson

It appears that space will eventually be as important to national power as the land, sea, and air mediums. The United States, as a nation, seems to recognize the importance of space. Since the dawn of the Space Age, Isaac Asimov, Wernher Von Braun, and many others have sparked the American public's imagination by revealing the potential of space. Every Administration and the Congress in the last thirty years have taken unprecedented steps to realize that potential. Other nations have also begun to explore and exploit the medium. There is international competition in space and it seems inevitable that there will be conflict, as well.

Yet, the extent to which space will become a part of national power is undetermined. Will it be a sanctuary, free of armed force? Is commerce in space fundamentally different from commerce in other mediums? The direction of spacepower is not clear without the answers to these and other basic questions. The broad arenas which will shape this evolution and the key factors that will influence it are not well understood. Furthermore, many are not even sure what constitutes spacepower! We cannot meet the challenge of space

unless we have a common conceptual framework in which to make decisions.

Purpose

The purpose of this paper is to capture the essence of spacepower and its evolution. In order to do so, we will scope the concept of spacepower, identify the arenas in which it must be forged, and outline the factors that strongly influence its evolution. The source of these insights is the history of the formation of land, sea, and air power. We should be able to deduce parallels among the mediums to define the concept of power in a medium and to determine arenas and key factors which influence the evolution of national power. This framework can then be used to determine the relative capacity of a nation to be a spacepower. Policy makers who understand and make decisions within this basic context will be able to more effectively influence the direction and extent of United States spacepower.

Overview

This study is divided into four distinct parts. The first part, Chapter II, broadly scopes the concept of power in a medium. A brief historical review of the components of land, sea, and air power substantiate the concept. The chapter concludes with some general observations on the progressive projection of national power into additional mediums. The second part consists of Chapters III and IV. These chapters outline the arenas and key factors that influenced the

evolution of national power on land, sea, and in the air. The integrated effect of the five arenas is summarized at the end of Chapter IV. The third part of the study, Chapter V, applies the concepts of the first two parts to the space medium. It becomes evident that spacepower is conceptually the same as power in the other mediums and that the same historical arenas and factors influence its evolution. The result is a conceptual framework for the evolution of spacepower. The final part, Chapter VI, puts the challenge of United States spacepower evolution in context and highlights several shortfalls the United States must overcome if it is to remain a preeminent spacepower.

CHAPTER II

POWER

Concept

Man's most basic need is self preservation, in the form of nourishment, shelter, and protection from the violence of other men. Man must satisfy these needs in order to survive and be secure. Since security is difficult to achieve as an individual, men band together to obtain it in collective fashion. Individual security then equates to security of the band or society as a whole and security of the society becomes the overriding need.¹

Over the millennium, the quest for security of societies has become extremely complex. The structure of societies became more sophisticated during the evolution from clans and tribes through fiefs and kingdoms to nations and empires. Also, the economic basis for satisfying a society's or nation's needs evolved from agrarian subsistence through trading of goods to the mass transformation of raw materials into products. Finally, the security needs of nations expanded from the basics of food, shelter, and protection to include the need for consumer goods and services for the enhanced well being of modern societies.²

The security of every society, whether it be a primitive tribe with simple needs or an industrialized nation with sophisticated needs, depends on resources. Thus,

security centers on the search for, acquisition, and protection of resources. The degree to which a nation successfully performs these exploration, economic, and combat tasks is the measure of its power.³ Hence, national power in a medium has exploration, commercial, and military components.

Power in the Mediums

National power in a medium begins with exploration for knowledge or territory to supplement existing national security and power in other mediums. This is the search for resources. Conquest of the medium to acquire right of passage, new territory, and natural resources soon follows. Other nations eventually contest a nation's exploration for and acquisition of resources. Military forces must then assist in exploration, enforce territorial claims, and protect commerce in the medium. Combat occurs within the medium, military capabilities mature, and nations eventually project force from the medium into other mediums. The ability to control the medium becomes an end in itself and the ultimate expression of a nation's power.⁴ Throughout history, men have pursued power in every medium in this manner.

Man first explored, conquered, and exploited land for its natural resources and trade routes. In ancient times, Assyria, Greece, Persia, China, and Rome created land empires for these reasons.⁵ The many European wars of the last five centuries have been basically struggles for economic and military domination of adjoining lands.⁶ Control of the

trade and invasion routes became key to national power. Nations that were unable to compete for resources on land or that wished to complement their land power, took to the sea.

Exploration, trade, and sea warfare evolved in rapid succession on the Mediterranean Sea about three millennia ago. Seapower came into its own as exploration for trade routes led to imperial conquest and exploitation of resources in the New World, India, the Orient, and Africa, starting in the fifteenth century.⁷ Oceans became transportation routes for commerce. The military mission at sea centered on protection of the friendly sealanes of commerce and disruption of those of the enemy. The sea soon became a means of projecting force, in the form of troops and bombardment, onto land. Ships evolved to fight each other and combat for control of the sea became an end in itself. The struggle for national security eventually extended into a third medium.

Nations quickly exploited the knowledge gained in exploration of the air for military applications. As with seapower, the observation balloons of the American Civil War and the aircraft of World War I initially complemented power in the more developed mediums. Subsequent to World War I, commercial use of the medium expanded through the transport of people and mail. Protection of this commercial use of the air was through military control, i.e. air superiority, of the medium. The military mission matured to include force projection of both troops and bombardment into the other

mediums. Escort and interceptor aircraft were developed to protect or prevent this force projection. Again, control of the medium became an end in itself. It is evident that as nations conquer and control each medium, they begin to project power into the next exploitable medium, despite the increasing difficulty of doing so.

Progression Between Mediums

A nation never has enough power to satisfy the continuously expanding and increasingly sophisticated security needs of its citizens. The most capable nations project power into ever more hostile mediums in an incessant search for more security. There appear to be several broad trends in this progressive quest for power in additional mediums.

Each newly exploited medium has been a more hostile physical environment than the last. It is more difficult to sustain a human presence. Fewer people actually operate in the medium and a larger portion of the people assist them from a base medium, most often land. This more hostile medium requires more sophisticated technology, with the attendant commitment of resources, to accomplish parallel exploration, commercial, and military tasks. From a commercial standpoint, the new medium will have fewer natural resources which are mechanically more difficult to exploit. These negative trends are offset by several positive trends.

Although more difficult to accomplish, exploration, commerce, and military operations can be performed more

rapidly in the more expansive operating arena of a newly developed medium. Technology compresses time and distance to provide this benefit. Also, the technological advances necessary to develop the new medium permit power projection across already developed mediums. An excellent example is the submarine launched cruise missile that flies through the air to strike a land target. This power melding across the mediums puts the security of each nation at risk in several mediums. Such a vulnerability is an important influence on the evolution of national power and will be discussed in the next chapter.

CHAPTER III

THREE ARENAS

The nation itself, economics, and international relations are three of the five arenas which strongly influence the evolution of a nation's power in a medium. We will examine the national arena first.

National

Several national characteristics are key determinants of power in a medium. They are geography, population, national will, and wealth. Wealth is so important that it will be discussed as a separate arena in the next section. Of the remaining three, the geographic and population influences on a nation's power are tangible, while national will is more elusive and difficult to assess.

Geography

The location of a nation affects which mediums it exploits for national power and how effectively it does so. Historically, nations tend to be economically and militarily vulnerable in a particular medium, so the nation first develops its economic and military power in that medium.¹ For instance, in recent centuries, France, Germany, and Russia were continental powers due to their vulnerability to land invasion. Conversely, Spain, England, the United States (US), and Japan were not easily invaded by land but became maritime powers because of their geographic isolation.²

Within this century, maritime and continental powers have all become vulnerable to power projection from the air.

Geography often hinders a nation in power projection into other mediums and reinforces the need to exploit the vulnerable medium. The seapower of France, Holland, Austro-Hungria, and Germany was ultimately limited by coastlines that could be dominated by less constrained seapowers, i.e. Great Britain.³ From another perspective, the relative isolation of the US makes it difficult for it to project military power on land and air. Forward bases are needed to accumulate supplies, troops, tanks, and aircraft to affect land and air events on other continents.⁴

A nation can draw on technology to overcome geography and project power into a medium. For example, carrier task groups are mobile sea bases that permit the US to project power onto distant lands. Technology of this nature requires national wealth. It will soon become clear that the benefits of diverting wealth to project power in one medium must be weighed against the potential payoff and the nation's vulnerability in other mediums.

Population

A large population has always been important to national power, despite the evolution in the economic basis of societies and the leverage of technology. Nations with large populations generate more wealth and can convert this wealth into more goods for trade or arms for war, than nations with

smaller populations. Large numbers of people, wealth, and arms can sustain large, well equipped commercial and military forces to exploit a medium.*

A large population is so important to national power that nations have often been compelled to supplement their inadequate indigenous populations. One approach, which takes generations, is to encourage higher reproduction. Another approach, most recently used in nineteenth century America and Nazi Germany, is that of slave labor.* Even a large population must be well focused to project power effectively in a medium.7

Will

While national will is difficult to define and measure, its influence can be very visible and have a great impact on national power. National will can be defined as: popular dedication to achieve national power in a medium even when personal sacrifice is necessary.* Mobilization of this sentiment can produce decisive national power.

National will seems to have two elements. The first is an underlying sense of national purpose or destiny in a medium. This feeling can be a strong imperial drive, as seen in the European colonial efforts from the fifteenth to twentieth century. It can also take on a hegemonic tone, as in British and US seapower supremacy over the last century or US global airpower since World War II.*

The other element of national will is the reaction to a threat within the medium.¹⁰ The need to preserve the nation's security in the face of a threat can motivate its citizens to achieve great power in a medium, as was the case with the French levee en mass and the post World War II transformation of the Soviet Union (USSR) into a super power.¹¹ It is this aspect of national will that is often the target of other nations in war. While national will can be affected rapidly by indirect methods, the limitations imposed by geography and population size must be overcome with technology, wealth, and time.

Economic

A nation requires wealth to project power into a medium. Wealth underpins actions in the other four arenas of power evolution and is, in turn, the object of power projection into the medium. Wealth invested in a medium must return resources and wealth to the nation in the long run.¹²

Nature of Wealth

Wealth is the surplus a worker produces after his most basic, subsistence needs are met. It is this surplus that can be used to explore, commercialize, and militarize a medium. Surplus per capita production in ancient subsistence societies was low but security needs were elementary.¹³ The per capita wealth generated in modern nations is much greater due to the leverage gained from machine technology. However, security needs are also more demanding. Surplus wealth

provides enhanced security in the form of consumer services and the care of nonproductive workers. Also, wealth must be allocated to protect the nation's economic empire or hegemony, which is the source of resources for conversion to wealth. Finally, wealth must be reinvested as capital, i.e. technology, in order to increase the production leverage of the worker and generate even greater surpluses of wealth. These three imperatives form the consumption, protection (military), and production (investment) sectors within every nation's economy.¹⁴

National Economic Conflicts

A nation's competing economic sectors must be reconciled to generate the wealth needed to project power. Wealth must be diverted from one or more sectors and converted into capital for new exploratory, commercial, and military capabilities in the undeveloped medium. The choices are not easy, since the diversion of wealth from any sector can have a negative impact on the nation.

A nation can suppress consumption, dampen consumer expectations, and deny its people the more sophisticated aspects of security to generate a larger surplus of wealth. The Soviet Union used this approach to successfully convert from an agrarian to an industrial society between the World Wars. However, there is the danger of internal conflict if the rising expectations of the populace are not met.¹⁵ If

this occurs, the nation will have great difficulty in looking outward to develop the new medium.

Another choice is to reduce the nation's protection or military presence in other power mediums in order to save wealth. Great Britain used this approach successfully in the late 1800s to reduce her overseas confrontations and commitments, while maintaining her empire, in order to generate production capital at home.¹⁴ The risk in this choice is that the nation may be unable to defend the distant sources of its resources.

A third choice is to improve per capita production of wealth and generate a greater surplus of wealth. The conversion of Great Britain and the US to industrial nations is the classic example of this approach. Wealth must be invested in technology to achieve production improvements, which may cause problems for a nation with great power in other mediums. Sophisticated consumption needs and the need to protect its power base in the other mediums may prevent a nation from diverting wealth for this capital investment.

One final means of obtaining capital is from other nations. It can be obtained by force, as occurred in ancient conquests of agricultural lands and trade routes for their manpower, produce, and tribute. Obviously, the wealth gained must be greater than the wealth expended to subjugate the territories. A more modern means is to obtain loans from other nations.¹⁵ This approach is attractive since the

recipient diverts little or no wealth of its own and can perhaps repay when the capital investment begins to return wealth. The risk lies in the conditions for repayment and the inevitable influence of the donor nation on the affairs of the recipient.

Economic Payoff and Risk

The payoff from investing capital in a new medium can be enormous but investment is at the risk of the nation's existing power in other mediums. Examples of payoff abound. Sparta and Rome were continental powers who diverted capital to become seapowers, defeated their opponents in their most vulnerable mediums, and subsequently increased their wealth through sea trade.¹⁸ Similarly, Portugal and Spain invested in exploration of the Far East and New World to acquire great colonial wealth.¹⁹ The US enhanced its post war wealth with commercial and military airpower during the Eisenhower Administration, at the expense of land and sea power.

There are also risks in projecting power into an additional medium. Dutch and French commercial and military seapower gradually diminished during the eighteenth century because they had to devote increasing wealth to fight the many wars on the Continent, their most vulnerable medium.²⁰ More recently, despite continental expansion in Asia during World War II, Japan lost the war in her most vulnerable medium, the sea. Allied seapower prevented the resources and

wealth acquired with her new landpower from sustaining Japan's war effort.²¹

Thus, power projection into a medium is a calculated risk that involves a careful assessment and balance of a nation's consumption, capital investment, and protection imperatives in the other mediums.

International

A nation's power in a medium is influenced by its interactions with other nations. There are three important aspects to these interactions. First, a nation's power is measured relative to that of other nations. The result is a hierarchy of power and influence among nations. Second, the absolute power of nations changes and affects the order of the hierarchy. Third, the relative power of a nation can be modified through formal commitments to other nations. As these commitments change, the power relationship among nations also changes.

Relative Power

A nation's power in a medium can be measured in absolute terms, such as territory controlled, gross national product, and size of armed forces. Yet, a nation's security and power depends on the degree to which other nations hinder or cooperate with it in the acquisition of resources. The absolute power of each nation establishes its relative influence on other nations and determines its place in the international hierarchy of power in a medium.²²

A nation increases its absolute power in a medium in order to exert more influence over other nations active in the medium. The object of this increased influence is to gain added resources and wealth. In ancient times, nations obtained wealth through territorial dominance and empires, whereas today they acquire it through a world market system of trade. The nations that benefit the most from the wealth acquisition process try to assure its stability and the power status quo through military or economic hegemony.²³ Any change in the relative order of international power threatens their security.²⁴

Power in Flux

Despite the efforts of the dominant nations, the power hierarchy in the medium does not remain static. The absolute power of the less powerful nations increases while the power of the dominant nations tends to remain static or even decline.²⁵ The relative distribution of power among the nations inevitably changes. Historically, the most powerful nations expend great wealth to preserve economic and military hegemony and the hierarchal status quo. They must simultaneously divert increasing wealth to satisfy rising consumer demands at home.

These two trends were evident in ancient empires as well as the more recent Spanish and British dominated power hierarchies. This diversion of wealth to maintain the power status quo prevents the dominant nations from investing

adequate capital in the production sector of their economies, whether it be agriculture or industry, to meet the increasing demands of the consumer and military sectors.²⁶ The dominant nations become overextended while attempting to maintain the power hierarchy status quo.

The less powerful nations are able to efficiently increase their absolute power through the diffusion of wealth and technology from the more powerful nations. The dominant nations tend to be technologically advanced because it is an important aspect of their power. Technology and wealth pass to less advanced nations through trade and the formation of joint wealth producing enterprises that initially benefit the dominant nations.²⁷

A less powerful, less secure nation is able to more efficiently apply technology and wealth to create power for three basic reasons. First, its consumer needs are more rudimentary and more easily satisfied, so wealth is not as likely to be diverted from capital investment for sophisticated consumer needs. Second, a less technologically and economically advanced nation is less likely to have capital invested in obsolete technology. It is free to use its wealth for current technology to more efficiently project power for the capital invested. Third, the dominant nation often protects the less powerful nation to assure access to its resources and markets. The less powerful nation can divert wealth from protection to capital investment.²⁸

Japan's metamorphosis from a devastated nation to economic superpower status in the 44 years since World War II epitomizes this process. Yet, there are other techniques to adjust a nation's relative power in a medium.

Power Modification

A nation's power can be enhanced or constrained by formal agreements with other nations. It can pool power with other nations in multinational alliances and cartels that collectively enhance the security of each member nation. In the case of a very powerful nation, a military or economic alliance is often a means of enhancing its power relative to increasingly powerful nations outside the alliance. Such was the case with the ancient Romans and the British prior to World War I.²⁹ Also, less powerful nations can band together to increase their collective leverage and change the relative power hierarchy. The Organization of Petroleum Exporting Countries cartel is a recent example.³⁰

The disadvantages of these power enhancing collectives is the need for consensus and their temporary nature. Nations pool power and use collective power only to the extent that it serves their individual security needs. As the absolute power of the member nations change and security interests diverge, the collective usually disintegrates.³¹

Formal agreements or treaties can also constrain a nation's territorial, economic, and military power in a medium so the relative power and security of the signatories

remains the same.³² As with agreements that enhance power, constraining agreements are temporary and unilaterally broken when a nation feels the agreement no longer serves its security. These methods to artificially modify a nation's power in a medium are temporary and can be disrupted at the most inopportune time. Thus, the relative power of nations in a medium continuously evolves as their absolute power changes through formal agreements as well as the transfer of wealth and technology.

CHAPTER IV

TWO MORE ARENAS

Technology and military doctrine are two more arenas in which national power in a medium is formed. We will conclude our investigation of these two arenas with a summary of the characteristics of all five arenas.

Technology

Technology is the physical means to project power into a medium. It compresses time and distance for movement and communication in hostile environments. It is also essential to a nation's productivity and combat capability. Two important, long term trends of technology are the acceleration of change and the melding of power across the mediums. These trends create problems of national acceptance and integration of new concepts, which can undermine the projection of national power in the medium.

Power Lever

Technology magnifies man's efforts in exploration, commerce, and combat in hostile environments. The key to this leverage is appropriate energy sources for transport, communication, and production.

Over the millennium, energy sources have evolved from fodder, wind and water, coal, and oil to nuclear. Through the use of technology, these energy sources have in turn fueled the horse, wheels and gears, steam engine, internal

combustion engine and electrical generators.¹ These are the engines that permitted movement and communications over greater distances in shorter periods of time. Powered vehicles like the sailing ship, locomotive, steamship, and airplane made it physically possible and economically feasible to acquire, protect, and transport distant resources for domestic use. These same engines also generated electricity and electromagnetic signals to rapidly communicate over great distances.² Extended lines of communication and more capable means of transport fostered larger empires and made more resources available to technologically advanced nations.

Technology is also the means to convert raw resources into wealth and increase per capita production of wealth. Resources acquired within the mediums can be more efficiently converted to wealth while manpower requirements decrease. The manpower required to meet the subsistence or basic needs of society can be reduced so more manpower can be devoted to the creation of surplus wealth.³ Throughout history, technology not only reduced the number of manual laborers but also increased the efficiency of those engaged in work. For instance, the mechanization of weaving resulted in as much as a 400 percent per capita increase in fabric production in the early 1800s. The industrial nations, with relatively few weavers, greatly outproduced Asian nations with large populations of manual weavers.⁴ This technological leverage is also evident in vast improvements in combat power.

Technology has often been an important element of a nation's superior combat power in a medium. The mechanical advantage of the pike and longbow increased lethality in land combat in ancient times. The controlled use of gunpowder in the Middle Ages provided a quantum gain in destructiveness. In the industrial age, lethality again increased with rapid fire, mobile weapons like the tank, aircraft, and ballistic missile and the awesome destructiveness of nuclear weapons.⁵ Yet, even these revolutionary weapons required congruent tactics and organization for success in combat.

The stimulus of revolutionary weapons change was often followed by a long period of weapons technology evolution. During these periods, the emphasis was on improvements in tactics and organization to more fully exploit the capabilities of the weapons.⁶ Throughout most of history, weapons technology was not perceived as the dominant factor in combat power since tactics and organization were quickly adjusted to compensate for technological perturbations. However, technology assumed a more obvious role in combat power with the Industrial Revolution.

Acceleration and Melding

There are two long term technology trends that affect the evolution of power in a medium. Over the millennium, technological change has accelerated and national power has been melded across mediums. However, these trends did not become obvious until the Industrial Revolution, when

scientific creativity was harnessed and channelled for commercial and military purposes.

Man's knowledge and the leverage of technology have multiplied continuously throughout history. Some would argue that the rate of change is not arithmetic but geometric.⁷ The accelerating pace of technological change has become very apparent since the Industrial Revolution. Technological innovation in weapons now occurs in decades, rather than centuries. The rate of change continues to accelerate.⁸ As a result, there is little time to fully iterate and refine tactics and organization for the most effective employment of weapons, before the next weapon innovation.

Over time, the engines of technology have melded military power, in particular, across the mediums. In antiquity, weapons were of limited range and combat tended to occur on land or sea or on both in parallel.⁹ Combined medium operations became possible as weapons began to span the two mediums. During the eighteenth century, the British successfully melded land and sea power, with ship bombardment of land fortifications during troop landings in the Seven Years War and the Napoleonic Wars. Cannons in forts began to bombard ships some distance at sea, resulting in specialized artillery that reached its zenith in the US Coast Artillery.¹⁰ With the advent of powered flight, weapons like land and sea launched ballistic missiles, submarine launched cruise missiles, and surface affect ships can traverse multiple

mediums. Such technological feats are not always readily endorsed by traditionalists.

Acceptance and Integration

Nations sometimes do not adopt or ineffectively use technology to project power because they are too conservative or parochial.¹¹ Nations reject technology because it threatens the structure of their societies. Technology provides knowledge and mechanical leverage to ordinary workers, raising their expectations and giving them the means to make change. The ruling elites wish to maintain the status quo, which is the basis of their power. They retain their position by rejecting technology but in the process the relative power of the nation declines.¹² Some argue that every great empire becomes satisfied with its existing technological basis for power and becomes less willing to adapt society for technological change.¹³ Even if a nation accepts change it must then be properly integrated into the power structure in the medium.

The military component of national power is particularly sensitive to proper technological integration. A weapon is fully integrated into a medium when it can effectively contribute to the formation of superior combat power. Integration usually affects the roles and missions of the nation's military forces in the medium, so parochialism must often be overcome.¹⁴ This parochial attitude is a combination of tradition and skepticism.¹⁵ The frustration and hard

experience of combat breed skepticism of new weapons that are often unproven and not effective, due to the friction of war.

There must be appropriate employment methods and organization to fully exploit new weapons technology. Proper employment tactics are determined through an iterative process that requires practical experience, i.e. combat, to accomplish. War speeds up the assimilation process because it provides rapid, repeated experience in the presence of the friction of war.¹⁴ Methods to employ weapons are a part of doctrine, the final arena for study.

Doctrine

Military doctrine is central to national power. It guides a nation in the effective use of military power to control and protect the nation's resources in the medium. The means to do so rests in superior combat power, which continuously evolves as tactics and technology change. Doctrine must evolve in a complementary fashion. A nation that fails to match its doctrine to the capabilities of its own and other nations' armed forces risks loss of all three components of national power in a medium.

Doctrine Defined

There are numerous definitions of military doctrine, which are usually expressed in terms of principles, policies, or theories. A most useful definition is: a shared set of beliefs on how to conduct military affairs in a medium.¹⁵

The physical attributes of the medium, whether it be the terrain and geography of land, the expanse and opaqueness of the sea, or the speed and aerodynamics of the air, shape the doctrine of beliefs. Doctrine also accounts for the weather environment in each medium. The beliefs derived from this insight may be as fundamental as the nature of war in the medium or as specific as the employment of a weapon.'*

Thus, doctrine is the foundation for a wide range of military affairs. It guides the nation in the strategic and tactical employment of combat forces, mixture of weapons types, roles and missions, and the organization of the nation's armed forces. Doctrine covers the entire spectrum of preparation for and execution of war.

Goal of Doctrine

The ultimate purpose of doctrine is to impose the nation's will on another nation or prevent the reverse. These concepts of offense and defense operate at all levels of combat, whether its global strategy or tactical engagement, in every medium. The goal of offense or defense is achieved by applying superior combat power at a decisive point in time and space in the face of friction.

Superior combat power is a combination of lethal weapons technology, tactics, and organization. A few extremely lethal weapons employed in a rudimentary fashion may overcome many of a less lethal weapon, e. g. several machine guns against several thousand native spearmen.'* The

decisive point in time and space is when and where the enemy does not have superior combat power. In the case of the natives, their spears may be decisive if they attack the machine guns in the dark and from the rear. Friction is the uncertainty of knowledge, the unpredictability of results, and the random occurrences that affect the ability to form superior power at the decisive point. If ignored, friction can negate the theoretical combat power or decisiveness of time and place. If considered in forming the course of action, it can enhance combat power and create the decisive point.²⁰ The nation with a doctrine that correctly integrates combat power, time and space, and friction into its offense or defense will prevail over the nation that fails to do so.

Pitfalls

Doctrine does not remain static. It is synthesized from inquiry and critical analysis of history, current experience, and projected future capabilities.²¹ The beliefs derived from this synthesis may be as unchangeable and indisputable as a law of physics while others may be as uncertain and arguable as an assumption. It is the vision of doctrine that drives technology requirements.²² In times of slow technological change, military advantage in the medium went to the nation that enhanced its combat power with improved tactics and organization. Today doctrine must be continuously adjusted to account for rapid technological change.

Since war is increasingly shaped by technology, weapons technology competition among nations almost seems to have become the ends instead of the means to war. The technological competition revolves around the pendulum effect that alternatively favors the offense, then the defense, then the offense again as each competing nation compensates for the other's weapons with their own improvements in theoretical combat capability.²³ For example, strategic nuclear weapons, around which complete doctrines have been built, have never been used in combat.

As doctrine evolves without the crucible of war, it is difficult to separate the immutable laws from the questionable assumptions in the set of beliefs. War experience fades and there is an increased reliance on perceived history and assumed capabilities as the basis of doctrinal beliefs. It is untested perceptions and assumptions that result in doctrinal errors and dogma.²⁴ Because doctrine is at the heart of a nation's combat power, dogma and erroneous beliefs can have devastating consequences. Without combat, these failings can be discovered only by critical thinking, receptivity to new information, and repeated synthesis. Existing beliefs on how to best project military power in a medium must be continuously scrutinized, tested, and revised.

Integration of Arenas

We will summarize the factors that shape national power in a medium before discussing their influence on

spacepower. National power evolves in five separate but interdependent arenas. The factors in the national, economic, international, technology, and doctrine arenas interact to affect the power evolution process.

The international arena might be considered the stage upon which a nation employs the exploratory, commercial, and military components of power to enhance national security. The actions of other nations on this stage are important inducements or restraints on the evolution of national power in a medium. The dominant nations use their power to favorably influence the exchange of resources and wealth among nations in order to enhance their own security. In the process, less powerful nations acquire wealth and technology from them. These less powerful nations increase their power by efficiently investing wealth in capital and increasing their productivity. They then challenge the hegemonic influence of the more powerful nations in order to meet their own growing security aspirations. The challenge is often enhanced or restrained through cartels, alliances, and treaties that pool or restrict the power of nations.

National attributes influence which mediums a nation chooses to exploit for national security. The geography of a nation may favor power projection in one medium over another. Also, geographic vulnerabilities may force a nation to project power into a particular medium. A large population is necessary to project power into additional mediums. The

populace must generate the wealth for commerce and provide the manpower for armed forces to exploit a new medium while maintaining national power in already developed mediums. The populace will make the sacrifices to do so if they can be focused by a sense of external threat to national security or a sense of national destiny. The national will can be focused fairly rapidly but the limitations imposed by geography and population size require wealth, technology, and time to overcome.

Power projection into a medium is a calculated economic risk with the potential reward of enhanced security. The populace must give up or risk some security provided by national power in other mediums in order to generate the necessary wealth to exploit an additional medium. The relative priority of a nation's consumption, capital investment, and protection imperatives determines whether enough wealth can be diverted to exploit a medium. The nation must carefully assess its power relative to other nations in its vulnerable mediums in order to properly prioritize these economic imperatives. The motivation and reward for diverting wealth to develop a medium must be enhanced national security.

Technology is the mechanism that permits nations to explore, commercialize, and project force in undeveloped mediums hostile to man. It is also the means to efficiently convert resources acquired in the medium into national wealth. Technology is also a liability. It continues to

change rapidly and permits projection of power across multiple mediums. Hence, nations must avoid technological obsolescence so they do not become vulnerable to the power of other nations in several mediums simultaneously. Also, nations often have to overcome conservatism and parochialism to accept and effectively integrate new technology as an element of power. Nations that fail to do so are eclipsed by others more receptive to technology.

The last arena is doctrine, a set of beliefs that guide the nation in the preparation of and effective projection of military power into a medium. The end goal of doctrine is to impose the nation's will on other nations, with superior combat power applied at a decisive point in time and space, in the face of the friction of war. New beliefs on how to accomplish this end goal constantly arise. These beliefs are based on history, experience, theory, and are frequently incorrect. Untested beliefs can result in dogma or erroneous doctrine that is difficult to discover without the test of combat. Since doctrine can only be validated in combat, the best hope for war winning doctrine is continuous inquiry and synthesis.

CHAPTER V

APPLICATION TO SPACE

We have defined the components of national power in a medium, broadly outlined the arenas in which power evolves, and described the key factors in each arena that influence the evolution. It is time to apply these concepts to the space medium. The first step is to define spacepower.

Spacepower Defined

Spacepower has exploration, commercial, and military components just like national power in the other mediums. Past US and Soviet space missions in near earth orbit, probes to other planets in the solar system, and manned landings on the moon certainly constitute exploration. The exploration of space has begun to expand as more nations, individually and in consortiums, enter space.¹ Even if there is no further exploration, an element of commerce will still flourish.

The current commercial component of space is acquisition and transport of an old product that has taken on new meaning as a resource: information. The instantaneous communication of information links the world finance, trade, and political centers together. Also, weather and earth resources satellites survey the earth to acquire and provide information. Communications satellites provide added span of control for power projection in the other three mediums.

The more traditional aspects of commerce, such as acquisition, transport, and conversion of raw materials into products, are possible in space. Raw material may be acquired on other bodies and transported to planetary, on orbit, or earth manufacturing sites. The physics of space, like those of other mediums, may offer unique manufacturing and energy generation opportunities. For example, space may be used to collect and beam concentrated solar energy to earth for power generation while its near zero gravity may produce improved crystals for electronic chips.² Traditional commerce in space will evolve as the cost-benefit trade-offs of scarcity, urgency of need, and unique production techniques favor space over other mediums.

The current military component of power in space, acquiring and transporting data, has a commercial flavor. Military navigation, reconnaissance, and communications satellites form the space lines of communications, the literal counterpart of military supply lines of communication (LOC) in other mediums. Just as resources acquired from other nations flow through land, sea, and air LOCs to sustain the commercial component of a nation's power in those mediums, so does the commercial flow of information in space LOCs. A nation cannot permit its LOCs to be disrupted in any medium, because they are the conduits of resources and wealth.

It seems logical that control of space LOCs will be a space military mission, just as it is in other mediums.

Given the nature of men, the reason for nations, and the increasing value of space data acquisition and transport, it is unlikely that space will remain a sanctuary, free of conflict. The rudimentary antisatellite weapons already developed by the US and Soviet Union mark the debut of the space version of medium control. Also, although there are near earth environmental effects and the physics of spaceflight to consider, it appears possible to project power from within the space medium to the terrestrial mediums. This military mission would be closely akin to naval gunfire and force projection or air force strategic bombing of other mediums.

In the distant future, it is reasonable to assume that portions of the vast expanse of space will come under the physical control or hegemony of terrestrial nations, despite the prohibitions of current space treaties.³ Events and contests within the five arenas of power development will determine the form and maturation rate of the exploration, commercial, and military components of spacepower, as well as the degree of hegemony of nations in space.

National

The three important national characteristics of geography, population, and national apply to the formation of spacepower. As with the other mediums, two of these characteristics can be circumvented with wealth, technology, and time.

Geography

The global, all encompassing nature of space makes every nation vulnerable in this medium. Since every nation is subject to the satellite reconnaissance of other nations, preparations for war or the types and extent of agricultural cultivation are likely to become common knowledge. While the early Soviet Fractional Orbit Bombardment System and similar space weapons of mass destruction are now prohibited by treaty, space treaties are no more sacred than other treaties that have been broken throughout history.⁴ Certainly, force projection of weapons with limited destructiveness is not prohibited. Every nation will eventually have to consider itself vulnerable to force projection from space.

As in other mediums, geography can hinder a nation's ability to project power into space. The location of a nation on the globe affects the safety of its launches, energy required to achieve certain orbits, and ability to control satellites. Peacetime launch safety precludes the launch of satellites in a direction that might result in spent rocket boosters falling on other nations' territory. Hence, the US, Soviet Union, and France have selected launch sites that permit them to launch in the direction of great ocean expanses over sparsely inhabited territory. The French have to launch from a former colony, French Guinea, to meet this self imposed constraint. On the other hand, nations in the Pacific Rim seem to have few launch safety constraints.⁵

It is more difficult to place a satellite in equatorial orbit as the launch site moves further north or south of the equator. More energy must be expended to change the launch plane of a satellite destined for geostationary orbit, in order to align it with the equatorial plane.⁶ More energy means more propellant, more weight, a larger rocket booster, greater launch infrastructure, and more cost. Hence, France, with its launch site close to the equator, can theoretically place geostationary satellites in orbit with less energy and expense than the Soviet Union, with its launch sites further from the equator.

Another constraint of geography is the location of ground stations to control and receive data from satellites. Most satellite orbits result in the satellite being out of view of the controlling nation's landmass for long periods of time during every revolution of the earth. During this time commands and product data may have to be exchanged between the satellite and nation. This situation dictates a global network of terrestrial control stations or on orbit cross links for frequent interaction with satellites. For example, the US relies on airborne and ground control stations in foreign nations while the Soviet Union can use sea based control stations for satellite contacts.⁷

The technological solutions to the constraints of national geography are also vulnerable to the actions of other nations. Foreign nations can refuse to host launch and

control sites while air, sea, and space relays for command and control can be negated by hostile action. Space systems may eventually be fabricated, fueled, and then controlled entirely from space. Until space assets are completely self sufficient in this manner, a nation's power in space will be dependent on its ability to protect the terrestrial resources upon which spacepower depend.

Population

A large population is necessary to become a space power. Most importantly, a significant portion of the population must be well educated to produce and work with the leading edge technology of space. While few people will actually operate in the medium, a large supporting infrastructure is necessary to sustain a space presence. People must be engaged in research and development of the technology needed to overcome the hostile environment of space and gain the leverage to reap its benefits. Another segment of the population must use high technology equipment on a daily basis to perform space operations.

That portion of the national populace devoted to spacepower must be complemented by a large population that maintains the nation's power in the other mediums. The terrestrial mediums are the physical and economic bases for the initial projection of spacepower. The populace must be able to generate enough surplus per capita wealth from the other mediums to finance the nation's spacepower. It is unlikely

that a nation without the productivity of an industrial society can generate enough surplus wealth. Additionally, the population must be large enough for adequate air, sea, and land armed forces to protect the nation's space launch and control sites. Thus, the technical dictates of space and the reinforcing efforts required in the other mediums mandate a large, well educated population. The US, USSR, and European Economic Community meet this twin requirement, as do the key Pacific Rim countries, as well as India, Pakistan, and Brazil.*

National Will

National will has been an important component of the evolution of spacepower to date. The US felt threatened by the Soviet Union's first use of space with the 1957 launch of Sputnik. That event briefly galvanized the US will to explore space. A flurry of significant actions ensued, including the formation of the National Aeronautics and Space Administration as well as the Explorer and Mercury space programs. The Kennedy Administration further mobilized national will and gave the populace a sense of purpose, with the goal of a man on the moon. President Reagan subsequently tried to draw on the threat of nuclear war to gain public consensus for the space oriented Strategic Defense Initiative (SDI). Public support for SDI appears to have dwindled, as has the share of national wealth to develop it.

The people of the Soviet Union have also demonstrated

national will in their space effort. Since Russia has been repeatedly devastated by invasion throughout its history, the populace can rationalize their consumer sacrifices as necessary to extend security of the motherland to space. Also, they probably have an ideological sense of destiny to be the world leader in every medium, including space.

There seems to be no lack of will on the part of other nations in their efforts to exploit space. The French and Chinese have reduced satellite launch prices and have attracted US commercial launch business. Japan and Israel are also rapidly developing indigenous boosters and satellites while India, Japan, and the multinational European Space Agency have begun research on horizontal takeoff spaceplanes similar to that of the US National Aerospace Plane. Technology and capital are the stumbling blocks, not will.

Economic

National wealth must be diverted from other security needs to develop spacepower, as was the case with power development in other mediums. There are, of course, associated risks. However, the payoff from parallel exploitation of space and the ongoing information revolution can be enormous. This revolution appears to be as significant to spacepower as the industrial revolution was to power projection in the other three mediums. Information has become an important source of national wealth and is the current economic

motivation for the exploitation of space.' Spacepower and the information revolution are dependent on each other.

The economic basis of the most powerful, technologically advanced nations is evolving from industrial production to information production. The information revolution centers on the ability to acquire, communicate, sort, synthesize, and make rapid decisions based on massive amounts of data. The result is automation, robotics, and artificial intelligence that can be incorporated in industrial processes to increase the production of wealth with less direct human involvement.¹⁰ Information processing reduces routine decision making and allows humans to concentrate on more difficult decisions that require greater synthesis.

Space and Information

Space is the ideal medium to exploit information technology. From the perspective of space needs, long mission durations in the hostile space environment require semiautonomous satellites with on board logic. Satellites also have broad areas of earth coverage that generate large amounts of data, which must be rapidly sorted and transported with great efficiency. From the perspective of space products, earth resources satellites help developing nations more effectively exploit their resources. Satellite communications also help to unify geographically fragmented nations like the many island nation of Indonesia.

Most importantly, space communications integrates less well developed nations into the every day flow of major power commerce. It is the diffusion of knowledge that awakens the expectations of these nations and allows them to industrialize. In this manner, space contributes to technology transfer from the industrial to the nonindustrial nations.¹¹ Hence, space depends on and produces the new resource of information. When the return on capital investment in information commerce in space increases sufficiently, information technology may be applied to exploit the more traditional aspects of the medium, such as acquisition of raw resources and energy, or its unique manufacturing environment.

Capital Investment

The projection of national power in space is wealth intensive. Technologically advanced nations struggling to meet soaring consumer demands and extensive protection needs will have great difficulty making the long term capital investment necessary to be a spacepower. The four major powers face this problem from different perspectives. The USSR emphasizes protection and devotes some 18 percent of its Gross National Product (GNP) to it. It is also interesting to note that 90 percent of its space assets are used for military purposes.¹² The US emphasizes consumption, which comprises about 78 percent of its GNP, and Japan puts about 30 percent of its GNP in investment. While the Soviets arm, the US consumes, and Japan invests; and the European Economic Community

(EEC) balances all three imperatives.¹³ Two of these powers are attempting to improve the investment sector of their economies. The EEC is pooling money in cartels and seeks a total economic union by 1992 in order to more efficiently transform resources into power. The Soviet Union is withdrawing from overseas commitments and, with perestroika, attempting to boost domestic per capita production in an effort to generate capital.

Other nations have less of a dilemma. Japan spends one percent of its GNP on protection needs compared to six percent for the US. Tokyo is free to invest a larger portion of its GNP in production capital and technology because the US includes Japan under its military umbrella in three mediums. South Korea and China allocate significant portions of their wealth for protection but have lower consumer needs than the west, so they divert relatively more wealth to capital investment. India allocates a low percentage of its GNP to protection and is able to invest more in capital, as well as consumption.¹⁴ Despite consumption and investment patterns similar to the US, as well as defense needs that require 27 percent of its GNP, Israel has been able to acquire enough US foreign aid to offset these imperatives and launch its first satellite in 1988.¹⁵

International

Just as in other mediums, there is already a power hierarchy in space that will change as more nations gain more

absolute power in the fourth medium. The relative order of power in space will also be modified through formal agreements between nations, as it is in the other mediums.

The US and Soviet Union are the preeminent spacepowers at this point in the development of the medium. United States power is somewhat more balanced, with more emphasis on commercial information processing satellites.¹⁶ The two spacepowers also have a high degree of hegemony in the medium. They provide the technical know-how to other nations and have taken the lead in constraining the use of space through formal treaties. Yet, the future relative power of the US and Soviet Union in space is likely to diminish.

History Repeats

The superpowers are trying to maintain the status quo in the power hierarchy in all four mediums. They will be unable to do so because they are militarily and economically overextended and other nations are increasing their absolute power.¹⁷ Like previous empires and hegemonies, superpower technology and expertise is diffusing to less powerful nations who can exploit it more efficiently. The transfer of technology can be slowed, through such agencies as the Coordinating Committee on Technology Exports. It cannot be stopped, however, because the present hegemonies are based on the transfer of technology to less powerful nations. Such transfers enhance the resource production capabilities of

these less advanced nations, which ultimately benefits them as well as their more technologically advanced suppliers.

China, India, and South Korea are less consumer oriented so they are able to more efficiently develop economic and military power, as necessary, through capital investment in superpower technology. Just as some nations of limited power are able to develop nuclear weapons due to the diffusion of technology from more powerful nations, these nations may be able to do the same in space to rapidly become strong competitors in the medium. Japan is a special case of an economic superpower with little military power whose technology is on par with that of the superpowers, due to several decades of strong capital investment. Thus, the space hierarchy of power will be continuously challenged in the future.

Power Modification

Power modification through formal agreements is already evident in space. The European Space Agency is a prime example of nations pooling their resources in joint ventures to increase their relative power in space. There are power limitations imposed on space capable nations by treaties that ostensibly guarantee right of passage, preclude territorial claims, and prevent certain types of military operations in space.¹⁰ These agreements must be considered as temporary. They will be unilaterally terminated when they no longer serve the security purposes of one or more signatories.

This may occur at the most inopportune time, as borne out by twentieth century history.

Technology

Space is the most hostile medium to be developed to date. Technology is clearly the lever man needs to fully develop transport, commerce, production, and combat capabilities in this hostile environment. Solid and liquid chemical energy sources, when coupled to rockets and satellites, permit man and his space vehicles to travel farther in shorter time than ever before. The globe can be circled in less than an hour and images of vast expanses of earth provide insight into large scale terrestrial phenomenon. Yet, man and his engines need to travel orders of magnitude faster if the vast reaches of space are to be explored and exploited. New sources of energy must be developed. The solar wind, ions, antimatter, photons, and perhaps undiscovered sources of energy may fuel the transport and communications equipment needed to extend lines of communication to deep space. It all depends on technology.

In war, the expanse of space may be rapidly bridged, perhaps at the speed of light, by weapons that require precision targeting against a multitude of space or terrestrial targets. Large amounts of force employment data must be acquired, sorted, and rapid decisions executed. Information technology is well suited and essential to these fusion and synthesis tasks. Certain technologies are at the heart of

information processing. Electronics technology is the key to acquiring and communicating large amounts of information. Computers and software combine to sort, synthesize, and even make decisions based on massive information gathering. When applied to combat systems, the ability to rapidly acquire, communicate, sort, synthesize, and make decisions based on massive amounts of data is combat power itself!

Rapid Change and Power Melding

The contribution of technology to change and the melding of power into the fourth medium is evident. A simple example illustrates the pace of technological change in space. The space technological equivalent of flying non stop around the world was, arguably, to land men on the moon. Both milestones required considerable technological innovation subsequent to first powered flight or first orbit in the medium. The former event required 46 years to accomplish while the latter took just 12 years.' The pace of change is also an argument for power melding. Space is evolving from ballistic launches and reentries of space vehicles to horizontal takeoff and landing of spaceplanes, like the US National Aerospace Plane. Spaceplanes will bridge the four mediums in a controlled fashion, reducing geographical constraints to give greater flexibility in national power projection. Also, directed or kinetic energy power projection from space will be able to destroy terrestrial targets. Conversely, power projection from earth, such as

antisatellite systems, can already threaten space vehicles. Space is not an isolated medium. Technology can make it a liability or an asset, depending on which mediums a nation chooses for power projection.

The question of whether technology is accepted and integrated by a society is certainly valid for space war fighting. Power melding of the fourth medium with the existing three accentuates the issue of armed services roles and missions. Armies, navies, and air forces have historically been organized for separate missions in separate mediums. Traditional roles and missions have become blurred since technology has made it possible to execute a mission across several mediums. It appears that no single medium can currently be decisive in war, so combat tends to be combined service operations in multiple mediums. Perhaps functional services, organized along strategic or tactical mission lines, will evolve to be more effective than services organized along medium lines.

Doctrine

For a nation to be a military spacepower, there needs to be a coherent set of beliefs that guide it in space force structure, development, tactics, and organization. Technology all too often seems to be the default driver.

The unique attributes of space as a warfighting medium must be a part of the doctrine of beliefs. Doctrine must account for the physics, i.e. orbital mechanics, near

earth weather, solar influences, and deep space environments of the medium. The physics and environmental attributes of land and sea are intuitive after many centuries of army and navy doctrine development. The attributes of the air medium are still not intuitive due to the relative youth of air power. Likewise, the unique attributes of space must be well understood to perform force structure, roles, and missions trade-offs between the four warfighting mediums.

The current role of space in wartime is enhancement of national combat power in the other mediums. The acquisition and rapid transport of information from space are war fighting capabilities. These capabilities will help land, sea, and air commanders overcome some of the friction of war to apply superior force at a decisive point in time and terrestrial space. Information produced or relayed through space can reduce the uncertainty of friction by providing strategic warning and perhaps tactical intelligence about the enemy's force disposition and intent. The unpredictability of friction may be reduced by precision, all weather location of targets via satellite geopositioning systems. These contributions of space to terrestrial combat presume that space forces are organized and employed in a manner that overcomes the friction that is certain to hinder execution of the space mission itself. When weapons are employed in space, the nations successful in space combat will be those that understand that superior combat power is a combination of not only

weapons technology, but also tactics and organization. Since space is very much a technology oriented medium and nations now tend to compete on technological terms, it will be easy to forget this axiom.

There has been no combat test of the rudimentary space doctrines that exist today. In any future large war, space assets will be attacked because they will be decisive components of combat power in the other three mediums.²⁰ There will, no doubt, be incorrect assumptions, misconceptions, and the ever present friction of combat that have not been accommodated in doctrine for the fourth medium. Lacking combat experience and validation, space doctrine will probably be found wanting in a long duration conflict. Hence, nations that wish to maintain their spacepower during a war must be able to responsively change not only doctrine, but space systems, tactics, and organization for combat.

CHAPTER VI

CHALLENGE REVISITED

There is nothing more difficult to take in hand, more perilous to conduct, or more uncertain of success, than to take the lead in the introduction of a new order of things.

Niccolo Machiavelli

Spacepower is not just a technological or a doctrinal challenge. The use of space for national power and security involves challenges within the national setting, in the economic arena, and on the international stage, as well. We can also see that the challenge of spacepower is really part of a larger challenge that nations face. As one of the most powerful nations in the existing power hierarchy, the US is faced with several national security dilemmas. It seems unlikely that the US can generate the wealth necessary to continue as a dominant power in all four mediums. One dilemma is whether to be a significant power in all four mediums or to dominate one or two. A significant power must enhance its relative power through continuously evolving formal cooperation with other nations. A nation that dominates one or two mediums may be able to stand alone and rely on its absolute power to influence the actions of nations in the other mediums. We must decide in which mediums we will vigorously pursue power and security.

Another dilemma is the mix of US industrial and information commerce for the future. As more nations have

industrialized, heavy industries like ship and automobile manufacturing, as well as light industries like garment and electronics fabrication, have moved offshore. As information production evolves as the basis of US economic power, we must decide how much of our industrial base to retain. If the US relies on other nations to provide an increasing share of our industrial needs, then we must decide which mediums to dominate in order to protect these sources of national security. The policies the US adopts in response to these two major dilemmas will determine whether we become a dominant spacepower.

Near Term Realities

Before the US decides that space is one of the mediums it must continue to dominate, we need to understand the current state of affairs in the medium. There is no assurance that the US will continue to dominate space.

Evolving Space Hierarchy

The US and USSR have been the prime exploiters of space to date. That is changing as more nations gain the correct attributes in the five arenas necessary for the formation of spacepower. The EEC and Japan are currently spacepower contenders, while China, India, and South Korea are rapidly approaching contender status.

In the aggregate, the EEC and these selected Asian nations have the natural attributes of geography, well educated populations, and some sense of national destiny.

They have a degree of economic balance, with an adequate focus on investment, and the societal discipline to restrain the consumption imperative. Most importantly, they benefit from the stabilizing influence of the superpowers, which allows them to divert relatively more wealth from terrestrial defense needs into investment for space.

The space aspirations of the contenders have been boosted by a proliferation of knowledge and diffusion of technology. China, Japan, and the EEC have begun to build and launch their own satellites. The US has invested in research and development of a reusable space shuttle and hypersonic spaceplane. The USSR, India, and Japan are drawing on that hard earned knowledge to develop their own versions, at much less risk and total expense. The French have even begun commercial sales of earth resources satellite imagery. With improved resolution in future satellites, this venture will proliferate imagery that was previously available only to selected government agencies.'

The US and USSR dominance of space is not likely to diminish for some time. Nonetheless, the hierarchy of power in space is broadening. The US needs to remember that the nations that initially explored and exploited the other mediums did not have the resilience and staying power to reap the ultimate benefits of those mediums.

United States Shortfalls

The US has become a dominant spacepower because it possessed the attributes of the five arenas. While these attributes coalesced for great achievements in space, we have not been able to sustain them continuously. The US currently has three shortfalls that we must rectify if we are to have staying power in the medium.

Within the economic arena, the US must revitalize the exploitation and commercial components of its spacepower. Our exploration role has diminished and the projected growth of commerce has not occurred while the US military presence in space continues to grow.² Military satellites enhance the physical security of the US, but they do not increase our wealth, which is the key object of exploiting any medium. It is the search for wealth that will motivate our consumption oriented society to invest in space. Expanded exploration and commerce will generate knowledge and wealth to fuel further investment in the medium in a cycle that will substantially increase US spacepower. In short, the US needs to be strong in all three components of spacepower.

A shortfall in the national arena is US reliance on fixed overseas sites to control and receive data from space assets. Emerging nationalism around the world threatens the long term viability of these sites for space operations. Many sites have no backup and are vulnerable to terrorist attack or wars of national liberation. Space can never be the

dominant medium as long as there are terrestrial nodes vulnerable to the actions of other nations. The US should protect its terrestrial base for space operations by developing on orbit data relay satellites to link US ground stations, afloat or in the continental US, with space assets.³

US military doctrine for space is inadequate because it does not account for the friction of war.⁴ Force enhancement for terrestrial combat can be degraded through jamming, antisatellite operations, or the destruction of overseas and continental US launch and control sites. The entire space operations network could be overloaded and break down with the degradation or elimination of selected nodes.⁵ US space doctrine does not provide for redundant, survivable, alternative means of continuing the force enhancement mission in the face of the uncertainty, unpredictability, and randomness of war.

Some zealots suggest that space is the new high ground, the all encompassing medium from which national power can be projected to dominate the other mediums. This situation may develop in the next century. However, the US cannot hope to dominate other mediums from space without a strong spacepower base on which to build. The near term reality is that the US is not a well rounded spacepower, our terrestrial base for spacepower is vulnerable, and we are not well prepared to deal with the practicality of executing terrestrial force enhancement operations during war.

Space Is the Future

The future of nations and mankind is in the vast, untapped expanse of space and distant planets. Even if the global population stabilizes, man will eventually deplete earth's natural resources and our global environment will inevitably change. Man can artificially condition earth's environment, develop synthetic materials, and develop renewable energy sources to some degree. But, these efforts will require a global discipline which will breakdown, due to human imperfections.

Man must exploit space so he can expand, obtain additional resources, conduct broader commerce, and relieve the pressures of population growth. While the full potential of space is unknown, unexploited mediums have always possessed great riches and provided enhanced security when fully developed. It is clear that man must vigorously explore and commercialize space today, if he is to reap the imagined benefits of the twenty-first century or the undreamed of benefits of later centuries.

It is easy to dream of the future, of what could be, and be discouraged by the hard reality of today, the starting point. Some predict the gradual decline of the US due to "imperial" overreach. The causes of decline can be reversed through a careful assessment of national priorities.* The evolving information economy, of which the US is a leader, offers tremendous opportunities for economic renewal. Space,

with its reliance on and production of information, holds near term promise in the revitalization and evolution of US power. Of course, the US has shortfalls to overcome if it is to lead in space. These shortfalls can also be resolved. Whether they will be depends on one other pervasive attribute of national power in a medium.

The US needs strong leaders if it is to be a spacepower for the future. It is leadership that creates the vision of what could be. It is leadership that galvanizes the populace, instills in them a sense of destiny, and focuses the resources of the nation on the evolutionary building blocks needed to be a spacepower. It may not be clear exactly how the space medium will evolve. But, a vision that draws on the five arenas to develop the three components of spacepower in a balanced fashion will not fail. Our national leaders must promote the vision and our policymakers must make tough decisions in the context of the five arenas. Anything is possible in space - with leadership!

NOTES

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4. Robert Gilpin, War and Change in World Politics (New York, NY: Cambridge University Press, 1981), 23-24.
5. Gilpin, War and Change, 109-113; William H. McNeill, The Pursuit of Power: Technology, Armed Force, and Society since A. D. 1000 (Chicago, IL: University of Chicago Press, 1982), 7-11.
6. Paul M. Kennedy, The Rise and Fall of the Great Powers: Economic Change and Military Conflict from 1500 to 2000 (New York, NY: Random House, 1987), 537.
7. Kennedy, Rise and Fall, 27-29.

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CHAPTER III (Pages 9-20)

1. Martin Blumenson, "Of Landpowers and Seapowers," in The Art and Practice of Military Strategy, edited by George E. Thibault (Washington, DC: National Defense University, 1984), 41.

2. Organski, World Politics, 135.

3. Gilpin, War and Change, 135-136; Theodore Ropp, War in the Modern World, revised ed. (New York, NY: Collier Books, 1971), 64-70. Geography constrains seapower even today. The Soviet Union has expanded its continental empire to obtain year round, ice free ports. Yet, Soviet naval and commercial fleets can be bottled up at strategic chokepoints in the Baltic Sea, Bosphorus Straits, and Sea of Japan.

4. Collins, Grand Strategy, 171-172; Organski, World Politics, 134.

5. Elbert V. Bowden, Economics Evolution (Cincinnati, OH: South Western Publishing Co., 1981), 21-35; Holsti, International Politics, 49-51. The Roman empire was based on an agrarian society of subjugated peoples that produced and converted resources into wealth. This wealth sustained the large army that guarded the empire's trade routes and boundaries. The same need for manpower continued through feudal societies, Renaissance mercantile city states, and on up to the industrial nations of today.

6. Organski, World Politics, 147-149.

7. Richard A. Preston and Sydney F. Wise, Men in Arms: A History of Warfare and Its Interrelationships with Western Society, 4th ed. (New York, NY: Holt, Rinehart and Winston, 1979), 192-193; John W. Spanier, Games Nations Play, 6th ed. (Washington, DC: Congressional Quarterly Press, 1987), 171-173. The national levee en mass and primitive mass production economy of France in the 1790s, as well as the rearmament of Germany between the two World Wars, illustrates how a large population can be mobilized to produce tremendous national power. On the other hand, when a large population cannot be focused, as was the case in Russia and Austro-Hungary in World War I, a nation cannot effectively project power into a medium.

8. Spanier, Games, 188.

9. Gilpin, War and Change, 136.
10. McNeill, Pursuit of Power, 380.
11. Spanier, Games, 186.
12. Kennedy, Rise and Fall, 539-540.
13. Organski, World Politics, 156.
14. Gilpin, War and Change, 158-167; Organski, World Politics, 163.
15. Gilpin, War and Change, 163-165; Organski, World Politics, 163, 198.
16. Gilpin, War and Change, 195-197.
17. Organski, World Politics, 195-199, 342.
18. Blumenson, "Of Landpowers," 37.
19. Ropp, War in the Modern World, 62.
20. Gilpin, War and Change, 167-168; Kennedy, Rise and Fall, 86-90.
21. Preston and Wise, Men in Arms, 316.
22. Organski, World Politics, 122-123.
23. Gilpin, War and Change, 94-95, 138-139; Hans J. Morgenthau, Politics Among Nations: The Struggle for Power and Peace, 5th ed. (New York, NY: Alfred A. Knopf, Inc., 1973), 51-61. Throughout history, imperialism and hegemony have been manifestations of the relative power among nations. This was as true in the era of the Egyptian, Assyrian, and Persian empires as in the great market empires of Great Britain and the United States.
24. Gilpin, War and Change, 94; Morgenthau, Politics Among Nations, 44; Organski, World Politics, 364-365.
25. Organski, World Politics, 344.
26. Gilpin, War and Change, 157-164.
27. Gilpin, War and Change, 176; Kennedy, Rise and Fall, 439; McNeill, Pursuit of Power, 262. Wealth and technology have always diffused from the more powerful to less powerful nations. This phenomenon was evident in Greece's

ascendancy over Egypt, the Germanic tribes' conquest of Rome, French displacement of the Italian city states, Great Britain's eclipse of Spain and Holland, and United States ascendancy over Great Britain.

28. Gilpin, War and Change, 176-178; Organski, World Politics, 341-344.

29. Gilpin, War and Change, 193-195.

30. Spanier, Games, 346-347.

31. Morgenthau, Politics Among Nations, 185-186; Organski, World Politics, 409.

32. Morgenthau, Politics Among Nations, 179. There are numerous examples of treaty constraints on national power in a medium. For instance, the 1713 Treaty of Utrecht and the 1815 Treaty of Vienna established the territorial limits of power for European nations after several wars. Similarly, the 1959 Antarctica Treaty limits territorial claims in that region of the world. The Washington Naval Treaty of 1925 and the Strategic Arms Limitations Treaty of 1972 limited arms buildups among the most powerful nations in the power hierarchy.

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CHAPTER IV (Pages 21-32)

1. Melvin Kranzberg and Carroll W. Pursell, Jr., Technology in Western Civilization, Vol. I (New York, NY: Oxford University Press, 1967), 740-741.
2. Victor Basiuk, Technology and World Power, (New York, NY: Foreign Policy Association, Inc., 1970), 10; Gilpin, War and Change, 57-58.
3. Basiuk, Technology and World Power, 51; Kranzberg and Pursell, Technology in Civilization, Vol. II, 702. The raw labor of slaves in ancient agricultural societies gave way to the serfs, windmills, and watermills of the Middle Ages. Manpower requirements decreased even more with the Industrial Revolution. Basiuk notes that in the United States, from 1860 to 1960, the animal and human labor contribution to the production of national wealth decreased from 70 percent to four percent, as the use of electromechanical energy increased.
4. Kennedy, Rise and Fall, 148-149.
5. Trevor N. Dupuy, The Evolution of Weapons and Warfare, (New York, NY: The Bobbs Merrill Co., 1980), 290-294.
6. Barry Buzan, An Introduction to Strategic Studies: Military Technology and International Relations, (New York, NY: St. Martin's Press, 1987), 18; Dupuy, Evolution of Weapons, 117, 315-317. Examples include weapons of the Roman legions, which changed imperceptibly over six centuries, and naval weapons that changed little from the fifth through the sixteenth century. Dupuy points out that Gustavus Adolphus, Marlborough, and Fredrick the Great achieved their combat successes by improving the tactics and organizational employment of weapons essentially unchanged over two centuries.
7. Kranzberg and Pursell, Technology and Civilization, Vol. II, 3.
8. Basiuk, Technology and Power, 17, 23; Dupuy, Evolution of Weapons, 286-294. Dupuy highlights 18 revolutionary changes in weapons technology in the past 4,000 years, 11 of which have occurred in the relatively short period since the beginning of the Industrial Revolution. Basiuk notes that the time between discovery of the

scientific principles of the electric motor, telephone, radio, vacuum tube, television, and transistor and their application to a product was 65, 56, 35, 33, 12, and 3 years, respectively. Indeed, the pace of technological change has accelerated throughout history to its present rapid pace.

9. Blumenson, "Of Landpowers," 37-38. Power projection across the mediums during ancient times, e.g. the Peloponnesian and Punic Wars, was limited to troop landings.

10. Preston and Wise, Men in Arms, 156-161.

11. McNeill, Pursuit of Power, 98-100. For instance, the Ming Dynasty and Ottoman Empire, during the thirteenth to seventeenth centuries, were too conservative to accept the evolving technology of transport and weapons initiated in the primitive culture of Europe. They turned inward and were eventually eclipsed when the Europeans gained more absolute power.

12. Kennedy, Rise and Fall, 6-13.

13. Gilpin, War and Change, 166; S. Lilley, Men, Machines and History, (New York, NY: International Publishers, 1966), 323-325.

14. McNeill, Pursuit of Power, 173; Ralph Sanders, Technology, Strategy and National Security, (Washington, DC: National Defense University Press, 1985), 170. As an example, artillery became accepted as a coequal partner of infantry and cavalry during the Napoleonic Wars only after battlefield experience overcame the biases of infantry and cavalry leaders. This phenomenon is also evident in Sander's description of the resistance to and lack of enthusiasm in testing and exploiting technologically advanced armored steamships and bombardment aircraft within the United States in the past century.

15. Alfred Skolnick, "The Navy's Final Frontier," Proceedings, Vol. 115, No. 1031, January 1989, 29.

16. Dupuy, Evolution of Weapons, 303; Sanders, Technology and Security, 170. The iteration to develop and refine tactics was apparent in the evolution of muskets from the sporadic actions of individuals to massed volleys in continuously revolving ranks during the fifteenth and sixteenth centuries. The evolution of tank tactics between the World Wars is another example of the combat power that can be gained from refinements in the employment of a weapon.

17. Dennis M. Drew, "Of Trees and Leaves: A New View of Doctrine," Air University Review, Vol. XXXIII, No. 2, January-February 1982, 41.

18. Drew, "Of Trees and Leaves," 43-46.

19. McNeill, Pursuit of Power, 258.

20. Thomas A. Fabyanic, "War, Doctrine, and the Air War College: Some Relationships and the Implications for the U. S. Air Force," Air University Review, Vol. XXXVII, No. 2, January-February 1986, 6-7.

21. Drew, "Of Trees and Leaves," 42; I.B. Holley, Jr., "The Doctrinal Process: Some Suggested Steps," Military Review, Vol. LIX, No. 4, April 1979, 5-6.

22. Dupuy, Evolution of Weapons, 203-205; McNeill, Pursuit of Power, 170-173. The French had the vision to systematically improve the accuracy and mobility of eighteenth century artillery with technological requirements based on battlefield experience. As a result, artillery assumed a major role on the battlefields of the Napoleonic era. Similarly, the vision of A.T. Mahan and Sir John Fisher in the late nineteenth century sparked the development of armored fleets of battleships with much improved gun systems. Certainly, the technological requirements of strategic bombardment were driven by the disciples of airpower visionaries Giulio Douhet and Billy Mitchell!

23. J.F.C. Fuller, Armament and History, (New York, NY: Charles Scribner's Sons, 1945), 20-21. The Intercontinental Ballistic Missile (ICBM), AntiBallistic Missile, Multiple Independently Targeted Reentry Vehicle, mobile ICBM, and Strategic Defense Initiative cycle of technology is an example of the pendulum swing between offense and defense.

24. Dupuy, Evolution of Weapons, 325-326. Two lessons illustrate the point. The United States Army Air Corps advocated unescorted, precision, daylight bombing prior to World War II. This doctrine became dogma, despite improvements in interceptor aircraft, the appearance of search radar, and British and German failures with the doctrine that indicated this belief needed to be revised. Also, France and Germany chose different interpretations of World War I experience with the new technologies of aircraft and tanks. The French employed the new weapons in a distributed fashion while the Germans integrated the weapons into a strategy of maneuver war. The dogma and erroneous beliefs in these two examples were resolved at great cost in combat.

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CHAPTER V (Pages 33-50)

1. Boyce Rensberger, "Europeans Endorse Joint Space Mission," Washington Post, 26 November 1988, 8; Jeffrey M. Lenorovitz, "Soviets to Study Phobos Surface From Fixed-Site, Mobile Landers," Aviation Week & Space Technology, 29 August 1988, 48-49. Saturn and Mars will be explored with sophisticated, unmanned probes in the mid 1990s. Both are multinational efforts with the US and USSR leading the respective efforts. The Soviets intend to eventually land men on Mars and have solicited US assistance to make it a joint venture.

2. G.K.C. Pardoe, "The Importance of Downstream Aspects: What Can Space Offer the User?," Space Policy, Vol. 2, No. 1, February 1986, 63-69. Pardoe gives a broad overview of the traditional and nontraditional commercial opportunities in space. He also outlines the sequential process necessary to form viable commercial enterprises in space.

3. The influence of space treaties is discussed in the follow on section in this chapter entitled International.

4. Nicholas L. Johnson, Soviet Military Strategy in Space (New York, NY: Jane's Publishing Co., 1987), 128-136. There was controversy as to whether the Soviet FOBS was actually prohibited under the treaty. The Soviets appear to have abandoned FOBS in favor of sea launched ballistic missiles.

5. China, Japan, and South Korea are the Pacific Rim countries that are important to this study.

6. Orbital Mechanics (Sunnyvale, CA: Ford Aerospace Corp., Contract No. F04690-81-C-0004, May 1982), 1-28 to 1-30.

7. Norman Polmar, "Space Ships," Proceedings, Vol. 114, No. 1022, April 1988, 129-130.

8. World Development Report (New York, NY: Oxford University Press, 1987), 254-255, 262-263. On average, 90 percent of the US, USSR, and EEC populations are secondary school graduates and about 38 percent have higher education. The Japanese and Korean populations have comparable education levels, while those of China, India, Pakistan, and Brazil average about 30 percent secondary school graduates and 6 percent with higher education. However, these smaller

percentages, when applied to the enormous populations of India and China, result in large absolute numbers of well educated people.

9. W. Michael Blumenthal, "The World Economy and Technological Change," Foreign Affairs, Vol. 66, No. 3, 1988, 534. Blumenthal indicates that information is now just as important a resource as capital, a large labor pool, and land were in the past.

10. Richard H. Solomon, "An Agenda for U.S. - Soviet Cooperation," Current Policy, No. 1129, November 1988, 1-2; Paul Kennedy, "The (Relative) Decline of America," The Atlantic Monthly, Vol. 260, No. 2, August 1987, 30. Kennedy notes that US manufacturing output is increasing as the number of people actually employed in manufacturing decreases, a natural result of the world moving from material to knowledge based production.

11. Solomon, "An Agenda," 2.

12. Commission on Integrated Long-Term Strategy, Discriminate Deterrence (Washington, DC: Department of Defense, January 1988), 52.

13. Samuel P. Huntington, "The U.S. - Decline or Renewal?," Foreign Affairs, Vol. 67, No. 2, Winter 1988/89, 85-87, 93.

14. Ruth L. Sivard, World Military and Social Expenditures, 1987-88, 12th ed. (Washington, DC: World Priorities, 1987), 43-44; World Development Report, 211.

15. World Development Report, 245. US aid to Israel comprised 10 percent of its GNP in 1985!

16. Commission of Integrated Long-Term Strategy, Discriminate Deterrence, 52.

17. Kennedy, "The (Relative) Decline of America," 34-36.

18. Johnson, Soviet Military Strategy, 236-263. This portion of Johnson's book contains the text of the salient space treaties.

19. Air Force Magazine, Vol. 72, No. 3, March 1989, 33.

20. James W. Canan, "Space Comes Into Its Own," Air Force Magazine, Vol. 72, No. 3, March 1989, 20. The Secretary and Chief of Staff of the Air Force, in a recent formal policy statement, stated that space is now a mission, not just a "place." They also indicated that "spacepower will be as decisive to future combat as airpower is today."

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CHAPTER VI (Pages 51-57)

1. Steven L. Ellis and Myron C. Lynch, "A Comprehensive Strategy For Space," Space Issues Symposium / Workshop Proceedings (Maxwell AFB, AL: Air War College, 1988), 238-240; Walter B. Wriston, "Technology and Sovereignty," Foreign Affairs, Vol. 67, No. 2, Winter 1988/89, 69-70. Ellis and Lynch highlight the activities and capital investment of the aspiring space nations. Wriston makes some interesting observations on the loss of national sovereignty due to commercial imaging satellites.

2. John M. Logsdon, "Status of Space Commercialization in the USA," Space Policy, Vol. 2, No. 1, February 1986, 9-12; R. Cargill Hall, "Thirty Years Into the Mission: NASA at the Crossroads," Space Issues Symposium / Workshop Proceedings (Maxwell AFB, AL: Air War College, 1988), 134-138. Logsdon points out the disappointing progress in US space commercialization while Cargill indicates that NASA's fascination with manned spaceflight has been at the expense of space exploration.

3. The author draws on his own experience in satellite operations to make these observations. The new Military and Strategic Tactical Relay (MILSTAR) satellite is a step in the right direction.

4. United States Air Force, Aerospace Basic Doctrine: Military Space Doctrine, AFM 1-6 (Washington, DC: U.S. Government Printing Office, 15 October 1982); United States Army, Operations, Field Manual No. 100-5 (Washington, DC: U.S. Government Printing Office, 5 May 1986). The Air Force appears to be the only US military service with a stand alone space doctrine. This doctrine does not mention the friction of war. In contrast, the Army highlights it in their general doctrine as a part of the "agility" of forces.

5. John L. Piotrowski, "A Soviet Space Strategy," Strategic Review, Vol. XV, No. 4, Fall 1987, 61. General Piotrowski paints a believable picture of how the terrestrial force enhancement mission of US space forces could be degraded in combat. The author's experience in satellite operations confirms the suggestion that friction will significantly degrade the combat performance of space systems, even if on orbit assets are not attacked directly.

6. Huntington, "The U.S. - Decline or Renewal?" and Kennedy, "The (Relative) Decline of America" are thought provoking articles that take opposing viewpoints to address the question of the future of US relative economic and military power.

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