# Spacepower and Space Warfare

## The Continuation of Terran Politics by Other Means

Submitted in fulfilment for the requirement of the degree of Ph.D.

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## Summary

Space technologies and the tools of space warfare are proliferating across Earth. The use of spacepower in conflict necessitates strategic thinking. Strategic theory can guide and improve strategic thought about outer space. Drawing on strategic theory, this thesis develops a spacepower theory in the next step of a collective theory-making effort about warfare in the Space Age. This spacepower theory is based on seven distinct, complementary, and interacting propositions that aim to shift the debate of spacepower away from space weaponisation and the Revolution in Military Affairs (RMA), and towards a more holistic view of the vast possibilities granted by spacepower. This spacepower theory proposes that space warfare only has meaning in so far it works towards the command of space; that the command of space is about manipulating celestial lines of communication; that spacepower in Earth orbit is a place to conduct strategic manoeuvres to influence the wider war and grand strategic goals; and that the command of space can have direct meaning for battlefield success through its dispersing effects. The theory is based on three major strategic analogies from terrestrial strategic theory and experience. First, space warfare is a continuation of terrestrial politics. Second, space is like the sea in its most basic concepts. Third, Earth orbit is like a coastal region. The contributions of this work are a theory that assists the individual's education on warfare in the Space Age that takes emphasis away from space-based weaponry and the RMA, and a treatise that demonstrates and encourages a pedagogical method of analysis in strategic studies. This has tentative implications for wider discussions of astropolitics in International Relations (IR) as well. IR will continue in its usefulness in the cosmos, while Terran IR today must account for the realities of the Space Age.

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## Recurring Abbreviations

AFRL – U.S. Air Force Research Lab
AFSPC – U.S. Air Force Space Command
ASAT – Antisatellite
ASBM – Anti-ship ballistic missile
BMD – Ballistic Missile Defence
C4ISR – Command, Control, Communications, Computers, Intelligence, Surveillance, Reconnaissance
CBRN – Chemical, Biological, Radiological, Nuclear
CCS – Counter Communications System
CFR – U.S. Council on Foreign Relations
CIA – U.S. Central Intelligence Agency
CIS – Commonwealth of Independent States
CLOC – Celestial lines of communication
CSCS – Counter Satellite Communications System
EHF – Extremely High Frequency
EGNOS – European Geostationary Navigation Overlay Service
ELINT – Electronic Intelligence
ESA – European Space Agency
EW – Electronic Warfare
DoD – U.S. Department of Defense
DMSP – Defense Meteorological Satellite Program
DSCS – Defense Satellite Communications System
DSP – Defense Support Program
FOBS – Fractional Orbital Bombardment System
GEO – Geosynchronous/Geostationary orbit
GEOINT – Geospatial Intelligence
GIG – Global Information Grid
GLONASS – *Globalnaya navigatsionnaya sputnikovaya sistema* (Russian GNSS)
GMES – Global Monitoring for Environment and Security (now called Copernicus)
GNSS – Global Navigation Satellite System
GPS – Global Positioning System (U.S. GNSS)
GRAB – Galactic Radiation and Background
HEO – High Earth orbit
HUMINT – Human intelligence
ICBM – Intercontinental Ballistic Missile
IMINT – Imagery Intelligence
IR – International Relations
IS – *Istrebitel Sputnikov* (satellite destroyer)
ISR – Intelligence, Reconnaissance, Surveillance
JFCC SPACE – Joint Functional Component Command for Space
JSpOC – Joint Space Operations Center
JV – Joint Vision
LEO – Low Earth Orbit
MASINT – Measurement and signals intelligence
MEO – Medium Earth Orbit
MoD – U.K. Ministry of Defence
NASA – U.S. National Aeronautics and Space Administration
NATO – North Atlantic Treaty Organisation
OODA – Observation, Orientation, Decision, Action
OSINT – Open Source Intelligence
OST – Outer Space Treaty (1967)
PGM – Precision Guided Munition

PLA – People's Liberation Army
PNT – Position, Navigation, and Timing
PPWT - Draft Treaty on the Prevention of the Placement of Weapons in Outer Space
RMA – Revolution in Military Affairs
RORSAT – Radar Ocean Reconnaissance Satellite
SATCOM – Satellite Communications
SATINT – Satellite Intelligence
SDI – Strategic Defense Initiative
SIGINT – Signals Intelligence
SPOT - Satellite Pour l'Observation de la Terre (French imagery satellite)
SSA – Space Situational Awareness
SSN – Space Surveillance Network
UN – United Nations
UNIDIR – United Nations Institute for Disarmament Research
USAF – United States Air Force
USMC – United States Marine Corps
USSTRATCOM – United States Strategic Command
WMD – Weapons of Mass Destruction

# SPACEPOWER AND SPACE WARFARE

## The Continuation of Terran Politics by Other Means

# Introduction: Space: A Familiar Frontier?

"To confine our attention to terrestrial matters would be to limit the human spirit." – Stephen Hawking[1]

In 1996, Colin Gray asked "where is the theory of space power? Where is the Mahan for the final frontier?"[2] This is still a pertinent question despite it being almost 30 years since spacepower had its 'coming out party' in the first so-called 'Space War'.[3] In Operation DESERT SHIELD in 1991, space power was introduced to half a million rank-and-file coalition troops to expel the Iraqi Army from Kuwait. In this war, the then-head of the U.S. National Reconnaissance Office attributed the coalition's stunning success, in terms of speed and low casualties, to spacepower's support to the battlefield.[4] Space has become an essential part of the American military machine, global finance, and critical infrastructure. Any modern command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) architecture depends on space infrastructure. As these systems become central to military capabilities, strategic thinking must accompany them so that they are protected, exploited, and those of the enemy's undermined and assaulted. Spacepower theory helps encourage a way of strategic thinking about spacepower and warfare in the Space Age through the creation and application of propositions. A spacepower theory is not a space strategy – i.e. an actual plan for space warfare – but a conceptual and reflective construction with pedagogical intent. The critical application of spacepower theory's propositions should assist the individual's self-education about space, warfare, and strategy to help devise better space strategies or war plans.

Gray's question remains unsatisfactorily addressed, despite some notable efforts at spacepower theory-making; which are featured prominently in the last three chapters of this thesis. A spacepower theory is developed in this thesis as the next step in a collective effort of spacepower theory-making. This thesis contends that spacepower theory should help train judgment and set constructive terms for debate over space warfare and space-centric considerations in grand strategic

[1] Stephen Hawking, 'Foreword', in: Lawrence M. Krauss, *The Physics of Star Trek* (London: Flamingo, 1995) p. xiii
[2] Colin S. Gray, 'The Influence of Space Power Upon History', *Comparative Strategy* (15:4, 1996) p. 307
[3] Peter Anson and Dennis Cummings, 'The First Space War: The Contribution of Satellites to the Gulf War', *RUSI Journal* (136:4, 1991) pp. 43
[4] Quote taken from: Bob Preston, *Plowshares and Power: The Military Use of Civil Space* (Washington, D.C.: National Defense University Press, 1994) p. 3

thinking. Strategic theory helps in this task, and can draw on many precedents from terrestrial experience and concepts. There is some merit in the argument that because there is little experience of spacepower in warfare, it is premature to develop spacepower theory.[5] However, as the spacepower theory proposed in this thesis shows, spacepower is not devoid of experience altogether. Indeed, there is a potential wealth of experience to draw on because space systems have been used in warfare and strategic considerations for many decades. Further, through the careful use of strategic analogies, strategic theories derived from experience on Earth can shed light on the nature of war in the cosmos, too. The need for strategic thinking about space is not a distant concern for the future. Strategic behaviour is already occurring in Earth orbit, and has done so since the dawn of the Space Age. The influence of spacepower upon history and the present is through the use of space infrastructure that provides everyday services and intelligence capabilities. Spacepower theory is needed *now* to improve the quality of strategic thinking and debate among analysts, observers, researchers, and practitioners in a way and that is not centred upon the cyclical debates over the deployment of space-based weapons. Practitioners do not have the luxury of waiting until after a conflagration in orbit – which may not include space-based weapons – occurs to have a set of ideas to guide their decisions. Steven Lambakis seems to have been correct to argue, in 1995, that "when an enemy can use the orbital highways overhead at will, or interfere with U.S. space missions critical to the course and outcome of a war, space [warfare] will no doubt receive the attention it deserves."[6] As seen in Chapter 1, the profile of space warfare is increasing with more militaries developing dependencies on spacepower and the means to mitigate its benefits to adversaries; and theory should not have to wait for Lambakis' future to come about.

Spacepower theory aims to help the reader imagine what space warfare is, what it has been, and what it can ever be. Spacepower theory also stresses the defining feature of spacepower to the reader: its less spectacular supporting role on an adjacent and celestial flank to terrestrial wars. Spacepower theory aims to explain and illustrate, as tersely yet holistically as possible, the universal

[5] James Clay Moltz, 'Space and strategy', in: Eligar Sadeh, ed. *Space Strategy in the 21st Century* (Abdingdon, Routledge, 2013) p. 17. Moltz summarises this article: Peter L. Hays, Charles D. Lutes, 'Towards a theory of spacepower', *Space Policy* (23, 2007) pp. 206-209

[6] Steven Lambakis, 'Space Control in Desert Storm and Beyond', *Orbis* (Summer 1995) p. 418, see also p. 427

(unchanging) nature of spacepower and space warfare, and connect them to their particular (changing) forms as they manifest in reality in any given case. This is done by providing a conceptual toolkit that is intended to be universally relevant across time and place. Thus spacepower theory provides a ready-to-use library of ideas to apply critically to any given case in order to (a) strategise (to develop an actual space strategy), (b) to examine military space history, or (c) to give a grand strategic context to a debate regarding spacepower or any aspect of it. Spacepower theory also stresses the 'so what' question in everything it does. Activity in space has to have meaning for the political, social, and economic existence of polities for it to have any strategic meaning and relevance.

Whilst lamenting the lack of spacepower theory, Colin Gray does not seem to have considered the possibility that Alfred Thayer Mahan himself is a 'Mahan for the final frontier.' To date, no spacepower theory explicitly discusses the educational intent of such theories, like Carl von Clausewitz's, Alfred Thayer Mahan's, Julian S. Corbett's, and Raoul Castex's own treatises do.[7] In this sense there is still no spacepower theory that emulates the educational intention and concepts from this collection of strategic theorists. This thesis answers Gray's question by creating a spacepower theory that is transparent and explicit in its pedagogical intent and in its use of strategic analogies as a means to an end of theory-making and education. This theory not only launches strategic concepts from Earth to space, it also boosts a method of analysis and a way of thinking into space. This method of analysis is rooted in a perpetual struggle to connect meaningful abstract universal concepts with ever-changing particular realities so that wider conclusions may be drawn that have relevance across time and space. Such an approach is rooted in historical research and theoretical flexibility that is turned to the end of providing information or arguments to enhance personal learning and strategic judgment.[8]

This thesis proposes a spacepower theory – composed of seven propositions – that aims to elucidate the universal elements of spacepower that allow others to critically apply it to scenarios of

[7] This is the subject of a large part of Chapter 3.
[8] On this aspect of Mahan's approach to strategic education, see: Jon T. Sumida, *Inventing Grand Strategy and Teaching Command: The Classic Works of Alfred Thayer Mahan Reconsidered* (Washington, D.C.: Woodrow Wilson Center Press, 1997) esp. pp. 99-117

their choice to better analyse strategic possibilities and considerations in competitive and antagonistic relationships between political entities that use space. This spacepower theory imitates Mahan's work (minus policy prescription) in the sense that it elucidates more universal and timeless elements of spacepower that can help educate readers in strategic thinking about spacepower and space warfare. Such theory can help in the self-education of strategic thinkers and may assist them in their own strategy-making to find their own solutions to their own problems. Much of the spacepower theory analogises concepts from Mahan's own work, therefore it seems that the 'Mahan for space' is in large part Mahan himself. Spacepower theory is meant to challenge the minds of those who attempt to apply the propositions in their strategising about space warfare, and if necessary, critique, amend, refine, or discard the propositions in the search for better alternatives. This is done with a methodology that is best explained through Kiesling's apt summary of Castex's approach, when commenting that "behind the strategy chosen to meet the needs of the moment must be a transparent and resilient conceptual foundation – transparent so that its validity can be challenged and reaffirmed, resilient so as to endure as conditions change."[9] The seven propositions of spacepower theory are meant to be this transparent and resilient conceptual foundation *behind* any given strategy about outer space that may be developed for particular belligerents and times. Indeed, such transparency can be seen in the works of the classical strategic theorists used throughout the coming chapters. The spacepower theory not only challenges the individual to contemplate everything space warfare could be, but it also reminds the reader of the need to remember the practicalities of warfare. After all, "Clausewitz was a practical soldier and he intended his work to serve as a very practical approach to real-world complexities—*without avoiding the complexity*."[10]

Events in recent years have only increased the salience of a spacepower theory. On the 11th of January, 2007, a Chinese mobile ground missile launcher conducted an anti-satellite (ASAT) test by despatching a kinetic kill vehicle towards a Chinese weather satellite, the *Fengyun* 1-C, at an altitude

[9] Eugenia C. Kiesling. 'Introduction', in: Raoul Castex, *Strategic Theories*, Eugenia C. Kiesling, trans., ed. (Annapolis, M.D.: Naval Institute Press, 1994) p. xviii

[10] Christopher Bassford, 'Tip-toe through the Trinity or: The strange persistence of trinitarian warfare', working paper, Clausewitz.com, Version 2 October 2012, http://www.clausewitz.com/readings/Bassford/Trinity/Trinity8.htm 2006-2012 (accessed 17/11/2012). Emphasis Bassford's.

of approximately 864 kilometres (km).[11] The kinetic kill vehicle slammed into the satellite, and caused the single-most debris-generating event in human space history.[12] At speeds measured in kilometres per second, even debris objects between 1cm and 10cm in diameter can be highly damaging or fatal to operating satellites, triggering even more debris-generating events. In the following year, an American satellite interception (Operation BURNT FROST), which was claimed by the U.S. government to be an environmental protection measure to prevent the satellite from reaching the Earth intact) appeared to confirm an equivalent sea-based American capability.[13] These events, alongside the 2013 Chinese Earth-based weapons test and the 2014 Russian satellite close-in manoeuvres,[14] are important because they demonstrate a desire among the three most capable space powers to maintain residual, if not overt, capabilities to destroy the satellite components of space infrastructure. It is not the means themselves that are the most important – it is their potential targets and the consequences of successful satellite destruction. This reality is what drives the need for strategic thinking to connect the means and objectives of space warfare to political ambitions, and for terrestrial designs to incorporate the possibilities of a hostile celestial coastline. The remainder of this introduction briefly overviews each chapter and also introduces the seven propositions for the first time.

This thesis begins by exploring the basic activities of outer space relevant to spacepower theory's considerations (Chapters 1 and 2) before venturing into strategic theory (Chapter 3) and spacepower theory (Chapters 4, 5, 6, and 7). Chapters 1 and 2 describe what space systems are used for, what the major space powers are doing to hold potential enemy spacepower at risk, critiques the

[11] Shirley Kan, 'China's Anti-Satellite Weapon Test', Congressional Research Service Report for Congress, 23/04/2007, Washington, D.C. http://www.fas.org/sgp/crs/row/RS22652.pdf (accessed 19/06/2013) p. 1; and Cesar Jaramillo, ed., Space Security Index. *Space Security Index 2008* (Kitchener, Ontario: Pandora, 2008) p. 29
[12] US Department of Defense (DoD), *National Security Space Strategy: Unclassified Summary* (Washington, D.C., January 2011) p. 2
[13] U.S. Missile Defense Agency, 'AEGIS Ballistic Missile Defense: One-Time Mission: Operation Burnt Frost', http://www.mda.mil/system/aegis_one_time_mission.html (accessed 05/10/2015)
[14] Brian Weeden, 'Dancing in the dark: The orbital rendezvous of SJ-12 and SJ-06F', *The Space Review*, 30/06/2010, http://thespacereview.com/article/1689/1 (accessed 06/10/2015); idem., 'Through a Glass, Darkly: Chinese, American, And Russian Anti-satellite Testing in Space', (Washington, D.C.: Secure World Foundation, 2014); idem., 'Dancing in the dark redux: Recent Russian rendezvous and proximity operations in space', *The Space Review*, 05/10/2015, http://thespacereview.com/article/2839/1 (accessed 06/10/2015)

space weaponisation debate, and clarifies the meaning of spacepower. All this acts as a justification for the creation of spacepower theory based on real-world developments.

Chapter 3 explains the epistemology and methodology of strategic theory (spacepower theory is a kind of strategic theory, like seapower and airpower theories). It has two parts: the first is an explanation of the Clausewitzian theoretical foundations of the thesis; the second part is a study of strategic analogies as a method and a means to the end of theory-making. Spacepower theory (which is a type of strategic theory) does not provide policy prescriptions, produce war-winning strategies, nor create unassailable maxims. This chapter also introduces the first (of three) major strategic analogy of the thesis: that space warfare is the continuation of Terran (Earth) politics with the addition of other means.[15] From this base strategic analogy, outer space is made a conducive realm for thinking with strategic theory and intuition gained from terrestrial experience in warfare. This chapter outlines six base Clausewitzian assumptions about war that are universal to all strategic theory:

1. War is emotional
2. War is political
3. War is chaotic
4. Theory is for education
5. The defensive is the stronger form of war
6. War has a paradoxical logic

Chapter 4 begins spacepower theory with the first four propositions, which theorises the command of space, the uniqueness of space, the limits of dominating space, and the forms of celestial lines of communication. This also establishes the second major strategic analogy: that outer space is like the sea in that it is a place and a medium constituted by lines of communication, along which materials (e.g. satellites and rockets) and information travel. Propositions I-IV moderate existing spacepower theory and synthesise it with an examination of bluewater seapower theory. The first four propositions are:

*I. Space warfare is about the command of space*

[15] Carl von Clausewitz, *On War*, Michael Howard and Peter Paret trans., ed. (Princeton, N.J.: Princeton University Press, 1984) p. 87

II. *Space is a distinct operational medium but it is not isolated from Earth*
III. *A command of space does not equate to a command of Earth*
IV. *The command of space is about manipulating celestial lines of communication*

Proposition V in Chapter 5 is also the third major strategic analogy of the thesis: Earth orbit is a coastline. Spacepower is suited to conducting supporting manoeuvres in Earth orbit, to support terrestrial warfare. Just as land powers sought to command the seas in their struggles against other land powers and island powers, contemporary space powers are all Earth powers attempting to use spacepower against other Earth powers. Continental seapower analogies incorporate the relatively mundane but defining roles and values of spacepower in ways that might be overlooked when using bluewater seapower theory to consider space-based weapons at the expense of everything else that happens in orbit. The fifth proposition, then, is:

V. *Earth is a cosmic coastline suited for strategic manoeuvre*

Proposition VI in Chapter 6 provides conceptual insights into the strategic cultures and internal affairs of Earth-bound space powers. Spacepower is caught up in the internal power struggles and bureaucratic politics of whatever entity uses it, and any theory and user must be aware of the internal dynamics of space powers. Proposition VI ends with an open door as to the development of space-based culture, giving the Proposition the title of:

VI. *Spacepower finds itself in a geocentric mindset, and may outgrow it*

Proposition VII, in Chapter 7, explores the consequences of the exploitation of spacepower from the cosmic coastline: dispersal. The increasing value and effect of spacepower for terrestrial warfare increases the potential strategic rewards of waging effective space warfare campaigns. The demands of dispersal on terrestrial forces, or attempts at its mitigation, can be seen as a consequence of an achievement of the command of space (Proposition I) which allows for the exploitation of celestial lines of communication through attempting a strategic manoeuvre (Propositions IV and V) which contributes to the effects of dispersal, or to mitigate those effects (Proposition VII). Proposition VII is:

### *VII. Dispersion is a condition and effect of spacepower*

Together, the seven propositions establish a framework that helps an individual to critically apply universal elements of spacepower to any given case of its use in the past, present, and future. Spacepower theory sets constructive terms of debate and starting points for analysis. It also sets a foundation to think about recurring dilemmas in space warfare whilst encouraging the appreciation of the particular details that make any historical episode unique.

Beyond spacepower theory's seven propositions, there are three major strategic analogies which make larger arguments that speak to the political study of the cosmos. First, outer space is a continuation of Terran politics by other means; the human use of space will reflect and be constituted by prevailing political conditions on Earth. Second, space is a place that is used to communicate information and transport materials and effects, like other geographies, which is an inherently political and strategic activity in relation to Earth, where humans live. Lastly, Earth orbit is only a celestial coastline. Humanity has only developed Earth orbit to play a part as critical infrastructure for the political-economy of Earth; it is merely dipping our species' toes into the cosmic shoreline and the rest of the solar system remains largely unused for strategic needs. These arguments are picked up again the Conclusion, which also applies the entire spacepower theory in an illustrative logic train.

Human activity in space is as conducive to examination in the humanities, social-scientific, and philosophical research as any other endeavour in human activity. Astropolitics is multi-faceted, and this thesis proves to be one example of the continuing presence of Terran politics and the continuity of some of its concepts in astropolitics. In that sense, space may be a somewhat familiar frontier. Perhaps one reason why Gray's call for a Mahan for the final frontier has gone unheeded is because of the general ignorance regarding the role that space technology has come to play as critical infrastructure. Space technology is as useful for precision agriculture as it is for precision bombing. Chapters 1 and 2 provide a brief but rounded introduction to contemporary space activity beyond the headline-grabbing feats of scientific space exploration and the doom-laden scenarios of space-based weaponry and the so-called 'militarisation' of space.

# Chapter 1: Precision, Ploughshares, and the Passage of Arms

## Introduction

> "Now sir, I know you and your scientist friends would like a new [weather] satellite – and I'd like to be able to give it to you – but I really can't justify it. After all, we already have the Weather Channel."
>
> – Unnamed U.S. House Committee on Science, Space, and Technology chairperson[1]

This first chapter sets out the basics of space activity because, beyond popular discourse on manned spaceflight and a basic education on the solar system, the realities of space activity (such as weather satellites providing data to the Weather Channel) can escape general knowledge. Space activity goes far beyond, and influences everyday life much more than, the historic feats of manned spaceflight. Space technology, fused with miniaturised computer and Information Communications Technology, has pervaded many aspects of developed ways of life through the use of precise position, navigation, and timing (PNT) services, wireless instantaneous global communications, and mapping the Earth and space's resources and hazards. Like much else, these are as useful in civilian and peaceful hands for economic life as they are for modern warfare. Because such information is not usually known outside of science and engineering communities, self-taught individuals in the humanities and social sciences, and (sometimes) individuals working in space policy and law, this chapter forms an empirical briefing on astrography and how space technology has proliferated.

This briefing on contemporary space activity is necessary because spacepower theory jumps straight to the task of strategic thinking about spacepower. Spacepower theory is not a description of the most important space activities are. Spacepower theory assumes a working understanding of orbital motion, the basics of satellite systems and service types, and how they have come to form critical infrastructure. For example, Proposition II (Chapter 4) attempts to use empirical knowledge about astrography to answer the 'so what' question of what the uniqueness of space means to a strategist, a practitioner, or a student of war or military history. This first chapter also adds some context on the debate on the Revolution in Military Affairs (RMA) is given because spacepower has

[1] Anecdote from a scientist at the U.S. National Weather Service, in: Joan Johnson-Freese, *Space as a Strategic Asset* (Chichester: Columbia University Press, 2007) p. 27

been integral to the technologies central to the debates on 'net-centric warfare' or 'information warfare'. It is necessary to distance spacepower theory from that debate because its challenges spacepower theory's attempt at universal theorising. This kind of theory is explained and justified in Chapter 3.

This chapter begins with a short introduction to the major aspects of astrography; followed by an examination of space systems as critical infrastructure; then a review of how space systems have become integral to a contemporary method of waging war is presented; and finally noting the proliferation of spacepower around the globe. These introductions are not comprehensive, and good primers on space physics, launch vehicles (rockets) and their technical histories, and space systems (satellites and their supporting infrastructure) exist elsewhere.[2] The single most intelligible, concise, yet comprehensive introduction to the physical characteristics of 'near-Earth space' for mathematically and technically disinclined readers is in Everett Dolman's *Astropolitik*.[3] This chapter covers the most important technical-physical principles that frame human activity in space which have direct relevance to terrestrial warfare.

## 1.1 Astrography

"But I canna change the laws of physics, Captain!" – Scotty[4]

Humans have spent over fifty years utilising 'space,' yet there is no single agreed upon technical-legal definition or international standard of what 'space' actually is. Specifically, there is no legal agreement on where 'airspace', or the Earth's atmosphere, ends and where 'space' begins. A working definition is the Kármán Line, the lowest point at which satellites may orbit Earth using the

[2] Useful reference materials are: U.K. Ministry of Defence (MoD), *The UK Military Space Primer* (Shrivenham: Development, Concepts, and Doctrine Centre, 2010); Air Command and Staff College Space Research Electives Seminars, *AU-18 Space Primer* (Maxwell AFB, AL: Air University Press, 2009); Barry D. Watts, *The Military Use of Space: A Diagnostic Assessment* (Washington, D.C.: Center for Strategic and Budgetary Assessments, 2001); Robert V. Brulle, *Engineering the Space Age: A Rocket Scientist Remembers* (Maxwell AFB, AL: Air University Press, 2008); Roger D. Launius and Dennis R. Jenkins, *To Reach the High Frontier: A History of U.S. Launch Vehicles* (Kentucky University Press, 2002)

[3] Everett C. Dolman, *Astropolitik: Classical Geopolitics in the Space Age* (Abingdon: Frank Cass, 2002) pp. 60-84

[4] *Star Trek* (CBS Television Distribution, 1966-1969)

principles of orbital mechanics. Named after Theodore von Kármán, a Hungarian-American physicist, the *UK Military Space Primer* describes the Kármán Line thus:

> "Although aviation is thus limited to below 100,000 [feet], at that point the atmosphere is still far too thick for a spacecraft to achieve orbit without continuous thrust. Any declared boundary is to an extent arbitrary, but… the Kármán Line – an altitude of 100 [kilometres] – [is] a working boundary. Below this altitude, a spacecraft would need to use thrust regularly to maintain orbit, and would face severe problems with frictional heating."[5]

Thermal variations in the atmosphere can raise or lower the minimum altitude where satellites can operate – the 100km Kármán Line is only approximate of the real physical distinctions between 'space' and the 'transverse' region and is subject to particular environmental factors at any given time. The transverse region refers to the areas between which most aircraft cannot fly (beginning at around 28km, the operational ceiling of the SR-71 *Blackbird*[6]) to around the Kármán Line where neither aircraft can rely on normal aerodynamics to fly because the air is too thin, and where there is too much air resistance for spacecraft to fly at orbital speeds without serious consequences for the craft and the need for continuous thrust. Research in the field of hypersonic flight is still at an experimental stage in the United States and China.[7]

Where space begins is important because it can affect jurisdictional claims over national air boundaries, sovereignties, and the global commons. The principle of satellite overflight for all observations and communications satellites, regardless of ownership, was established following the Soviet Union's successes with *Sputnik* flights (the first in October 1957), the U.S. efforts to launch a science satellite during the International Geophysical Year (1957-1958), and the secret U.S.

[5] U.K. MoD, *The UK Military…* p. 2
[6] Or the Lockheed A-12 *Oxcart*, operated by the U.S. Central Intelligence Agency
[7] See: Loulla-Mae Eleftheriou-Smith, 'China 'conducts fourth hypersonic missile test' as tensions with US mount over contested South China Sea islands', *The Independent*, 15/06/2015, http://www.independent.co.uk/news/world/asia/china-conducts-fourth-hypersonic-missile-test-as-tensions-with-us-mount-over-contested-south-china-sea-islands-10320242.html (accessed 03/07/2015); Lockheed Martin, 'Falcon HTV-2', http://lockheedmartin.com/us/products/falcon-htv-2.html (accessed 03/07/2015); on a history of U.S. hypersonic research in the Dyna-Soar programme, see: Roy F. Houchin, *US Hypersonic Research and Development: The Rise and Fall of Dyna-Soar 1944-1963* (Abingdon: Routledge, 2006)

CORONA photo-reconnaissance satellite programme.[8] The established right of satellite overflight matters because it permits a form of spying on a target's territory without violating laws governing sovereign airspace (an exotic and untested technical method in the 1950s). The principle of overflight was unsuccessfully challenged by equatorial states in the mid-1970s through the largely ignored Bogota Declaration to extend state sovereignty upwards to infinity.[9] Some equatorial states attempted to claim the lucrative equatorial geostationary orbit band as sovereign 'space'. Early warning and communications satellites were being positioned in these lucrative positions that enabled very useful celestial lines of communication (discussed further Proposition IV) between satellites 'above' their territories and their users and targets on Earth.

The U.S. Air University's *Space Primer* stresses that "knowledge of orbital motion is essential for a full understanding of space operations."[10] Intuition based on terrestrial physics can mislead, and an education in the basic realities of orbital flight is necessary. Most humans cannot see or feel how spacecraft behave in the same way they have grasped how aircraft and ships move. Visualisations and simulations may help bridge this gap between the intuitive perception of sea and air travel and that of orbital motion, short of subjecting much larger proportions of the human population to the stresses of space travel. Seeing orbital flightpaths,[11] or creating one's own celestial trajectories,[12] can go some way to challenge erroneous conceptions of spaceflight found in popular science fiction tropes.

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[8] Walter A. McDougall, *...The Heavens and the Earth: A Political History of the Space Age* (Baltimore, M.D.: Johns Hopkins University Press, 1997) p. 134. The first successful CORONA mission occurred on 18th August 1960, see: Jeffrey T. Richelson, *America's Secret Eyes in Space: The U.S. Keyhole Spy Satellite Program* (Harper Collins, 1990) p. v; Pat Norris, *Spies in the Sky: Surveillance Satellites in War and Peace* (Chichester: Praxis, 2008) pp. 65-72

[9] John J. Klein, *Space Warfare: Strategy, Principles, and Policy* (Abingdon: Routledge, 2006) pp. 61-62, 85

[10] *AU-18 Space Primer*... p. 89

[11] For example, see the software company Analytical Graphics's Systems Tool Kit (STK): https://www.agi.com/about-agi/ (Accessed 25/05/2015)

[12] Such as in the space programme simulator/computer game, *Kerbal Space Program* (Squad, 2015), https://kerbalspaceprogram.com/en/?page_id=7 (accessed 25/05/2015). Indeed, the computer game *Kerbal Space Program* has become an educational tool in classrooms and has garnered the attention of some space agencies in their public outreach and educational initiatives. See: Ian Birnbaum, 'NASA's Favorite Video Game, Kerbal Space Program, Launches Today', *Motherboard/Vice News*, 27/04/2015, http://motherboard.vice.com/read/nasas-favorite-video-game-kerbal-space-program-launches-today (Accessed 25/05/2015)

Contrary to Moran's description, friction *does* occur in Earth orbit.[13] Atmospheric drag, geomagnetic and solar storms, gravitational perturbation, and the gravitational pull of other celestial bodies all effect the orbits of satellites. All these factors mean that satellites need, over time, to be able to correct for environmental factors in order to remain useful – this means that human commands are necessary to issue corrections and that space weather forecasting and environmental surveillance of space are necessary for a properly functioning space system. Friction – both in the Newtonian and Clausewitzian senses – is still a phenomenon that occurs in orbit.[14] Satellites cannot be launched and forgotten – they need operational celestial lines of communication (explained in Proposition IV) to extend their useful lives.

Human agency has to account for physical laws and properties – these properties in turn affect the capabilities of satellites and the composition of traffic in orbit. A high-resolution photo-reconnaissance satellite in Low-Earth orbit (LEO) will orbit Earth every 90 minutes and cannot be 'parked' above a target location on the Earth's surface for continuous observation. Satellites in LEO can take detailed views of small patches of Earth, but are in constant motion relative to the Earth's surface. Satellites in the geosynchronous belt (GEO), however, can *appear* stationary over a point on the Earth's surface. Not all orbits are the same, and just as orbital mechanics imposes severe constrains on current technological capabilities and human wishes, it can also provide opportunities, as seen in how different orbits are utilised in the next section. Proposition IV examines the strategic consequences of diverse and converging celestial lines of communication, which may provide some possibilities for controlling 'chokepoints' in Earth orbit.

Different altitudes result in different orbits as the relative speed of the satellite across the Earth's surface changes (see table 1.1, all values are approximate).[15] There are four general classification of orbit: low-Earth orbit (LEO), medium Earth orbit (MEO), geostationary Earth orbit (GEO), and high-Earth orbit (HEO). LEO ranges between 150km altitude to 1,600km, with orbital

[13] Daniel Moran, 'Geography and Strategy', in: John Baylis, James J. Wirtz, Colin S. Gray, eds., *Strategy in the Contemporary World* (Abingdon: Oxford University Press, 2013) p. 128

[14] Clausewitzian friction – the culmination of unforeseen or unaccountable problems in war – is explored in Chapter 3.

[15] On more details on orbit types, as Table 1.1. is not exhaustive, see: UK MoD, *UK Military Space…* pp. 1-44-1-53; *AU-18 Space Primer…* pp. 89-112

periods of around 90 minutes.[16] Satellites in LEO typically perform remote sensing, Earth observation (which includes optical and signal spy satellites), weather, and scientific missions. There are some communications satellite constellations at this altitude as well, such as Iridium, with its 66-satellite constellation. Moving up to orbits of approximately 20,000km (within MEO), this is where global navigation satellite systems (GNSS) are found. It is worth noting that China's GNSS, Beidou, is made up of satellites that are based in MEO *and* GEO.[17] The boundaries between LEO and MEO are not clearly defined.[18] However, *most* GNSS satellites are generally placed into 19,000-24,000km altitudes. Up at 35,786km (GEO) are geostationary and geosynchronous satellites. Their orbital periods are approximately 24 hours long, and geostationary satellites *appear* to remain above the same point of the Earth's surface, and generally orbit directly above the equator. Geosynchronous orbit refers to a satellite with a 24 hour period, regardless of inclination.[19] In GEO, satellites tend to perform communications roles, nuclear detection and ballistic missile early warning, and some weather observation functions. As of 31st January 2015, there are over 1,200 operational satellites in orbit.[20] High Earth orbit (HEO) are orbits that can be designed to loiter above a hemisphere of the Earth for a longer time, whilst passing over the opposite hemisphere very quickly. An example is the Soviet Union's Molnyia satellites which would reach an apogee (highest altitude in an orbit) of around 40,000km above the northern hemisphere to detect missile launches from the United States, and fly quickly over the southern hemisphere with a perigee (lowest altitude of an orbit) of around 400km to return to the northern hemisphere as quickly as possible.[21]

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[16] *AU-18 Space Primer…* p. 89. Note that *UK Military Space Primer* says 100-1,200km for LEO on p. 1-46,

[17] Information on any public-knowledge satellite can be taken from this crucial open intelligence source as a downloadable and periodically updated Microsoft Excel file : Union of Concerned Scientists (UCS), 'UCS Satellite Database', http://www.ucsusa.org/nuclear_weapons_and_global_security/solutions/space-weapons/ucs-satellite-database.html (file used dated 01/02/2015)

[18] See the discrepancy between: Ibid., p. 91 which lists MEO with an upper ceiling of 19, 300km, the figure of 20,700km in: Watts, *The Military…* p. 9; and the figure of 26,000km altitude in Martin E.B. France and Jerry Jon Sellers, 'Real Constraints on Spacepower', in: Charles D. Lutes and Peter L. Hays, with Vincent A. Mazo, Lisa M. Yambrick, and M. Elaine Bunn, ed., *Toward a Theory of Spacepower: Selected Essays* (Washington, D.C.: National Defense University Press, 2011)

[19] *AU-18 Space Primer…* p. 92

[20] UCS, 'UCS Satellite Database'

[21] On apogees, perigees, and HEO, see: UK MoD, *UK Military Space…* pp. 1-30 - 1-31, 1-36 – 1-37, 1-50 – 1-51

**Table 1.1: Orbital regions**

| Orbital region | Altitude (km) | Orbital period | Satellite Functions |
|---|---|---|---|
| Low-Earth orbit (LEO) | 100 to ~1,600 | 90-100 minutes | Reconnaissance, Earth observation |
| Medium-Earth orbit (MEO) | 2,000-35,785 | ~12 hours | Global Navigation Satellite Systems |
| Geostationary Orbit (GEO) | ~35,786 | 24 hours | Early Warning, Communications |
| High Earth Orbit (HEO) | ~400 perigee to ~40,000 apogee | ~12 hours | Early Warning, Telecoms |

Launch sites closer to the equator have an efficiency advantage for most kinds of orbital launches that travel from the west to the east, especially for geosynchronous orbits (GEO). For most west-to-east LEO, MEO, and GEO orbits, it is advantageous in economic terms to launch as close to the equator as possible in order to benefit from the increased effect of the Earth's rotation at the equator. The French spaceport at Kourou, *Le Centre Spatial Guyanais*, French Guyana, has 17% greater fuel efficiency at 5 degrees north of the equator than the American Cape Canaveral spaceport at 28.5 degrees north.[22] Satellites can fly from east to west – in a retrograde orbit – but at great costs to fuel efficiency and lift capacity. Other orbits, such as north-to-south polar orbits (named so because they will fly past the earth's northern and southern poles) derive less benefit from the equatorial gravitational boost and therefore more northern launch sites are as practical as southerly ones.

'Space' is not a uniform geography. Everett Dolman argues that "what appears at first a featureless void is in fact a rich vista of gravitational mountains and valleys, oceans and rivers of resources and energy alternately dispersed and concentrated, broadly strewn danger zones of deadly radiation, and precisely placed peculiarities of astrodynamics."[23] An important feature of Earth orbit is that there are two bands of highly intense radiation and charged particles that produce a very hazardous realm for the electronic systems of unshielded satellites, called Van Allen belts (at 5,000km and 16,000-20,000km).[24] There are other bodies of potential future strategic interest in the cosmos – asteroids, planets, comets, and moons each having their own unique atmos- and magnetospheres (or

[22] Klein, *Space Warfare…* p. 10
[23] Dolman, *Astropolitik…* p. 61
[24] *AU-18 Space Primer…* p. 118. For an excellent map of the Van Allen belts in the context of various Earth orbits, see: Watts, *The Military Uses…* p. 9

lack of them) – as well as areas of gravitational peculiarities – such as the Lagrange Libration points between any two orbiting bodies. Only two of the five points are truly stable because the competing gravitational forces cancel each other out. The $L_4$ and $L_5$ points are stable and permanent, whereas $L_1$, $L_2$, and $L_3$ are unstable and transient. In the distant future, these could be highly advantageous positions in military and economic terms.[25] Natural bodies caught inside the $L_4$ and $L_5$ zones, such as asteroids, are called Trojan asteroids,[26] suggesting that Trojan space stations may become important forts in the cosmos.

The cost of access is a major factor in thwarting access to outer space. In general, it costs approximately $20,000 per kilogram sent into LEO.[27] When satellites are measured in terms of tons, any launch efficiency can save significant costs or increase capability. That said, countries such as India are able to provide low launch costs at a global level.[28] Satellites have a limited lifespan that is partly determined by how much fuel they have on board, which is heavy and expensive to carry into orbit. Innovations like electrostatic ion engines may increase the ability of GEO satellites to remain 'in place' because they can provide low-level but constant thrust without the need to carry heavy and inefficient chemical fuel.[29] However, for satellites in LEO, chemical thrusters provide the raw power needed to move a large amount (in terms of energy) into other orbital planes as desired, but each burn of the thrusters will limit its ability to move again. This translates into logistical constraints which influences spacepower's flexibility in warfare, as mentioned in Propositions V. This also means that satellites are not agile things that can flexibly disperse and concentrate on demand, like ships or aircraft may be able to. Spacepower and dispersal is returned to in Proposition VII.

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[25] Dolman, *Astropolitik*... p. 75

[26] Earth has one known Trojan asteroid. See: Martin Connors, Paul Wiegert, Christian Veillet, 'Earth's Trojan asteroid', *Nature* (475, 2011) pp. 481-483

[27] David Kestenbaum, 'Spaceflight is getting cheaper. But it's still not cheap enough', *Planet Money*, 21/07/2014, http://www.npr.org/blogs/money/2011/07/21/138166072/spaceflight-is-getting-cheaper-but-its-still-not-cheap-enough (accessed 02/08/2014). On examples of launch costs, see: United Launch Alliance, 'Frequently Asked Questions – Launch Costs', http://www.ulalaunch.com/faqs-launch-costs.aspx#Is-ULA-reducing-costs (accessed 22/05/2015); SpaceX, 'Capabilities & Services,' http://www.spacex.com/about/capabilities (accessed 22/05/2015)

[28] Joseph Stromberg, 'India's mission to Mars cost less than the movie Gravity', *Vox*, 24/09/2014, http://www.vox.com/2014/9/24/6838079/india-mars-mangalyaan (accessed 21/09/2015)

[29] On ion engine technology, see: Airbus Defence and Space, 'Ion Propulsion Systems', http://cs.astrium.eads.net/sp/spacecraft-propulsion/ion-propulsion/ (accessed 22/09/2015)

'Space' can be thought of as one indivisible medium, but such a view masks the diversity of astrographic regions. 'Outer space' can be taken to mean anything beyond the Kármán Line – Earth/Terran space, Lunar space, solar space, and the entire universe beyond.[30] 'Space' is a distinct area separate from the surfaces and atmospheres of celestial bodies (e.g. planets other than Earth, moons, and asteroids), a distinction expressed in Article IV of the 1967 Outer Space Treaty (OST). Only the placing of chemical, biological, radiological, and nuclear (CBRN) weapons (referred to as weapons of mass destruction in the Treaty) is banned in orbit, and not non-CBRN weapons (such as lasers, particle beam weapons, radiofrequency weapons, and kinetic-kill vehicles). Yet *all* 'weapons' are banned on celestial bodies, as the OST declares:

> "States Parties to the Treaty undertake not to place in orbit around the Earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction, install such weapons on celestial bodies, or station such weapons in outer space in any other manner… The testing of any type of weapons and the conduct of military manoeuvres on celestial bodies shall be forbidden."[31]

Spacepower theory is primarily concerned with Earth, and Earth space – from its surface up towards geosynchronous orbit and the Molnyia-type orbits whose highest points reach towards the 40,000km mark over the northern hemisphere, as it is only these regions that are of direct relevance and use to human civilisation today and the foreseeable future. In Proposition V, these places in space are referred to as Earth's cosmic coastline – places that are not that distant from strategic concerns on Earth, if not directly relevant to questions of military, economic, and political activities on Earth.[32] Although Earth is not a 'closed system' – events and objects beyond Earth's gravitational influence can affect life on Earth, and humans on Earth could come to use space beyond Earth's gravity well[33] - it is what goes on between Earth and geostationary orbit (GEO) and high Earth orbit (HEO) which

[30] Dolman, *Astropolitik…* pp. 69-70
[31] United Nations (UN), 'Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies', 'United Nations Treaties and Principles On Outer Space, related General Assembly resolutions and other documents', UN Office of Outer Space Affairs (UNOOSA), http://www.unoosa.org/pdf/publications/st_space_61E.pdf, (accessed 20/02/2013) p. 4.
[32] Perhaps by the second half of the twenty-first century other regions of space will become politically and economically significant, with humanity developing beyond the celestial coastline around Earth.
[33] James A. Vedda, *Choice, Not Fate: Shaping a Sustainable Future in the Space Age* (Xlibris, 2009) p. 3

most concerns spacepower theory *now*. Regions beyond Earth orbit are of less practical value for contemporary astrostrategists than building a spacepower theory that focuses on contemporary use.[34]

Compounding the technical ambiguities surrounding the definition of 'space' is the fact that there are many possible different socio-political approaches to outer space.[35] Given that space systems are crucial to contemporary civilisation's functioning, how humans conceptualise space is of "fundamental moral, political, and strategic importance."[36] Whilst space is a physical and objective geography, as crudely outlined above, there is also 'the geography of the imagination,' a social construction or understanding of a geography which can influence how we may act. Gray adds that "mythical geography of the imagination can blind us to an appreciation of what is, and what is not, practicable in the conduct of war."[37]

The cultural aspect to strategy and geography features in Proposition VI under the term 'strategic culture'. Space, and humanity's use of it, is a fruitful realm for many aspects of thought and inquiry across the academy. Does humanity's use of space change economics, law, politics, society, and international relations? If so, how? Is space a realm for humans to colonise through notions of 'empire' and the 'geopolitical gaze', or a fundamental challenge to Westphalian concepts of territorial sovereignty?[38] Is space the global commons and heritage of mankind – a sanctuary from conflict, violence and selfish appropriation – or merely the latest realm to exploit for political, economic, and military effect?[39] – or is that a fair dichotomy in the first place? Is space a pristine environment where we 'ought' to do things 'differently' than we do on Earth?[40] What are the domestic and international

[34] For an example, see: Jeremy Straub, 'Application of a Maritime Framework to Space: Deep Space Conflict and Warfare Scenario,' *Astropolitics* (13:1, 2015) pp. 65-77
[35] See: Michael Sheehan, *The International Politics of Space* (Abingdon: Routledge, 2007) pp. 5-19
[36] Natalie Bormann and Michael Sheehan, 'Introduction', in Natalie Bormann and Michael Sheehan (eds.) *Securing Outer Space* (Abingdon: Routledge, 2009) p. 3
[37] Colin S. Gray, 'Inescapable Geography', *Journal of Strategic Studies* (22:2-3, 1999) pp. 161-162
[38] For example, see: Jonathan Havercroft and Raymond Duvall, 'Critical astropolitics: The geopolitics of space control and the transformation of state sovereignty', in: Bormann and Sheehan (eds.) *Securing Outer Space…* pp. 50-57; Karl Leib, 'State Sovereignty in Space: Current Models and Possible Futures', *Astropolitics* (13:2, 2015) pp. 1-24
[39] On 'space security' policy schools of thought: James Clay Moltz, *The Politics of Space Security: Strategic Restraint and the Pursuit of National Interests* (Stanford: Stanford University Press, 2011) pp. 23-40
[40] Sheehan, *The International…* p. 183

legal challenges of harvesting the resources of celestial bodies – and of enforcing those laws?[41] What if humans make contact with extra-terrestrial intelligence?[42] What does space travel mean for terrestrial religions and theology?[43] How has space activity informed political and cultural ideas?[44] If space warfare is a continuation of Terran politics by other means (argued in Chapter 3), then space activity as a whole will prove to be a continuation of international relations (theory) by other means.[45] The same can be said of any area of study in the humanities. Space is not solely the province of scientific, engineering, or mathematical inquiry. That said, there is an argument for complementing the theories and methodologies of international relations with the epistemological positions of theoretical physics and cosmology.[46]

These rhetorical questions illustrate that thinking about space is not necessarily limited in terms of its military applications, strategic thought, and policy studies. "Geography is an inescapably social and political *geo-graphing*, an 'earth writing'", and further, "it is a cultural and political writing of meanings about the world," and research intent carries through into what outer space can be in its meanings to humanity.[47] Acknowledging these different conceptions of space, and different modes of enquiry, serves as a reminder that individuals may have pre-existing dispositions and social conditioning, or value-laden approaches, which will influence the ontology and epistemology of their studies which run alongside the more objective features of space (such as orbital mechanics). Chapter 3 establishes the universe that strategic theory inhabits in the interests of methodological and pedagogical transparency, and not in the quest of universal knowledge about the cosmos.

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[41] For example, see: Michael Listner, 'The Moon Treaty: failed international law or waiting in the shadows?', *The Space Review*, 24/20/2011, http://www.thespacereview.com/article/1954/1 (Accessed 26/05/2015); Vid Beldavs, 'The International Lunar Decade', *The Space Review*, 13/01/2014, http://www.thespacereview.com/article/2431/1 (accessed 26/05/2015)

[42] See: Michael A.G. Michaud, *Contact with Alien Civilizations: Our Hopes and Fears about Encountering Extraterrestrials* (New York, NY: Copernicus Books, 2010)

[43] On religion and theology in space, see: a special issue of *Astropolitics* on spaceflight and religion: *Astropolitics* (11: 1-2, 2013) pp.1-121; and: McDougall, *…The Heavens…* pp. 436-461

[44] Daniel Sage, *How Outer Space Made America* (Farnham: Ashgate, 2014)

[45] International relations in astropolitics can and should include the relations and space activities of non-state, suprastate, and substate actors.

[46] Milja Kurki, 'Stretching Situated Knowledge: From Standpoint Epistemology to Cosmology and Back Again', *Millennium* (43:4, 2015) pp. 779-797

[47] Gearoid O Tuathail, 'Understanding Critical Geopolitics: Geopolitics and Risk Society', *Journal of Strategic Studies* (22:2-3, 1999) p. 109. Emphasis original.

'Space', therefore, needs to be understood in two ways – first, in terms of its physical attributes and specific boundaries for this study. This means the orbital regions of Earth between approximately 100km altitude above sea level to approximately 40,000km altitude, the operating 'ceiling' of most of the relevant satellite systems in use today, and which are subject to the laws of orbital mechanics which govern how spacecraft may physically behave in that environment. That said, events that occur below 100km altitude are still of crucial to planning for and thinking about 'space warfare', as space weapons may be based on Earth's surface, and it is there that humans live. Events and capabilities on Earth are still essential to grasp in spacepower theory, as they often determine key conditions in space warfare scenarios. Proposition II examines the 'so what' aspect of the unique aspects of astrography in the strategic context of adjacency to other geographic media, and the relevance of spacepower only insofar as it affects life on Earth. Proposition II should immediately analyse the 'so what' question of astrography without getting bogged down in describing the entirety of the space environment, justifying the need for a separate briefing here. Astrographical influence can be seen in Propositions IV, V, and VI, VII, as referrals to these propositions in this section have already indicated.

The second, and complementary, way space should be understood is through its social constructions, be they shared or contested. Proposition VI looks at strategic culture, and allows spacepower theory to consider the different ways different human groups may approach the use and integration of spacepower to their strategic needs. As an example, Proposition V makes a case for viewing Earth orbit as a coastal theatre, rather than as analogous to an open ocean. It is a subjective argument based on imaginative geographical construction, and not a declaration of objective geographic knowledge. Some competing social understandings of space are involved in the next chapter, where uncritical and a-strategic visions of inevitable conflict in space or hopes for perpetual peace in orbit clash in their differing prescriptions of whether to deploy space-based weaponry. However, before that literature is reviewed, the remainder of this chapter examines space systems and how they are viewed as critical infrastructure, and how space technologies have proliferated.

## 1.2 Critical Infrastructure

"It's there. Use it." – EGNOS slogan[48]

At the dawn of the Space Age[49] the United States and the Soviet Union each invested resources into developing intercontinental ballistic missiles, suborbital rockets, and satellite technologies.[50] Even at this stage in U.S. space sectors, the division between military and civilian worlds was blurred at best, and non-existent at worst. Michael Sheehan points out that "the two could never be kept completely separate, and as a result there were problems from the outset over the relative priorities, goals and public profiles of the civil and military space programmes."[51] Any individual aware of the fact that space technology has military roots and that it carries through into the military or civilian capabilities of, for example, satellite navigation and remote sensing should cast a sceptical eye on pejorative or alarmist claims that someone is 'militarising space'.[52] As the remainder of this and the next chapter show, most major powers have developed space systems that have military uses, and many 'non-military' space systems still support military organisations and operations. This means that space has been militarised since the dawn of the Space Age, making claims of space being militarised today misleading. Whilst individual civilian-orientated space programmes or agencies, such as ESA, may be being subjected to 'militarisation',[53] space or Earth orbit has essentially been militarised since the first successful breach of the Kármán Line by Wernher von Braun and his team's V-2 rockets in the Second World War. The bloody and genocidal heritage

[48] European Geostationary Navigation Overlay Service website, http://egnos-portal.gsa.europa.eu/ (accessed 26/05.2015)

[49] A nominal start date is 4th October 1957, when the USSR launched the first artificial satellite *Sputnik I*, although rocket research progressed in the United States, Germany, and the USSR throughout the first half 20th century.

[50] On a concise and multipolar history of the early Space Age, see: Robert C. Harding, *Space Policy in Developing Countries: The search for security and development on the final frontier* (Abingdon: Routledge, 2013) pp. 29-71

[51] Sheehan, *The International…* p. 38

[52] For example, see: Ian Sample, 'China's Jade Rabbit rover makes crucial tracks in space and on Earth', *The Guardian*, 20/12/2013, http://www.theguardian.com/science/2013/dec/20/china-jade-rabbit-rover-space-politics (accessed 26/05/2015)

[53] On the military elements of the European Union's space sector, see: Frank Slijper, *From Venus to Mars: The European Union's steps towards the militarisation of space* (Amsterdam: TNI, 2008); Michael Sheehan, 'Profaning the path to the sacred: the militarisation of the European space programme", in: Natalie Bormann and Michael Sheehan, ed. *Securing Outer Space…* pp. 170-185; Frank Slijper, 'The EDA's inroads into space', in: Nikolaos Karampekios and Iraklis Oikonomou, ed. *The European Defence Agency: Arming Europe* (Abingdon: Routledge, 2015) pp. 241-256

of humanity's entry into space seems like a far cry from today's apparently benign invisible infrastructure in orbit and the possibly genuine ulterior motive of von Braun in achieving spaceflight.[54] Even though space is a highly militarised place, it is arguably unweaponised. No overt or known weapons are currently in space (excepting the pistols in the survival kits of Russian cosmonauts). The next chapter addresses the problems of viewing space in terms of its weaponisation or non-weaponisation.

The military utility of space has only grown as space technologies, combined with miniaturised information and computing technologies, have become tactically and operationally advantageous in armed conflict and useful, if not essential, to everyday life in developed and developing economies. This Janus-face of space technology and space systems is starker today than it was at the dawn of the Space Age. A 'space system' is a spacecraft-dependent technological system which is made up of four segments – the spacecraft or space segment (or a constellation of them), the groundstation(s), the communications uplink, and the communications downlink. The uplink is where the communications stream from the surface to the spacecraft which can issue commands to the satellite or send data from users on the ground to be passed on by the satellite to elsewhere. The downlink is the communications stream from the spacecraft to the surface that sends data to users and surface terminals for dissemination elsewhere. An important note to bear in mind is that a space system could be attacked at any of these points via different means for different effects. Attacking a satellite is one way; attacking the master control station(s) for an entire constellation of satellites is another. Disrupting the communications streams can have similar effects too.[55]

Space systems are an important utility and it is not for nothing that space systems are considered to be parts of critical infrastructure.[56] It is difficult to concisely categorise the different

[54] McDougall, *... The Heavens...* pp. 41-42. Certainly there was no shortage of idealism among the rocket pioneers in the late 19th early 20th centuries, see: Ibid., pp. 17-21

[55] This is examined further in Chapter 4, specifically in Proposition I, which discusses how to struggle over the command of space.

[56] For example, see: European Commission, 'Towards a Space Strategy for the European Union that Benefits its Citizens', Brussels, 04/04/2011, p. 6, available at: http://ec.europa.eu/enterprise/policies/space/files/policy/comm_pdf_com_2011_0152_f_communication_en.pdf (accessed 11/05/2013); and U.S. Department of Defense (DoD), Directive 3100.10, 'Space policy', 18 October 2012, Washington, D.C., http://www.dtic.mil/whs/directives/corres/pdf/310010p.pdf (accessed 25/11/2012)

kinds of space systems that make up critical infrastructure in orbit when dual use technology (technology that can be turned to civilian and military uses) makes a single space system a definitional chimera. For example, the GPS system can be simultaneously used for precision warfare and precision agriculture.[57] GPS could be construed as critical infrastructure for the global political-economy, and not just that of the United States. [58] If all GPS services were terminated, Edward Morris argues that:

> "the effects would be serious and widespread. Businesses and governments would continue operating, but at significantly reduced levels of efficiency. Airlines would have to revert to legacy systems... Cargo vessels entering harbors would slow to a crawl… or they might not be allowed dock at all. Container cranes at ports would revert to cumbersome manual operations… Construction and mining projects would become delayed as expensive manual labor replaced systems used to automate surveying… Farmers… may not be able to harvest all their crops before they spoil in the field… Computer networks would experience slowdowns..."[59]

The consequences and opportunities of space system loss can be felt in many sectors, not just that of the military and intelligence communities.

Because space systems can be used for a plethora of functions it is more useful to categorise the uses of space in terms of the services and data that can be provided. Designations of civilian, military, and commercial can overlap to such a degree that it confuses and politicises rather than educates. GPS can be categorised as critical infrastructure, a military system, and a commercial one simultaneously. Yet one can say with certainty that it is a navigation system and understanding that is

[57] European Geostationary Navigation Overlay Service, 'Precision agriculture', http://egnos-portal.gsa.europa.eu/discover-egnos/about-egnos/success-stories/precision-agriculture (accessed 26/05/2015)

[58] On debate in the US as to whether GPS should be considered as critical infrastructure, see: U.S. Department of Homeland Security, 'Critical Infrastructure Sectors', http://www.dhs.gov/critical-infrastructure-sectors, 12/06/2014 (accessed 20/06/2015); Dee Ann Divis, 'PNT Advisory Board Debates Critical Infrastructure Designation for GPS,' *Inside GNSS*, 16/06/2015, http://www.insidegnss.com/node/4536 (accessed 20/06/2015). Meanwhile, Canada's military has called for Canadian satellites and those it uses to be protected as critical infrastructure: Dean Beeby, 'Satellites need protection as 'critical infrastructure,' military says', *CBC News*, 29/11/2015, http://www.cbc.ca/news/politics/canada-satellite-security-infrastructure-1.3337241?utm_content=bufferbf1ce&utm_medium=social&utm_source=linkedin.com&utm_campaign=buffer (accessed 30/11/2015)

[59] Edward Morris, Steven Anderson, Ronald Hatch, Peter Hays, James Armor, and John Sheldon, 'A Day Without Space: Economic and National Security Ramifications,' (Washington, D.C.: George C. Marshall Institute, 2008) pp. 4-5

the key to anticipating the consequences of placing such a system in orbit – regardless of whether individuals in uniform or not control the satellites. The PNT service is universal, but its uses and end users can and do differ.

For the purposes of a short introduction to space systems, it is best to categorise their uses in five ways: Earth observation; space observation; intelligence, surveillance and reconnaissance (ISR); communications; and navigation. These categories provide useful distinctions between various uses of space and they make no judgments about whether some are inherently civilian- or military-run or orientated, and whether they are commercially-minded, state funded, or something in between. Those are specific judgments to be made on the states and organisations involved, but a common understanding of *functions* along these five categories are more or less universal to all who wish to understand how space systems can be used today. This should become clearer as each category is described in turn.

Two aspects of space capabilities are omitted here for practical reasons. The first – anti-satellite or 'counterspace' capabilities – are dealt with in the next chapter as much of the literature there centres upon space warfare. Also, the focus of this chapter is to highlight capabilities and realities of the more mundane yet important aspects of everyday spacepower that can become relevant in military conflagrations. The second omitted category is the use of space for science and exploration. 'Civil' space capabilities are not given an exclusive category here because they serve a minimal immediate strategic interest at present, though in the long term this may change. It is true and not trifling that missions to other planets, moons, or comets and asteroids can bestow prestige upon those responsible, but although "prestige is nice…you cannot eat it."[60] The spacepower theory proposed in this thesis is concerned with the more practical and applied facets of spacepower relevant to a military confrontation. Space exploration and manned flight can take part in a struggle for power in its broadest sense (such as economic, scientific, and cultural power) within mostly peaceful

[60] Roger Handberg and Zhen Li, *Chinese Space Policy: A Study in Domestic and International Politics* (Abgindon: Routledge, 2007) p. 35. On the Chinese space programme and prestige, see also: Michael Sheehan, ''Did you see that, grandpa Mao?' The prestige and propaganda rationales of the Chinese space program', *Space Policy* (29:2, 2013) pp. 107-112

competitive relationships between entities, but spacepower theory is more concerned with antagonistic relationships between entities that will consider exercising violence against one another, and in timescales where the decades-long ventures of space exploration may not factor into acute military crises or wars on Earth.

Earth observation means a diverse collection of capabilities, such as weather observation and forecasting, "surveillance of borders and coastal waters; monitoring crops, fisheries, and forests; and monitoring of natural disasters".[61] In short, this means data gathering and analysis about physical or topographical features of Earth – the soil, the atmosphere, the seas, and everything within them. Space observation means watching the space environment, producing space weather forecasts, tracking debris, and observing and identifying space traffic, which is a prerequisite for managing space traffic. Space observation is concerned with what happens in orbit (and beyond to the solar system, especially with regard to forecasting solar storms). Most sensors for space observation are based on Earth, rather than in space, but more satellites for space observation (like the U.S. Space-based Surveillance Satellite and Canada's *Sapphire*) are being developed. Amateur space observation is possible too, meaning that even small states can develop a rudimentary picture of what is orbiting above its territory.[62]

The collection and analysis of information about activities in space, data gathered from space, and on activities that will have a significant impact on space activities and others that depend on the normal running of space infrastructure are all intelligence activities that spacepower theorists and strategists must acknowledge. Intelligence, surveillance, and reconnaissance (ISR) is the more overtly military, security, and intelligence aspects of earth and space observation, it is the "collection of data information on an object or in an area of interest on a continuing, event-driven, or scheduled basis."[63] Intelligence here refers to the product of the collection and analysis of data from surveillance and

[61] Cesar Jaramillo, ed., *Space Security Index 2014* (Kitchener, Ontario: Pandora Print Shop, October 2014) p. 13
[62] See: Marco Langbroek, 'KH-11 USA 224 recovered', *Sattrackcam Leiden (B)log*, 29/04/2015 http://sattrackcam.blogspot.co.uk/2015/04/kh-11-usa-224-recovered.html?utm_content=bufferd26da&utm_medium=social&utm_source=twitter.com&utm_campaign=buffer (Accessed 30/04/2015); Steven Lambakis, *On the Edge of Earth: The Future of American Space Power* (Kentucky University Press, 2001) pp. 120-122
[63] *AU-18 Space Primer*… p. 167

reconnaissance satellites, rather than as a particular class of satellite system.[64] Space systems that contribute to ISR can be managed by non-military entities and civilian organisations outside of an Intelligence Community, but data can be supplied to them.[65]

Satellite communications (SATCOM) was the focus of Arthur C. Clarke's argument for positioning three satellites in a geosynchronous orbit to produce a communications relay system to enable world-wide wireless communications capabilities; staff at the RAND Corporation were also thinking along these lines in the 1940s and 1950s.[66] Arguably, what telegraphy did for intra-Empire communications in the 19th century, communications satellites have done for the post-Second World War coordination of vast continental states, transcontinental alliances, economic blocs, and expeditionary warfare. Dedicated telecommunications satellites have a multitude of uses. They are used for secure military communications (like the UK's Ministry of Defence's Skynet or the U.S. Department of Defense's Defense Satellite Communications System (DSCS) and Wideband Global SATCOM (WGS)) to commercial or state television broadcasts, individual hand-held land-based satellite phones (like Iridium), and ship-based maritime SATCOM (like Inmarsat).[67] The growth in demand for bandwidth in the U.S. military in the years following the 1991 Gulf War is a useful demonstration of these technological developments – SATCOM bandwidth in 1991 was 100 megabytes per second, and by Operation Iraqi Freedom in 2003, demand had risen to 2.4 gigabytes per second (2,400 megabytes per second).[68] Meeting this demand has involved leasing bandwidth with commercial communications systems.[69] Plugging the gaps with, or relying on, the commercial sector has its benefits and drawbacks, and are explored further in Proposition V.

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[64] *AU-18 Space Primer*… p. 168
[65] On the earliest ISR satellite programmes, such as the Naval Research Laboratory's Galactic Radiation and Background (GRAB) satellite, see: Navy Research Laboratory, 'SOLRAD/GRAB', http://www.nrl.navy.mil/accomplishments/solar-lunar-studies/solrad-grab/ (accessed 22/06/2015); *AU-18*… pp. 174-175; Norris, *Spies in*… pp. 27-27, 96; on CORONA and *Keyhole*, see: L. Parker Temple III, *Shades of Gray: National Security and the Evolution of Space Reconnaissance* (Reston, V.A.: American Institute of Aeronautics and Astronautics, 2005) pp. 142-143, 172-175, 358-359; Lambakis, *On the Edge*… pp. 16-17, 32-34; Norris, *Spies in*… pp. 57-81, 103-111
[66] Temple, *Shades of Gray*… p. 46
[67] For a list of frequency spectrum uses, see: *AU-18 Space Primer*… p.186
[68] Patrick Rayermann, 'Exploiting Commercial SATCOM: A Better Way,' *Parameters* (Winter 2003/4) p. 55
[69] *AU-18: Space Primer*… pp. 192-193; Watts, *The Military Use*… pp. 72-73

Navigation by space systems is an extremely important aspect of the modern uses of space technology. By being within the line of sight of at least four GPS (the U.S. GNSS controlled by the U.S. Air Force) satellites, a user on Earth with a GPS receiver can gain an accurate positional reference or an accurate and universal time stamp, though the signal is weak (therefore susceptible to jamming) and cyber intrusions can allow one to 'spoof' the signal to provide false data.[70] The risks and consequences of GNSS on modern warfare are explored throughout the spacepower theory, but in particular in Propositions I and IV, where GNSS provide extremely important celestial lines of communication, and in Proposition VII which explores the dispersal effects of precision guidance and surveillance capabilities for modernised armed forces.

These modernised forces, being subjected to the proliferation of a fusion of space and information technologies, had led many practitioners and analysts to declare that a 'revolution in military affairs' (RMA) was taking place in the wake of the 1991 Gulf War, where military forces would become lighter, more lethal, more precise, and that the 'fog of war' would dissipate leaving reliable combat advantages, if not a decisive superiority, to forces that harnessed network-enabled forces and 'informational dominance' over their enemies.

## 1.3 The RMA's Shadow

"The forces were matched in size. Iraq's equipment was modern... But, among many differences – in personnel, equipment, training, leadership, and purpose – this one stands out. We went to war with space systems. Saddam did not. We could see, hear and talk. After the first hours of the war, Iraq could not." – Martin C. Faga, Director of the U.S. National Reconnaissance Office, 1989-1993[71]

The 1991 Gulf War began with American strikes against Iraq's early warning air defence radars and its command and control centres. Such attacks took advantage of superior American command and control, in part enabled by spacepower, to assault Iraqi ground-based equivalents,

[70] For a detailed overview of GPS, see: Scott Pace, Gerald Frost, Irving Lachow, David Frelinger, Donna Fossum, Donald K. Wassem, Monica Pinto, *The Global Positioning System: Assessing National Policies* (Washington, D.C.: RAND, 1995); and on the signal degradation options to mitigate the misuse of the signal by an adversary, see: Richard D. Easton and Eric F. Frazier, *GPS Declassified: From Smart Bombs to Smartphones* (Potomac Books, 2013) pp. 122-123, 152-153

[71] Bob Preston, *Plowshares and Power: The Military Use of Civil Space* (Washington, D.C.: National Defense University Press, 1994) p. 3

rendering Baghdad blind, deaf, and mute. It is hard to disagree with Keith Shimko that when one talks of the 1991 Gulf War, or the United States military's combat performance and *modus operandi* during and in the wake of its post-Cold War wars, it is difficult to do so without referring to a Revolution in Military Affairs (RMA) or some form of military transformation, regardless of one's opinion of an RMA itself.[72] Indeed, the shadow cast by the RMA in the 1990s on spacepower is unfortunate, as argued by Gray and Sheldon, because it inihibited thinking about space systems and spacepower on their own terms.[73] This means that many of the routine and unspectacular support aspects of space systems were overlooked in favour of missile defence roles and the potential of space ISR to eliminate the Fog of War. However, dues must be paid owing to the concept's dominance in American military affairs, before putting it in its place with regard to spacepower and the arguments of this thesis.

The United States has integrated space and information technology into its armed forces to a level unmatched by other states on Earth. The U.S. military's use of highly networked forces, enmeshed in a single 'global information grid' (GIG), cannot work without the critical infrastructure of space systems. Satellites relay information from local commanders and units to theatre commanders, into higher command structures, the executive leadership, and vice versa. An example of this is the DSCS which provided the U.S. with effective command and control of forces in the Gulf War in 1991.[74] This information allows for more precise and efficient warfare. Heavy forces can carry less ammunition, and aircraft perform fewer sorties, if they have a higher accuracy rating and synchronising among dispersed forces to cover the most ground efficiently. The RMA was a name given to the perceived changes occurring within the composition of, and way of, warfare within the US military from the 1990s. The RMA is used here, as with Shimko's work, as a catch-all concept to

[72] Keith L. Shimko, *The Iraq Wars and America's Military Revolution* (Cambridge: Cambridge University Press, 2010) pp. 2-3
[73] Colin S. Gray and John B. Sheldon, 'Space Power and the Revolution in Military Affairs: A Glass Half Full?', *Airpower Journal* (Autumn 1999) pp. 23-26
[74] See: David N. Spires, *Beyond Horizons: A Half Century of Air Force Space Leadership* (Montgomery, A.L.: Air University Press, 1998) p. 256

describe technological changes in the U.S. military since the late 1980s which emerged from analyses of the Soviet 'military-technical revolution'.[75]

The basic tenet of the RMA debate was that the transition from industrialised economic bases of warfare to information-based economics and warfare would be transformational as industrialisation was in the latter half of the 19th century. The ability to destroy a single bridge in a single strike in 1991, rather than having to use a concentrated air assault with dozens of aircraft as in the case of the Gaulier bridge in May 1940, represented a very visible form of this change in the character of warfare.[76] Being able to reliably destroy specific parts of infrastructure from the air is a significant advancement in bombardment capabilities. There are many permutations and specific flavours to categorisations of RMA, though according to Shimko they all agree that airpower's increased precision and speed are an important component of the RMA in recent decades, but few today go so far as to claim that the use of airpower with this RMA is a sole determinant of victory in war.[77] The RMA argument sometimes fixated on the decisive roles of technology and information, such as in the Tofflers' *War and Anti-war*.[78] The reliable ease at which forces that have undergone this improvement in precision, speed, lethality, and mobility can win battles is another aspect. However, the United States has not fought a technological peer in recent decades.[79] Changes in military force structure, however did occur. A scepticism over the prognostications of the more extreme RMA proponents does not need to detract from the reality that the Operation DESERT STORM in 1991 did see significant new operational behaviour enabled by spacepower. John Ferris wrote that:

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[75] Shimko, *The Iraq Wars…* p. 6. For some other key texts on the RMA debate, see: Stephen Peter Rosen, 'The impact of the Office of Net Assessment on the American military in the matter of the Revolution in Military Affairs', *The Journal of Strategic Studies* (33:4, 2010) pp. 469-482; Michael O'Hanlon, *Technological Change and the Future of Warfare* (Washington, D.C.: Brookings Institution, 2000); Michael Raska, 'The "Five Waves" of RMA Theory, Processes, and Debate', *Pointer* (36:3-4, 2011) pp. 1-12; MacGregor Knox and Murray Williamson (eds.) *The Dynamics of Military Revolution 1300-2050* (Cambridge: Cambridge University Press, 2001); Colin S. Gray, *Strategy for Chaos: Revolutions in Military Affairs and the Evidence of History* (London: Frank Cass, 2002), esp. pp. 9-12; John Arquilla and David Ronfeldt, 'Cyberwar is Coming', *Comparative Strategy* (12:2, 1993) pp. 141-165; Alvin Toffler and Heidi Toffler, *War and Anti-war: Survival at the Dawn of the 21st Century* (London: Little, Brown, 1994); David J. Lonsdale, *The Nature of War in the Information Age: Clausewitzian Future* (London: Frank Cass, 2004), esp. pp. 201-233

[76] See: Karl-Heinz Frieser, with John T. Greenwood, *The Blitzkrieg Legend: The 1940 Campaign in the West* (Annapolis, MD: Naval Institute Press, 2005) pp. 174-180

[77] Shimko, *The Iraq Wars…* p. 15

[78] Toffler, *War and Anti-war…*

[79] Shimko, *The Iraq Wars…* pp. 13, 24-25

> "for the first time, GPS was the leading source of tactical intelligence. Information surged across the system without swamping it, carried, one journalist wrote, by 'an unsung corps of geeks improvising as they went, cobbling together a remarkable system from a hodgepodge of military-built networking technology, off-the-shelf gear, miles of Ethernet cable, and commercial software', and Microsoft Premier online help for trouble-shooting. Reachback, push and pull techniques and a 'Warfighting Web' linked national intelligence agencies to theater commands and rear headquarters, like Air Force Space Command, to ground forces, equipped with 100,000 portable GPS receivers, one each to most squads of nine soldiers or five Marines."[80]

However, Ferris later stressed that not everything had changed because of this confluence of information technology enabled by 'spacepower'. Although great changes may have occurred for an air force's precision bombing capabilities, there were few changes in C4ISR [command, control, communications, computers, intelligence, reconnaissance, surveillance] below the corps level in land warfare.[81] The RMA, then, was not universal or ubiquitous in its effects and presence for military forces.

Michael Raska wrote that "from 2005 onward the RMA discourse became less "revolutionary" or "transformational" in all its three key aspects – magnitude, speed, and implications. More critical voices emerged questioning both its projected efficiency and effectiveness."[82] The technological changes that manifested themselves in U.S. military forces in both of its wars in Iraq are changes in the character of warfare – its nature remains static as a continuation of politics with the addition of other means fraught with passion, reason, and chance.[83] David Lonsdale makes a convincing case for the permanence of the human and political elements of war in the 'information (technology) age' which are featured in Chapter 3.[84]

[80] John Ferris, 'A New American Way of War? C4ISR, Intelligence and Information Operations in Operation 'Iraqi Freedom': A Provisional Assessment,' *Intelligence and National Security* (18:4, 2003) p. 167
[81] Ferris, 'A New American…' p. 169
[82] Raska, 'The "Five Waves"…' p. 8
[83] See Chapter 3 on this Clausewitzian approach. See also: Colin S. Gray, *Another Bloody Century: Future Warfare* (London: Weidenfeld & Nicolson, 2005) pp. 116, 291
[84] Lonsdale, *The Nature…* esp. pp. 229-233

Regardless of one's views on the concepts and debates of the RMA, the U.S. military is dependent on space systems for its mission of projecting power across the globe. The melding of space technology *and* miniaturised computer technology on satellites, military vehicles, weapons platforms, and individual mobile peripherals has created the connecting mesh that merits discussion of an 'RMA' in the first place. Communications relays link together US forces across the globe with their political masters in Washington, satellite telemetry tells troops and missiles where they are, where they are going, on what ground and conditions they will be, and sometimes the same of the enemy. Aircraft can leave for their sorties and receive up-to-date targeting data *en route*. It is not for nothing then that space is often labelled as the United States' Achilles' Heel. The 2001 Rumsfeld Space Commission called for the development of space-based lasers and warned of a 'Space Pearl Harbor' reminiscent of arguments during the 1980s on the Strategic Defense Initiative (SDI).[85] A dependence on space systems is indeed a potential vulnerability to US forces, but precise targeting capabilities are required to achieve the doom laden scenario of a 'Space Pearl Harbor' to come about because of the variety in the types and redundancies of space systems. Space systems, as the connecting backbone of complex information networks, are now crucial for the US military as it has become accustomed to operating today.

Space is a crucial component of the US military's continuing drive to realise the networked, lighter, and more lethal force articulated in the Joint Vision (JV) 2020 concept.[86] JV 2020 established the general framework for US military evolution after the 1990s; it professed the need for a joint force, to achieve and take advantage of 'full spectrum dominance'.[87] This term means that US forces should be able to "conduct prompt, sustained, and synchronized operations with combinations of forces tailored to specific situations and with access to and freedom to operate in all domains – space, sea, land, air, and information."[88] JV 2020 also refers to 'full dimensional protection' which is achieved in part through "the tailored selection and application of multi-layered active and passive

[85] Commission to Assess United States National Security Space Management and Organization, 'Report of the Commission to Assess United States National Security Space Management and Organization', 11/01/2001, Washington, D.C. pp. 59, 68
[86] US DoD, 'Fiscal Year 2013 Budget Request', Washington, D.C., February 2012, p. 2-3
[87] US Joint Chiefs of Staff, *Joint Vision 2020: America's Military: Preparing for Tomorrow* (US Government Printing Office: Washington, D.C., June 2000) p. 6
[88] Ibid.

measures" in space.[89] Michael Sheehan asserts that a significant shift in US military space doctrine took place from the 1970s to the 1990s. During the 1970s and 1980s space systems were seen as tools for supporting defence capabilities at the strategic level. This reflects the operational turn of USAF's military space capabilities at the same time.[90] By the 1990s, and certainly through to the 2010s, space assets are now seen as crucial to enhancing military capabilities on the tactical and operational levels.

This brief examination of the contours of the RMA illustrates the limitations of approaching spacepower as a sub-topic within defence transformation. As space systems helped a perceived RMA develop in the U.S. military, space weapons became a possible way to ensure the security of U.S. space infrastructure for its precise and rapid military capabilities. Simultaneously, the dependence on space weapons became a source of concern because of a possible U.S. vulnerability if an adversary was to attack its satellites. These concerns led to a renewed space weaponisation debate which is examined in the next chapter. This thesis is interested in spacepower, not in what the United States has done with a fusion of space and information technologies *per se*. To remain too focused on an idea of an RMA betrays an "inability or unwillingness… to approach space as just another geographical environment for conflict."[91] A context of an RMA risks portraying spacepower and space weapons as 'revolutionary' through implication when the spacepower theory crafted later in the thesis is an exercise in arguing that space warfare will, conceptually and politically, be 'more of the same' that follows the contours of terrestrial strategic history. The RMA and space weaponisation debates disguise the more constructive view of space warfare as the continuation of Terran politics with the addition of other means.

Gray and Sheldon rightly point out that spacepower is not, and should not be, dominated by the policy moniker of the day, such as SDI (also known as pejoratively 'Star Wars') of the 1980s or the RMA debate of the 1990s and 2000s. Space is a medium and geography of power (like seapower and airpower) in its own right. One example of a narrative of spacepower development (from a USAF perspective) before and during the periods of SDI and RMA is David Spires's account of the USAF in

[89] Ibid., p. 26
[90] Spires, *Beyond Horizons…* pp. 209-242
[91] Gray and Sheldon, 'Space Power…', p. 27

space, which charts the major developments in U.S. spacepower from its early days and into the hands of USAF culminating in the force-enhancement roles we are now familiar with.[92] The summary of the RMA above helps place spacepower's connections to mainstream debate and information technology but asserts the unabashedly space-centred focus of spacepower theory. Spacepower is not restricted to the American military experience and neither to an age where miniaturised computing and internet technologies pervade everything. Spacepower existed before Internet technology, and it is has long since proliferated to other powers in the international system. However, the marrying of the two can form a powerful tool in competent hands. Michael Smith wrote in 2002 that "if you have a credit card and access to a telephone of the internet, you can build your own spacepower" and he seems to have foreseen the reality today that smartphone users can purchase satellite-based imagery on demand.[93] One example is an Israeli company with prices for a "freshly tasked image" beginning at $500.[94] This highlights how, even at the individual and commercial levels, spacepower has proliferated.

## 1.4 Space proliferation

"Space has acquired an elevated importance in the growth of the modern "information society," the monitoring of weather and global warming, and democratizing the distribution or boundless information from the Internet." – Robert Harding[95]

This section will briefly describe certain examples of proliferated space power to illustrate how other space powers have developed their space infrastructures. The significance of proliferation is that as the number of valuable of satellites in orbit increase and the manner of their integration into life and warfare on Earth continues, the more the potential value of engaging in space warfare will become. This perception of reality serves as a basic justification for the need of strategic theory about spacepower, and also for the overview of antisatellite weapons in the next chapter. If space warfare is a potentially useful activity in war, then sound strategic thinking is needed to grasp how it might be

[92] Spires, *Beyond Horizons…* esp. pp. 174-269
[93] Michael V. Smith, *Ten Propositions Regarding Spacepower* (Montgomery, A.L.: Air University Press, 2002) p. 61
[94] Jonathan Charlton, 'SpyMeSat App Developer Looking to Contract More Satellites,' *Space News*, 25/06/2015, http://spacenews.com/spymesat-app-developer-looking-to-contract-more-satellites/?utm_content=buffer0c22f&utm_medium=social&utm_source=linkedin.com&utm_campaign=buffer (accessed 26/06/2015)
[95] Harding, *Space Policy…* p. 71

done and what its consequences may be so that practitioners and observers can make better judgments and decisions. Spacepower theory can and should help in developing such sound strategic thinking.

India, China, and Russia are examples of major powers that already benefit from the influence of spacepower alongside the United States, and are continuing to invest in space power for military modernisation. This section is designed to give a brief illustration of *some* of the major powers of the international system engaging with spacepower, and how all seem to have been influenced to some degree by the events of Operation Desert Storm in 1991.

Russia continues to be a significant spacepower, despite still recovering from a general collapse in its space infrastructure the 1990s.[96] In the 2000s Russia repeatedly lost photo-reconnaissance, maritime ELINT, and more worryingly, once lost early warning capabilities, making the Kremlin blind and deaf at times in these areas.[97] In May 2001 a fire destroyed the command and control centre at Serpukhov-15 near Moscow, which meant that Russia did not have the ability to detect missile launches from space for four months because it could not communicate with four of its early warning satellites.[98] Russia maintains a significant space infrastructure, though with some shortcomings. Most notable is the field of IMINT satellites which is improving after serious gaps between 2006 and 2013.[99] Russia continues to possess capabilities in Earth observation, space observation, communications, and navigation services to varying degrees and continues to develop new systems.[100]

Russia is integrating spacepower and information technology into its armed forces. The 1991 Gulf War "stimulated demands in the Russian military for the extension of satellite communications

[96] For example, Russia's GNSS, GLONASS, system fell apart as replacement satellites failed to be launched. During that decade, however, what was left of Russian space capabilities and industry was sustained by commercial launch successes and cooperation with other states. See: Nader Elhefnawy, 'A Russian resurgence? (part one)', *The Space Review*, 10/11/2008, http://www.thespacereview.com/article/1246/1 (Accessed 30/06/2015)

[97] Brian Harvey, *The Rebirth of the Russian Space Program* (Chichester: Praxis, 2007) p. 136-138

[98] Pavel Podvig, 'Russia and Military Uses of Space', in: Pavel Podvig and Hui Zhang Pavel Podvig and Hui Zhang, *Russian and Chinese Responses to US Military Plans in Space* (Cambridge, MA: American Academy of Arts and Sciences, 2008) p. 7

[99] See: Harvey, *The Rebirth…* p. 137; Phillip Clark and William Graham, 'Soyuz 2-1B launches third Persona-1 spy satellite', *NASA Spaceflight*, 23/06/2015, http://www.nasaspaceflight.com/2015/06/soyuz-2-1b-persona-1-spy-satellite/ (accessed 30/06/2015)

[100] Anatoly Zak, 'Lotos-S spacecraft for the Liana system', *Russian Space Web*, 20/06/2015, http://www.russianspaceweb.com/liana.html (accessed 24/09/2015)

to tactical command and control echelons." The Unified Satellite Communications System now provides the "backbone" of the Russian military's satellite communications infrastructure.[101] 'Force enhancement' is being pushed into the Russian armed forces alongside concepts such as 'information strike/fire' which seeks to disrupt enemy command and control systems. The thinking along the lines of integrating spacepower into terrestrial forces is familiar; Russia is investing in C4ISR capabilities despite its lack of expertise in microelectronics and communications systems.[102] Russia also maintains a significant space situational awareness capability through radar stations throughout the territories of the Commonwealth of Independent States (CIS).[103]

Although The role of C4ISR in improving the odds of combat success is widely recognised and understood in Russian military circles along similar lines to the U.S.,[104] Roger McDermott claims that "more than twenty years after forming its Armed Forces, the Russian Federation is yet to narrow the gap between defense capacity, force structure and the state's changing strategic-threat environment."[105] The space sector is caught up in this malaise, demonstrated with a Stalinist spirit in 2012 when a defence industry official, Dmitry Rogozin, after referring to note written by Stalin to 'encourage' machine gun magazine production said that: "our satellites are falling, our ships are sinking, we had seven space failures in the last 18 months but not a single plant felt the consequences… The culprits should come on stage. The country should know them.""[106] As significant as Russia is as a spacepower, it has been eclipsed somewhat by Chinese space development.

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[101] Jana Honkova, 'The Russian Federation's Approach to Military Space and its Military Space Capabilities', *Policy Outlook*, November 2013, (Washington, D.C.: George C. Marshall Institute) p. 25
[102] Ibid., p. 7
[103] David A. Vallado and Jacob D. Griesbach, 'Simulating Space Surveillance Networks', Paper AAS 11-580 presented at the AAS/AIAA Astrodynamics Specialist Conference. 31/07/11-04/08/2011, Girdwood, A.K., pp. 5-6
[104] Honkova, 'The Russian…' pp. 5, 40
[105] Roger McDermott, 'The Transformation of Russia's Armed Forces', in: Roger McDermott, ed., *The Transformation of Russia's Armed Forces: Twenty Lost Years* (Abingdon: Routledge, 2015) p. 3
[106] Gleb Bryanski, 'Russia's Putin calls for Stalin-style "leap forward"', *Reuters*, 31/08/2012, http://www.reuters.com/article/2012/08/31/us-russia-putin-stalin-idUSBRE87U16420120831 (accessed 01/07/2015), found in: Stephen Blank, 'Russia's Armed Forces and Future Warfare: Lt. Kizhe Rides Again: Magical Realism and Russian National Security Perspectives', in: McDermott, *The Transformation of*... p. 30

China is developing a significant Earth and space observation capability alongside wider military modernisation drives, including space warfare capabilities. It is easy to view Chinese achievements in space as nothing short of remarkable, given its recent historical context. It has rapidly gone from a relatively underdeveloped country devastated by subversion, conquest, imperialism, the systematic pillaging of its population and land, civil war, and disastrous mismanagement[107] to a modern space power with few equals and arguably only one superior. Since the early days of Qian Zuesen and Nie Rongzhen's 'two bombs and one satellite' effort,[108] China has become more dependent on space systems. Since the death of Mao Zedong in the mid-1970s Chinese missile/rocket and satellite design took a more developmental approach, as opposed to military-orientated needs.[109] Chinese space systems began to contribute to Chinese economic development by linking together remote and disparate regions, and providing topographical and meteorological data. Today, Chinese spacepower is also being looked at an enabler of the 'informationalisation' of the People's Liberation Army (PLA), and to attack an enemy's Achilles' Heel.[110] As space systems have become more crucial for military modernisation and tactical and operational capability, between 2000 and 2002 Chinese Defence White Papers moved from opposing the 'militarisation of space' to enunciating their opposition only to the 'weaponisation of space.'[111]

China's terrestrial forces are evolving to depend more on space systems, echoing those of the United States. China could face a range of contingencies upon which Beijing may call on the PLA. This includes a Taiwan scenario,[112] maritime conflicts with other Asian powers over the South China Sea, internal uprisings, or an emergency intervention into North Korean territory to secure nuclear sites and materials. Beijing's 'Malacca Dilemma' – its alleged strategy of placing a 'String of Pearls' made up of naval bases and listening posts across the Indian Ocean, and the PLA's desire to win a

[107] Referring to the 'Great Leap Forward' and the 'Cultural Revolution'.
[108] Two bombs refer to the fission and fusion bombs. See: Dean Cheng, 'Spacepower in China', in: Lutes et al., *Toward a Theory…*
[109] Handberg and Zhen, *Chinese Space Policy…* pp. 82-83, 90
[110] Kevin Pollpeter, 'The Chinese Vision of Space Military Operations', in James Mulvenon and David Finkelstein, eds. *China's Revolution in Doctrinal Affairs* (Alexandria, VA: Center for Naval Analysis, 2005) p. 356
[111] Ibid., p. 354
[112] For a speculation of the role of space systems in such a conflict, see: Michael O'Hanlon, *Neither Star Wars nor Sanctuary* (Washington, D.C.: Brookings, 2004) pp. 91-104

command of the sea and the air for these contingencies[113] – are all limited and enabled to varying extents by its capability to achieve some form of the control or denial of space and cyberspace, which is essential for any sort of local or regional geographic dominance in wartime, and the PLA recognises this.[114] Indeed, if China's participation in anti-piracy missions off the Horn of Africa, disaster relief operations, and multinational training exercises are a sign of things to come with the PLA Navy (PLAN), space capabilities are to become more crucial.[115]

As within Russia, the 1991 Gulf War confirmed beliefs within the PLA that first emerged in the mid-1980s – there was a need for (a) standing forces with a high level of readiness; (b) integration of military services for joint operations; and (c) effective C4ISR capabilities.[116] According to Peter Hays, "China has moved more quickly in developing a wider range of space capabilities… and today has deployed comprehensive space systems that are less capable but parallel to those of the United States in all mission areas except for space-based missile launch detection."[117] By 2011, "China [had] substantially narrowed the gap between it and the United States in the amount of time it can reconnoiter maritime targets from space each day."[118] New Chinese space systems are providing China with more tactically relevant information for its weapons systems.[119]

Regardless of the finer points of distinction in the debate over how unique China is as a spacepower,[120] China is modernising its armed forces with space and information technology, after having modernised much of its domestic infrastructure. The constraints of physics are common to the

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[113] Geoffrey Till, *Seapower: A Guide for the Twenty-first Century*, 3rd Edition (Abdingdon: Routledge, 2013) p. 219

[114] Dean Cheng, 'Prospects for China's Military Space Efforts', in Roy Kamphausen, David Lai, Andrew Scobell, eds. *Beyond the Strait: PLA Missions Other Than Taiwan* (US Army War College, 2009), particularly pp. 224-225

[115] Chinese Central Government, 'The Diversified Employment of China's Armed Forces', Beijing, 16/04/2013, available at: http://news.xinhuanet.com/english/china/2013-04/16/c_132312681_4.htm (accessed 17/04/2013); on the debate within China on the role of the PLAN and Chinese seapower for the 21st century, see: Andrew S. Erickson, Lyle J. Goldstein, Carnes Lord, eds. *China Goes to Sea: Maritime Transformation in Comparative Historical Perspective* (Annapolis, M.D.: Naval Institute Press, 2009)

[116] Paul H.B. Godwin, 'The PLA Faces the Twenty-First Century: Reflections on Technology, Doctrine, Strategy, and Operations', in James R. Lilley and David Shambaugh (ed.) *China's Military Faces the Future* (Washington, D.C.: East Gate, 1999) p. 55

[117] Hays, *Space and Security…* p. 95

[118] Eric Hagt and Matthew Durnin, 'Space, China's Tactical Frontier', *Journal of Strategic Studies* (34:5, 2011) p. 734

[119] Ibid., p. 735-736

[120] See: Handberg and Zhen, *Chinese Space Policy…* pp. 11-14

major spacepowers, but the use made of and priorities given to various space systems and technological advances vary according to their perceived needs. That said, there may be some value in appreciating the nuanced influences of differing strategic and military cultures in the contexts of the universal constraints of physics and opportunities of space-based data transmission and gathering, as explored in proposition VI.

India, too, has developed a large and robust spacepower infrastructure in the wake of an imperial legacy. India has a long-established space programme under the auspices of the Indian Space Research Organisation (ISRO), founded in August 1969. Today, India is claimed to possess "one of the most extensive domestic satellite communications networks in Asia."[121] Through spacepower New Delhi has, *inter alia*, secured water supplies for its population, protected crops from pests and severe weather, mapping geographic risks, and pioneered satellite tele-education.[122] Indeed, in a follow-up programme to its successful Satellite Instructional Television Experiment (SITE), India broadcast information via the Satellite Telecommunications Experimental Project (STEP) in response to natural disasters "and for broadcasting other matters of national importance (viewers noted that cricket matches fell within this definition)."[123] India's military, too, stands to gain great advantages by modernising its large and scattered armed forces with spacepower.[124]

These illustrative examples show how spacepower is proliferating, horizontally and vertically, and is providing more targets worth shooting down or aspects of critical infrastructure that may be harassed in times of war.[125] In other words, the proliferation of spacepower makes space warfare more attractive (if not necessary in some cases) as a strategic option (see next chapter). Not only is

[121] Jaramillo, ed., *Space Security Index 2014…* p. 16
[122] Sheehan, *The International…* pp. 147-151; Brian Harvey, Henk H.F. Smid, and Theo Pirard, *Emerging Space Powers: The New Space Programs of Asia, the Middle East, and South America* (Chichester: Praxis, 2010) pp. 155-158, 173-183
[123] Harvey et al., *Emerging Space…* p. 157
[124] Sheehan, *The International…* p. 152
[125] Studies of many states and their space capabilities can be found elsewhere on powers such as Brazil, European states and the European Union, Israel, Argentina, Iran, North Korea, South Korea, Japan, Nigeria, and others, but a broadened empirical description would not add any further substance given the intent of the thesis. For example, see: Sheng-Chih Wang, *Transatlantic Space Politics: Competition and cooperation above the clouds* (Abingdon: Routledge, 2013); Harding, *Space Policy…*; Eligar Sadeh, ed. *Space Strategy in the 21st Century* (Abingdon: Routledge, 2013); Harvey et al., *Emerging Space…*; Saadia M. Pekklanen and Paul Kallender-Umezu, *In Defense of Japan: From the Market to the Military in Space Policy* (Stanford: Stanford University Press, 2010)

spacepower and orbital critical infrastructure proliferating, so are the twin realisations that modern and efficient warfare depends upon it and adversarial space infrastructure is becoming a potentially lucrative target. Spacepower theory can play a part in helping make sense of the vast array of possibilities in space warfare, and how it relates to the recent past, present, and future of the human experience of politics and war on Earth.

## Conclusion: The Space Age

"We must ponder the ambiguities of the Space Age, because we have to live in it, willy-nilly." – Walter McDougall[126]

This chapter has introduced the very basics of astrography and orbital mechanics; the functions of satellites; how they collectively form diverse critical infrastructures; how this has become integral to modernised armed forces; and how spacepower has proliferated across the globe. Earth orbit as a cosmic coastline, which begins at a nominal altitude of 100km and reaches to around 40,000km, is only one part of 'outer space' and is where this thesis is ultimately concerned with, alongside relevant events on Earth.[127] Earth orbit is a diverse place, with hazardous zones of enhanced radiation, diverse orbital paths that allow different satellites to perform different functions, and where human intuition of physics on Earth are of little use to understanding orbital movement. Space systems have also become a critical infrastructure, providing numerous services that enable a global digital information-based economy. With more states and other actors in the global political-economy coming to benefit from, and depend upon, space technology for security and development needs, the risks of losing space systems or the benefits of denying them to an adversary become more apparent. As spacepower has proliferated vertically (within actors) and horizontally (to more actors) it is not unreasonable to think of a more global 'Space Age' than in the classic Cold War space race era from the 1950s to the 1970s. Space systems today form critical infrastructure to the global political-economy as we know it. It also allows states to develop dual-use technology. As a pitchfork can turn

[126] Walter McDougall, *…The Heavens and the Earth: A Political History of the Space Age* (Baltimore, M.D.: Johns Hopkins University Press, 1985, 1997) p. 451

[127] Spacepower theory may only become relevant beyond Earth orbit once a human political-economy escapes Earth's gravity well and into interplanetary space.

the soil to plant the seeds of the next harvest, a farmer can turn a pitchfork or any farming equipment to violent ends. Satellite data can be used to boost yields through precision agriculture but also to further the passage of arms. A rocket can carry a satellite or a nuclear warhead – the sole differences are payload and intent.

As spacepower becomes more influential on operational and tactical levels of warfare, the denial of the right space systems and their lines of communications at the right time against the right terrestrial forces could help tip the scales in favour of one side or another in an engagement, causing the opposing side to disperse or face certain defeat (explored in Proposition VII). When the dispersing effects of a superior spacepower capability on terrestrial warfare are realised, it is unsurprising that three of Earth's major military powers have active or at least residual anti-satellite or counterspace weapons programmes and deployments to deny celestial lines of communications to foes and protect their own. Moving past the contours of the RMA debate and developing spacepower theory that is rooted in a Clausewitzian methodology (the subject of Chapter 3), the universal elements of spacepower and its consequences for modern warfare becomes more apparent, intelligible, and less ethnocentric (Proposition VI addresses ethnocentrism). The beginning of the integration of spacepower, and information technology, into the U.S. military in from the 1980s was no small part of the debate on whether the U.S. military, and warfare itself, was undergoing an RMA. However, spacepower – as a theme in its own right – was overshadowed by the RMA debate, similar to SDI in the 1980s, as Gray and Sheldon argue.[128] This may have inhibited thinking about space as 'just another' realm for conflict and a form of power, and not as somewhere that is only relevant insofar as it may or may not transform the character of war on Earth. The influence of spacepower on warfare has led the United States, China, and Russia to research, develop, and maintain residual antisatellite or counterspace capabilities. There is a large body of literature on space warfare, but it too often only examines a narrow aspect of it: space-based weapons and the prospect of space weaponisation. The next chapter examines this literature and puts debates on space weaponisation in its context of proliferated spacepower and critical infrastructure and where it fits relative to a theory of spacepower.

[128] Gray and Sheldon, 'Space Power…' pp. 23-25

# Chapter 2: From Space Weapons to Spacepower Theory

"Technology is our subcreation. We made it, we will be disappointed in it, but we must love it anyway, or it cannot be redeemed." – Walter McDougall[1]

## Introduction

The previous chapter set the context of spacepower theory through orbital mechanics, the development of space infrastructure, the integration of spacepower into conventional military capabilities, and its proliferation across Earth. This chapter completes this context of spacepower theory by discussing space warfare technological development and the literature on space weaponisation, before defining spacepower and outlining its position in wider astropolitical literature. The literature on space weaponisation is large enough to warrant significant scholarly examination; it disproportionately dominates international relations, strategic studies, and security studies analyses within astropolitics. Resultantly there needs to be a summary of these debates and a justification for escaping the gravity well of the narrow weaponisation debate. First, however, this chapter briefly explores some historical and contemporary anti-satellite weapons capabilities in the United States, China, and Russia as they represent the most capable states in these areas. These have been placed in this chapter (rather than the previous chapter) as it leads into the space weaponisation debate. Space weapons development (and the threat of it) is self-evidently intertwined with discussions on space weaponisation. There is no intent to get into the finer details of the space weaponisation debate as the base assumptions of the debate pose problems for the construction of spacepower theory. The space weaponisation debate – usually centred upon whether the United States should base 'weapons' in Earth orbit or not – has an intellectually stifling quality if the intention is to provide a wide-ranging and universally relevant strategic education on spacepower and how to go about its practical application. Space-based weapons are but one part of the whole vista of spacepower. There are no overtly deployed space-based weapons, but several technologies and capabilities exist in some form that could be turned to hostile purposes because of the dual-use nature of the relevant technologies.

[1] Walter McDougall, *…The Heavens and the Earth: A Political History of the Space Age* (Baltimore, M.D.: Johns Hopkins University Press, 1985, 1997) p. 460

One example is the 'on-orbit inspection' technologies and close manoeuvring capabilities being tested by the United States and Russia.[2] China has also conducted 'proximity operations' – satellite manoeuvres that take one close to another that can be used for inspection, docking, or to behave as a 'space mine' that can stalk a target satellite and be set to explode or interfere with its prey when the order is given.[3] As stated in the previous chapter, space is arguably not weaponised, although it is a highly militarised realm (i.e. used for military purposes). Finally, this chapter ends with a definition of spacepower, in order to demonstrate how it has been interpreted by others and spelling out that spacepower theory is a type of strategic theory and which is examined in the following chapter.

## 2.1 Antisatellite Capabilities

"During the Cold War [naval targeting satellites] were vital to each side's plans to destroy the other's fleets, and they were therefore well worth destroying." – Norman Friedman[4]

Antisatellite capabilities are essential to wage space warfare, both in the electromagnetic spectrum and the physical realm. As chapters 3 onwards are orientated towards developing theory, a basic knowledge of which tools are available to do such things is necessary. A strategic mind can then begin to visualise the practicalities and realities of space warfare beyond the abstractions of spacepower theory whilst reading and considering the theory. Today, the United States, China, and Russia possess a range of counterspace capabilities. Many states possess some residual space weapons capabilities, but for the sake of brevity and illustration, the United States, Russia, and China are used here to illustrate existing systems. The label 'antisatellite weapon' is a more restrictive term because it denotes physical action taken against a satellite, while 'counterspace' is more open to include any methods that cause effects against a satellite's normal functioning.[5] Counterspace can include:

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[2] Mike Gruss, 'Maneuvering Russian Satellite Has Everyone's Attention', *Space News*, 17/07/2015, http://spacenews.com/maneuvering-russian-satellite-has-everyones-attention/ (accessed 18/07/2015); Brian Weeden, 'Dancing in the dark redux: Recent Russian rendezvous and proximity operations in space', *The Space Review*, 05/10/2015, http://thespacereview.com/article/2839/1 (accessed 06/10/2015)

[3] Brian Weeden, 'Dancing in the dark: The orbital rendezvous of SJ-12 and SJ-06F', *The Space Review*, 30/06/2010, http://thespacereview.com/article/1689/1 (accessed 06/10/2015); Weeden, Dancing in the dark redux…'

[4] Norman Friedman, *Seapower and Space: From the Dawn of the Missile Age to Net-Centric Warfare* (London: Chatham, 2000) p. 10

[5] Such is the definition of 'counterspace' in: Bruce W. McDonald, 'China, Space Weapons, and U.S. Security', Council Special Report No. 38 (Washington, D.C.: Council on Foreign Relations, 2008) p. 50, endnote 2.

electronic warfare (EW) that interferes with celestial lines of communication, or jamming; attacks on Earth-based facilities; and the use of antisatellite weapons that range from hit-to-kill or explosive devices (known as physically destructive antisatellite weapons), particle beam weapons, radiofrequency weapons, directed energy weapons, satellite-on-satellite ramming, and nuclear weapons.[6] USAF doctrine describes 'counterspace' in much the same fashion, and its description of the 'suppression of adversary counterspace capabilities' includes the deception, denial, disruption, degradation, and destruction of "air, land, maritime, space, special operations, or information operations in response to an attack or threat of attack."[7] Multi-environment and multi-method aspects of 'space warfare' are necessary, and single-environment views of spacepower and space warfare will blinker holistic analyses.[8]

### 2.1.1 A very brief history of antisatellite weapons

Early antisatellite weapons programmes relied on missile-launched nuclear warheads to destroy the satellite with an area-effect fireball and an electromagnetic pulse.[9] The United States was the first to test an antisatellite weapon, with the Bold Orion and High Virgo systems which were nuclear-tipped air-launched ballistic missiles, between May 1958 and October 1959.[10] In the post-Cuban Missile Crisis context of the 1960s the Soviet Union and the United States had agreed to stop testing nuclear weapons in orbit, codified in the Limited Test Ban Treaty (LTBT) in 1963, and then outlawed the basing of nuclear weapons (under the term 'weapons of mass destruction') in orbit under Article IV of the Outer Space Treaty (OST) of 1967. The LTBT paved the way for the OST in the manner it expressly allowed the 'military' uses of space (such as reconnaissance satellites, launch detection, and military communications). But the ban on nuclear weapons in orbit "though reassuring to a nervous world, meant little" in the context of the continued prospect of nuclear war from nuclear

[6] For an overview of all of these, see: Air Command and Staff College Space Research Electives Seminars, *AU-18 Space Primer* (Maxwell AFB, AL: Air University Press, 2009) pp. 273-281
[7] U.S. Air Force, 'Annex 3-14 Space Operations', 19/06/2012, https://doctrine.af.mil/download.jsp?filename=3-14-Annex-SPACE-OPS.pdf (accessed 05/10/2015) p. 62
[8] This point is taken up in Propositions III and V, which stress the multi-environment reality of spacepower.
[9] L. Parker Temple III, *Shades of Gray: National Security and the Evolution of Space Reconnaissance* (Reston, V.A.: American Institute of Aeronautics and Astronautics, 2005) pp. 110-111, 271
[10] Brian Weeden, 'Through a Glass, Darkly: Chinese, American, And Russian Anti-satellite Testing in Space', (Washington, D.C.: Secure World Foundation, 2014) p. 21

weapons based on Earth. It was a recognition by the Soviet Union that it had the same interest as the United States in developing military satellite support systems without interference short of overt hostilities.[11]

Despite this, since the 1960s antisatellite weapons and counterspace capabilities had proliferated in terms of basic research, especially when the dual-use nature of missile defence and laser technology is considered alongside jamming capabilities. The U.S. Nike Zeus missile defence programme, for example, enabled Project Mudflap, which was designed to counter the Soviet Fractional Orbital Bombardment System (FOBS).[12] FOBS was the Soviet system to deploy nuclear-capable weapons in orbit, ready to re-enter the atmosphere and destroy the United States by approaching from the southern hemisphere, bypassing the Ballistic Missile Early Warning System (BMEWS). [13] In 1983, SALT-II (Strategic Arms Limitation Treaty) prohibited FOBS and consigned it to the pages of history.[14] In the 1970s, the *Salyut-3* space station was equipped with a so-called self-defence gun which was remotely test-fired shortly before the space station was de-orbited.[15]

Another significant Soviet antisatellite weapons system was the co-orbital satellite weapon *Istrebitel Sputnikov* (IS – 'satellite destroyer') and later *Naryad* – demonstrating a different preference in antisatellite technologies to the United States and China, which have to date tended to prefer 'direct ascent' Earth-based antisatellite weapons, rather than space-based weapons systems.[16] However, as mentioned above, the U.S. and China have tested such technologies themselves. The IS system became operational in 1979, and its upgrade was declared operational in 1991.[17] Pavel Podvig

[11] Mc Dougall, *...The Heavens...* pp. 274-275
[12] Weeden, 'Through a Glass…', p. 23
[13] Miroslav Gyűrösi, 'The Soviet Fractional Orbital Bombardment System Program: Technical Report APA-TR-2010-0101', *Air Power Australia*, January 2010, updated April 2012, http://www.ausairpower.net/APA-Sov-FOBS-Program.html (accessed 10/07/2015)
[14] GlobalSecurity.org, 'R-36-O / SL-X-? FOBS', http://www.globalsecurity.org/wmd/world/russia/r-36o.htm (accessed 05/11/2015)
[15] Anatoly Zak, 'Spacecraft: Manned: Almaz: OPS-2 (Salyut-3)', *Russian Space Web*, http://www.russianspaceweb.com/almaz_ops2.html (accessed 02/11/2015)
[16] Weeden, 'Through a Glass…' p. 30
[17] Jana Honkova, 'The Russian Federation's Approach to Military Space and its Military Space Capabilities', *Policy Outlook*, November 2013, (Washington, D.C.: George C. Marshall Institute) p. 35

claims that Russia had no specific plans for "anti-satellite systems",[18] yet the residual capabilities are there, and dual-use techniques are being developed.

In 1985 a U.S. ASAT weapon, the Miniature Homing Vehicle (MHV), was launched from an F-15 during flight.[19] This allowed some measure of a responsive antisatellite weapon (in terms of launch-to-interdiction points, maintenance access, and general readiness) that could be aimed at low-orbiting targets. This weapon system was partly in response to the Soviet development of the Radar Ocean Reconnaissance Satellite (RORSAT, or US-A in Russian) – an ocean-spying electronic intelligence (ELINT) satellite.[20] The playing down of the threat of RORSAT to U.S. ships by the U.S. Navy may have reflected the fact that the MHV was a USAF programme.[21] Meanwhile, China's Programme 863 was launched under the 'State High-Tech Development Plan' which included developments in military space technology.[22]

### 2.1.2 Antisatellite weapons today: Back to the future?

Today, China's ELINT programme, in conjunction with weapons systems like the anti-ship ballistic missile (ASBM), could be a powerful motive for the United States (or any belligerent facing the People's Liberation Army) to neutralise Chinese celestial lines of communication, much like how RORSAT threatened the U.S. Navy in the 1980s.[23] Indeed, satellite systems such as GPS and RORSAT are more orientated towards tactical and operational combat and targeting support rather than the arms control treaty verification and reconnaissance satellites that contribute to nuclear

[18] Pavel Podvig, 'Russia and Military Uses of Space', in: Pavel Podvig and Hui Zhang Pavel Podvig and Hui Zhang, *Russian and Chinese Responses to US Military Plans in Space* (Cambridge, MA: American Academy of Arts and Sciences, 2008) p. 4

[19] Wade Boese, 'Chinese Satellite Destruction Stirs Debate', *Arms Control Association*, March 2007 http://www.armscontrol.org/act/2007_03/ChinaSatellite (accessed 25/02/2013); Forrest E. Morgan, *Deterrence and First-Strike Stability in Space: A Preliminary Assessment* (Washington, D.C.: RAND, 2010) p.12

[20] Podvig, 'Russian…' p. 10

[21] Paul B. Stares, *Space and National Security* (Washington, D.C.: Brookings Institution, 1987) pp. 131-136

[22] Yongjin Zhang, 'The eagle eyes the dragon in space – A critique', *Space Policy* (29, 2013) p. 119

[23] On Chinese ELINT and ASBM, see: Ian Easton and Mark A. Stokes, 'China's Electronic Intelligence (ELINT) Satellite Developments: Implications for U.S. Air and Naval Operations' (Washington, D.C.: Project 2049 Institute, 2011); Andrew S. Erickson, *Chinese Anti-Ship Ballistic Missile (ASBM) Development: Drivers, Trajectories, and Strategic Implications* (Washington, D.C.: Jamestown Foundation, 2013)

stability and had little tactical impact on military capabilities.[24] However, in a nuclear war, they may be of little ultimate relevance as such a war may centre upon or escalate to the eradication of entire cities with nuclear weapons that are able to survive a first strike; but in a war that remains non-nuclear or in pre-nuclear hostilities, it may be useful to challenge the command of space of an enemy that depends on space for conventional combat capabilities, economic life, and diplomacy.[25] Satellites, then, are potential targets in warfare in a context where nuclear escalation may not be a significant factor. Regional wars between major spacepowers and small non-nuclear powers may be illustrative of such scenarios (e.g. China-Vietnam, U.S.-Islamic State, Turkey-Kurds, Russia-Ukraine, Syrian Government-rebels).

The United States and China continue to research and develop space weapons, or technologies that could be construed as being space weapons owing to the dual-use nature of such technology. The 2008 US antisatellite test's SM-3 missile was launched from a warship that also has a missile defence function,[26] and in 2014 the USAF declassified its Geosynchronous Space Situational Awareness Program. Those satellites will reside in GEO, and will be able to rendezvous and manoeuvre very close to target satellites, in addition to contributing to space situational awareness.[27] The 2007 Chinese antisatellite test used a mobile land-based launcher,[28] and China has conducted a series of tests from 2005 onwards that proved an ability to intercept satellites at various altitudes.[29] China has also launched rockets on ballistic trajectories that could be used for satellite intercept missions, this time hinting at a Chinese interest in developing antisatellite weapons that can reach

[24] Herbert F. York, 'Nuclear Deterrence and the Military Uses of Space', in: Franklin A. Long, Donald Hafner, Jeffrey Boutwell, eds. *Weapons in Space* (New York, NY: W.W. Norton, 1986) p. 22
[25] On the role of space warfare in the context of wider 'conventional' deterrence and nuclear deterrence, see: Morgan, *Deterrence*... pp. 16-21; John B. Sheldon, 'Deter War, Not Attacks Against Space Systems', *Space & Defense* (3:1, 2009) pp. 35-36. On China's development of a second strike nuclear capability, see: U.S.-China Economic and Security Review Commission, 2014 Annual Report to Congress, 20/11/2014, http://www.uscc.gov/Annual_Reports/2014-annual-report-congress (accessed 20/07/2015), pp. 301, 319-320
[26] Geoffrey Forden, 'A Preliminary Analysis of the Proposed USA-193 Shoot-down', 18/02/2008, revised 12/03/2008, http://web.mit.edu/stgs/pdfs/Forden_Preliminary_analysis_USA_193_Shoot_down.pdf (accessed 25/02/2013) p. 3
[27] USAF Space Command, 'Geosynchronous Space Situational Awareness Program (GSSAP)', 15/04/2015, http://www.afspc.af.mil/library/factsheets/factsheet.asp?id=21389 (accessed 18/07/2015)
[28] Shirley Kan, 'China's Anti-Satellite Weapon Test', Congressional Research Service Report for Congress, 23/04/2007, Washington, D.C. http://www.fas.org/sgp/crs/row/RS22652.pdf (accessed 25/02/2013) p. 1
[29] Weeden, 'Through a Glass…' p. 18

30,000km, almost at the GEO belt.[30] Such technologies will find a welcome in the PLA, if statements from its officials regarding the 'inevitability' of space warfare in the context of an anti-access or area-denial (A2/AD) campaign against the United States are an indicator of the PLA's wishes to embrace space warfare.[31] Regardless of the finer details as to the thinking among the PLA's leadership, "China's growing space capabilities translate into military capabilities that affect all aspects of conventional and nuclear targeting, ground-air-sea operations, precision conventional strike capacities, and missile defense."[32] Again, this assumes a decision has been made by both parties to engage in conventional hostilities either as a prelude to nuclear warfare or in ignorance of nuclear escalation.

These systems could be considered 'space weapons', although they may have alternative uses and stated design objectives such as missile defence. In 2009, the Russian Deputy Defence Minister Vladimir Popvkin 'reassured' journalists that Russia has demonstrated its ability to shoot down satellites since the 1960s, and in a separate statement claimed that Russia was developing direct-ascent antisatellite weapons. According to Honkova, the Russian interest in antisatellite weapons are borne of concerns over Chinese and American testing, as well as over U.S. ballistic missile defence (BMD) technological advances and deployments in Europe.[33] China, too, is developing BMD technologies, and the midcourse interception technologies have potential antisatellite capabilities.[34] Following suit and to broaden space warfare potential beyond the United States, Russia, and China,

[30] Brian Weeden, 'Anti-satellite Tests in Space – The Case of China', 18/05/2015 (Washington, D.C.: Secure World Foundation, 2015) p. 2, http://swfound.org/media/115643/china_asat_testing_fact_sheet_aug_2013.pdf accessed 10/07/2015

[31] Anthony H. Cordesman, Ashley Hess, and Nicholas S. Yarosh, *Chinese Military Modernization and Force Development: A Western Perspective* (New York, N.Y..: Rowman & Littlefield, 2013) p. 20

[32] Ibid., p. 257

[33] Honkova, 'The Russian Federation…' pp. 34-35

[34] On Chinese BMD, see: A. Vinod Kumar, 'Impressions on China's Second Missile Interceptor Test,' 22/02/2013, (New Delhi: Institute for Defence Studies and Analyses, 2013) http://www.idsa.in/idsacomments/ImpressionsonChinasSecondMissileInterceptorTest_avkumar_220213.html (accessed 10/07/2015); Lora Saalman, 'China's Evolution on Ballistic Missile Defense', 23/08/2012, (Washington, D.C.: Carnegie Endowment for International Peace, 2012) http://carnegieendowment.org/2012/08/23/china-s-evolution-on-ballistic-missile-defense (accessed 10/07/2015); Nuclear Threat Initative, 'China-Missile', May 2015 http://carnegieendowment.org/2012/08/23/china-s-evolution-on-ballistic-missile-defense (accessed 10/07/2015)

India is scoring initial successes in its missile defence technologies, which provide building blocks for antisatellite weapons systems including lasers and kinetic-kill vehicles.[35]

Space warfare is being hedged against by these three space powers, though few officials may use such frank language. A large body of literature centres on the issue of the hypothetical U.S. deployment of antisatellite weapons, space weapons, or space weaponisation. A recurring problem in the literature is that space-based weapons are sometimes the *only* weapons examined, to the detriment of other means (such as electronic warfare) of attacking space systems which can sometimes bring about the same results, or can be ascribed the attributes of a silver bullet that would solve terrestrial strategic ills by virtue of their deployment. This is not to dismiss debates regarding space-based weapons. It is to argue that they should be seen as one form of space warfare among many, when some alternatives may be more plausible than space-based weaponry.[36] The next section examines the broad contours of this literature that is based on the idea of space weaponisation as a central concern or focal point when discussing space warfare or 'space security.'

## 2.2 'Space Weapons' and 'Weaponisation'

"Unknowingly following their strategic antecedents, these theorists claim either that the sky is falling or that the magical new capability is the key to certain victory. We have seen it all before [as with torpedo boats, airpower, and atomic weapons.]" – Colin Gray[37]

There has been considerable debate on whether the United States should place weapons *in* space, and the debate has plenty of authors claiming a new era of panaceas for strategic problems through space-based weapons or that world politics will take a dystopian turn if and when Earth has

[35] See: Victoria Samson, 'India, China, and the United States in Space: Partners, Competitors, Combatants? A Perspective From the United States', *India Review* (10:4, 2011) esp pp.426-429; Victoria Samson, 'India's missile defense/anti-satellite nexus', *The Space Review*, 10/05/2010, http://www.thespacereview.com/article/1621/1 (accessed 10/07/2015); Michael Listner, 'India's ABM test: a validated ASAT capability or a paper tiger?', *The Space Review*, 28/03/2011, http://www.thespacereview.com/article/1807/1 (accessed 10/07/2015); Ajey Lele, 'Space security: possible options for India', *The Space Review*, 28/10/2013, http://www.thespacereview.com/article/2390/1 (accessed 10/07/2015)

[36] An example of a rare, but valuable, technical, legal, and practical study of space-based weaponry in the context of terrestrial warfare is: Bob Preston, Dana J. Johnson, Sean J.A. Edwards, Michael Miller, and Calvin Shipbaugh, *Space Weapons, Earth Wars* (Washington, D.C.: RAND, 2002)

[37] Colin S. Gray, *Another Bloody Century: Future Warfare* (London: Weidenfeld and Nicolson, 2005) p. 314

(American) orbiting weapons platforms. For the purposes of spacepower theory, that body of literature has little *conceptual* utility, despite its usefulness as a source of empirical information on space activities and the politics between and within spacepowers and arms control negotiations. Spacepower theory should consider the possibility of basing dedicated weapons in orbit in their rightful place as *one* form of space warfare. But it is not the task of spacepower theory to take a prescriptive policy position on whether or not it is desirable for particular belligerents to deploy space-based weapons under particular conditions – that is an act of political, economic, and military judgment. Debate on whether or not one state should place a particular kind of weapon system in a particular place is a narrow issue within a much bigger strategic context of a globalised political-economy, the conditions of nuclear relationships among the nuclear-armed states of Earth, and security dilemmas that may include, but are not restricted to, what occurs in space. To focus on space-based weapons to the exclusion of other technical means of space warfare and the wider strategic context within which they reside is an exercise in 'means-fetishism'.[38] What this section elucidates is everything a space weapon, and by extension space warfare, can be, and what kind of debate the space weaponisation arguments usually are. This is to distinguish the subject and idea of spacepower (theory) from the space weaponisation debate, and is a necessary step because of the predominance of space weaponisation in astropolitical literature. A persistent sticking point in space arms control negotiations and the space weaponisation debate has been an inability to form a consensus on what 'space weapon' and 'space weaponisation' actually mean. Their meanings can shift depending on one's policy position and political attitudes. Examining what a space weapon can mean is useful because it outlines why the space weaponisation debate is a poor way to deliver a strategic education on space warfare.

### 2.2.1 The trouble with terminology: Defining space weapons

The difficulty in defining a space weapon is due to the dual-use nature of space systems technologies (also referred to as duality) and that no commonly accepted space weapons are currently deployed *in orbit.* Rendezvous operations (docking between spacecraft), on-orbit repair (repairing

[38] Richard Wyn Jones, *Security, Strategy, and Critical Theory* (London: Lynne Rienner, 1999) p. 131

satellites in space), and even lasers for debris removal purposes can be construed as technologies which can be used for space warfare purposes.[39] Determining intent would be extremely difficult should a space power decide to utilise residual space weapons-related technologies to develop a covert space weapons programme; indeed, the 'dilemma of interpretation' is particularly acute with regard to all the systems that can be construed as 'space weapons' because of their symbolic ambiguity.[40] Defining weapons or systems according to their specific function is an understandable goal, however, since there is no dedicated 'space weapon' deployed, analysts are forced to consider technologies and systems which *could* be used for violent purposes, regardless of their original intent. The problem with this approach is that banning technologies which could be used for warfare would also mean banning useful technologies used for more benign or everyday infrastructure needs. Colin Gray likens this to attempting to ban aerial bombardment through banning civil aviation in the 1930s.[41]

Despite the suggestion that the coherent definition of space weaponry is impossible due to duality/dual use, scholars have not shied away from attempting to define them.[42] Describing the task as impossible and using it as a means to shut down space weapons debates is rightly condemned by Joan Johnson-Freese.[43] Other weapons which have dual-use technologies, such as those used in intercontinental ballistic missiles (ICBMs), have been defined for treaty purposes despite the problems raised by duality. A recent example is the New START (Strategic Arms Reduction Treaty) of 2010, which aimed to put limits on ICBM deployment but does not resolve the issue surrounding

[39] On debris removal systems and the problems raised by duality: Bleddyn E. Bowen, 'Cascading Crises: Orbital Debris and the Widening of Space Security', *Astropolitics* (12:1, 2014) pp. 46-68
[40] On the Security Dilemma and weapons as ambiguous symbols: Ken Booth and Nicholas J. Wheeler, *The Security Dilemma: Fear, Cooperation, and Trust in World Politics* (Basingstoke: Palgrave Macmillan, 2008) pp. 1, 4-5
[41] Gray, *Another…* p. 307
[42] For example: Gray, *Another…* p. 310-311; James Clay Moltz, *The Politics of Space Security: Strategic Restraint and the Pursuit of National Interests* (Stanford: Stanford University Press, 2011) pp. 42-43; Stephen Lambakis, *On the Edge of Earth: The Future of American Space Power* (University Press of Kentucky, 2001) p. 135; Michael O'Hanlon, *Neither Star Wars nor Sanctuary: Constraining the Military Uses of Space* (Washington, D.C.: Brookings Institution, 2004) p. 109
[43] Joan Johnson-Freese, *Heavenly Ambitions: America's Quest to Dominate Space* (Philadelphia: University of Pennsylvania Press, 2009) p. 80

the development and deployment of space launch vehicles and the potential for using those systems for ICBM-like purposes, or proliferating such technology.[44]

Defining a 'space weapon' matters because it influences any assumption over the current state of space weaponisation, which is an act of political judgment and intent (either as a policy actor or an analyst with preferred policy prescriptions to offer). One mischievous definition of space weapons by James Oberg argues that space could be understood to be already weaponised because 'weapons' have been in space since American astronauts and Soviet cosmonauts were required to carry firearms in their survival kits.[45] Another example is the claim that duality renders numerous pre-existing Earth-based weapons systems (like missile defence technologies) *de facto* space weapons, and therefore space is weaponised as states can destroy targets in space if they so choose even without basing weapons in space. If space weaponisation is a condition that is to be prevented or exploited because it will mean that Earth orbit will become a realm for direct violence and satellites become targets, it is hard to take the notion of weaponisation seriously when it does not include the reality of Earth-based antisatellite or other counterspace weapons. A space weapon definition proposed by the UN Institute for Disarmament Research (UNIDIR) in 1991 opens the definitional floodgates when it defines a space weapon as:

> "a device stationed in outer space… or in the earth environment designed to destroy, damage or otherwise interfere with the normal functioning of an object or being in outer space, or a device stationed in outer space designed to destroy, damage or otherwise interfere with the normal functioning of an object or being in the earth environment. Any other device with the inherent capability to be used as defined above will be considered as a space weapon."[46]

If space systems with *inherent* capabilities for destroying, disabling, or interfering with satellites are classed as space weapons, then trying to prevent space weaponisation is a futile effort because the

[44] Protocol to the New Strategic Arms Reduction Treaty (New START), Prague, 08/04/2010, available at: http://www.state.gov/documents/organization/140047.pdf (accessed 26/02/2013), p. 2
[45] James Oberg, *Space Power Theory* (USAF Academy, 1999) p. 144
[46] David Webb, 'On the definition of a space weapon', The Praxis Centre. From a presentation: Webb, D.C., "When is a Space Weapon Not a Space Weapon?" presented at the British International Studies Association Annual Conference BISA05, Andrews University, December 2005, http://praxis.leedsmet.ac.uk/praxis/documents/space_weapons.pdf(accessed 04-02-2013)

opportunity for doing so has already passed. For example, ground-based lasers are routinely used as part of space infrastructures to precisely locate satellites. Weapons-grade lasers are merely a matter of increasing power output and refining focusing lenses. In addition, the classing of 'interference' as a role of space weapons also opens the door to jammers and reversible electronic effects, or electronic warfare to be classed as kinds of 'space weapons'.

As examples, the U.S. Air Force (USAF) 76th Space Control Squadron operates the Counter Communications System (CCS), a mobile ground-based system designed to attack enemy celestial lines of communication between satellites and terminals or users on Earth (Proposition IV examines celestial lines of communication in more depth).[47] Electronic warfare is not unique to space warfare – an excellent example that demonstrates the ubiquity of electronic warfare, or the need for 'electromagnetic spectrum control' (EMS control) is the U.S. Marine Corps' (USMC) Marine Air Ground Task Force (MAGTF) concept which aims to develop overall electronic warfare capabilities that are 'platform agnostic'. In other words, the integration of electronic warfare devices suited for all environments and technical or vehicular support systems, within which are space systems and celestial lines of communication that the USMC depends upon.[48] China is reported to have installed "advanced electronic warfare systems on some of its aircraft" and may seek to conduct computer network attacks that interact with celestial lines of communication through its integration of electronic warfare and cyber espionage capabilities.[49] Russian military thinking may be orienting towards integrating electronic warfare into its precision strike systems, and already possesses matured technologies in this regard from the Soviet era – such as the *Khibiny* modular airborne electronic warfare suite.[50] Given the ubiquity of electronic communications, it is understandable that electronic warfare specialists are now stating that EMS is *the* mission, as opposed to merely supporting others.[51]

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[47] USAF, '76th Space Control Squadron', Peterson Air Force Base, 24/03/2013, http://www.peterson.af.mil/library/factsheets/factsheet.asp?id=4808 (accessed 20/07/2015)
[48] U.S. Marine Corps, 'Marine Air Ground Task Force (MAGTF) Electronic Warfare (EW)', U.S. Marine Corps Concepts and Programs, 03/03/2015, https://marinecorpsconceptsandprograms.com/programs/aviation/marine-air-ground-task-force-magtf-electronic-warfare-ew (accessed 20/07/2015)
[49] U.S.-China Economic and Security Review Commission, 2014 Annual Report to Congress, 20/11/2014, http://www.uscc.gov/Annual_Reports/2014-annual-report-congress (accessed 20/07/2015) pp. 309, 313, 327
[50] Honkova, 'The Russian Federation…', p. 3
[51] John Knowles, 'The EW Phalanx', *The Journal of Electronic Defense* (37:1, 2014) p. 6

However, like space warfare, electronic warfare too must be subordinated to an overall joint war plan that satisfies political aims.

Despite this, claiming that weaponisation has already occurred clashes with the views of governments and analysts that may declare it otherwise.[52] Failing to acknowledge and accommodate differing constructed conceptions of the present state of space weaponisation could lead to (and arguably has already caused) a 'dialogue of the deaf' with different camps failing to appreciate each other's premises. Indeed, as the main proponents of the draft Treaty on the Prevention of the Placement of Weapons in Outer Space (PPWT), the Chinese and Russian governments do not necessarily view space as already weaponised (despite the existence of Earth-based space weapons): if they did, they would not see the need for a treaty to prevent the placing of 'weapons' there in the first place.[53] The United States does not engage in these discussions because it refuses to accept the premise that an arms race in space is occurring, and therefore there is no problem for arms control to solve; space is not weaponised, and no state is actively deploying 'space weapons.'[54] Joan Johnson-Freese summarises the definitional problem well when she argues that:

> "the narrowest definitions hold that space weapons are those systems in which the destructive component resides in orbit. A slightly broader category includes both terrestrial and space-based systems directed at space-based and terrestrial targets. The broadest category includes fundamentally all space systems: any dual-use capability… The first category is so narrow it excludes a number of ground-based or air-based programs that would result in the same effect as space-based programs… The last category is so broad, however, that it offers little utility."[55]

Michael Krepon agrees, stating that: "an inclusive definition of a space weapon would foreclose essential military capabilities, while a limiting definition would allow many kinds of latent

[52] Karl P. Mueller, 'Totem and Taboo: Depolarizing the Space Weaponization Debate', in John M. Logsdon and Gordon Adams, eds. *Space Weapons: Are They Needed?* (Washington D.C.: Space Policy Institute, 2003) p. 3
[53] Conference on Disarmament (CD), CD/1839, 29-02-2008, Draft: TREATY ON PREVENTION OF THE PLACEMENT OF WEAPONS IN OUTER SPACE AND OF THE THREAT OR USE OF FORCE AGAINST OUTER SPACE OBJECTS (PPWT), available at: http://www.cfr.org/space/treaty-prevention-placement-weapons-outer-space-threat-use-force-against-outer-space-objects-ppwt/p26678 (accessed 06/10/2015)
[54] Michael Moore, *Twilight War: The Folly of US Space Dominance* (Oakland: Independent Institute, 2008) p. 206
[55] Johnson-Freese, *Heavenly Ambitions…* p. 80

[antisatellite] systems to run free."[56] Across this spectrum of definitions of space weapons, a workable definition could be crafted in between this push and pull of the narrow and broad definitions of 'space weapon.' Johnson-Freese defines a space weapon as any system based anywhere that is designed and operated for the purpose of physically disabling and destroying satellites, and to attack terrestrial targets from space. Her definition specifically excludes jamming or electronic warfare technology as weapons because their effects are reversible, unlike other antisatellite systems.[57] Michael Moore refers to a space weapon as a kinetic- or explosive-kill antisatellite weapon;[58] Bulkeley and Spinardi also restricted space weapons to physically destructive systems.[59] The permanence of effects, according to these authors for their studies, should be a crucial distinction between space weapons and other possibly 'offensive' systems.

A strong case can be made to the contrary. Reversible effects usually mean that a satellite's functions can be restored as they were before hostile action began, and very valuable satellites could be bargaining chips as hostages in peace negotiations. If applied judiciously and competently, reversible electronic warfare and cyber-counterspace operations could be used with minimal collateral damage (to the space environment) with the potential of returning the hostage satellite(s) or space system back to its owner intact – a potentially attractive peace offering depending on the exact character and value of the space systems and belligerents involved. Excluding jammers from a definition of 'space weapon' may be problematic, because, like the UNIDIR use of 'interference' as a weapon's possible function, the PPWT leaves some scope for jamming technology to be considered as weapons by choosing to include the phrase "to… disrupt".[60] Rejecting electronic warfare devices from an analysis of space weaponisation and space warfare may make it a conceptually 'cleaner' exercise, yet such a view precludes the possibility that practitioners and policymakers consider them to be space weapons and parts or space denial operations, given some of the official definitions exhibited in this chapter. Omitting reversible counterspace devices and effects is unwise if we wish to understand

[56] Michael Krepon, 'What is a Space Weapon?', *Arms Control Wonk*, 18/03/2010, http://krepon.armscontrolwonk.com/archive/2665/what-is-a-space-weapon (accessed 04/02/2013)
[57] Johnson-Freese, *Heavenly Ambitions…* p. 81
[58] Moore, *Twilight War…* p. xvii
[59] Rip Bulkeley, Graham Spinardi,. *Space Weapons: Deterrence or Delusion?* (Cambridge: Polity Press, 1986) p. 3
[60] CD/1839, 29-02-2008, PPWT, p. 3

all possible forms of denying celestial lines of communication, or space warfare. To better grasp how 'space warfare' may manifest itself, one needs to account for the possibility of electronic warfare being used. Indeed, the use of electronic warfare against space assets already has historical precedent as Iraq attempted to jam coalition satellite signals in the 2003 Iraq War.[61] Proposition I (see chapter 4) takes the view that the method matters in so far as the effects it generates – if reversible weapons systems secure or challenge the command of space by disrupting celestial lines of communication at a critical time for terrestrial operations, whether it is permanent or not is a secondary (yet an important long-term) concern for war planners.

As well as UNIDIR, China, Russia (the Russian position can be traced back as far as 1981[62]), and the U.S.-based Council on Foreign Relations (CFR) included devices that can 'disrupt' satellites as space weapons. The CFR made a distinction between 'ASAT' and 'counterspace' weapons. Antisatellite weapons, for the CFR, specifically means weapons that physically intercept and destroy satellites, whilst counterspace weapons mean all weapons which 'interfere' with a satellite's normal functioning, through both physical and non-physical 'interception'.[63] Indeed, any device that can push a satellite into a less useful orbit – thereby interfering with normal functions and degrading a celestial line of communication – can be seen as a space weapon. Although the U.S. doctrine document *Counterspace Operations* may not exclusively refer to all electronic warfare devices as 'space weapons', 'purposeful interference' can be construed as an escalatory act towards the United States during wartime or periods of greater tension or crisis.[64] This is enough to raise the possibility that a jamming incident could have similar political effects as a kinetic-kill attack – a definition of 'space weapon' by proxy. A definition from the Canadian government further builds this apparent consensus on jamming technology as weapons by defining space weapons as "any device designed or modified

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[61] Frank Vizard, 'Safeguarding GPS', *Scientific American*, 14 April 2003, http://www.scientificamerican.com/article.cfm?id=safeguarding-gps (accessed 22/02/2013)

[62] On the 1981 Russia proposal to ban space weapons, see: Michael Krepon and Christopher Clary, *Space Assurance or Space Dominance? The Case Against Weaponizing Space* (Washington, D.C.: Stimson Center, 2003) p. 30; Harry H. Almond, Jr., 'Arms Control, International Law, and Outer Space', in: Uri Ra'anan and Robert L. Pfaltzgraff, Jr. eds. *International Security Dimensions of Space* (Hamden, CT: Archon Books, 1984) p. 237-240

[63] Bruce W. MacDonald, 'China, Space Weapons, and US Security', Council Special Report No. 38 (Washington, D.C.: Council on Foreign Relations, 2008) p. 50, endnote 2.

[64] U.S. Joint Chiefs of Staff, *Joint Publication 3-14: Space Operations* (Washington, D.C., 2013) p. I-2

to inflict physical or operational damage to an object in space through the projection of mass or energy."[65] Inflicting operational damage can be taken to mean the disabling of a function without inflicting physical damage – the function of most kinds of electronic warfare, with the exception of radiofrequency weapons which can cause physical damage to electronic components.

Michael Krepon concedes that defining space weapons in a watertight manner is difficult and possibly fruitless. But he does not agree that space arms control is futile because:

> "we're barking up the wrong tree in trying to define space weapons. How nations act in space matters far more than how they define space weapons. A treaty banning space weapons remains a distant goal. There are other ways, far more realizable, to strengthen norms for responsible space-faring nations – including the norm of not using satellites for target practice… The European Union has endorsed the… norm of "no harmful interference" against space objects. Yes, this invites a debate over the definition of "no harmful interference." But reaching a reasonable conclusion on this subject is far easier than trying to define a space weapon."[66]

What Krepon proposes is that, as far as preventing the weaponisation of space goes, it is best to ban the testing of space weapons by prohibiting the shooting-down of satellites and the 'dazzling' of satellites (firing lasers at satellites, and sometimes damaging their optical equipment) which may constitute as 'harmful interference' in certain political circumstances. Testing destructive and debris-generating antisatellite weapons are difficult to do covertly, especially as space surveillance is a proliferated capability. However, banning all forms of weapons testing may prove difficult if there are 'legitimate' environmental concerns for assisting a satellite's breakup on re-entry into the atmosphere, for example because of the danger posed by toxic or radioactive fuel supplies if they survived re-entry. Also, in electronic warfare, a state could potentially test reversible or non-physically damaging devices on their own satellites – such activity may be easier to hide from global observers.

This should not prohibit a limited or partial weapons test ban in space – banning debris-generating tests above an altitude of approximately 250km may be plausible and verifiable, not to

[65] Krepon and Clary, *Space Assurance*... p. 30
[66] Krepon, 'What is a Space Weapon…'

mention significantly environmentally beneficial.[67] However, there could still be disputes as to whether an antisatellite test could have been a mission to de-orbit a satellite that could not be allowed to survive re-entry, like the reason given by the United States for its interception of the USA-193 satellite in 2008. One analyst weighed the orbital debris risk as being greater than the public health risk of any surviving hydrazine fuel canister landing in a populated area.[68] This shows the difficulty of determining a risk that may necessitate a satellite intercept that can be simultaneously seen as an antisatellite test.

To summarise, a broad definition of 'space weapon' makes the term meaningless in practice as anything could be turned to a space weapon relative to one's desperation and the value of the intended target, and misleading when applied to debates on space weaponisation because of a persistent social understanding among space powers that space is not yet weaponised. Conversely, narrowing the definition could leave out crucial means of space warfare from analyses, such as electronic warfare devices, which could have the similar political and military effects as those which are considered 'space weapons'. There is a resolution to this dilemma – but not if the aim is to define 'space weapons' to the satisfaction of those who wish to ban their technological components or forestall space weaponisation. The definition put forward below errs on the side of a broader definition because it assists in a more holistic approach to the entire gambit of space warfare – from nuclear detonations to generate electromagnetic pulses to localised jamming equipment deployed by special forces on Earth to deny space communications at a specific place at a critical time.

### 2.2.2 A proposed definition for the benefit of spacepower theory

Devising a politically or legally amiable definition is not the objective here. The definition of space weapon put forward here is designed to help further an analysis of space warfare, and not to progress space arms control or contribute to policy debate as to whether the United States should 'weaponise' space or not. Nevertheless, one has to be aware of the sensitivities, interpretations, and

[67] Ross Liemer and Christopher F. Chyba, 'A Verifiable Limited Test Ban for Anti-Satellite Weapons', *Washington Quarterly* (33:3, 2010)

[68] Jeffrey Lewis, 'Don't Shoot Down USA 193', *Arms Control Wonk*, 18/02/2008, http://lewis.armscontrolwonk.com/archive/1796/dont-do-it (accessed 24/07/2015)

practical considerations of significant actors in this political realm, which is partly why electronic warfare devices will be considered as possible space weapons. It is useful to begin to visualise some categories of space weapons guided by their basing location and targeting area. Donald Kerr used an old Soviet system of classifying possible space weapons: Earth-to-space, space-to-space, and space-to-Earth weapons.[69] These categories are useful in that they categorise each geographic form of basing and targeting, and some are distinguished in some space arms control initiatives. For example, the PPWT only aims to ban space-based weaponry, but not Earth-based weaponry which may have its targets in space.[70]

These weapons' methods of attack can be kinetic, electronic, laser, or electromagnetic, and the effects can be permanent and reversible. Space weapons, like satellites, are a diverse collection of technologies, with different kinds of basing, potential targets, attack mechanisms, effects, discrimination abilities, and general usefulness relative to other existing capabilities.[71] Spacepower theory and interested strategists have to be aware of any means of influencing the Command of Space and harassing enemy celestial lines of communication (see Propositions I and IV). This includes all methods that some authors are wrong to omit on account of spacepower theory's holistic view. *Space weapons can be based anywhere, with targets anywhere utilising any means of destruction, damage, or interference against a space segment or communications streams of a space system*. This definition assumes a space component in the actual target or basing of the system is present, otherwise it would be a normal terrestrial weapons system, like a ground-based missile firing on a satellite control station or axe-wielding humans breaking into a satellite manufacturing facility.[72] This does not include space-enabled weapons, such as GPS-guided precision munitions, which are not aimed at space and do not originate from space. This crude technical definition should always be a *basis* for understanding the social construction of space weapons encountered in astropolitics, as the technical understandings

[69] Donald M. Kerr, 'Space weapon verification', in Bhupendra Jasani (ed.) *Space Weapons and International Security* (Oxford: Oxford University Press, 1987) p. 211
[70] CD/1839, 29-02-2008, PPWT, p. 3
[71] These useful categories are found in: Mueller, 'Totem and Taboo…' p. 5
[72] On axe-wielding activists breaking into a GPS facility, see: Ingrid Burrington, 'The Failed Attempt to Destroy GPS', *The Atlantic*, 05/03/2015, http://www.theatlantic.com/technology/archive/2015/03/the-failed-attempt-to-destroy-early-gps/386656/ (accessed 24/07/2015)

help keep open possible systems that *could* be socially constructed as space weapons, but not necessarily constructed as such in a specific case and time by particular agents.

The weakness of this definition is that it does not help address the duality problem with space technology, if it can be addressed at all, and cannot add anything substantially new to space arms control negotiations. However, the strength of this definition and its flexible approach to social understandings in classifying weapons is that it allows for a comprehension of the differing interpretations of space weapons in the global political, legal, military, and academic worlds. The absence of clear definitions on space weapons need not hinder the analysis of space warfare, but it should serve as a cautionary note that this study, like any other, will not have a monopoly on the meaning of the term 'space weapon.' Clausewitz's caution against the tight and restrictive definitions of objects or phenomena under examination are useful for the matter of space weapons. Clausewitz believed that his definitions were "aimed only at the centres of certain concepts; we neither wish nor can give them certain outlines. The nature of the matter should make this obvious enough."[73] For spacepower theory, what matters about whatever constitutes 'space weapons' is how certain devices and actions can ultimately influence the command of space (argued in Proposition I) by safeguarding or threatening the use of celestial lines of communication (explained in Proposition IV). To apply definitions of space weapons that ignore significant methods of waging space warfare, such as the PPWT which seeks to ban only space-based weaponry, is an exercise in social construction that is extremely blinkered for any creative strategist in space warfare.

### 2.2.3 The space weaponisation debate

The space weaponisation literature sometimes does not examine the consequences of its definitions. As already referred to above, Joan Johnson-Freese selectively ignores the practical effects of electronic warfare systems and Earth-based weapons systems on space warfare considerations in her analyses. There is much to be gained from engaging with Johnson-Freese's work in the empirical and policy areas, but conceptually there are some issues from a spacepower theory perspective, and

[73] Clausewitz, *On War*... p. 486

are emblematic of the problems of framing space warfare around the space weaponisation debate. Despite declaring that "a threat-based risk analysis is inherently needed, based on facts rather than seeking confirmation of a predetermined, ideological conclusion," *Space as a Strategic Asset* can be criticised for being guilty of what it criticises.[74] Across the book, Johnson-Freese argues that the United States is in effect the only state pursuing antisatellite capabilities and space weaponisation, sensationalising and overtly demonising the United States' research of space-based weapons or related dual-use technologies. This is whilst simultaneously ignoring the horizontal and vertical proliferation of Earth-based space weapons systems and electronic warfare capabilities.[75] This terminological *coup de grace*, of only defining space weaponisation as placing weapons in space, ignores existing Earth-based weapons systems and the military utility of space for any major military power today.[76] It white-washes the military space programmes and antisatellite technologies of other states to further an argument against U.S. research into space-based weapons technologies, and leaves the reader ignorant to the fact that space-based weapons may not necessarily be needed to 'shut other countries out of space' – thereby defanging the apparent sensationalism or strategic uniqueness of space-based weapons. This is despite the book making several references to electronic warfare and Earth-based space weapons systems – including the dual-use potential of missile defence technologies.[77]

The argument in *Space as a Strategic Asset* neatly encapsulates much that is problematic about the typical anti-space-based weapons perspective in the debate. The incongruence of Johnson-Freese's arguments on the inherent importance of basing weapons in space is apparent when contrasting two specific passages. The first is where Johnson-Freese makes the important connection between the dual-use nature of BMD technology as both warhead and satellite interception systems:

> "What would justify spending vast amounts of money to build a missile defense system that provides little defense capability, squeezing other countries out of space, and developing weapons that potentially turn near space into a shooting gallery?… The value of missile defense

[74] Joan Johnson-Freese, *Space as a Strategic Asset* (Chichester: Columbia University Press, 2007) p. 244
[75] Ibid., pp. 2, 19-20, 25, 98, 135
[76] When the book was written, such examples were U.S. and Russian missile defence technologies.
[77] Johnson-Freese, *Space as a…* p. 96-101, 116-134

> as an explicit part of space superiority or an implicit part of space dominance may better justify the money being spent. This gets into the idea of potentially using missile defense for more than simply defense against ICBMs, but rather as space weapons. Where is all the interest coming from?"[78]

Here, BMD technologies are tacitly seen as space weapons, in effect already making space a potential 'shooting gallery' should hostilities commence. Johnson-Freese goes on to ask:

> "Would having the United States be the first to develop and deploy space[-based] weapons induce others not to develop and deploy them? Perhaps, but they would almost certainly concentrate on ways to minimize the value of American space weapons – which again, could push the United States into a position of use it or lose it. It also forces the United States to constantly try to stay ahead of the cheaper and easier countermeasures developed against its space weapons. That puts the United States on a quest for invincible technology that is either impossible or obscenely expensive to create… Ironically, the countries most capable of developing space weapons, China and Russia, have been the strongest advocates for a space arms control agreement, which casts further doubt on the argument that space weaponisation is inevitable."[79]

Johnson-Freese only implicitly makes the point that one can shoot down satellites without needing to station weapons in orbit by referring to 'cheaper and easier countermeasures.' Indeed, she asks: "What could the United States do with this capability that it could not do faster and cheaper with a ballistic missile?"[80] In practice, does this ability to strike at enemy satellites with 'ballistic missiles' effectively weaponise space, thereby making hypothetical space-based weapon scenarios a marginal issue compared to the reality of the consequences of physical counterspace capabilities based on Earth? Unfortunately that question is not asked by Johnson-Freese. Because electronic warfare and Earth-based weapons systems are selectively ignored in her argument against a U.S. 'weaponisation' of space, it directs strategic thinking away from the entire gambit of controlling or denying space

[78] Johnson-Freese, *Space as a…* pp. 98, 101
[79] Ibid., p. 135
[80] Ibid., p. 139

through means other than space-based weapons – primarily through systems that already exist – the very weapons systems that Johnson-Freese excludes in her definition of space weapon.[81]

The overall argument – for the United States to ban space-based weapons – is further weakened by Johnson-Freese's early admission that developing 'space weapons' may be necessary at some indeterminate point in the future, because leaving the possibility in future for the development of space-based weapons at the right time and place at an unforeseeable future is a powerful argument to oppose the outright banning of space-based weaponry.[82] This is not to say that Johnson-Freese is wrong to oppose the basing of weapons in space, despite the self-defeating view that it may be necessary at some point in the future. It is argued here that arguments like Johnson-Freese's is built on somewhat doubtful terminological and polemical grounds and does more harm than good in the name of strategic education.[83] Johnson-Freese's approach to discussing the best way to secure the United States' use of space is also at odds with government and military thinking as to what constitutes present and credible dangers to space systems. Such argumentative logic makes more sense if it is viewed as a modern form of 'benign hypocrisy' – how Walter McDougall characterised U.S. space diplomacy in legitimising spy satellites, and the principles of the use of outer space under the guise of using space "for the benefit of all mankind" whilst improving the United States' strategic position against the Soviet Union in the late 1950s and early 1960s.[84] Indeed, then, as perhaps now, "the only customers for the unrealistic rhetoric, the only ones who may have believed in it, were the American people themselves."[85]

This shows how problematic framing things under a specific understanding of what counts as a space weapon or what constitutes space weaponisation, if the intent is to encourage creative and transparent strategic thought about space warfare. Indeed, the very problem of a *de facto* weaponisation of space through the deployment of BMD and other counterspace technologies remains

[81] Ibid., pp. 134-135
[82] Ibid., p. 21
[83] On the polemic content, see: Johnson-Freese, *Space as a…*pp. 2-5, 19-23, 51, 99
[84] McDougall, *…The Heavens…* pp. 359-360
[85] Ibid., p. 360

unaddressed in order to leave the policy argument against space weaponisation intact and internally consistent, but absent of any strategic context and conceptual merit for spacepower theory.

Karl Mueller's 2003 work on the parameters of the debate on space weaponisation remains the most useful summary of the U.S. debate on placing weapons in space. In general terms, opponents of space weaponisation advocate "some variation on the same policy theme" of keeping orbital space free of weapons because of fears of making the international security situation unstable, resulting in potential first-strike scenarios between states with space weapons, or that it may ultimately make the United States less secure, as others will develop space-based weapons in response.[86] A persuasive and detailed critique of the assumptions of arguments resting on a belief that an arms race *in* space is inevitable if the United States deploys space weapons has been undertaken by Delgado Lopez.[87] Of the more powerful critiques is the apparently unchallenged view (until Lopez wrote) that the status quo of international relations is 'stable' in the absence of space weapons in the first place.[88] In addition, much of the debate seems to view 'weaponisation' as some irreversible threshold that cannot be undone, when historical events suggest no such 'tipping point' is inherent to the *deployment* of 'space weapons.' Indeed, while the Soviets did in fact eventually deploy a so-called fractional orbital bombardment system (FOBS), and although both the Soviet FOBS (without nuclear warheads in orbit) and the U.S. anti-satellite system remained deployed for more than a decade, each was eventually decommissioned."[89]

Mueller describes the general outlines of the pro-weaponisation argument as the prescription that a U.S. decision to weaponise space should be taken when it is deemed to be advantageous to do so.[90] Johnson-Freese's caveat on encouraging the U.S. to deploy space-based weapons at some point (see above) would place her argument in this group and in self-contradiction of other aspects of her argument. Mueller argues that "this vision of the future represents the core elements of the other pro-

[86] Mueller, 'Totem and Taboo…' pp. 13-16
[87] Laura Delgado Lopez, 'Predicting and Arms Race in Space: Problematic Assumptions for Space Arms Control', *Astropolitics* (10:1, 2012)
[88] Ibid., pp. 53-55
[89] Herbert F. York, 'Nuclear Deterrence and the Military Uses of Space', in: Franklin A. Long, Donald Hafner, and Jeffrey Boutwell, ed. *Weapons in Space* (New York, NY: W.W. Norton, 1986) p. 23
[90] Mueller, 'Totem and Taboo…' pp. 22-23

weaponization perspectives being carried to their logical extreme: if space weapons are too powerful not to build, they must also be too powerful to allow our potential enemies to possess."[91] In other words, according to some pro-weaponisers, influencing the command of space in a conflict will be most reliably and effectively done with space-based weapons. This in turn would confer massive terrestrial power advantages to the state that dominates space. This is an outcome of the logic deliberately pushed to its extreme in Dolman's theory of *Astropolitik*.[92]

A major problem in discussions of space weaponisation is that it is at best marginal, and at worst irrelevant, for the practice of spacepower today and the near future. The argument that a U.S.-led weaponisation of space would trigger similar responses from other powers that in turn would threaten U.S. satellites flies in the face of an important reality: *other states are already developing the means to attack satellites in the absence of space-based weapons deployment.*[93] For the intent of this thesis, it is more useful to consider space-based weapons as only one form of space warfare. Debating their deployment at the expense of all other spacepower activities does little to train strategic thought about the reality of the dependence on space systems as a critical infrastructure for a global political-economy and for crucial modernised military capabilities, in conjunction with the development of diverse Earth-based counterspace systems. Some fear a symmetrical response to U.S. space-based weapons by imitating space weaponisation, or in undermining U.S. space-based weapons by using Earth-based missile-launched countermeasures.[94] What these omit is the apparent 'symmetry' of what spacepowers are already doing with regard to space weapons development and its supporting critical infrastructure today. All are growing more dependent on space, and the United States, Russia, and China are all developing Earth-based space weapons, or counterspace, technologies and competencies in order to threaten or secure the command of space. That can be ascribed *some degree* of symmetry, if one is to adopt the conceptual language of the space weaponisation debate.

[91] Ibid., p. 25
[92] Dolman, *Astropolitik…;* for a response to the logic of *Astropolitik*, see: Matthew Burris, 'Astroimpolitic: Organizing Outer Space by the Sword', *Strategic Studies Quarterly* (Autumn 2013) pp. 108-129
[93] Mueller, 'Totem and Taboo…' p. 16
[94] Ibid., p. 18-20

Mueller deftly summarises four problems in the space weaponisation debate that both camps are guilty of, and all of which are constructively engaged with at various junctures throughout this thesis on spacepower theory. First, many tend to ignore the political, subjective, and human nature of judging whether or not one achieves a sense of security with space-based weapons or not; second, too many use a broad-brush approach to describe weapons systems and satellites, when in reality specific weapons systems target specific satellites that perform specific functions and can have widely different strategic meanings (see Chapter 1 and Proposition II in Chapter 4); thirdly, many participants in the debate tend to harbour unrealistic expectations about the utility of space-based weapons and the costs in developing them, in conjunction with little thought as to how they would alter the overall strategic landscape (see Proposition III in Chapter 4); and finally, there is not enough recognition that all arguments on space weaponisation are based on educated speculation, not certainty (see Chapter 3 on uncertainty in war).[95] Indeed, it is this poorly structured speculation about placing weapons in space that spacepower theory should avoid.

Arguably, the space weaponisation debate has failed to move beyond the parameters outlined by Mueller in 2003, with exception to more pragmatic arguments that advocate a hedging strategy to wait and see how technology, economics, international relations, and perceived necessities develop. In addition to Mueller's four problems, the debate tends to ignore the wider ramifications of the existence of BMD technology and Earth-based means of waging space warfare, choosing instead to focus upon the hypothetical deployment of U.S. weapons *in* space which are often given either an omnipotent or an impotent quality to influence the course of events before and during a war, depending on one's preferred policy prescription of placing weapons in orbit.[96] However, one

[95] Ibid., pp. 39-40

[96] For examples of work on space weaponisation that fail to meet or acknowledge some or all of Mueller's suggestions or follow through on the ramifications of extant methods of space warfare in questioning the feared power of space-based weaponry, see: Dale Armstrong, 'American National Security and the Death of Space Sanctuary', *Astropolitics* (12:1, 2014); Promit Chaterjee, 'Legality of Anti-Satellites Under the Space Law Regime', *Astropolitics* (12:1, 2014) esp. p. 45; Karl D. Hebert, 'Regulation of Space Weapons: Ensuring Stability and Continued Use of Outer Space', *Astropolitics* (12:1, 2014) pp.1-26 Alan Steinberg, 'Weapons in Space: The Need to Protect Space Assets', *Astropolitics* (10:3, 2012) pp. 248-267; Kenneth S. Blazejewski, 'Space Weaponization and US-China Relations,' *Strategic Studies Quarterly* (Spring 2008) pp. 33-55; Ajey Lele, 'Should India Conduct an ASAT Test Now?', in: Ajey Lele, ed. *Decoding the International Code of Conduct for Outer Space Activities*(New Delhi: Pentagon Press, 2012) pp. 155-161; Everett C. Dolman, 'A Debate About Weapons in Space: For U.S. Military Transformation and Weapons in Space,' *SAIS Review* (26:1,

constructive exchange of views on China's counterspace capabilities and possible responses was a discussion of Sino-U.S. space warfare dispositions which was not dominated by space weaponisation. The debate centres on the relative capabilities of China today with that of the Soviet Union in 1991, whether the United States prefers non-destructive methods of space warfare, to what extent is the United States technologically superior than China in the field of space weapons, and how far can one take writings on space warfare by officers from the PLA as indicative of Beijing's policies or strategy. Indeed, all participants in that debate were concerned about methods of space warfare between the United States and China that are not being considered seriously in the general space weaponisation literature.[97] This is not to say there is nothing to be gained from the space weaponisation debate; it is extremely useful in garnering an insight into the politics of the Washington D.C. space policy and think-tank community and empirical details in an aspect of international space activity. Conceptually, however, the debate is very limiting for crafting a spacepower theory or providing an education on the entire character of spacepower today and historically.

Spacepower theory should be agnostic on the issue of space-based weapons, as there are many variables (political, economic, and technical) that would inform an analysis of how effective space-based weapons could be, versus Earth-based counterspace capabilities. There is the possibility

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2006) pp. 163-175; Raymond Duvall and Jonathan Havercroft, 'Taking sovereignty out of this world: space weapons and empire of the future', *Review of International Studies* (34, 2008) pp. 755-775; Wesley Hallman, 'A fast-following space control strategy,' *Astropolitics* (3:1, 2005) pp. 35-42; Joan Johnson-Freese, *Heavenly Ambitions: America's Quest to Dominate Space* (Philadelphia, PA: University of Pennsylvania Press, 2009); Howard Kleinberg, 'On War in Space', *Astropolitics* (5:1, 2007) esp. p. 22; Gene V. Milowicki and Joan Johnson-~Freese, 'Strategic Choices: Examining the United States Military Response to the Chinese Anti-satellite Test', *Astropolitics* (6:1, 2008) esp. pp. 11, 15; Sterling Michael Pavelec, 'The Inevitability of the Weaponization of Space: Technological Constructivism Versus Determninism', *Astropolitics* 10:1) pp.39-48; Matthew Mowthorpe, *The Militarization and Weaponization of Space* (Lanham: Lexington Books, 2004) esp. pp. 3-13; Columba Peoples, 'Assuming the Inevitable? Overcoming the Inevitability of Outer Space Weaponization and Conflict', *Contemporary Security Policy* (29:3, 2008) pp. 502-520; Alessandro Shimabukuro, 'No deal in space: A bargaining model analysis of U.S. resistance to space arms control', *Space Policy* (30:1, 2014) pp. 13-22; UNIDIR, 'An Analysis of Emerging Space Capabilities in Eurasia and Rising Security Tensions', Geneva, 2014.

[97] See: Ashley J. Tellis, 'China's Military Space Strategy', *Survival* (49:3, 2007) pp.41-72; Michael Krepon , Eric Hagt , Shen Dingli , Bao Shixiu , Michael Pillsbury and Ashley Tellis, 'China's Military Space Strategy: An Exchange', *Survival* (50:1, 2008) pp. 157-198. On other works that provide discussion of space warfare, security, and defence policy beyond the weaponisation debate's usual parameters, see: Walt Conrad, Justin Anderson, and Sarah Jacobs, 'Arms Control in the Third Space Age', *Space & Defense* (6:1, 2012) pp. 4-21; see the entirety of *Space & Defense* (3:1, 2009), a special issue on space deterrence; Michael O'Hanlon, *Neither Star Wars nor Sanctuary: Constraining the Military Uses of Space* (Washington, D.C.: Brookings, 2004); Bob Preston, Dana J. Johnson, Sean J.A. Edwards, Michael Miller, and Calvin Shipbaugh, *Space Weapons, Earth Wars* (Washington, D.C.: RAND, 2002); Michael Krepon and Christopher Clary, *Space Assurance or Space Dominance? The Case Against Weaponizing Space* (Washington, D.C.: Stimson Center, 2003)

that if weapons are to be deployed in space and used in wartime, a large debate would occur over their effectiveness, though this is an elaboration of Mueller's criticism of the weaponisation debate to fail to come to terms with its highly hypothetical nature. Spacepower theory helps put space-based weaponry into its strategic context, and does not set out to ignore them. Spacepower theory can help an individual approach the question of weaponisation and train strategic judgment regarding placing weapons in orbit, but the theory itself will not prescribe a set course of action. An obsession within policy, diplomatic, and academic circles on space-based weapons and weaponisation have distorted wider analyses of spacepower's roles in modern warfare and contemporary strategic planning. John Klein makes this point in that:

> "much of the current debate regarding space power and military strategy in space deals with – to the exclusion of almost everything else – the role of weapons in space. Such a narrow focus on just one part of strategy is a myopic approach to a subject deserving a broader scope of consideration. As a result, the often overstated arguments regarding whether weapons should be "allowed" in space or not have led to an underdeveloped understanding of the proper role of [spacepower], along with its subordinate role within grand strategy."[98]

A prudent strategist cannot assume that space may be a sanctuary from attack if any space-faring state were to wage war against the deeply held and valued interests of an opponent that possesses Earth-based counterspace capabilities; conversely, can any state that does not enjoy the benefits of spacepower integration in its terrestrial forces afford to allow a spacepower-supported enemy to have its celestial lines of communications remain unthreatened? Space is not a realm that is a sanctuary from humanity's threat to wage war. Whether or not satellites will be targeted in future is uncertain – but the possibility and consequences of it must be considered because of its feasibility and the potential payoff of such actions, especially if the victims of such actions have taken no steps to counter such an event. Paradoxical thinking in strategic theory is explored further in the next chapter. This pressure to consider planning to attack, and responding after an attack on, space systems only grows with the proliferation of the integration of spacepower to major militaries and the development

[98] John J. Klein, *Space Warfare: Strategy, Principles, and Policy* (Abingdon: Routledge, 2006) p. 131

of capabilities to destroy, damage, or disrupt celestial lines of communications in tandem with any breakdown of cordial or tolerant relationships between spacepowers. Spacepower theory is an idea whose time has come.

## 2.3 Spacepower Theory and Space Strategy

"To be blunt, hardly anybody really has been very interested in "space power," let alone a general theory for space power, or indeed in the space environment as an environment for conflict." – Colin Gray[99]

Since Gray wrote this, spacepower thinking has emerged in a small number of published works. The space weaponisation literature, surveyed above, is of little direct value to spacepower theory because it overlooks many aspects of spacepower that need to be theorised. These are, for example: force enhancement and spacepower integration in terrestrial warfare (Proposition VII); terrestrial warfare waged in support of the command of space and space warfare in support of terrestrial operations (Proposition V); and how spacepower relates to larger questions of the politics of war and peace (Chapter 3). Spacepower theory aims to help educate the reader on how to strategise based upon how space is used *now*, and what the possibilities are for securing and contesting the command of space with known technologies, keeping an open door to constructive, critical, and self-conscious speculation as to what may be possible in future and how this may affect the overall strategic situation between belligerents. In keeping with Mueller's criticism above, spacepower theory must be recognised as a tool to help in a reasoned debate about a host of possibilities to guide decision-making in the present. This element of Clausewitzian theory is explored in the next chapter more thoroughly. A strategic planner may find some use for strategic theory (in her or his own personal studies and education) that has considered, and may have use in considering, the ever-changing character of spacepower in the context of its unchanging nature, and how to consider celestial lines of communication as they are widely used now. Spacepower theory should provide conceptual tools and starting points for analysis for any given scenario concerning spacepower, allowing an individual to adapt to the situation at hand based on constructive questions and

[99] Colin S. Gray, 'Introduction', in: Oberg, *Space Power…* p. xiii

assumptions that retain analytical usefulness regardless of the contingency at hand. That is the value and remit of spacepower theory in strategic studies.[100]

Strategy, spacepower, and spacepower theory are terms that need to be explained as they appear frequently in the literature and discourse, and their meanings can change among their users. Spacepower and 'space strategy' are not the same things, but they can be conflated or given unhelpful meanings. First, it is necessary to settle on a definition of strategy. Colin Gray defines strategy as the "use that is made of force and the threat of force for the ends of policy."[101] 'Strategy' is the practice of connecting political ends with the threat and actual use of force, of imposing one's will on another, in spite of uncertainty, passions, and the paradoxical logic of strategy that frustrate or accelerate one's plans at every turn (explored further in the next chapter). The use of strategy can entail much more than strictly military instruments to achieve a political objective. Gray continues:

> "freely translated, [Clausewitz] tells us that strategy is the use of tacit and explicit threats, as well as of actual battle and campaigns, to advance political purposes. Moreover, the strategy at issue may not be military strategy; instead it may be grand strategy that uses 'engagements', meaning all of the relevant instruments of power as threat or in action, for the objectives of statecraft."[102]

If strategy is the practice of, or application of a plan towards, meeting particular political objectives through feasible means, usually involving the threat or use of force at some point, then strategic theory means a summation of ideas or concepts that should assist in one's practice of strategy and comprehension of strategic events in history through self-education. Spacepower theory is thus a strategic theory of the use of spacepower. What is spacepower, then? Sheldon and Gray described the nature of spacepower as "simply the ability to use space for political purposes, and that too will never change."[103] A space power, as an entity that possesses that measure of spacepower abilities, is, as Stephen Lambakis writes:

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[100] It also has a value in examining military history, which is explored further in Chapter 3.
[101] Colin S. Gray, *Modern Strategy* (Oxford: Oxford University Press, 1999) p. 17
[102] Gray, *Modern Strategy…* p. 17
[103] John B. Sheldon and Colin S. Gray, 'Theory Ascendant? Spacepower and the Challenge of Strategic Theory', in: Charles D. Lutes and Peter L. Hays, with Vincent A. Mazo, Lisa M. Yambrick, and M. Elaine

> "any entity that has the capacity to utilize effectively the space medium for commercial or national security purposes... the baseline measure of space power will be a country's ability to integrate space capabilities with other national activities and manage the rapid and immense flow of information. Clever space powers will be those that can effectively utilize the combinations of all the space services and elements available to it. Superior space powers will own and confidently apply significant space capabilities and possess, as part of their national infrastructures, the requisite skills to exploit them fully."[104]

However, as argued in Proposition V, a more accurate description of a space power is an entity that depends upon and inhabits the cosmos beyond Earth. As the analogy in Proposition V argues, 'true' spacepowers are like island seapowers, but Earth-based spacepowers are like continental sea powers. This means that today's spacepowers are more like the continental seapowers because they still depend on Earth, and Earth's immediate orbital regions, for security and essential resources.

In a general sense, the spacepower theory proposed here is not restricted to overtly military space activities as it has to be related to all events and instruments that have a bearing on the composition and exercise of capabilities in space in competitive or adversarial relationships. In other words, spacepower is relevant to wider non-military aspects of 'grand strategy.' In practice, the dual-use nature of space infrastructure makes a narrow and strict compartmentalisation of any part of spacepower as 'military', 'intelligence', 'commercial', 'offensive', or 'defensive' misleading at best, and intellectually hamstrung at worst. Spacepower is diverse and contextual; it neither exists in a single form nor in isolation from other forms of power. Spacepower finds itself embedded in the bigger context of grand strategy. Paul Kennedy argued that:

> "the crux of grand strategy lies therefore in *policy*, that is, in the capacity of the nation's leaders to bring together all of the elements, both military and nonmilitary, for the preservation and enhancement of the nation's long-term (that is, in wartime *and* peacetime) best interests. Such an endeavor is full of imponderables and unforeseen "frictions." It is not a mathematical science in

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Bunn, ed., *Toward a Theory of Spacepower: Selected Essays* (Washington, D.C.: National Defense University Press, 2011)

[104] Stephen Lambakis, *On the Edge of Earth: The Future of American Space Power* (Lexington: University of Kentucky Press, 2001) p. 46

> the Jominian tradition, but an art in the Clausewitzian sense – and a difficult art that, since it operates at various levels, political, strategic, operational, tactical, all interacting with each other to advance (or retard) the primary aim."[105]

Here, 'policy' means the actual objectives and (ideally) coherent actions of a leadership of a specific entity that crosses sectors and generic types of power that are not restricted to military kinds, such as 'soft' and 'hard' power in popular discourse.[106] In addition to Kennedy's definition, grand strategy as a description of top-level leadership of a political entity need not necessarily be restricted to states.[107]

John Klein's *Space Warfare*, whilst a valuable contribution to spacepower theory and a useful exercise in analogising Corbettian theory to outer space, conflates terms such as 'spacepower', 'strategy', and 'space strategy'.[108] Although Klein's work is on the whole very useful for the creation of spacepower theory, as demonstrated in Propositions I and IV, this terminological untidiness puts the reader on uneasy ground when grappling with the differences between an applied particular strategy and an abstract universal strategic theory. Klein's intent was "to develop a clearly articulated, all-encompassing strategy for military operations in and through space."[109] However, Klein fails to clarify whether his view of his work *Space Warfare* should be spacepower theory, or a particular strategy for a particular scenario for particular belligerents that is centred upon space. Eligar Sadeh defines space strategy as a plan "to coordinate, integrate, and prioritize space activities across security, commercial, and civil sectors. Without strategy, space activities continue to provide value, but it becomes difficult to… optimize the use of space for security, economic, civil, and environmental ends."[110] Although Klein's work sometimes reads as a space strategy for the United States, the bulk of it reads more like a text on spacepower theory rather than an applied strategy.[111] This problem is partly rooted in Klein's mischaracterisation of seapower theory and Mahanian

[105] Paul Kennedy, 'Grand Strategy in War and Peace: Toward a Broader Definition', in: Paul Kennedy, ed., *Grand Strategies in War and Peace* (London: Yale University Press, 1991) p.5
[106] Joseph S. Nye, *The Future of Power* (New York, N.Y.: Public Affairs, 2011) pp.3-109
[107] The matter of 'Clausewitzian art' and the imponderables of strategy are examined in the next chapter.
[108] Klein, *Space Warfare…* pp. 3-7, 13, 35
[109] Ibid., p. 3
[110] Eligar Sadeh, 'Introduction: Towards space strategy', in: Eligar Sadeh, ed., *Space Strategy in the 21st Century* (Abdingdon, Routledge, 2013)
[111] A clear example of a particular applied 'space strategy' is: O'Hanlon, *Neither Star Wars…* esp. chapters 4 and 6.

thought (as detailed in Chapter 4). Klein misinterprets Mahanian theory as limited to the 'offensive' actions of the fleet at the expense of 'defensive' operations, amphibious tasks, and economic, diplomatic, and cultural aspects of seapower. As a result, Klein portrays Corbett as distinct from Mahan in the way that Corbett theorised about economics and interactions with land power in *Principles of Maritime Strategy*, whilst Mahan is accused of focusing only on the deployment and use of fleets.[112] As argued throughout the seven propositions, Mahan does not lack for such insights. The sum of ideas in Corbett's *Some Principles of Maritime Strategy* is not *a* maritime strategy but it can be mistaken as one, which helps explain Klein's terminological ambiguity. Corbett's *Principles of Maritime Strategy* is in effect (but not in word) a seapower theory that is meant to help readers and planners at the highest levels develop *a* maritime strategy for whatever contingencies they face. His seapower theory concerns the crafting and execution of maritime strategy. The *principles* of any maritime strategy – the foundation where any specific plan of action can draw inspiration – are in effect seapower theory, though Corbett himself does not use such terminology in his definition of maritime strategy and its relation to seapower.[113] According to Corbett's language, maritime strategy is concerned with the coordination of naval forces with land forces in order to achieve the ultimate political aim; but that is not the entirety of seapower (theory).[114] Given these parameters, any space strategy's guiding principles or propositions are the elements of spacepower theory. Spacepower theory is not a course to victory.

John Klein's is right to distance his work from the established doctrinal schools of thought within the USAF regarding the space power and space warfare. These schools – that of the sanctuary, survivability, high-ground, and control – are often referred to during space weaponisation debates.[115] These 'doctrines' are statements of belief and prescriptive frameworks regarding satellites and space weapons, rather than frameworks for creative and critical strategic thought about spacepower. The sanctuary school claims that the value of space systems in producing transparency should induce all states to make outer space a sanctuary from conflict because they are seen as stabilising in their

[112] Klein, *Space Warfare…* pp. 19-23
[113] Julian S. Corbett, *Principles of Maritime Strategy* (Mineola, N.Y.: Dover, 2004) pp. 8-14
[114] Ibid., p. 14
[115] Klein, *Space Warfare…* p. 16

effects in international relations.[116] The survivability school argues that since satellites are inherently vulnerable to terrestrial weapons, they should not be relied upon for core military and security tasks in war.[117] The high ground school emphasises the potential of effective missile defence systems and other space-based weapons system in controlling or dominating Earth from space.[118] This position is explicitly criticised in Proposition III. The control school argues that space control would assume a 'coequal' importance in war with air and sea control.[119] These schools are avoided for the remainder of the thesis because of their proximity to not only the space weaponisation debate, but also the needs of the USAF because spacepower theory is meant to escape the needs of any particular actor and be universal in its applicability for enhancing strategic thought. Further, whilst all these schools demonstrate some kernel of truth, they are too narrow in their focus on the USAF's needs and particular techno-economic conditions when spacepower theory's remit is very broad. Further, the control school is extremely vague in its articulation, and is of limited use despite its direct reference to air and sea control. Finally, these schools' prescriptive tones are not conducive to the pedagogical nature of spacepower theory, as articulated in the next chapter.

Another example of a differing and contradictory idea of what spacepower theory should be is that spacepower theory should define, explain, and predict "the nature, significance, and functioning of space power… more than five decades since the first steps into space, there is no definitive work on space theory comparable to the writings of Clausewitz, Mahan and Mitchell among others in their respective fields. Spacepower still lacks a holistic approach and its elements remain disjointed and embryonic".[120] As explored in chapters 4, 5, and 6, some spacepower theorists have already begun to explore the nature of spacepower. But a view that it should be prescriptive, as the spacepower theorists sometimes argue, may be at odds with an interpretation of Clausewitzian, Mahanian, and Corbettian epistemologies of strategic theory that do not intend to prescribe, but educate through the

[116] David E. Lupton, *On Space Warfare* (Maxwell AFB, Alabama: Air University Press, 1998) p. 19
[117] Ibid.
[118] Ibid., p. 21
[119] Ibid.
[120] Nicolas Peter, 'The New Space Order: Why Space Power Matters for Europe', *Space & Defense* (4:1, 2010) p. 58

application of basic propositions to particular cases. Explaining this epistemology is the theme of the next chapter.

Robert Harding takes another view of what spacepower theory is. For him, a spacepower theory "builds upon the traditional concepts of international relations theory, but applies the history and attendant realities of space to understanding the policies and motives of modern space-faring states."[121] The spacepower theory proposed below does not seek to analyse motivations: it assumes that antagonistic relations are established or is a contingency that is planned for, and a decision to engage in hostilities is an accepted possibility on the part of a leadership. That does not mean that one has to believe that antagonism and the threat of force will always be a theme of a relationship between two current or potential adversaries. Whilst a grasp of spacepower theory may assist in helping in an understanding of a more competitive spacepower relationship between states and other entities, that is not its primary intent. Spacepower theory aims to better train strategic thought about exercising spacepower and waging modern spacepower-influenced warfare. Harding is correct however, to stress the geopolitical heritage of spacepower theory, which proposes a "problem-solving theory for the conceptualization and practice of statecraft."[122] Perhaps a better moniker for a theory which seeks to explore, explain, or predict international relations under a space-centric theme is 'astropolitical theory', rather than spacepower theory which invokes a strategic theory orientation and should refrain from any restrictively predictive and prescriptive intent. Rather, in spacepower theory, constructive hypothetical scenarios and predictions about possible courses of actions are a *means* to the end of encouraging better strategic thinking. Harding's view places prediction as an end for theory, which is what spacepower theory does not do.

Deliberations over the International Code of Conduct for space activities, currently circulating the halls of the United Nations, is an astropolitical matter where policy analysis and the lenses of IR theory can contribute to discussion and analysis. Spacepower theory takes no position on the

[121] Robert C. Harding, *Space Policy in Developing Countries: The search for security and development on the final frontier* (Abingdon: Routledge, 2013) p.21
[122] Ibid., p. 21, Harding quotes Gearoid O Tuathail, 'Understanding Critical Geopolitics: Geopolitics and Risk Society', in Colin S. Gray and Geoffrey Sloan, eds. *Geopolitics, Geography, and Strategy* (Abingdon: Routledge, 1999) p. 107

particular merits of such a Code of Conduct, but it does help challenge assertions that such a code would need to address space-based weapons. Any individual that has grasped the reality that space-based weapons are not the only means of waging space warfare may realise that attempting to ban space-based weapons may doom such a Code to diplomatic oblivion whilst not addressing any reasonable and well-founded concerns about the proliferation of space warfare and the risks of accident, mistaken intent, and security dilemmas that entail.[123]

Where does this leave the idea of spacepower theory? Klein portrays 'space power' thinking up to 2006 as offensive-focused, or too constrained by debates on space weaponisation. As will be seen below, such a charge is unfair to the works of Gray, Smith, and Sheldon.[124] The lines of distinction between military and non-military, or violent and non-violent, are blurred as non-military space capabilities may be harnessed for the ultimate ends of a grand strategy that employs violence or causes violent human suffering at some point. Spacepower has qualities that can apply themselves in numerous ways in a competitive relationship regardless of whether there are open hostilities or not.[125] This does not assume that this is not the case at sea, land, or air; this is merely the first of many analogical observations from terrestrial experience that have resonance in space. The seven propositions gravitate towards thinking about spacepower in a context of a competitive environment, of conflicting wills and agendas, and under the risks of the use of violence; it is about employing spacepower to impose will on another. If 'strategy' or 'a space strategy' is the actual practice of connecting politics, (possible and real) violence, and the contests of wills, *strategic theory* is meant to educate individuals about its practice, and not necessarily to prescribe specific actions for any given case.

[123] On ploys to expand the Code's remit to include space weapons, see: Michael Krepon, 'Space Code of Conduct Mugged in New York', *Arms Control Wonk*, 04/08/2015, http://krepon.armscontrolwonk.com/archive/4712/space-code-of-conduct-mugged-in-new-york (accessed 06/10/2015)

[124] Klein, *Space Warfare*... pp. 131, 163. Admittedly, Sheldon's PhD was being written at the same time as Klein's, but the point stands against any similar charge made against Sheldon's work today.

[125] On 'strategy' evolving to mean matching political ends and military (and more) means in peacetime, see: Beatrice Heuser, *The Evolution of Strategy: Thinking War from Antiquity to the Present* (Cambridge: Cambridge University Press, 2010) pp. 24-28

This thesis is an attempt to theorise spacepower, and not to develop a space-orientated strategy for any belligerent. Alfred Thayer Mahan's work, for example, elucidated some principles of seapower theory and simultaneously used it as a call for massive U.S. investment and engagement in naval matters to protect its interests, creating an applied case of seapower theory to advocate a particular maritime-centred (grand) strategy for the United States. Today, some continue to call for an application of spacepower theory into a specific space strategy for a political entity of their choice:

> "Echoing a call made by Gray nearly a decade ago, the world still awaits a Mahan for the space age, a theorist who can articulate how space power contributes not only to national security and prosperity, but creates a lasting and significant benefit for all of humankind. If such a strategy were clearly articulated and accepted by the American people, political support and funding for a space force would follow in its wake."[126]

This thesis does not answer this call and is not geared towards the perceived needs of the United States of America. Indeed, Chapter 3 and the seven propositions argue that this is not the purpose of a 'Mahan for space.' Indeed, such utopianism in making spacepower a benefit for 'all mankind' ignores the competitive, antagonistic, and brutal realities of warfare, and risks massaging ethically vain self-images of one's preferred, enforced, or habitual political beneficiaries and benefactors. In addition to believing that spacepower theory 'ought' to serve for the benefit of all mankind - which is a notion dangerously distant from the intentional suffering, death, and destruction caused by war upon the essential 'other' and 'ourselves' - thinking that Mahanian theory should only serve the interests of the United States in space, too, is an injustice to the contributions of Mahan's theory for strategic thought and education.

Honesty in accepting and explaining the intent to produce destruction and violence is, understandably, rare in astropolitical texts, despite the reality that the major space powers continue to retain nuclear arsenals ready to fire on each other. Texts on spacepower are not immune from contradictory moral positions. In his introduction to a significant volume in astropolitical study, Eligar

[126] James J. Wirtz, 'Space and grand strategy', in: Damon Coletta and Frances T. Pilch, eds., *Space and Defense Policy* (Abingdon: Routledge, 2009) p. 25

Sadeh argues that any space strategy (i.e. an actual plan of action with associated goals for space activity) has to acknowledge that all space users "share a set of basic strategic goals" such as "securing the space domain for everyone's peaceful use." Yet he immediately adds the desire "to protect legitimate space assets from the various types of threats." On the next page, Sadeh condemns space strategies that fail to "understand and deter threats and adversaries."[127] One can also presume the need to 'address' those threats should deterrence fail. Any honest individual or organisation cannot sincerely aim to assure access to all whilst simultaneously preparing for space warfare and forms of competition against some space users. The global commons of space will be denied to some if the necessity of war demands it. Spacepower theory can be agnostic on such issues and tolerate such a juxtaposition of moral values among its users, but it does encourage honesty in strategising about who may be threats and why. A space strategy cannot assume such contradictory moral positions, unless it admits to hypocrisy of the most blatant kind. When warfare is being prepared for, no illusions as to its costs and 'othering' tendencies should be hidden with linguistic sleights of hand.

If by a Mahan for space, it is meant that "over ten years later, such an exhortation still has resonance as the realm of spacepower still lacks a "space focused strategy theory" and a "binding concept" that can aid understanding of what it is all about," then this thesis is an attempt at that task.[128] This is not creating spacepower theory for its own sake or on the vague terms issued by Sheldon and Gray, but to follow Mahan's pedagogical view of the value of theory; to train judgment through the *critical* application of principles that has value beyond any single military service or political entity.

There is no intent here to subordinate spacepower theory (and by extension spacepower theorists) as a tool for a specific state, the so-called international 'community', or any form of political-economic organisation. This is not to say that entity-specific studies have no merit, indeed such works may be more immediately relevant to decision-makers, but such studies may not be the best placed for an attempt at theorising about a facet of the human experience – in this case of

[127] Eligar Sadeh, 'Introduction', in: Sadeh, *Space Strategy*... pp. 2-3.
[128] Sheldon and Gray, 'Theory Ascendant…'

strategic thinking and education on the use of outer space. Spacepower theory is seen in this thesis as a neutral concept that is applicable to many groups, and any use of it must be aware of the assumptions made and the possible perpetuation of conceptual or political hegemonies.[129] Ethnocentrism is a perennial concern, as it can be difficult to notice at all times. At a symposium of the U.S. National Defense University's *Towards a Spacepower Theory*, some "delegates seemed to think that a theory of spacepower was essentially a theory for the unilateral domination of space by the United States."[130] As well as the dangers of ethnocentrism and political-centrism, state-centrism needs to be checked as well. Spacepower exists among many actors, and not just states. The United States is one space power among many, and one type of many. Propositions V and VI (Chapters 5 and 6 respectively) explores ethnocentrism and state-centrism further.

Making spacepower theory contribute to any state capability in practice, or the capability of any spacepower-interested entity, is a different thing to creating spacepower theory. That is a matter of strategy and the politics of practice. *A* strategy may be developed for a specific problem for a specific actor for a specific time and place. Spacepower theory educates the individual to ask better questions about the possible courses of action ahead given the particular circumstances of the scenario based on a good understanding of the propositions of spacepower theory. But the actual plan of action is *a* strategy, not spacepower theory. This boundary of a spacepower theory is best summarised by John Logsdon, who argues that "developing a sound and comprehensive theory of spacepower is a necessary but insufficient condition for ensuring the full contribution of space capabilities and activities to furthering national interests. To be meaningful, such a theory must be used as a foundation for a spacepower strategy."[131] In addition to this boundary of spacepower theory, there is a major caveat to the listing of propositions in a strategic theory as Sheldon articulates:

[129] Such is the argument made by Bridoux and Kurki about the uncritical use of concepts in democracy promotion, which can apply to an uncritical and ethnocentric use of the concept of 'spacepower'. See the preface of: Jeff Bridoux and Milja Kurki, *Democracy Promotion: A Critical Introduction* (Abingdon: Routledge, 2014)
[130] Sheldon and Gray, 'Theory Ascendant…'
[131] John M. Logsdon, 'Emerging Domestic Structure: Organizing the Presidency for Spacepower', in: Charles D. Lutes and Peter L. Hays, with Vincent A. Mazo, Lisa M. Yambrick, and M. Elaine Bunn, ed., *Toward a Theory of Spacepower: Selected Essays* (Washington, D.C.: National Defense University Press, 2011)

> "a theory of space power must guard against a creeping inflexibility and orthodoxy that stifles innovative thinking or constructive criticism. A theory of space power will evolve along with its actual use, and it may be found that some tenets of space power thought are in fact wrong. A theory of space power must also guard against flights of fancy and over active imaginations that make theory useless as a guide to practice."[132]

The propositions elucidated in this thesis should not be uncritically accepted, and always seriously considered and assessed before final use by future strategists, be they theorists, educators, or practitioners. This is what is considered to be a Mahanian style of applying strategic principles. It is hoped that this theory escapes the fate of some of Mahan's work – to be reduced to maxims for automata and popular war and foreign policy pundits. Sheldon was correct to introduce this caveat and it should be applied to any strategic theory, not only spacepower theory. Indeed, the dearth of empirical evidence in the form of military space history,[133] relative to land, sea, and air operations, only makes the challenge of future history all the more daunting for contemporary spacepower theorists.

## Summary

This chapter concludes the scene-setting for the thesis, which takes a more conceptual and theoretical turn from the next chapter onwards. This chapter outlined a very brief sketch of the heritage of antisatellite technology and antisatellite thinking that dates back to the launch of the first *Sputnik* satellites. Indeed, scholars should be careful not to pacify the (recent) past and see it as irrelevant to modern warfare, as is arguably often done in anthropology.[134] Today, the United States and China have various technological systems that can be used to wage space warfare, and threaten celestial lines of communication. Russia has a great Soviet heritage in space-based weaponry and may be resuming the development of dual-use orbital inspection and rendezvous technology. This is in addition to other 'counterspace' systems such as electronic warfare suites which can be turned against space communications. This chapter has also examined the problems of defining space weapons, and

[132] John B. Sheldon, *Reasoning by Strategic Analogy: Classical Strategic Thought and the Foundations of a Theory of Space Power* (PhD Thesis, University of Reading, 2005) p. 13
[133] On empirical challenges of space warfare, see: Sheldon, *Reasoning by Strategic Analogy…* pp. 33, 51-52;
[134] Lawrence H. Keeley, *War Before Civilization* (Oxford: Oxford University Press, 1996) p. 23

resultantly, has distanced itself from the frames of the space weaponisation debate. That debate narrows strategic thinking about space warfare down to an obsession of means in space warfare. Further, space-based weapons will remain only one of many methods of waging space warfare. In addition, the debate is U.S.- and policy-centric, which impose limitations on creating strategic theory, which demands a more open view as to how the command of space can be threatened and exploited, a broader grasp of the influence of spacepower on modern warfare and global politics, and casting a reasoned eye on the unpredictability and speculations of the myriad possibilities of the future. Spacepower has been defined and spacepower theory put in its literary context. Spacepower is the use of space systems and resources towards ultimately political ends. Spacepower theory is not a (space) strategy, which is an applied plan for a specific space power to follow to achieve specific goals in a specific scenario. Rather, spacepower theory is a collection of concepts and ideas that are intended to assist in the self-education of the individual to think more constructively about space warfare and its place in modern warfare through the critical application of its principles to real-world cases. This is rooted firmly within a Clausewitzian and Mahanian approach to strategic education, which is the subject of the next chapter. This approach is necessary as a fundamental building block for any strategic theory that intends to train strategic thought about a kind of warfare that is open to be applied and examined across time and place.

# Chapter 3: Clausewitz in Orbit: Theory, Analogy, and Spacepower

## Introduction

"[Theory's] purpose is to demonstrate what war is in practice, not what its ideal nature ought to be." – Carl von Clausewitz[1]

Having outlined the context of activities in outer space in the previous chapter the thesis now turns to strategic theory to apply some conceptual order to the apparent chaos of human politics and orbiting spacecraft. This chapter establishes the first of three major analogies that form the core of spacepower theory. This analogy is that space warfare is the continuation of Terran (Earthly) politics by other means, because war on Earth is a continuation of politics by other means. As a foundation for constructing a theory of spacepower, this chapter outlines what strategic theory is and how it works by examining Clausewitz's ideas of the trinity, theory for education, and the strength of the defensive form of war, and Luttwak's paradoxical logic of strategy. Transposing Clausewitz's thinking of war as inherently political clarifies the connections of space warfare to the phenomenon of war as we know it in a Clausewitzian universe. The chapter then briefly examines the promises and perils of analogical reasoning, explaining how seapower theory (and terrestrial strategic experience more generally) can be used to establish useful reference points to think about space warfare, and guide strategic thought therein. The seven propositions developed in the subsequent chapters rely on the assumptions and epistemologies of Clausewitzian theory and analogical reasoning, and these must be understood to prevent the misuse of the seven propositions. This chapter demonstrates that spacepower theory – and this thesis – is not merely the transposition of Terran strategic concepts to outer space, but also a continuation of a way of thinking, and a method of analysis, rooted within strategic theory. Such theory is meant to reduce possible sources of error in strategic judgment. Understanding this way of thinking clarifies the limits of spacepower theory and should help mitigate its abuse by readers attempting to derive axioms or false analogies from the theory.

[1] Carl von Clausewitz, *On War*, Michael Howard and Peter Paret trans., ed. (Princeton, N.J.: Princeton University Press, 1984) p. 593

There is arguably no single author with a surrounding literature that provides such penetrating and enduring insight into the politics and practice of war as Clausewitz.[2] Carl von Clausewitz's approach to understanding war and promoting self-education, with an elaboration of the workings of strategic analogies, helps establish the epistemological boundaries of the thesis and clarify the nature of the conclusions in creating a spacepower theory that borrows much from terrestrial strategic experience. It cannot be stressed enough that *the propositions of a spacepower theory are not meant to be used prescriptively to determine a particular course of action in a given scenario or to advocate a particular policy*. There is ample room in strategic theory for constructive and creative strategic thinking which uses hypothetical scenarios and predictions about the future as a *means* to the end of improving political judgment and strategic creativity. Jon Sumida deftly summarises Clausewitz's epistemological style that the spacepower theory developed in this thesis adopts when he argues that:

> "Clausewitz does not believe that any theoretical formulation [...] can prescribe the actual conduct of war. But this does not rule out the use of theoretical propositions to set the terms of thinking about a strategic problem. Theory accomplishes this by identifying the nature of things in war. By so doing, it pushes deliberation in directions that it might otherwise not have done, raising questions rather than providing answers. The purpose of such a process is to prevent bad intellectual habits [...] from determining strategic courses of action."[3]

'Bad intellectual habits' in discussing spacepower, as in the previous chapter, is a fixation on space-based weapons. Spacepower theory should push deliberation on space warfare, grand strategy, and power in the Space Age down more constructive paths, and this theory ultimately takes shape through the seven propositions that are constructed in the following four chapters.

Strategic theory should help convey to the reader what war is in practice, and it must do so by attempting to identify the nature of things under discussion. Sumida's argument below is that *On War* may be less of a *theory of a phenomenon* and more of a *theory for practice in war* and historical

[2] On Clausewitz's ideas as having no equal in terms of analytical quality and continued usefulness in strategic studies, see: Colin S. Gray, 'Clausewitz Rules, OK? The Future is the Past: With GPS', *Review of International Studies* (25: Winter, 1999) pp. 163, 179-182

[3] Jon T. Sumida, *Decoding Clausewitz: A New Approach to On War* (Lawrence, KA: Kansas University Press, 2008) pp. 99, 180

analysis. But such a theory has to have a starting point based on constructive assumptions about what the phenomenon of war is.[4] The propositions developed in this thesis are pedagogical in intent, best summarised in Clausewitz's view that:

> "theory [should be] used to analyze the constituent elements of war, to distinguish precisely what at first sight seems fused, to explain in full the properties of the means employed and to show their probable effects, to define clearly the nature of the ends in view, and to illuminate all phases of warfare in a thorough critical inquiry. Theory then becomes a guide to anyone who wants to learn about war from books; it will… train his judgment, and help him to avoid pitfalls… It is meant to educate the mind of the future commander… to guide him in his self-education, not to accompany him on the battlefield."[5]

The seven propositions of spacepower separate things that at first seem fused in a large and interconnected whole. The propositions identify and separate major components of spacepower theory whilst continuously stressing their nuanced interconnections and mutual interactions. No silver bullets or axioms are offered to a strategic problem. No war-winning space strategy is drafted. Rather, a treatise to educate the reader on the basic elements of spacepower in war through propositions that lend themselves to critical consideration in their application is proposed. It is not claimed that, in the absence of these 'bad intellectual habits', better strategic behaviour is an automatic outcome. Poor decisions can still be made by strategically-educated individuals and organisations. However, reducing potential sources of error in judgment that are derived from a flawed strategic education (or none) is a worthy goal. In its most basic form, strategic theory should introduce readers to the paradoxical logic of strategy – thinking about war and planning for it is an exercise in non-linear thought and anticipation in the midst of subjective political values, frustrating any plans based on linear logic.[6] Spacepower theory should yield a more constructive discussion among practitioners, researchers, and students of war on the larger questions of the practice of war and peace with regard to outer space and space systems.

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[4] Ibid., p. 182
[5] Clausewitz, (H/P) *On War…* p. 141
[6] Such is the entire argument of: Edward N. Luttwak, *Strategy: The Logic of War and Peace* (London: Harvard University Press, 1987)

## 3.1 Clausewitzian Fundamentals

"War, war never changes." – Narration, *Fallout*[7]

The seven propositions of spacepower theory should not be treated in isolation from, or in ignorance of, these following Clausewitzian principles. Indeed, no strategic theory should be crafted without considering them, regardless of the thematic or geographic focus to a particular theory. These Clausewitzian principles have been separated from spacepower theory itself to illustrate the grounds for the unity of the most abstract strategic theory regardless of specific interests in time or place. For example, Colin Gray's airpower theory, in 27 dicta, puts Clausewitzian assumptions into the dicta of airpower theory.[8] Mixing the Clausewitzian base with any *x*-power theory does not help in identifying more universal concepts of war with those relevant to particular geographies. It is important to understand the roots of various concepts, especially when attempting to delineate what is unique for spacepower and what is more common to all forms of this kind of strategic theory. This helps limit drawing too much from one sub-type of strategic theory and applying it universally. The term 'Clausewitzian' is used interchangeably with the general philosophies of the thinkers mentioned in addition to Clausewitz because they all exhibit similar, or at least compatible, philosophies and arguments that can exist in a Clausewitzian theoretical approach to war that possesses a pedagogical intent. This section provides six general assumptions as a concise description of the emotional, political, and uncertain universe the seven propositions of spacepower inhabit. The six Clausewitzian assumptions about war and practice that are the foundations for the seven propositions are as follows:

1. War is emotional
2. War is political
3. War is chaotic
4. Theory is for education
5. The defensive is the stronger form of war
6. War has a paradoxical logic

[7] The verbal leitmotif of the post-apocalyptic role-playing videogame series *Fallout* (Interplay Entertainment, 14 Degrees East, Bethesda Softworks, 1997-2015)
[8] Colin S. Gray, *Airpower for Strategic Effect* (Montgomery, A.L.: Air University Press, 2012) pp. 274-305

After an interpretation of the trinity and its three interplaying elements, this section (3.2) proceeds to examine the role of Clausewitzian theory (and by extension spacepower theory) for education. Thereafter, Clausewitz's belief that the strategic defensive as the stronger form of war is examined and applied to considerations in space, culminating with Luttwak's description of war as an inherently and inexorably paradoxical activity, which the practice of space warfare and the exercise of spacepower will still be subjected to.

The concept of the trinity is important because it anchors this thesis' philosophical foundations about war. It describes what war is and it charts the boundaries of the epistemology of spacepower theory. The trinity is a conceptual structure that forms an understanding of war as a three-headed phenomenon each representing a universal element that manifest in every war in highly variable particular forms. These are the interacting elements of passion, reason, and chance. It identifies the universal tendencies of war between which any theory of war (e.g. spacepower theory) should hold a balance. Identifying and separating the universal and the particular aspects of war is essential to understand how any strategic theory can claim to have relevance beyond a particular set of circumstances to a different time and place. It allows us to anticipate broad recurring dilemmas in the *conduct and analysis* of warfare; for practitioners as well as historians. It might be that "war never changes," but only in conjunction with the understanding that *warfare* most certainly changes. This corresponds to Clausewitz's distinctions between an unchanging *nature* of war, and an ever-morphing *character* of war.[9]

Alongside the likes of Thucydides and Mahan, Clausewitz shared "the premise that strategy contains elements independent of contemporary material conditions and common therefore to every time and place."[10] Identifying, and more importantly, bridging, the 'universal' and the 'particular' of war can be done through understanding and using Clausewitz's trinity.[11] These conclusions include

[9] Colin S. Gray, *Strategy and History: Essays on Theory and Practice* (Abingdon: Routledge, 2006) p. 82; and: Clausewitz, (H/P) *On War*... pp. 85. The Howard and Paret translation refers to the terms objective (nature) and subjective (character).

[10] Eugenia C. Kiesling, 'Introduction', in Raoul Castex, *Strategic Theories*, Eugenia C. Kiesling, trans., ed. (Annapolis, MD: Naval Institute Press, 1994) p. xiii

[11] Defending and clarifying Clausewitz's ideas from their detractors in recent years has been undertaken elsewhere to arguably compelling conclusions. For example, see: Christopher Bassford, 'John Keegan and the

the important observations that Clausewitz's Trinity is not restricted in application to states; that the political nature of war *includes* motivations of war that may be described as economic, cultural, ideological, religious, and territorial; and that his theory is not restricted to 'conventional' warfare and is useful to examine 'guerrilla' or 'unconventional' warfare. This does not imply or suggest that space warfare is 'conventional' or 'unconventional'. It is simply war, and therefore Clausewitzian concepts are still useful.

Clausewitz's ideas are used to improve intuitive and deliberate strategic thought and action.[12] The trinity acts as a starting point for further analysis and evaluation in any war. Spacepower theory is not intended to be a comprehensive statement on the nature of the entirety of astropolitics as a phenomenon. For example, aspects of astropolitics that are not the focus of spacepower theory are economics, law, ethics, technological development, and popular perceptions of space activities. However, a knowledge of these aspects of astropolitics will undoubtedly be of use to any strategist, scholar, or decision-maker, especially when in the process of crafting grand strategies. Spacepower theory is a starting point for relating the problems and possibilities facing commanders and strategists when considering space warfare. The critical application of propositions will further strategic education and improvements in understandings of spacepower and warfare, and with a better grasp of how to relate all aspects of space activity and space warfare within grand strategic thinking.

Spacepower theory's foundations in, and interpretation of, Clausewitzian theory is a demonstration of its continuing usefulness in strategic studies education and research; Clausewitz in orbit is not a space odyssey for the sake of idle theorising. Despite great material and political changes, the 19th century Prussian still has useful insights for war above humanity's cradle. Clausewitz's desire to learn and explain more of military history beyond what operational military

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great tradition of trashing Clausewitz: A polemic', *War in History* (1:3, 1994) pp. 319-336, available at: http://www.clausewitz.com/readings/Bassford/Keegan/index.htm (accessed 17/11/2013); Christopher Bassford, 'Tip-toe through the Trinity or: The strange persistence of trinitarian warfare', working paper, *Clausewitz.com*, Version 2 October 2012, http://www.clausewitz.com/readings/Bassford/Trinity/Trinity8.htm 2006-2012 (accessed 17/11/2012); Edward J. Villacres and Christopher Bassford, 'Reclaiming the Clausewitzian Trinity', Parameters (Autumn 1995) pp. 9-19; Thomas Waldman, *War, Clausewitz and the Trinity* (Farnham: Ashgate, 2013) especially pp. 13-17; Isabelle Duyvesteyn and Jan Angstrom eds., *Rethinking the Nature of War*, (London: Frank Cass, 2005) especially pp. 1-14, 33-52, 66-74; David J. Lonsdale, *The Nature of War in the Information Age: Clausewitzian Future* (London: Frank Cass, 2004) pp. 24-28.

[12] Sumida, *Decoding…* pp. 127, 135

records would allow – meaning little-recorded aspects such as strategic decision making, political conditions, psychology, and uncertainty - led his mind to the crystallisation of persistent and recurring dilemmas in war. As Sumida articulated: "the objective of re-enacting [the military history] process is not to learn correct procedures, but to engage and come to terms with the rational and emotional elements of command dilemma." And despite all the changes in history there is still "the necessity of making hard decisions."[13] Deciding to go to war in the Space Age involves making hard decisions. Outer space, and human activity and strategic behaviour in relation to it, is not exempt from this observation and analysis. Space warfare commanders will continue to suffer from the 'rational and emotional elements of command dilemma'.

The decision to attack or wait, to launch or escalate a conflict, or not, will be subject to the recurring strategic and ultimately political dilemmas of whether or not the targets are a menacing tank battalion on a border or a satellite lofted into orbit, or a freighter carrying resources between the asteroid belt and Terran (Earth) space. Chance, passion, and reason all play their roles in influencing a war's course and those making decisions in it. These three elements of the trinity should train minds to consider passion, reason, and chance as organising factors in all wars, regardless of whether they involve space warfare or not. Sumida contends that:

> "Clausewitz thus argues that a universally applicable theory of war must take into account that each of the three variables and their interrelationships can vary widely. Such a general theory of war, therefore, has to be constructed in a way that ensures that changes in the values of the three elements of the trinity will not invalidate the basic propositions of that theory."[14]

Strands of military thought in the Enlightenment established the general notion that military history and experience could be distilled to reveal some universal principles that may be put to use in future wars.[15] However, Clausewitz retained inclinations towards historicism: that every historical event was unique, moderating ambitions of distilling some form of common historical truth from

[13] Sumida, *Decoding…* p. 45
[14] Ibid., p. 126
[15] For a comprehensive and concise overview of Enlightenment military thought, and its connections to Clausewitz's thought, see the entirety of Azar Gat, *A History of Military Thought: From the Enlightenment to the Cold War* (Abingdon: Oxford University Press, 2001), Book I.

experience that could be relevant beyond a particular event's place in time and space.[16] The trinity was Clausewitz's conceptual tool to construct a theory which recognises that war has a certain universal nature that is unchanging and present in every conflict, yet still accommodate constant change *and* unpredictability in how war happens in reality. Unchecked passions of war would lead to an 'absolute war' which would express itself in a single, massive, decisive, and annihilating action, conclusively deciding the outcome of a conflict with its escalatory tendencies reaching their climax. However, in reality, the passion of war – expressed as pure hatred, enmity, and violence which tend to the absolute and as one element of the trinity – is kept in check by the interaction of the two other elements of the trinity, the 'reason' of policy, and chance in a world of uncertainty. These two can create friction which prevents war from reaching its absolute form to produce what we see in reality – 'real war'.[17] Reason gives war in reality its ultimate purpose and political context; chance and uncertainty create pauses and imperfections in the execution of war, usually providing a (relatively) moderating context.

With this brief description, a reading of Clausewitz's single page in Book I which describes the Trinity can be attempted.[18] The Paret and Howard translation may be better read in conjunction with Christopher Bassford's interpretation and rewording, which is based upon the first English translation by J.J. Graham.[19] Unfortunately there is an issue with Bassford's translation of the first sentence. Although he is right to change 'a true chameleon' to 'a mere chameleon', he may have overreached when changing the second half of the same sentence, stating that war "changes its nature to some extent in each concrete case."[20] This muddies the waters of an already much abused passage of *On War*. The first sentence of the Bassford translation below has been synthesised with Paret and Howard's more appropriate translation of the second half of the first sentence (inset in quoted passage below). Bassford's translation goes against Clausewitz's principle that war's *nature* (of escalatory

[16] Gat, *A History*… pp. 188-189
[17] On absolute war and real war, see: Clausewitz, (H/P) *On War*… pp. 579-581; Sumida, *Decoding*… pp. 121-135
[18] Clausewitz, (H/P) *On War*… p. 89
[19] Carl von Clausewitz, *On War*, J.J. Graham, trans. (New York, NY: Skyhorse, 2013)
[20] Christopher Bassford, 'Teaching the Clausewitzian Trinity', Clausewitz.com, 3 January 2003, http://www.clausewitz.com/readings/Bassford/Trinity/TrinityTeachingNote.htm (accessed 21/11/2013). The page also includes a reasoned argument behind the changes suggested of the Paret and Howard translation.

violence, passion, reason, and chance) is always present to some degree, whereas Clausewitz refers to war's ever-changing surface *character*, or characteristics in any given case (for example, how a particular war is fought and to what extent passions override reason or vice versa in any given case). Because the 'nature' of war means a very specific thing in Clausewitzian theory, it serves to confuse the reader more by using it to describe war's changing 'surface' characteristics, or particulars. War does not change its nature; but its character changes, and its absolute tendencies kept in check, through the constant interplay with the elements of passion, reason, and chance. This forms a trinity of multilateral interaction and intertwined relationships. In the Howard and Paret edition, the term 'remarkable trinity' was used in the first edition, followed by 'paradoxical trinity' in a later edition, with J.J. Graham it is a 'wonderful trinity', the Jolles translation suggests 'strange trinity', while Christopher Bassford settles for 'fascinating trinity'.[21] The description of the trinity below adopts Bassford's use of 'fascinating' to convey Clausewitz's apparent wonderment with the trinity.

> "War is thus more than a mere chameleon [that slightly adapts its characteristics to the given case]. It is also, however, when it is regarded as a whole and in relation to the tendencies that dominate within it, a [fascinating] trinity—composed of:
>
> 1) primordial violence, hatred, and enmity, which are to be regarded as a blind natural force;
> 2) the play of chance and probability, within which the creative spirit is free to roam; and
> 3) its element of subordination, as an instrument of policy, which makes it subject to pure reason.
>
> The first of these three aspects concerns more the people; the second, more the commander and his army; the third, more the government. The passions that are to blaze up in war must already be inherent in the people; the scope that the play of courage and talent will enjoy in the realm of probability and chance depends on the particular character of the commander and the army; but the political aims are the business of government alone.
>
> These three tendencies are like three different codes of law, deep-rooted in their subject and yet variable in their relationship to one another. A theory that ignores any one of them or seeks to fix

[21] On this, see: Clausewitz, (H/P) *On War*... p. 89; Bassford, 'Teaching …'; Jon T. Sumida, 'A Concordance of Selected Subjects in Carl von Clausewitz's *On War*', *The Journal of Military History* (78: January, 2014) p. 317, note 7.

> an arbitrary relationship among them would conflict with reality to such an extent that for this reason alone it would be totally useless.
>
> The task, therefore, is to keep our theory [of war] floating among these three tendencies, as among three points of attraction.
>
> What lines might best be followed to achieve this difficult task will be explored in the book on the theory of war [i.e., Book Two]. In any case, the conception of war defined here will be the first ray of light into the fundamental structure of theory, which first sorts out the major components and allows us to distinguish them from one another."[22]

It is important to stress Clausewitz's insistence that we render the trinity useless if we fix the relationships and the interactions *between* the elements of the trinities in any way. The meaning of this is that the trinity allows us to identify consistent, or universal, points of gravitation, but not predict the exact manner or form of their interactions with a great degree of accuracy. The trinity prompts a scholar to ask questions about passion's manifestations and interactions in that particular war, or organises an historical study in such a way as to retain a balance between the various factors that pertain to passion, reason, and chance to shed light on the unrecorded aspects of conditions within which events occurred and decisions were made. This is also true of the seven propositions. None of the seven propositions should be considered in isolation from the others. None *by themselves* will show the specific detail of any of their influences in a specific case, but it allows the reader to improve her analysis by comprehending the theory as a tool to assist the analysis of specific scenarios.

Because of this versatility, the trinity is not restricted to examining Westphalian notions of the state in warfare. The 'primary trinity' of passion, reason, and chance is always present and unchanging, and encompasses all belligerents that engage in warfare regardless of their composition and behaviour.[23] The "people, commander and army, and government" is a secondary trinity; an illustrative example of the first. By associating each of the three elements of war with a manifestation in reality as examples, Clausewitz *illustrated* how those elements appeared in his 19th century European environment. The trinity is not restricted to states and their so-called 'regular' forces; Clausewitz himself used his concepts to understand guerrilla warfare and popular armed uprisings,

[22] Clausewitz, (H/P) *On War*... p. 89
[23] Waldman, *War*... pp. 161-162

and vice versa, by examining the Spanish resistance against French occupation.[24] These nuances dispel, or at least severely challenge, critiques of Clausewitzian theory that claim his concepts lack utility in analysing wars where not all belligerents are states, or there are strong economic, cultural, or religious motivations for fighting, as seen in the conceptual arguments of the proponents of some 'New Wars' theses.[25] Recognising the intent of all belligerents as political is the basis for exploring and comprehending their own agendas. [26]

Recognising the wholly abstract nature of the primary trinity in order to aid the study of military history and the development of strategic theory is important. This interpretation of Clausewitz's trinity allows David Lonsdale to claim that "in the end, a less rigid interpretation of Clausewitz's theory leaves us with a work which is far more universal than either van Creveld or Keegan give it credit for."[27] This understanding of the trinity should put to rest arguments that Clausewitzian theory is made obsolete by technological change or the end of the Cold War – that the trinity, and all six points put forward in this section, accurately captures recurring dilemmas of war that must be faced regardless of surface political, technological, cultural, societal, or material characteristics. Hence, passion, reason, and chance do influence space warfare, the first of which is now examined in greater detail.

[24] Clausewitz, (H/P) *On War*... pp. 220, 350, 469-483, 592
[25] On 'New Wars', see: Mary Kaldor, *New and Old Wars: Organized Violence in a Global Era* (Cambridge: Polity Press, 2006); Daniel Hoffman, 'Violence, Just in Time: War and Work in Contemporary West Africa', *Cultural Anthropology*, (26:1, 2011) pp. 34-57; Jacob Mundy, 'Deconstructing civil wars: Beyond the new wars debate', *Security Dialogue* (42:3, 2011) pp. 279-295; Isabelle Duyvesteyn and Jan Angstrom, eds. *Rethinking the Nature of War* (London: Frank Cass, 2005); Karen Ballentine and Jake Sherman, eds. *The Political Economy of Armed Conflict: Beyond Greed and Grievance*, (London: Lynne Rienner, 2003); Mats Bersdal, 'How "New" are "New Wars"? Global economic change and the study of civil war', *Global Governance* (9, 2003) pp. 477-502
[26] Bassford, 'Tip-toe…'
[27] Lonsdale, *The Nature*... p. 27

### 3.1.1 War is emotional

> "[A machine] can have but one principle of motion, whereas in an army, each individual part has, within itself, the spring and source of action, which it may exert or not at pleasure." – Henry Lloyd[28]

Passion contains the visceral and often irrational emotions that arise in war, push war to its absolute extremes, and drive escalatory reciprocal actions by the belligerents. Using passion as a starting point to introducing the trinity, we have begun to tease out the interaction between passion and reason, between emotion and policy, irrationality and rationality. It is an interaction, not a dichotomy, which fascinated Clausewitz. He stood apart from most of his peers because rather than fall into one side or the other on the mechanistic or romanticist approach, he built a theory which actively attempted to incorporate both.[29] Soldiers, for example, must be imbued with emotion, but must also be led by competent leaders as much like automata by military institutions without stifling strategic creativity and will in the rank and file.[30] Emotion may be embodied in the citizenry, and not just in troops. Passion is a neutral and ambiguous concept; it can generate altruism as well as cruelty, becoming a potential limit on war's escalatory nature whilst simultaneously being a potential source of escalation.[31] Indeed, human passions – the flaws of irrationality – help make war an uncertain and sometimes ill-advised option, as argued by Clausewitz:

> "it would be an obvious fallacy to imagine war between civilized peoples as resulting merely from a rational act on the part of their governments and to conceive of war as gradually ridding itself of passion, so that in the end one would never really need to use the physical impact of fighting forces – comparative figures of their strength would be enough."[32]

This passage bears a striking anticipation and critique of a desire to reduce war to a completely rational and predictable affair based on the eradication of the Fog of War and wholly measureable

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[28] Henry Lloyd, *Continuation of the History of the Late War in Germany, Between the King of Prussia, and the Empress of Germany and Her Allies, Part II* (1781), in: Patrick J. Speelman, ed. *War, Society and Enlightenment: The Works of General Lloyd* (Lieden: Koninklijke Brill NV, 2005) p. 437

[29] Waldman. *War*… pp. 137-138. Examining Henry Lloyd's passages quoted above reveals possible exact sources of influence on Clausewitz's thinking.

[30] A point made of Henry Lloyd's theories by Patrick J. Speelman, in his editor's introduction to: Lloyd, *Continuation of the History*… pp. 379-380

[31] Waldman. *War*… pp. 147-158

[32] Clausewitz, (H/P) *On War*… p. 76.

aspects of capabilities and outcomes in warfare advocated by the extreme proponents of the RMA in the late 20th and early 21st centuries.[33] Passion can impose itself on individual commanders as well as the masses that might be susceptible to bellicosity from forms of patriarchal, monarchical, ideological, or nationalistic duty. In battle as well as the situation room:

> "action can never be based on anything firmer than instinct, a sensing of the truth… fresh opinions never cease to batter at one's convictions. No degree of calm can provide enough protection: new impressions are too powerful, too vivid, and always assault the emotions as well as the intellect."[34]

Clausewitz emphasised the psychological and 'moral' factors of war in part due to his unhappiness with his peers and predecessors for failing to take them into account properly, if at all.[35] Clausewitz addressed the feelings of the rank-and-file in combat in a non-derogatory manner in his assignments at the Institute for Military Sciences, which was uncommon for his time, and proposed solutions to ease the soldiery's natural emotional concerns and frailties in the heat of battle.[36]

Clausewitz believed that a war's outcome cannot be explained by accounting for rational methods alone, but must also account for the role of emotional, cultural, and individual psychological factors.[37] It was important for theory to distinguish between human reason and human emotion, as both are in constant interaction and can exert very different forces on war and our understanding of it.[38] Passions are a source of uncertainty, in addition to the realm of chance, in war as 'moral forces' were a conglomerate of many intangible unknowables, such as a fighting spirit and the will to persist

[33] On Clausewitz, uncertainty, and chaos, see section 3.2.3 and: Alan D. Beyerchen, 'Clausewitz, nonlinearity, and the unpredictability of war', *International Security* (17:3, 1992) pp. 59-90, available at: http://www.clausewitz.com/readings/Beyerchen/CWZandNonlinearity.htm (accessed 25/11/2013); Antoine Bousquet, *The Scientific Way of Warfare: Order and Chaos on the Battlefields of Modernity* (London: Hurst & Co., 2009) pp. 196-203, 216-217
[34] Clausewitz, (H/P) *On War*... p. 108
[35] Ibid., p. 178
[36] Peter Paret, *Clausewitz in His Time: Essays in the Cultural and Intellectual History of Thinking about War* (Oxford: Berghahn, 2015) pp. 22-23
[37] Clausewitz, (H/P) *On War*... pp. 177-178, 184-188
[38] Bassford, 'Tip-toe…'

after a major defeat. Because of passion and chance, war could not be reduced to rules and algebraic systems.[39] Handel makes this element relevant to the present day by writing that:

> "Did the President of the United States and his advisors correctly identify the culminating point of victory at the end of the Gulf War? Did he accurately assess the 'moral factors' involved? Whether he did or not remains open to debate, but all of the modern technology at his disposal certainly could not help him make a better decision."[40]

Clausewitz insisted that generals could not be judged by reason alone – their personalities and emotional conditions had to be taken into account.[41] Passion intrudes upon reason. Indeed, "there can be no "rational" consideration of goals without taking into account the emotions that give rise to the goals in the first place. Can we imagine policy, politics, economics, or reproduction without fear, love, greed, lust, or hope?"[42] Clausewitz took issue with Jomini's apparently mechanistic principles of war, and "their presentation as a general science of war which he regarded as absurd. Jomini's abstract principles, [Clausewitz] argued, ignored the living reality of war, the operation of moral forces, and the unique conditions of every case."[43] For Clausewitz, Jomini was too prescriptive and saw war as more of a linear and mathematical process, where Clausewitz was concerned with individual creativity, unquantifiable factors, and the uniqueness of every war.[44] Passion was a large part of this unquantifiable factor in war. In Clausewitz's vision of guerrilla warfare, undercutting the superior enemy's morale and will to fight was a significant aspect of it.[45] As passion may be *less* susceptible (but not impervious) to academic inquiry than material aspects, it is unsurprising that there is little more that can be done than attempt to anticipate the intrusion of passion on any propositions or at least be open to the possibilities and consequences of human emotions.

So what? Space warfare is still a form of war, and invokes passion in any Clausewitzian approach to it. Passion is still an element in modern warfare, and by extension, space warfare. The

[39] See: Michael I. Handel, *Masters of War: Classical Strategic Thought* (Abingdon: Frank Cass, 2001) pp. 81-88
[40] Ibid., p. 87
[41] Gat, *A History…* p. 180-182
[42] Bassford, 'Tip-toe…'
[43] Gat, *A History…* p. 125
[44] Antulio J. Echevarria II, *Clausewitz and Contemporary War* (New York, N.Y.: Oxford University Press, 2007,2013) pp. 15-16
[45] Beatrice Heuser, *Reading Clausewitz* (London: Pimlico, 2002) p. 136

decision to attack or respond to an assault on space infrastructure is a political and emotional one. As Handel argues above, decisions resting on an analysis of political and 'moral forces' are just as difficult now as before the age of satellite technology. A decision to go to war or to violently resist will still benefit from marshalling popular support or tolerance of some kind. Spacepower does not change this, or lives in a universe where this does not matter. Determining whether any act of space warfare is escalatory or not is a subjective and contingent political-military analysis. Shooting down a satellite can mean a multitude of different things, both in actual effects on military capability as well as in political effects. The reaction to the loss of a satellite will vary, in part, because of the emotions and rational calculations of the leadership and wider populations involved; in the same spirit the reaction of isolated troops suddenly losing their spacepower support in battle is unknown and perhaps hard to anticipate despite understandings of a particular military service's culture when units are cut off, isolated, and its back pushed against the wall.

Not everyone or every organisation will react to space warfare and the loss of spacepower in the same way, and it will not necessarily translate into the same political results or military effects. Such a statement may seem overtly banal or trite, but the recognition of this now-evident truth escapes the space weaponisation literature examined in the previous chapter, and exemplifies the value of this sort of theory. Paret certainly accepts that many parts of Clausewitz's work can appear as obvious banalities, but "it is one thing to know and accept a self-evident truth, another to formulate it clearly, understand its place in theory, and apply it in practice."[46] This is what is meant when passion is an element that is in space warfare – it pushes the individual to consider the manifestations and effects of it in any particular case, where theory becomes less immediately useful beyond as a starting point for strategic analysis. In one extreme, the loss of satellites may create little visceral reaction because of the lack of immediate human costs.[47] Another extreme would be that attacking satellites may trigger an irrational emotional response that is out of all proportion to the strategic effects actually created. There is no set response for any act of space warfare, and the passions of war play their parts in shaping them.

[46] Paret, *Clausewitz in His…* p. 83
[47] Over the long term, however, human costs to the loss of space infrastructure may increase.

Clausewitzian passion manifests in spacepower theory at several junctures: in the next chapter, Propositions II and III iterate that what happens in space is not in a political (nor geographic) vacuum; and in Chapter 6, Proposition VI examines the human element and cultural aspects of spacepower. Capitulation, renewed resistance, or degrees of both, are possible outcomes to the loss of celestial lines of communication. Even though satellites and most space infrastructure do not involve humans in orbit, space systems connect humans, direct, influence, and enable forms of human agency. Humans are still in the communications chains of the use of force that celestial lines of communication stitch together in modern states, economies, and militaries. Humans are at the controls of the satellites, drones, aircraft, tanks, ships, and firearms that through spacepower are supported, enabled, protected, and made ever-more-lethal and precise.[48] Further, people are at the receiving ends of military action and political-economic disputes through the intentional imposition of suffering, death, and destruction. Humans in the Space Age may still be subject to the thrills of offensive action, the malaise of defensive warfare, the fears of battle, and the weight of responsibility for their comrades. But that emotion needs a measure of direction, of reason.

### 3.1.2 War is political

> "An army, like the sea, is sometimes calm and slothful, at others, furious and outrageous, wholly ungovernable; both extremes are to be equally avoided. It must have such a degree of motion as is required to perform whatever is prescribed, and no more, that it may be confined and directed to a certain end." – Henry Lloyd[49]

> "The function I perform [assassination] has been referred to as 'wanton slaughter.' I prefer to see it as a means of facilitating communication, resulting in the termination of hostilities." – HK-50[50]

Left to reach its extreme, war can become 'wanton slaughter' with little discernible reason directing it. Indeed, the brutalities of war may mask any rational thinking directing such apparent barbarism. However, Clausewitz's assertions on passion are always meant to be taken in the context

[48] Although developments in 'artificial' or synthetic intelligence may raise some questions on decision-making.
[49] Lloyd, *Continuation of the History…* p. 438
[50] HK-50, an assassin droid in: *Star Wars: The Knights of the Old Republic II: The Sith Lords* (Obsidian, LucasArts, 2004)

of the interaction of emotion with the reason of politics, and with the element of chance and genius.[51] If passion and chance interact with the reason of policy, what is policy in the trinity? Clausewitz wrote that if "war is a pulsation of violence, variable in strength and therefore variable in the speed with which it explodes and discharges its energy… We see, therefore, that war is not merely an act of policy but a true political instrument, a continuation of political intercourse, carried on with other means."[52] Clausewitz *idealised* the elements of passion and reason so that the reader can more easily see their distinguishing features, because in practice they are nuanced and emerge only through interaction as an entire trinity.

As long as humanity's political-economies are based on Earth, space warfare will be a continuation of Terran politics with the addition of other means. Clausewitz's thinking on the relationship between war and politics is just as fundamental to thinking about space warfare as it is to terrestrial warfare. Azar Gat explains that "politics is an external force which works against the true essence of war, harnesses to its needs, and in the process modifies the imperatives which it imposes."[53] Clausewitz claimed that one can "take the political object as a standard [of measurement of a war's intensity and purpose] only if we think of the *influence it can exert upon the forces it is meant to serve*."[54] This means that a second unchanging feature of war in the trinity is how a political leadership may use war to further its ends, adding 'reason' to what is often a passionate and seemingly irrational human activity. *Reason* should not be equated to some ideas of *rationality*, however, as Bassford reminds us that "outcomes are seldom if ever precisely what any individual participant desired or intended."[55] A Clausewitzian conception of war is anything but dominated by reason, or the view that war is always a completely rational instrument for a rational policy.[56] Reason in war means that war is used – instrumentalised – by human wills to varying degrees to reach some desired goal. This moderates the mindless passions of the first element of the trinity.

[51] On Clausewitz's interest in the interactions of reason and emotion, see: Waldman, *War*... p. 137
[52] Clausewitz, (H/P) *On War*... p. 87. Emphasis Clausewitz's.
[53] Gat, *A History*... p. 223
[54] Clausewitz, (H/P) *On War*… p. 81. Emphasis Clausewitz's.
[55] Bassford, 'Tip-toe…'
[56] Waldman, *War*... p. 73

Space warfare, then, will be waged with some measure of reason, with the intent of reaching some desired goal. Destroying satellites or fouling Earth orbit with indiscriminate debris may not necessarily be a mindless act of barbarism, but a possibly calculated act with political intent and consequences. The point here is to chart possibilities – not to categorise a 'scorched orbit' approach to space warfare as inherently desirable or wise. By referring the emotional section above, one could foresee a furious response to the fouling of swathes of useful Terran space, perhaps triggering mass international opposition and retaliation, against the calculation of the perpetrator which may have attempted to be more calculating in its weapons firing and debris generation. But this is not guaranteed – the operation might have failed for technical reasons or the political consequences might have gone against expectations. The perpetrator would have to contend with the reason, the emotion, and the uncertainty of war, *in space*.

The originally German *On War* refers to '*politik,*' which can interchangeably mean politics and policy. War is a continuation of politics when we speak of the universal nature of war; but a particular war is a continuation of a particular policy, which is a manifestation of politics. Policy is a single focus of an object of a war for any given belligerent, or a directive that is meant to provide some measure of purpose for a population and armed forces. Any particular policy proposed by a government in war may be limited in its influence and potency by political conditions (i.e. *politics*) such as public opinion and civil-military relations.[57]

War is not entirely subordinate to politics, and a 'policy' does not have total control of its violent instrument; "Clausewitz's ideas are more nuanced than any crude depictions of strict political rationalism would suggest. Even a cursory acquaintance with his work would reveal the prominent role that emotional and contingent factors play in his theory."[58] The analogy that space warfare is the continuation of Terran politics by other means does not entail that political determinism is the correct way to view space warfare (just as technological determinism is a similar logical fallacy[59]). Like the titles of the propositions of spacepower, it is an economical way to allude to Clausewitz's discussion

[57] Bassford, 'Tip-toe…'; and Echevarria, *Clausewitz*... p. 93
[58] Waldman, *War*... p. 73
[59] Echevarria, *Clausewitz*... p. 94

of the trinitarian nature of war. Rather, 'politics' – in its broadest and most holistic sense – is what gives war its purpose, and that includes space warfare.

All wars can be given a specific political purpose - a policy - but reason's presence in war does not mean that it will be executed flawlessly, or that the specific reasoning behind a war's purpose is well-founded.[60] In other words, there is such a thing as bad policy.[61] In defending Clausewitz from Martin van Creveld's criticism that the trinity can only be used when war is waged for the 'political reasons' of states, David Lonsdale wrote that "policy may concern religious issues, territorial disputes, resources, or indeed important cultural events."[62] Policy in the trinity is the congruence and direction of interests among people, organisations, and leaders which gives a war's ultimate purpose. Whether disputes are shaped by economic, religious, ideological, ethnic, or other reasons, questions over, and practices of, their management, exploitation, and resolution is inherently a *political* task. Policy could make an unreasonable demand of its military to perform tasks it cannot undertake with any great measure of success; as such it can be seen as an ill-considered policy from a Clausewitzian point of view.[63] But that would still be 'reason' in war, and a deeply problematic manifestation of it. As a result, any such problems where the leadership asks too much of its available means is not about the *influence* of policy – its influence is always there. The quarrel would be with the policy or 'reason' itself demanding too much of its capacity for violence.

Politics does not always limit passion's escalatory tendency. Like all three elements, its influence does not always push in one direction.[64] 'Reason' in some cases could be pushing towards an escalation of war, in tandem with passion, if accepted ethical conduct in war to one belligerent allows the indiscriminate killing of non-combatants. Policy does not fully let go of its bonds or is completely dominated by passion, the same as policy does not entirely dominate war's passions. The trinity portrays war as distinctly nonlinear, and "politics is about power, and the feedback loops from violence to power and from power to violence are an intrinsic feature of war. It is not simply that

[60] Clausewitz, (H/P) *On War…* pp. 86-88
[61] Ibid., 606-607
[62] Lonsdale, *The Nature…* pp. 25-26
[63] Clausewitz, (H/P) *On War…* p. 607
[64] Ibid., p. 584

political considerations weigh upon military commanders. War is inherently a subset of politics, and every military act has political consequences."[65] There is always a degree of reason in conducting war. Furthermore, the political object itself (or a policy in a war) may be up for negotiation and change as the war progresses. For example, even in the midst of a total war mentality, the United States scrapped the policy goal of unconditional surrender for Japan in 1945, creating another factor in determining why Japan surrendered when it did.[66]

In space warfare, like any kind of warfare, "the compulsion which we must use towards our enemy will be regulated by the magnitude of our own and his political demands."[67] Depending on the political stakes involved, something that may appear 'suicidal' – like fouling a region of Earth orbit with a debris field – may appear like a price worth paying for political-military triumph on Earth. Space warfare is not inherently an all-or-nothing affair and could be used in 'limited' regional wars as well as wars for survival. The decision to employ space warfare will be an act of political judgment that would ideally be in step with the overall analysis of the value of the political object at stake. When engaging in space warfare, it still needs to be turned to the ultimate reason of its leadership. This does not make space warfare inherently rational, but it does impose a form of reason in a Clausewitzian sense. The political consequences of fouling Earth orbit *may be desirable* in some circumstances. The influence of reason and policy means that military services cannot complain of the presence of 'policy' in their space warfare plans; policy is always present and they are an instrument of it. True of any other instrument, a leadership should not make demands of spacepower that it cannot fulfil. The element of reason comes through in spacepower theory most forcefully in Propositions II and III in Chapter 4, and Proposition V in Chapter 5. Propositions II and III warn against treating spacepower in isolation from the rest of human experience. Proposition V integrates spacepower into wider grand strategic considerations. The instrument under examination in this thesis

[65] Beyerchen, 'Clausewitz, nonlinearity…' p. 89

[66] On the debate over the Japanese surrender in August 1945, see: Gar Alperovitz, Robert Messer, and Barton Bernstein, 'Correspondence: Marshall, Truman, and the Decision to Drop the Bomb', *International Security*, (16:3, 1991/2) pp. 204-221; Robert Butow, *Japan's Decision to Surrender* (Stanford, C.A.: Stanford University Press, 1954); J. Samuel Walker, *Prompt and Utter Destruction: Truman and the Use of Atomic Bombs Against Japan* (London: University of North Carolina Press, 2004); Ward Wilson, 'The Winning Weapon? Rethinking Nuclear Weapons in the Light of Hiroshima', *International Security*, (2007, Vol. 31:4) pp. 162-179

[67] Carl von Clausewitz, *On War*, O.J. Matthis Jolles, trans. (Random House, 1943) in: Caleb Carr, ed., *The Book of War* (New York, N.Y.: The Modern Library, 2000) p. 908

– spacepower – ultimately involves humans and should be moulded towards war's reason, but this still needs shrewd leadership to overcome the imponderable chaos of war and to stand the best chances of success. "All wars may be regarded as political acts" – the same may be considered true of all acts of space warfare.[68]

### 3.1.3 War is chaotic

"It is not enough that [the troops]… can perform what is prescribed to them, they must [be] desirous and anxious to second your intentions at the risk of their lives; they must be determined to succeed or perish in the attempt. To infuse such sentiments into all ranks of men under your command… demands uncommon qualities." – Henry Lloyd[69]

"*Never* tell me the odds!" – Han Solo[70]

The element of 'chance' encapsulates a number of important and useful ideas for understanding war and creating spacepower theory. Firstly, it is important to understand Clausewitz's concept of friction in limiting war's nature. Friction *mainly* resides in this part of the trinity, but as expressed above, it is not always the case. Friction is what makes the simple aims of strategy so difficult to achieve: "everything in war is simple, but the simplest thing is difficult."[71] Things *will* go wrong; there is a need to prepare for unforeseen consequences. These can simultaneously help or hinder one's effort.[72] There will be gaps in one's knowledge and commanders never have perfect information. Some elements such as weather will be beyond a commander's control, but may yet be turned to one's advantage. There is much beyond any authority's control because "countless minor incidents – the kind you can never really foresee – combine to lower the general level of performance,

[68] Ibid., p. 281
[69] Lloyd, *Continuation of the History…* pp. 439-440
[70] Han Solo in: *Star Wars: The Empire Strikes Back*, Dir. Irvin Kershner, Wri. Leigh Brackett, Lawrence Kasdan (20th Century Fox, 1980)
[71] Clausewitz, (H/P) *On War…* p. 119
[72] Conversely, exceptional successes can cause friction of its own, such as in the German advance in the Ardennes in May 1940 against the Belgian Ardennes Light Infantry. The success at which German forces cut Belgian communications meant that Belgian troops continued to resist at Bodanges because the order to retreat did not reach them. This German paratroopers' success caused harm and delays for the 1st Panzer Division! See: Karl-Heinz Frieser, with John T. Greenwood, *The Blitzkrieg Legend: The 1940 Campaign in the West* (Annapolis, MD: Naval Institute Press, 2005) pp. 121-127

so that one always falls far short of the intended goal."[73] Uncertainty played a large part in Clausewitz's entire outlook on war; to expect the unexpected and make reliable alternative plans as "every war is rich in unique episodes. Each is an uncharted sea, full of reefs. The commander may suspect the reefs' existence without ever having seen them; now he has to steer past them in the dark."[74]

This illustrates how Clausewitz marries the universal with the particular in war: it is useless to prescribe specific action in a general theory against all uncertainties because to do so would contradict the very nature of uncertainty, historicism, and the purpose of the trinity. Rather, the abstracted universal *influence* of uncertainty on the trinity, and therefore every war, is that the belligerents are constantly acting in a world of probabilities, of unknowns and imperfect knowledge, and should have reserve forces and a plan B should plan A go awry. Friction can mean that political goals have to be adjusted against materially insurmountable odds; or a gargantuan effort may be needed on account of the political leaders to match the potential friction they could face in order to meet their political object. Whilst war's passion may not override the limits of friction, friction may sometimes be weak in some wars to allow passion or reason to proceed apace. Indeed, Clausewitz's treatment of uncertainty and the interactive and multilateral behaviour of the elements of his trinity are characteristic of a 'nonlinear' system, which ignore rules of proportionality and additivity, meaning that it cannot be broken into parts that may be compartmentalised and isolated for analysis, and small actions can have both large and small consequences.[75]

Second, there are the material characteristics of any belligerent (geographic composition and martial capabilities, for example), and the 'objective environment' of the physical world and humans and their characteristics.[76] In other words, these are things that may not be changed quickly about the belligerents involved and the world they inhabit. A belligerent with little military infrastructure will face limited attritional options against a vastly superior one; a belligerent with a fractured political

[73] Ibid.
[74] Ibid., p. 120
[75] Beyerchen, 'Clausewitz…', pp. 62-63
[76] Bassford, 'Tip-toe'

will or a weak economic base may struggle to fight a protracted conflict against a determined and patient foe. Indeed, a persistently under-endowed entity may develop flexibility, surprise, and deception into a 'national style' or strategic culture, as Luttwak notes with Israeli strategic experience.[77] What this means is that a given characteristic of a belligerent is in part a product of its physical position and resources, as well as its unique cultural character. These affect strategic planning in both how to exploit and undermine the particular characteristics of any belligerent. The chance characteristics of belligerents can cause their own points of friction and uncertainty, especially when one belligerent may expect a particular kind of behaviour from its enemy, only to be surprised by a foe that undertakes an 'unthinkable' action against it. Proposition VI elaborates on strategic culture and spacepower.

Third, the realm of chance is where Clausewitz situates his concept of command genius. Genius in an individual is described by Clausewitz as the "appropriate gifts of intellect and temperament. If they are outstanding and reveal themselves in exceptional achievements, their possessor is called a "genius."[78] Furthermore, "war is the realm of uncertainty… A sensitive and discriminating judgment is called for; a skilled intelligence to scent out the truth."[79] Skilled individuals are needed to ascertain fact from fiction during war, and to hold steady in the terrifying and inhibitive 'climate of war', composed of danger, exertion, uncertainty, and chance.[80] A commander must rely, among other things, on intuition to compensate for the paucity of reliable information and the mountain of irrelevant or misleading data, a steadfast resolve in one's convictions yet an ability to modify them should the need arise, and a sensitivity to the demands of war without being overcome by the horrors of it. Furthermore, genius at the highest of levels would equate to an individual with a thorough understanding of the matters of state (or a political entity's entire grand strategy) and the demands of warfare.[81] A commander possessing genius can appear at any level – from a tactical level through to the top of a political entity. They can intuitively see through the

[77] Luttwak, *Strategy…* pp. 16, 97-98
[78] Clausewitz, (H/P) *On War…* p. 100
[79] Ibid., p. 101
[80] Ibid., p. 104
[81] Ibid., p. 100-112

problems they face and take actions and decisions that often result in desirable outcomes, while inspiring others to perform their tasks competently, if not outstandingly.

Genius can behave in an extremely unpredictable manner, especially as genius pertains to living people and is highly dependent on the individuals involved.[82] Drawing on Kantian and Machiavellian ideas of genius,[83] Clausewitz intended to incorporate rather than exclude yet another imponderable factor in a theory of war, and make it an element which can be accounted for in a holistic analysis of war through his trinity. When analysing or theorising war one must take into account humans' abilities to use intuition and good judgment – and to the contrary, poor judgment that may defy expectation, rules of thumb, and modes of best practice. Genius may severely affect the element of chance's interaction with passion and reason. For example, a quick and decisive campaign orchestrated by a genius may make a war more attractive to a political entity with a weak passion base.

The genius of war is affected by 'moral forces', what we may refer to today as psychology, morale, and the will to fight, as much as the ordinary soldier or civilian are. Humans are thrown into the chaos (in terms of chaos theory[84]) of war, battling and exploiting uncertainty, their passions, and the 'reason' of leaders. Uncertainty helps qualify Clausewitz's most striking passages, which considered in isolation, often contradict each other. Alan Beyerchen explains this by arguing that "the elegance of military axioms is a mirage shimmering above the distinct abstractions of implicitly idealized, isolated systems; the denseness of Clausewitz's forest of caveats and qualifications more faithfully represents the conditions and contexts we actually encounter."[85] Reality, or 'real war', is a result of the chaotic, reasoned, and passionate interactions of war which are unpredictable in detail but distinguishable as recurring universal elements. In Clausewitz's day most philosophers tried to delineate objective and impersonal principles or propositions of war. As Sumida describes,

[82] Gat, *A History…* p. 180
[83] Ibid., p. 177; Waldman, *War…* pp. 124-125
[84] On chaos theory, see: Ian Stewart, *Does God Play Dice?* (London: Penguin, 1990)
[85] Beyerchen, 'Clausewitz…'

"Clausewitz, in contrast, called for the imagination of the highly variable, contingent, fraught, and therefore personal nature of the capacity to respond effectively to difficult situations."[86]

The use of spacepower is subject to these abstractions on chance and uncertainty; Clausewitzian friction still occurs in orbit. Spacepower theory must accommodate this. Failures of all kinds can occur – space technology is not immune to 'glitches' or technical mishaps. Indeed, rocket launches are still a risky affair and no launch is guaranteed to be successful. Space weather, though forecastable to varying degrees like terrestrial weather, can still cause problems. A powerful solar flare could inhibit the celestial lines of communications of a spacepower-enabled alliance and terrestrial military forces, providing a window of opportunity to its enemies. Furthermore, spacepower does not inherently provide omniscience – knowledge gaps and uncertainties will always prevail, especially when considering the element of passion in whatever contingency is under examination. Space warfare is also subject to the nonlinearity and disproportionality of warfare as a whole. A major offensive against celestial lines of communication may yield puny results on Earth depending on its character and co-ordination with terrestrial action and objectives. Conversely, a lone attack on a satellite may "let slip the dogs of war"; unleashing violence and destruction on Earth, which may make the destruction of one or a few satellites look like a relatively uncostly event compared to what follows.

Genius and talented humans still retain their relevance in spacepower and space warfare. In the so-called 'First Space War'[87] of the 1991 Gulf War, U.S. military space capabilities were not ready to offer operational and tactical level support to deployed forces in Operation DESERT SHIELD. The U.S. military space posture was geared towards the more static and strategic capabilities of nuclear deterrence and ballistic missile launch detection, and linking up static military bases and diplomatic missions across the globe. However, innovation and five and a half months of fervent trial and mass-shipping of satellite receiving equipment to the Gulf ensured that coalition forces were supported to a degree that was unimaginable a few years prior by the eve of Operation

[86] Sumida, *Decoding…* p. 68
[87] The term secured its place in academic and specialist discourse in: Peter Anson and Dennis Cummings, 'The First Space War: The Contribution of Satellites to the Gulf War', *RUSI Journal* (136:4, 1991) p. 45

DESERT STORM.[88] In a few months at the end of 1990, talented space specialists were able to work with military leaders at U.S. Central Command to push U.S. spacepower down operationally and tactically relevant routes, such as precision-guided munitions and precise navigation for tank assaults through a featureless desert.

As a result, space warfare is not a wholly predictable affair. Cunning space strategists can confound and surprise enemies through the creative and unexpected use of various means, overall war plans, and diplomatic initiatives. There is no set way to attack celestial lines of communication or deny and secure spacepower – there are a variety of means that can be mixed and matched to a plethora of prevailing political conditions and command geniuses on Earth. Indeed, making spacepower relevant to a terrestrial war is the prevailing theme of Proposition V in Chapter 5. A genius may be able to pull off a remotely achievable feat in space warfare, and confound expectations. As war is a very human affair, so is space warfare. Human command genius will still come through in determining a successful use of spacepower, or its denial, in war.

### 3.1.4 Theory is for education

> "The purpose of theory… is improved perception of the particular, not prescription."
>
> – Jon Sumida[89]

The trinity forms three points of gravitation between which any theory of war must hold a balance. This is true of spacepower theory, which must allow for the tendencies of passion, reason, and chance to play out even in warfare that consumes Earth orbit. But what is the purpose of such theories of war? Clausewitz's theoretical intent is best described as how to think about, learn from, and apply war plans, not how to win any particular war – although the former is intended to help in the latter. This is exactly what spacepower theory's intent is. Spacepower theory should help illuminate the strategic significance of the particulars of any case of space warfare, or hypothetical

[88] David N. Spires, *Beyond Horizons: A Half Century of Air Force Space Leadership* (Montgomery, A.L.: Air University Press, 1998) pp. 209-269; Frank Gallegos, 'After the Gulf War: Balancing Spacepower's Development', in: Bruce M. DeBlois, ed., *Beyond the Paths of Heaven: The Emergence of Space Power Thought* (Montgomery, A.L.: 1999) pp. 63-80
[89] Sumida, *Decoding…* p. 170

scenario, by understanding everything that may be possible, with its caveats, in space warfare and why it matters to the overall war effort. This pedagogical intent of strategic theory is common among the major seapower theorists used to create spacepower theory.[90] Spacepower theory, like strategic theory, should *help* its readers ask, answer, and understand questions such as: what kind of war is this? What kind of warfare and consequences can be expected? Why is this kind of warfare being waged? So what? Spacepower theory will not by itself provide answers to these questions that examine specific concerns in specific scenarios – but it can help frame analyses that might provide answers to such questions. This is what Clausewitz intended with his principles of war. In Echevarria's words, Clausewitz's work: "is an effort to spare readers the burden of recreating the universe of war, so to speak, whenever they needed to learn about war through books. Clausewitz performed the taxing and time-consuming labor for them."[91] Clausewitz's theory is a foundation for thinking about war that readers can use for their own analyses and theorising, as has been done here in the creation of spacepower theory.

Jon Sumida regards *On War* "as a *set of instructions on how to engage in serious learning of a highly personal nature* rather than an *impersonal representation of the totality of that which is to be learned*."[92] Eugenia Kiesling regards that sentence "as intelligent an explanation of the book as one is likely ever to read. Those of us who teach military history in an effort to educate soldiers will find in *Decoding Clausewitz* an inspiring explanation of what we ought to be doing."[93] It is difficult to disagree, least of all for clarifying the intent of the seven propositions of spacepower theory and how Clausewitzian theory is used here. Although Sumida is mostly correct, *On War* still contains ideas that help represent the totality of war. There need not be an argument on whether *On War* is strictly a theory of war, or a theory for practice in war. It can be interpreted and used as tools for both, and they are quite complementary. Indeed, it would be impossible to teach and learn about war without having

[90] For example, see: Jon T. Sumida, *Inventing Grand Strategy and Teaching Command: The Classic Works of Alfred Thayer Mahan Reconsidered* (Washington, D.C.: Woodrow Wilson Center Press, 1997) pp. xv-xviii, 6-7, 44, 67, 69. On agreement here with Corbett and Castex, see: Julian S. Corbett, *Principles of Maritime Strategy* (Mineola, N.Y.: Dover, 2004) pp. 1-9; Castex, *Strategic Theories…* pp. 21-25
[91] Echevarria, *Clausewitz…* p. 26
[92] Sumida, *Decoding…* p. 5. Emphasis Sumida's.
[93] Eugenia C. Kiesling, ''*Decoding Clausewitz: A New Approach to* On War', by Jon Tetsuro Sumida, University Press of Kansas, 2008', *Army History* (76, 2010) p. 47

a workable notion of what the phenomenon of war actually is. Conversely, understanding what Clausewitz conceived of as war is aided by understanding the pedagogical intent of his thesis in an objective approach to understanding war that refrained from providing prescriptive axioms to the reader.[94] Clausewitz attempted to set out useful truths as constructive starting points of learning about, and analysing, war.

The trinity is a tool to help balance competing and interacting abstractions about war. As Sumida again describes, "the object suspended between the three poles of force is not war or the dynamics of war, but a theory of war."[95] Any theory that is meant to re-enact or recreate the dilemmas of military history to enhance command education must take into account passion, reason, and chance. The three elements achieve definition or clarity in one's mind by their interaction with each other and through our imagining or experience of their many forms. The interaction of the three elements of war is how this thesis bases its understanding of the phenomenon of war. It is a starting point to help understand practice in warfare at the strategic level of any war. This is what is meant by the first major analogy of this thesis – that space warfare is the continuation of Terran politics by other means – it is a starting point to make the Clausewitzian trinitarian view of war relevant to warfare in orbit and in war in the Space Age. All three elements of passion, reason, and chance will influence the actual conduct of warfare in orbit.

Furthermore, the trinity helps comprehend empirical aspects of any war because it relates a particular case to a wider universal knowledge of war as a phenomenon and to other wars in history. This allows some structured comparative thinking to occur, seeing what is similar and what is not. No two wars are exactly alike, but Clausewitz saw recurring universal elements in the wars he knew and studies, which formed the idea of the trinity. The methodological link between Clausewitzian theory and analogical reasoning (see below) which influences the seven propositions of spacepower emerges strongly here. There is a consistency to the complexity and diversity of strategic experience;[96] and analogical reasoning is necessary to bridge the gaps between the vast particulars of each case of

[94] On Clausewitz's views on subjective and objective knowledge, see: Echevarria, *Clausewitz…* pp. 21-33
[95] Sumida, *Decoding…* p. 116
[96] Waldman, *War…* p. 179

strategic experience, to distil recurring dilemmas and form some useful observations to guide thinking (or educated guessing) about an uncertain future. Clausewitz's trinitarian methodology stresses that any analysis of war will need to take its universal elements into account, which will manifest themselves in ways that may or may not be recorded in history.

In addition, the trinity promotes a balanced theory that can not only enhance historical study and vice versa, but also help develop principles to create useful strategic analogies. A sufficient grasp of historical method and its limitations is required to understand the limitations of empirical study and analogical thinking (explored further below). History should be embraced within strategic studies, much like the "classical tradition in international relations (IR) theory, perhaps most obvious in figures such as Niebuhr, Carr and Morgenthau, which intimately associated the craft of international theory with deep immersion in history."[97] Histories of human relations should be seen as an 'open problem' that one can approach history with ideas to help construct various historical truths; indeed there are no "fixed points of historical settlement" and it can be viewed as an "undecideable infinity of possible truths."[98] Perhaps the view of history taken in this Clausewitzian approach to spacepower theory resembles that of the English School in IR theory, where history is seen as "'useful knowledge', serving as a means of illuminating concrete puzzles in world politics." Simultaneously, however, there is resistance to "attempts to capture history within broader explanatory frameworks or, indeed, to generate accounts of 'final causes'."[99] As seen throughout the spacepower theory, the core strategic thinkers grapple with the problems – or puzzles – of multicausality and historical contradictions in war. They come to a practical conclusion for their readers: historical knowledge can help identify common rules of thumb, but be prepared to discard it as the future, and war, is unpredictable and quintessentially human. Theory can help in understanding history, but neither should determine the other, particularly when considering basing future actions on one's knowledge of the past. History and theory, therefore, are closely connected and should be in constant dialogue as they help the individual grapple with puzzles of history and the future. This is demonstrated in

[97] George Lawson, 'The eternal divide? History and International Relations', *European Journal of International Relations* (18:2, 2010) p. 206
[98] Ibid., pp. 207-208
[99] Ibid. p. 209

spacepower theory by the way history is used, via strategic analogies, to set foundations for thinking about recurring problems regarding space warfare, which has yet to happen in earnest. Spacepower theory must be in constant interaction and reflection with reality – be it in historical terms or in use in the present world. Sheldon is correct to state that strategic analogies are a means of developing higher-level critical thinking skills; that may be extended to the entirety of war studies and Clausewitzian theorising.[100]

Critical thinking in the creation and intelligent application of propositions are the ideal outcomes of the propositions of spacepower. The pedagogical nature of the spacepower theory is best summarised by Sumida who says: "[it] does not… teach its reader how to acquire a skill as such, but rather how to explore realms of personal thought that included emotional elements in relation to the sorts of difficult problem-solving likely to arise in the course of decision-making in war."[101] Sumida goes on to state that "the intended product of this process is a sensibility – that is, a mental character encompassing emotion as well as knowledge – that, in the absence of actual experience, can provide a measure of sound understanding and a platform for further learning."[102] This kind of theory and the exercises it encourages are meant to engage 'the undermind' – through grasping the subconscious processes of human thought and the intangibles of war, one can help develop a familiarity for acting and taking decisions in the unknown and with gut instinct.[103] This is reflected even within the work of Clausewitz's Swiss counterpart – Antoine-Henri Jomini – which led Michael Handel to reason that:

> "closer scrutiny of Jomini's treatise reveals the tension in his work between the non-scientific nature of the conduct of war on the higher level, and his attempt to demonstrate that war can be directed scientifically on the lower levels. But even Jomini, to reconcile this tension, insists that it is crucial to find an inspired commander whose intuition or *coup d'oeil*… will ensure the correct application of his principles of war."[104]

[100] John B. Sheldon, *Reasoning by Strategic Analogy: Classical Strategic Thought and the Foundations of a Theory of Space Power* (PhD Thesis, University of Reading, 2005) p. 297
[101] Sumida, *Decoding…* pp. 100-101
[102] Ibid., p. 101
[103] Ibid., pp. 119-120
[104] Handel, *Masters…* p. 3

Handel argued further that "the contradictions within each of [the works of inter alia Clausewitz, Sun Tzu, Jomini, and Mao] are more interesting than the contradictions between them."[105] Handel added that in contemplating these contradictions, not resolving them, it is hoped that a better understanding of war comes about. As the following chapters demonstrate, the canon of strategic theorists used are notable for how they grapple with similar problems by themselves, not in how they argue against each other. Such a view may fall victim to the 'mythology of doctrines', critiqued by Quentin Skinner as:

> "the tendency to find advocates of a position in earlier times and earlier places. Hence, Thucydides, Machiavelli, Hobbes et al. are taken to be part of a realist canon not because they would have recognized modern usage of the term – or necessarily have related to contemporary language games, concepts and ideas – but because we find affinities between their work and our times. In short, we read us in them."[106]

This 'myth of doctrine,' however, is not necessarily so insensitive to proponents of historicism – of the unique and contingent diversity of historical experience. The theorists used in spacepower theory are similar, and all Clausewitzian, in the sense that they aim to promote critical thinking based on the sheer complexity and diversity of historical experience coupled with the perils of considering action in an uncertain present and future, despite the view that the past, too, is ever-shifting in its meanings and interpretations.

For strategists, commanders, and scholars, the "objective is not necessarily to resolve or eliminate every anomaly, but rather to understand why wrestling with these questions can bring better insight into the nature of war."[107] A better understanding of the nature of war, in turn, should improve the quality of analysis and decision-making in the practice of strategy. This is no less true of spacepower's role in bringing about better 'space strategies,' or astrostrategies. Clausewitz insisted that "the influence of theoretical truths on practical life is always exerted through critical analysis rather than through doctrine. Critical analysis being the application of theoretical truths to actual

[105] Ibid., p. 7
[106] Lawson, 'The eternal…' p. 216
[107] Handel, *Masters…* p. 7

events, it not only reduces the gap between the two but also accustoms the mind to these truths."[108] The Prussian elaborated that principles, rules, and methods "are there to be used when needed, and their suitability in any given case must always be a matter of judgment. A critic should never use the results of theory as laws and standards, but only – as the solider does – as *aids to judgment*."[109]

Waldman captures the overarching purpose of the trinity and its value to spacepower theory by explaining that:

> "[the trinity] cannot, of course, tell us anything substantive about modern conflict, but rather encourages consideration of the essential dynamics that underlie any situation of organised violence waged for political ends. The value of this lies in the way that essentials are often lost in the welter of overpowering images and the inordinate confusion of the 'here and now'."[110]

The trinity enhances understanding about war and illustrates the bare essentials of what is a complex phenomenon in the context of a shifting past and an indeterminate future. It is easy to become distracted by the 'here and now' in terms of space industry trends, but a Clausewitzian method encourages thinking that applies across technological, economic, and political conditions, ensuring that analysis does not become distracted by everyday trivia. There are two further aspects that can be drawn from Clausewitz's trinitarian method that can usefully inform *any* analysis of war beyond what has already been said about war's emotional, political, and uncertain nature, and form the next two sub-sections: that the strategic defensive is an inherently stronger form of war, and that strategy has a paradoxical logic. These two observations can be grasped with nuance only in conjunction with the trinity in mind – as tools to guide constructive thinking and not as axiomatic declarations of reality.

[108] Clausewitz (H/P) *On War*... p. 156
[109] Ibid., p. 158. Emphasis Clausewitz's.
[110] Waldman, *War*... p. 179

### 3.1.5 The defensive is the stronger form of war

"The defensive form of war is not a simple shield, but a shield made up of well-directed blows."– Carl von Clausewitz[111]

"When your forces do not permit you to oppose your enemies at once in every point, you must act in part on the defensive, and in the other offensively. If you are too weak to act in many points at once, you must abandon some of them, that you may act with more vigour than in others." – Henry Lloyd[112]

Book VI of *On War* is the summation of Clausewitz's views on tactical and strategic defence. A defensive war usually provides more opportunities for victory for a competent defender than that of an offensive war for the aggressor. Clausewitz described defence as:

> "easier than attack. But defense has a passive purpose: *preservation*; and attack a positive one: *conquest*. The latter increases one's own capacity to wage war; the former does not. So in order to state the relationship precisely, we must say that *the defensive form of warfare is intrinsically stronger than the offensive.*"[113]

Defence is ideally the anticipation of the blow of the attacker with a counterattack ready to follow when the blow has been parried. A strategically passive posture puts the initiative of striking a major blow to the attacker, but also the greater costs of error if the defender has a waiting counterattack. If a defender can trade space for time, it can accrue benefits by intelligently responding to an enemy's moves as it advances; slowing the advance, buying time for the looming counterattack. A strategic counterattack after the enemy has overextended or lost momentum is the realisation of a successful strategic defence. A classic example here is Russia's ability to turn the tables against France in 1812, after France overextended and Russia continued to resist before and after Napoleon was in headlong retreat westwards.[114] Even when the defence of a territory may have failed utterly, and a land is then

[111] Clausewitz (H/P) *On War*… p. 357
[112] Lloyd, *Continuation of the History*… p. 494
[113] Clausewitz (H/P), *On War*… p. 358. Emphasis Clausewitz's.
[114] Sumida, *Decoding*… pp. 90-91

occupied, Clausewitz's view on guerrilla warfare supported his theories of the *inherent* strength of the defensive as options keep presenting themselves to a competent defender.[115]

Clausewitz's idealised conception of the strategic defence increases the problems of supply and general friction to the attacker, and reduces them to the defender.[116] However, this by no means makes an aggressive war of conquest unattainable. It makes offensive wars more risky and difficult to exercise than the defender's objectives as a general rule. Understanding the *relative* ease at which a strategic defence can be executed informs how a strategic offensive can be better created as "one should from the start give very close attention to… the defensive that will follow" a strategic attack, unless that campaign produces immediate peace.[117] This was a way Clausewitz made an overall weaker power's smaller size and capacity still useful at a strategic level against an apparently stronger foe – forces could scatter and strike at opportune moments in a strategically defensive plan.[118]

It may be tempting to describe offense as stronger in space warfare because satellites may be vulnerable to attack with little direct means to counter such attacks. However, that may be restricted to satellites in specific altitudes, orbits, and satellites because of the proximity of satellites and celestial lines of communication in LEO to Earth-based space weapons. More important than this, however, such an argument is made on tactical-operational, not strategic, levels of analysis. Just as a ground-based laser may have an advantage, or ease of striking, against a satellite in LEO, numerous circumstances and multiple engagements beyond that one 'battlefield' instance at a tactical level will have to be accounted for when considering politics, logistics, economics, and reinforcements at the strategic level. Just because it may be easy to shoot down *some* satellites does not mean that the *strategic* defender does not get the opportunity to seize the benefits of awaiting the attack, preparing the counterattack, rallying popular support, operating with allies, and in sum, undermining the entire plan of the attacker that has invited a devastating counterattack and, with luck, complete with glaring weaknesses the defender can prey upon as it turns the screw in the counterattack. Strategically, as

[115] Ibid., pp. 15-16
[116] Clausewitz (H/P) *On War…* p. 365
[117] Ibid., p. 365
[118] Sumida, *Decoding Clausewitz*

time passes without result for the aggressor, advantages tend to accumulate for the defender as it organises a response.[119] An initial attack on space infrastructure may be successful, but the victim's space infrastructure may be able to compensate and reconstitute after such attacks, and assist in the following counterattacks that may enjoy significant popular support to allow a heavy-handed escalation and retaliation on the guilty party, whether on the detected sites of anti-satellite weapons or on other targets for retribution or to cripple the most valuable aspects of the enemy's war-making capacities.

If space warfare is a continuation of Terran politics, spacepowers will also have to be wary of the culminating point of victory – the point when a belligerent has achieved enough in warfare to demand appropriate concessions from an enemy that has nothing to gain and much more to lose from continued resistance. However, if an aggressor passes this culminating point, the defender may have imposed enough penalties that continued resistance seems like a price worth paying to win concessions for itself, especially if it has little more to lose and a lot more to gain.[120] This stresses the point that an end to hostilities in orbit will be as much a political question as that of technical realities.

A strategic defence is "simply the more effective form of war: a means to win a victory that enables one to take the offensive after superiority has been gained".[121] Key to the concept of defence is the counterattack – the following offensive – because "Once the defender has gained an important advantage, defense as such has done its work. While he is enjoying this advantage, he must strike back, or he will court destruction."[122] The defence provides more opportunities with less inherent friction than the offence – but these only matter if they are seized upon by the defender or are not counteracted by the attacker. Clausewitz reminds us that "defense has its strengths and weaknesses. Though the former may not be insurmountable, the cost of surmounting them may be disproportionate."[123] Defensive Welsh strategies against economically superior Anglo-Norman

[119] Carl von Clausewitz, *On War*, O.J. Matthis Jolles, trans. (Random House, 1943) in: Caleb Carr, ed., *The Book of War* (New York, N.Y.: The Modern Library, 2000 p. 619
[120] Clausewitz, (H/P) *On War*… p. 528. On the examples of overshooting the culminating point of victory in World War II and the Korean War, see: Luttwak, *Strategy*… pp. 22-26
[121] Clausewitz, (H/P) *On War*… p. 370
[122] Ibid.
[123] Ibid., p. 523

dynasties are interesting examples in the historical applications of these abstract concepts.[124] Indeed, perhaps because of the intelligent use of the advantages of the defensive form of war that Wales' conquest had taken "so long."[125]

For now, it can be asserted that a power on the strategic defensive has options to withstand the blows of a spacepower, or adapt and plot a counterattack against a spacepower. Proposition VII examines some responses to spacepower-enabled military forces by adapting through dispersal, concealment, and opportune concentration. Although the United States was able to exploit spacepower in its offensive wars in Afghanistan and Iraq, the spacepower-less adversaries adapted and resisted with varying degrees of success.[126] Their ultimate defeat must not blind observers to the reality that they were anything but passive, unthinking, static targets. They were waging a defensive war against a spacepower exploiting its celestial lines of communication. The Taliban and the remnants of Al-Qaeda were ultimately able to retreat and capitalise on political stratagems to find shelter beyond Afghanistan; Iraq descended into civil war against a spacepower struggling to (re)learn how to occupy a restless population. Spacepower does not give an overwhelming offensive advantage in an entire war. Resistance is not futile, as Proposition III implies. Even if Earth orbit and one's celestial lines of communication remain unmolested, that does not translate into an easy victory on Earth. Paradoxically, however, understanding the strengths of the defence can assist in identifying the defender's weaknesses. The paradoxical nature of warfare is the final Clausewitzian point relevant to spacepower theory.

[124] On a concise history of Welsh warfare, see: Sean Davies, *Welsh Military Institutions 633-1283* (Cardiff: University of Wales Press, 2004) pp. 85-134

[125] R.R. Davies expresses surprise that the Welsh conquest had taken as long as 350 years to complete (950-1300AD), despite the seemingly hopeless situation of the Welsh kingdoms against their Anglo-Saxon-Norman conquerors as early as 1093. See: R.R. Davies, *The Age of Conquest: Wales 1063-1415* (Oxford: Oxford University Press, 1987, 2000) p. 461

[126] On U.S. offensives into Afghanistan in 2001 and Iraq in 2003, see: Gary C. Schroen, *First In: An Insider's Account of How the CIA Spearheaded the War on Terror in Afghanistan* (New York, N.Y.: Ballantine Books, 2005); Charles H. Briscoe, Richard L. Kiper, James A. Schroder, and Kalev I. Sepp, *U.S. Army Special Operations in Afghanistan* (Boulder, C.O.: Paladin Press, 2006); Benjamin S. Lambeth, *Air Power Against Terror* (Washington, D.C.: RAND, 2005); Williamson Murray and Robert H. Scales, *The Iraq War* (Cambridge, M.A.: Harvard University Press, 2003); Alastair Finlan, *Contemporary Military Strategy and the Global War on Terror* (London: Bloomsbury, 2014)

### 3.1.6 War has a paradoxical logic

"When you are going to attack nearby, make it look as if you are going to go a long way; when you are going to attack far away, make it look as if you are going just a short distance." – Sun Tzu[127]

Edward Luttwak's erudite treatment of the paradoxical logic of war is crucial to contextualise and grasp any propositions on warfare. "*Si vis pacem, para bellum* (If you want peace, prepare for war) goes the Latin proverb attributed to Roman wisdom [and] still much used today by speakers preaching the virtues of strong armament." Although such a proposition is banal, Luttwak argues, the fact that a paradoxical phrase is presented as "straightforwardly logical" is noteworthy.[128] For Luttwak, the "*entire realm of strategy is pervaded by a paradoxical logic of its own*, standing against the ordinary linear logic by which we live in all other spheres of life."[129] Luttwak's observation of the "*coming together and reversal of opposites*" (e.g. defence and offence) is illustrated through the dilemma of choosing a 'good' road (wide, extensive, direct, good quality) or 'bad' road (narrow, indirect, poor quality, enclosed for potential ambush) to one's destination. However, if a road is usually of a good quality it also forms the most expected line of attack, making that road strategically 'bad' because it allows the enemy to plan around that probable avenue of attack. It is "only if combat is possible that a bad road can be good *precisely because it is bad* and may therefore be less strongly held or even left unguarded by the enemy."[130] A 'good' quality road might be bad strategically because the enemy fully expects the one to take that 'good' road, making it the 'bad' road in strategic terms. This exemplar paradox is crucial in playing on the minds of commanders and it requires a great skill and internal strength to commit to a decision in the context of imperfect information on the enemy's intent – is the enemy bluffing and will take an unexpected road? Are they double-bluffing and actually preparing to take the major 'good' quality road in a frontal assault? Will the expected form of attack come, or will the enemy proceed down a completely unexpected route? There are no universal answers to these questions and a commander cannot indefinitely second-guess enemy intent.

[127] Sun Tzu, *The Art of War*, Thomas Cleary, trans. (Boston, M.A.: Shambala, 1988) p. 13
[128] Luttwak, *Strategy…* p. 3. Emphasis Luttwak's.
[129] Ibid., p. 5. Emphasis Luttwak's.
[130] Ibid., pp. 5, 7. Emphasis Luttwak's.

The prevalence of the paradoxical logic "in the conduct of war should reflect the perceived balance of strength… In a manner itself paradoxical, it is those who are materially weaker, and therefore have good reason to fear a straightforward clash of strength against strength in facing an unsurprised enemy, who can most benefit by self-weakening paradoxical conduct[131] – if it obtains the advantage of surprise, which may yet offer victory."[132] In order to create surprise, real weaknesses may be presented to the enemy to conceal strength. Like passion, reason, and chance, there are particular wars where the manifestations of the paradoxical logic are lacking but are still present to some degree, such as in attritional warfare.[133] The paradoxical logic may be infinite in its variability and importance, but recurring and permanent only in its presence.

Paradox logics mean two things for spacepower theory, first, it challenges any decision or action that may be derived from a proposition of spacepower, and second, it undermines *any* prescriptive military axiom. The paradoxical logic of strategy demands pragmatism in the practice of war, and propositions are a way to get started on thinking through scenarios and possible outcomes. Luttwak worried about the problem of setting out a comprehensive and conscious strategy in the context of a paradoxical logic – an error in a systematised strategy risks replicating the error across all the organs of state. Conversely, a more flexible and pragmatic approach with only a clear and open eventual goal will produce numerous smaller errors that may cancel each other out.[134] Deciding how to use spacepower is an activity reflecting human creativity in using and exploiting technical realities, bringing a more human element to space warfare.

The propositions do not encourage a particular course of action that risks being seen as an axiom, as sometimes a strict adherence to an axiom may be the worst possible decision to make owing to the paradoxes of strategy. The propositions are instead meant to be applied intelligently to real world cases and scenarios in a heuristic fashion – intentionally leaving room for creative command decisions that may be able to exploit uncertainties and the paradoxical quality of clashing forces and

[131] Luttwak means deception, surprise, and indirect approaches to circumvent the enemy's strength, but doing so can weaken the overall strategic combat capability of one's own forces.
[132] Luttwak, *Strategy…* p. 16
[133] Ibid., pp. 92-99
[134] Ibid., pp. 234-235

wills. Indeed, "boldness, daring, and risk-taking defy rational analysis and transcend all rules, which is what makes them so unpredictable and difficult to counter; therefore, a course of action known by both sides to be risky but dismissed by only one may, paradoxically, have a better chance of succeeding."[135] However, at the same time, risk-taking for its own sake can be fatal. The challenge is knowing *when and how* to take a bold risk, which is an immensely particular and contingent decision. This only adds more complexity to the conditions a 'genius' must operate within and raises the importance of strategic theory in communicating these complexities to those without the innate talent for command and decision-making in war.

Space warfare and the exercise of spacepower are not immune from the paradoxical logic of strategy. If an attack on U.S. space systems is all too attractive for China, the United States may therefore take appropriate measures and plan against or around such an event, therefore making it a less attractive, or at least more unreliable, option for China to find some advantage against the United States' modernised forces. For example, a technological response to the proliferation of jamming technology and the denial of celestial lines of communication has already emerged among the manufacturers of precision-guided munitions.[136] Another possibility is that, during a conventional military effort on Earth, space warfare never occurs, leading to either possibility that the enemy has no ability to fight over the command of space, or it is still waiting for the most opportune time to strike at the spacepower elements of a military machine. Guarding against actions that may or may not come impose costs, risks and opportunities, and space warfare will not escape the paradoxes of double-bluffing, strategic and tactical surprise, or allowing a previously-thought suicidal strategic move (such as a high-altitude nuclear strike) to become so bold and unexpected as to be all-too-successful against complacent adversaries that rely on space infrastructure. However, the global political fallout of such a move may eventually come to weigh against the party responsible for the nuclear strike, or it may cow a global audience into accepting the whims of a risk-taking belligerent. The point here is that the paradoxical logic of strategy makes it difficult to claim any inevitable

[135] Handel, *Masters…* p. 8

[136] Joe Gould, 'Guided-Bomb Makers Anticipate GPS Jammers', *DefenseNews*, 01/06/2015, http://www.defensenews.com/story/defense/air-space/2015/05/31/guided-bomb-makers-gps-jammers-battlefield-spoof-munitions-laser-jdam/28117951/ (accessed 30/07/2015)

consequences for any specific action, and space warfare is no different. This paradoxical logic is why much of the space weaponisation debate as explored in the previous chapter is strategically flawed – convenient possibilities or useful risks are portrayed as inevitabilities or impossibilities.

This completes the six Clausewitzian principles of war. However, an aspect of strategic theory that is important and as yet unexamined here is that such theory rests on analogical reasoning. The remainder of the chapter examines this logic in Clausewitzian theory and how this has allowed seapower theory to speak usefully to spacepower theory whilst avoiding the common pitfalls of analogical thinking.

## 3.2 Analogical Reasoning

"*Fallai yw hanner y ffordd i felly*." – Welsh proverb: Perhaps is halfway to therefore.

The seven propositions use strategic analogies from seapower, airpower, and Clausewitzian theory. Clausewitz's attempts to develop a theory to understand past wars and apply strategic concepts to other scenarios and future possibilities – which were derived from the recurring dilemmas he observed his studies and experiences of military operations – are forms of analogy. Clausewitz uses a strategic analogy, which is not to be confused with an historical analogy. Strategic analogies develop and explore strategic concepts for use across time and space, rather than applying an historical truth to a different situation as historical analogies do.[137] David Fischer provides a useful definition of an historical analogy as signifying:

> "an inference that if two or more things agree in one respect, then they might also agree in another. In its most elementary form, an analogy consists in a set of propositions such as the following: *A* resembles *B* in respect to the possession of the property *X*. A also possesses the property *Y*. Therefore, it is inferred that *B* also possesses the property *Y*."[138]

[137] On studies of the use of historical analogies in foreign policy decision-making and popular narratives, see: Scot Macdonald, *Rolling the Iron Dice: Historical Analogies and Decisions to Use Military Force in Regional Contingencies* (London: Greenwood Press, 2000); Yuen Foong Khong, *Analogies at War: Korea, Munich, Dien Bien Phu, and the Vietnam Decisions of 1965* (Princeton, NJ: Princeton University Press, 1992)

[138] David Hackett Fischer, *Historians' Fallacies: Toward a Logic of Historical Thought* (London: Routledge, 1971) p. 243. Emphasis Fischer's.

In 2014, a special issue of *Astropolitics* was dedicated to the use of *historical* analogies in explaining space exploration following a long history of analogical reasoning to explain and predict space exploration.[139] Despite the explicit use of historical knowledge to advance scientific knowledge in space exploration, it is still useful to consider the methodological questions raised by Roger Launius in the special issue's introduction, if only to understand the intent and limitations of *strategic* analogies. Launius highlights the need to appreciate differences as well as similarities between phenomena, the implications for present-day policymakers, and the risks of unintended consequences and the possible lack of consequence of analogy-making for decision-makers.[140] These concerns are resonant within Sheldon's approach to strategic analogies, as explored below.

The basis of a seapower to spacepower analogy are twofold: first, is that seapower theory is concerned with seapower's use during war, and like war, it is a continuation of politics; second, the sea and space are geographical media that political-economic-military effects and information are transported through along lines of communication in places that cannot be held and only transiently occupied, if at all. Since strategic use of the sea is well-articulated through certain strategic concepts, so may be the strategic use of space. This is where strategic concepts of seapower theory can be transplanted into spacepower to discover possibly useful propositions for spacepower theory. Strategic theory, then, may still be useful for strategic thinking about outer space. Airpower theory fits into these same analogies. Indeed, many of its concepts on contesting the command of the air and on lines of communication via the air are derived from seapower theory.[141] As a result, the bulk of spacepower theorising on war's contests on lines of communications are based on seapower theory, especially as it connects wider issues such as cultural, economic, and technological concerns to wider concerns of war planning. However, airpower experience and thinking does feature more prominently in Proposition VII in Chapter 7, as there are some resonances between the exploitation of spacepower on Earth as there are in harnessing air superiority against ground forces. The concepts borne of

[139] *Astropolitics* (12: 2-3, 2014)
[140] Roger D. Launius, 'Power of Analogies for Advancing Space Scientific Knowledge', *Astropolitics* (12:2-3, 2014) pp. 127-128
[141] Beatrice Heuser, *The Evolution of Strategy: Thinking War from Antiquity to the Present* (Cambridge: Cambridge University Press, 2010) pp. 300-305. Most notable is the concept of the 'command' or 'control' of the air as a requisite for successful air operations against enemy forces, interests, and territories.

strategic theory, from land, sea, and air, are applied to what is understood about outer space to develop useful propositions. The analogy itself is not the primary product of the thesis – rather, it is the seven propositions of spacepower theory. Proposition V, for example, draws heavily on seapower analogies to make a constructive observation that Earth orbit is like a cosmic coastline, rather than a distant theatre that is out of reach. Analogies, then, are a means to an end.

Before an analogy breaks down, as it inevitably does in its continued application, it will have presented its conceptual value and furthered the cause of spacepower theory on the highest abstract terms. An analogy is a device for discovering explanations, not explanations in themselves.[142] Lawrence Freedman argues that "…comparing and contrasting two apparently similar situations can be quite fruitful, so long as the aim is to identify recurring dilemmas rather than to draw lessons. The limits of the exercise must be understood."[143] A strategic analogy is when a theory, concept, or generalisation about one phenomena or environment is transposed to another – not *necessarily* an historical understanding of specific events. However, the concepts or strategic theories themselves may be partly the products of historical analogies. For example, as will be seen in chapters 4 and 5, Alfred Thayer Mahan used his historical studies of the Age of Sail to draw historical analogies to devise advocative ideas for a greater United States Navy. These historical analogies between the Age of Sail and the United States' strategic position in the late 19th century produced some of the classic concepts that seapower theorists and maritime strategists are familiar with – such as the command of the sea, sea lines of communication, and multinational consortia ensuring the security of sea-based commerce. A strategic analogy is a study and application of *strategic concepts* from one time or place to another. However, taking the step of advocating a particular policy or strategy is applying strategic theory, not creating it. This means that spacepower theory is about facilitating thinking about spacepower, and not to advocate particular courses of action for particular belligerents at specific times.

[142] Fischer, *Historians' Fallacies…,* p. 243
[143] Lawrence Freedman, 'Iran, History, and Strategy by Analogy', *War on the Rocks*, 17/02/2014, http://warontherocks.com/2014/02/iran-history-and-strategy-by-analogy/# (accessed 22/08/2014)

### 3.2.1 Strategic analogy

Describing all wars as a continuation of politics by other means allowed Clausewitz to see how different wars conjured similar dilemmas for the commander, leader, and historian. Clausewitz wrote that "*war is only a branch of political activity; that it is in no sense autonomous*", and "only if war is looked at in this way does its unity reappear; only then can we see that all wars are things of the *same* nature; and this alone will provide the right criteria for conceiving and judging great designs."[144] War as a continuation of political activity is a strategic concept that Clausewitz uses to infer strategic analogies between different wars. In Clausewitz's terms, all wars are conceived of as something political in nature (War *A* and War *B* possess *X*), therefore we may be able to detect or anticipate the recurring dilemmas of chance, friction, uncertainty, reason, genius, and passion, and paradox (*Y*) because they were dilemmas that could be abstractly observed in at least one known case of war (*A*). This can then direct inquiry to discover if the lesser-studied historical war, or one yet to occur (*B*), manifested these characteristics (*Y*), but also to highlight the particular differences in each case. This would be a strategic analogy and its application; transposing strategic theory or concepts from one or many cases to another to attempt to discover something about a new or lesser-known topic.

Clausewitzian theory attempts to develop principles or observations that are useful across time and space for pedagogical purposes. All acts of strategic theorising through Clausewitzian concepts are instances of analogical reasoning to some degree. A short definition of strategic analogy, from this example, can be: *the transposition of a strategic theory or concept derived from any particular case of warfare or strategic dilemma to another*. The cases of war or strategic dilemmas for contrasting may differ in *at least* one of many aspects, such as: geographical environments, time, technological devices, belligerent types, political conditions, societies, military organisation, and economic models, among others. However, the point of similarity is that all wars are the same thing: a contest to impose will between opponents by the threat or use of force; a continuation of politics with the addition of other means.[145] Because all wars are things of the same nature, useful comparisons and contrasts can be drawn between cases with a contest of political wills being the standard against

[144] Clausewitz, (H/P) *On War*... pp. 87, 605-606. Emphasis Clausewitz's.
[145] Clausewitz, (H/P) *On War*... pp. 75, 86-89.

which different cases of war are held against in order to identify recurring dilemmas and draw generalizable observations to provide an education for those who lack strategic experience. His observation and theoretical assumption that all wars are political in nature is designed to be a useful starting point to delve into the particulars of the case at hand and make such a case study useful to researchers and practitioners that may not be especially concerned with the history of that specific case study. Every time Clausewitz's trinity is invoked to understand a war, a strategic analogy is made from the cases of war that Clausewitz used to derive his theory, in order to apply the strategic concepts to another case of war.

John Sheldon examined analogies in strategic theory, and argues that:

> "a strategic analogy can be inferred if two or more strategic environments separated, among other things, by time (though this is not a necessary criterion, strategic analogies may be used contemporaneously), geographical characteristics, doctrine, technology, culture, and political context agree in one respect, then they may also agree in another. Strategic analogies are used... to provide a rational means for the comprehension of, and planning in, novel strategic environments by retrieving information, principles and past experiences from other, more established strategic environments (the *source*) and applying those to the new, unfamiliar strategic environment (the *target*). In short, strategic analogies may provide a "shortcut to rationality" in new and poorly understood strategic environments where there is no known strategic experience or established principles for effective operations."[146]

A strategic analogy can be used, then, if the two cases of war differ in any of the factors listed by Sheldon but are linked by and what is deemed to be common among them. They are subject to strategic logic in a contest of wills where war is the continuation of politics. This would be what Colin Gray refers to as a unity in strategic experience.[147]

In the seven propositions, strategic analogies are made between Clausewitzian and seapower theory (the source) and applied to outer space and space systems (the target). The seapower theories

[146] Sheldon, *Reasoning…* p. 19
[147] Colin S. Gray, *Modern Strategy* (Oxford: Oxford University Press, 1999) pp. 1, 8

are typically from the mid-19th to the late 20th century, separating the sources from the target in time as well. Sheldon uses four steps to describe the analogical process, which frames his own analysis of air and sea analogies to outer space:

> "The first, representation, is the preliminary identification of a target's major features and characteristics. The second, retrieval, using the data gathered from the representation step, identifies useful analogies (sources) that could potentially be applied to the target. The third, mapping, applies data from the source to the target, seeking to match apparently similar features, and inferring other features from the source to the target. The fourth step, adaptation, occurs when the mapping step is successfully completed."[148]

These steps are useful categories to describe the workings of an analogical construction, and identify the various aspects of making an analogy. However, in practice, the process is not as teleological as Sheldon's words illustrate. Imagining an idealised method of crafting strategic analogies may help keep in check some bias and tendencies of the individual making such analogies, or at least to be able to issue warnings of potential pitfalls in making analogies. Fischer argues that an intelligent use of an analogy begins with knowing its limits.[149] A major limitation is that it is difficult to be able to approach a problem or issue of any kind with a clean conceptual slate. Few may be free from the logics of their own 'rational' assumptions; and to believe a strategist can operate without preconceived notions, questions, and biases is a Baconian fallacy: it is impossible to be perfectly neutral without preconceived notions, prejudices, or prevailing biases, however subtle, in any historical or political study.[150] The choice of analogies can be further influenced by the familiarity, notoriety, or sensationalism of some events and concepts.[151] The four steps of creating an analogy helps create some degree of transparency and accountability in the methodology of the seven propositions and help expose any conceptual overreach.

[148] Sheldon, *Reasoning…* p. 20
[149] Fischer, *Historians' Fallacies…* p. 258
[150] Ibid., pp. xvi, 4.
[151] Macdonald, *Rolling…* p. 8; see also: Sheldon, *Reasoning…* p. 23

### 3.2.2 Analogical reasoning's limits

In practice it is difficult to structure this thesis' analogy-crafting in the rigid four-step process above. The Clausewitzian principles discussed demonstrate the 'original sin' of the analytical bias of this approach to spacepower theory. The spacepower theory in chapters four, five, and six blend the seapower analogies into a simultaneous discussion of the propositions of spacepower. This reflects a decision to present a better spacepower theory that is transparent in its method and produces a better explanation of the strategic concepts at work. The promises and pitfalls of analogies cannot be ignored whilst reading the seven propositions, making them transparent and more amenable to critical thinking by the reader. In the process of researching these analogies, it has been difficult, if not futile, to approach strategic thought about outer space as a realm of warfare without consciously and subconsciously referring to already-known concepts such as Clausewitz's trinity as well as Mahanian and Corbettian notions of seapower and lines of communication. These are but two examples of inescapable concepts as a result of prior education in strategic theory and a lack of formal education or experience in space activities.

In other words, the first step – representation – is difficult to do without simultaneously executing step two – retrieval – to some degree. These pre-existing concepts may influence the representation stage – creating some form of selection bias in what the most important or distinguishing features of outer space (the target) are. Further complicating this, the analogical sources in step two are themselves products of analogies, as already discussed. Clausewitz's theories, which have since applied themselves to all strategic environments, were based on observations following studies and experiences of land warfare. There is a cacophony of analogies at work. However, this thesis has already taken the first step of analogy-making, of representing the strategic use of outer space.

Step one, representation, was the historical, physical, and technical description of outer space in Chapter 1. That precedes the seven propositions, which, as will become evident, are simultaneously performing steps two and three. Retrieval and mapping has already occurred partially in the Clausewitzian theory above, and will continue to occur throughout the remaining three chapters as

seapower theory is placed alongside spacepower. Step four – adaptation – is the culmination of the entire thesis and is the finished product of the seven propositions of spacepower theory. The process of 'mapping,' or adjusting the original strategic concepts to the new target, reflects the wider research process in which the questions and answers "are fitted to each other by a complex process of mutual adjustment."[152] A serious attempt at a seapower analogy would not have been attempted if it was grasped from the outset that there was no cause for it to work at all. The very act of asking whether seapower theory could assist in the creation of spacepower theory implies that there is some extant reasoning to make the question feasible and worthy of study.[153]

Further to what has been said on history and its place with theory above (section 3.2.4) Sheldon argues that "history, like analogies, suffers from inherent limitations that automatically affect the quality and reliability of both strategic and historical analogies. Often, the history used in analogies is treated as self-evident, complete, and objective, when in fact nothing could be further from the truth."[154] Strategic analogies, as products of the use of historical analogies, rely to varying degrees on historical study – taking on board their strengths and weaknesses as forms of knowledge. History may not be a good 'guide' to the present and the future, but it is the only one beyond gut instinct.[155] This means that the seapower theories used are by no means objective accounts or completely unbiased interpretations of strategic history. The analogical sources can be challenged if a reading or interpretations of the works of inter alia Mahan, Corbett, and Castex differ between individual scholars and analysts proposing analogies.

This raises an issue of contention with Sheldon's strategic analogies between seapower and spacepower, which will be examined in depth in chapters 4 and 5 when dealing with economic decisiveness in seapower and spacepower. Sheldon builds a seapower theory in part from a source of analogy by focusing on Mahanian and Corbettian theories. The seven propositions of a spacepower theory bring to light other aspects of a spacepower theory that Sheldon may have omitted because the

[152] Fischer, *Historians' Fallacies…* p. xv
[153] Ibid., p. 36
[154] Sheldon, *Reasoning…* p. 24
[155] Sheldon, *Reasoning…* pp. 24-26; Gray, *Modern Strategy…* p. 121

source analogy of maritime theory used in chapters 4 and 5 - which draws in seapower theory from other seapower theorists - is different to Sheldon's source analogy of seapower theory that is based on Mahan and Corbett alone. Sheldon's observations of the shortcomings of seapower and airpower theory lead him to call for theorists to move on from analogical reasoning.[156] Yet he is perhaps too quick to dismiss seapower because his use of it is mostly based upon Mahan and Corbett, especially on the case of economic warfare.[157] Sheldon's own understanding of the target and source are coherent in themselves, but expanding the source (seapower theory) can yield yet further propositions and illustrative insight for the target (spacepower theory). Inductive reasoning based on experience in space should be encouraged, but there is still more wisdom to take from terrestrial strategic experience, and especially seapower theory from Mahan and Corbett. To what extent can scholars at present be inductive on space warfare (to mean more than U.S. force enhancement, strategic warning, communications, and intelligence gathering) when none of the major space powers have had their space systems denied to them yet? Prudent strategists will still need to plan for such scenarios, however, as numerous means of engaging in space warfare have already proliferated.[158] Guidance and education about space warfare is needed *today*, and not at the leisure of archival declassification schedules. Space warfare may remain 'the undiscovered country' in some empirical respects, but strategic theory can help structure thinking about it.

There is another problem with analogising that Sheldon raises – analogical reasoning may not help to identify a crucial difference between the source (seapower theory) and target (spacepower theory), or the source may create the illusions of the workings of a principle in the target that may not actually apply.[159] An example is the false analogy that satellites are analogous to battleships and satellite constellations are like fleets, as some thinkers have done (see Proposition V, part 1, in Chapter 5). Satellites transmit information, they do not directly execute violence, like battleships. Further constellations are usually dispersed around the globe, unlike concentrated fleets. The closest analogy would be space-based weapons, which are non-existent in a meaningful sense at present. This

[156] Sheldon, *Reasoning…* p. 10
[157] Ibid., p. 292
[158] As argued in Chapter 1.
[159] Sheldon, *Reasoning…* p. 22

false analogy can lead to problematic applications of concepts of 'fleet' manoeuvring, a fleet in being, and concentration and dispersal in orbit that are not that useful to explore the realities of operating satellite constellations. These are explored further in Propositions I, IV, V and VII. Furthermore, the resonance of seapower theory for spacepower is not a blank cheque for others to argue for the existence other analogical resonances.

It is necessary to be explicit about an analogical method as greater transparency should make the analogies easier for readers to hold to account and to critically engage. The propositions, if successful, should produce a net gain for strategic thought and education about space, and that "even bad theory can be harnessed in the service of making good strategic theory, if only to act as a means of proving how spacepower does not work."[160] Even if the propositions developed are "bad theory," their application might yet yield some useful heuristic results if better observations and theories take their place through the understanding and demonstration of their flaws.

## Summary: Analogies and Clausewitzian Theory

"The simple principles that govern strategy are not chains but flexible guides leaving free play to the creative imagination and to the human spirit in situations that are themselves enormously variable." – Raoul Castex[161]

"All progress in the area of military space must begin with education." – Steven Lambakis[162]

The declaration that space warfare is the continuation of Terran politics by other means is the first major strategic analogy necessary to grasp the meaning of space warfare, and the kind of Clausewitzian world spacepower theory inhabits. This chapter has explained the epistemological, methodological, and pedagogical Clausewitzian underpinnings at the base of the seven propositions of spacepower theory that follow in the final three chapters. Strategic analogies are a means to provide general propositions. These are then intended to be heuristic declarations that should trigger critical thinking in readers about space warfare as a continuation of Terran politics. These propositions are

[160] Sheldon, *Reasoning…* p. 297
[161] Raoul Castex, *Strategic Theories*, Eugenia C. Kiesling, trans., ed. (Annapolis, MD: Naval Institute Press, 1994) p. 21
[162] Steven Lambakis, 'Space Control in Desert Storm and Beyond', *Orbis* (Summer 1995) p. 432

rooted in a Clausewitzian worldview, summarised in six points. First, war is a passionate activity and may not always be a simply rational tool. Second, war always consists of elements of reason, where political intercourse ensures that war is to some extent instrumentalised. Third, and completing the 'fascinating' trinity, war is a phenomenon rife with uncertainty that begs for good judgment and bold command to deal with it. Fourth, this trinity is there to facilitate a balanced theory of war which should help train commanders and scholars in their self-education in the practice of war. Fifth, the strategic defensive is the stronger form of war, which confers more inherent opportunities for the defender to exploit when the time for a counterattack is right. Sixth and last, war's logic is paradoxical – strategy is the realm of paradoxical action and thought where linear plans are ill-suited for a thinking and reacting enemy in an uncertain environment.

So what if a theory of spacepower is proposed? Theory is a means, not an end. It is a means to enhance learning about effective strategic command and analysis through the application of generalised principles to real-world scenarios.[163] Alfred Thayer Mahan's approach to seapower theory was very much in line with Clausewitz's own, and only strengthens its value as a base to draw from for spacepower theory. Sumida writes that:

> "Mahan's historically based policy analysis was a matter… of applying judgment that had been well-schooled in the study of complex historical phenomena, with due appreciation for the bounded but still significant and possibly even decisive role that contingency could play. In sum, he did not reject contradiction, but rather embraced it, recognizing that its production was inherent to the intelligent consideration of what was a range of possibility."[164]

This description of Mahan's view of the epistemology and intent of strategic theory should preface any such theory. Indeed, such an epistemology – a view as to what kind of knowledge strategic theory is – can be found from Sun Tzu's ancient text to Colin Gray's latest offering on airpower theory.[165] As mentioned above, this could merely be 'reading us in them' when it comes to reviewing the strategic theories from the past, but embedded within the caveats of analogical reasoning and the foundations

[163] See: Sumida, *Inventing*… pp. 104-105, 109-114
[164] Sumida, *Inventing*… p. 106.
[165] Sun Tzu, *The Art*… pp. 93-94, 95, 110; Gray, *Airpower*… pp. 275-277

of Clausewitzian theory above, it can be put to constructive use, as shown in the spacepower theory that follows.

Through strategic analogies with Clausewitzian theory, seapower theory, and existing spacepower theory, space need not be approached as an undiscovered country considering war and peace in the Space Age. Terrestrial wisdom should not be left at the launch pad, in spite of the flaws of analogical reasoning and the problems of discovering and re-examining historical truths. In terms of strategic thought, it may be a more familiar frontier of power politics and security dilemmas – at its core human political intercourse continues. By extension, human political thought goes with it, as demonstrated by an application of classic international relations thinking to behaviour in outer space.[166] Now that the Clausewitzian foundations and the pedagogical intentions of spacepower theory are outlined, the final three chapters explore spacepower theory through seven complementary and mutually interacting propositions. This is based on the second major strategic analogy – that space, like the sea and the air, is a place and a medium along which power travels via lines of communication along territories that cannot be held but only passed through. This is done through analogising seapower theory to space in the first four propositions of spacepower theory in the next chapter.

[166] See: Robert L. Pfaltzgraff Jr., 'International Relations Theory and Spacepower', in: Charles D. Lutes and Peter L. Hays, with Vincent A. Mazo, Lisa M. Yambrick, and M. Elaine Bunn, ed., *Toward a Theory of Spacepower: Selected Essays* (Washington, D.C.: National Defense University Press, 2011)

# Chapter 4: Command and Communication: Propositions I-IV

## Introduction: Seven Propositions of Spacepower

"Where is the theory of space power? Where is the Mahan for the final frontier?" – Colin Gray[1]

The analogy that space warfare is the continuation of Terran politics with the addition of other means sets the foundation for all spacepower theory that resides in a Clausewitzian universe, and is explored in this thesis through seven interrelated and interconnecting propositions. This chapter proceeds as follows: it begins with a brief introduction of the seven propositions, followed by an exploration of first four propositions. All seven propositions are borne of the second major strategic analogy: that space is a medium along which lines of communication travel to exert power, influence, and transfer information, much like the sea and air. All the strategic analogies follow from that basic resonance between these diverse geographically-bound theories. The seven propositions that form the core of this thesis and of a spacepower theory are:

I. Space warfare is about the command of space
II. Space is a distinct operational medium but it is not isolated from Earth
III. A command of space does not equate to a command of Earth
IV. The command of space is about manipulating celestial lines of communication
V. Earth orbit is a cosmic coastline for strategic manoeuvring
VI. Spacepower finds itself within a geocentric mindset, and may outgrow it
VII. Dispersion is a condition and effect of spacepower

Like in Mahan's classic treatise on seapower, it is useful to list the constituent elements of a space power – a political entity that has the capability to use space systems or the ability to deny them to further its ends. Spacepower theory will be of use to individuals wishing to better understand the actions, options, and opponents of spacepowers. Describing the attributes of an ideal space power is not a spacepower theory in itself. It is a useful thought exercise when making net assessments of any particular space power and their capabilities. Everett Dolman transposed Mahan's attributes of a sea power to space and identified the needs of an *ideal* space power, and is used here as the starting point

[1] Colin S. Gray, 'The Influence of Space Power Upon History', *Comparative Strategy* (15:4, 1996) p. 307

for this thesis' seapower analogising to space. Mahan's six 'principal conditions' affecting seapower were geographic position, physical conformation and national production, the extent of territory, the population, the character of the people, and the character of the government.[2] According to Dolman, the corollaries to spacepower in the early 21st century are:

1. A favourable geographic endowment to access space
2. A space-educated and enthusiastic society and culture with suitable and efficient institutions
3. A wealth-driven population to make space an economic asset with suitable political institutions
4. The dominance of space chokepoints and orbital strategic narrows
5. The possession of useful celestial outposts
6. Sufficient military power to protect and impose political, military, and commercial space interests[3]

This serves as a list of constituents of an *ideal* and dominating space power – in reality space powers may struggle to fulfil all of these requisites. Other space powers are succeeding in targeted areas, developing niches in space capabilities as their needs and means allow.[4] However, there may be a widespread underestimation at the expense and demands of developing and sustaining the human skills and the terrestrial elements of spacepower.[5]

This thesis is meant to be taken in the spirit of another step in a collective effort of theory-making.[6] Should this spacepower theory only be critiqued in order to produce a better spacepower theory in its wake, it will have propelled this intellectual quest further. Sheldon referred to the works of Everett Dolman, Colin Gray, and Michael V. Smith as standard texts in any attempt to further

[2] Alfred Thayer Mahan, *The Influence of Sea Power Upon History* (Boston: Little, Brown, 1890) p. 29-89
[3] Dolman, *Astropolitik…* pp.33-37
[4] For example, see the various ways in which Japan, India, South Korea, Brazil, Iran, and Israel are pursuing space capabilities in: Brian Harvey, Henk H.F. Smid, and Theo Pirard. *Emerging Space Powers: The New Space Programs of Asia, the Middle East, and South America* (Chichester: Praxis Publishing, 2010)
[5] A point alluded to by James Andrew Lewis, 'Neither Mahan nor Mitchell: National Security Space and Spacepower, 1945-2000', in: Charles D. Lutes and Peter L. Hays, with Vincent A. Mazo, Lisa M. Yambrick, and M. Elaine Bunn, ed., *Toward a Theory of Spacepower: Selected Essays* (Washington, D.C.: National Defense University Press, 2011)
[6] As John Sheldon did in his PhD thesis which built on late 1990s and early 2000s spacepower theory. See: John B. Sheldon, *Reasoning by Strategic Analogy: Classical Strategic Thought and the Foundations of a Theory of Space Power* (PhD Thesis, University of Reading, 2005) p. 152

develop spacepower theory.[7] These works form the core of existing spacepower theory, but other works are consulted when they offer constructive criticism or supporting insights. Since 2005 three notable works have broken *new* ground in the "relatively small"[8] spacepower theory literature. The first is the United States' National Defense University's publication, *Toward a Spacepower Theory*, which brought many of the authors above and numerous others together to contribute to a single edited volume.[9] This large volume provides a discussion involving a range of authors, exposing the reader to the many aspects of human activity in space. The second is John Klein's 2006 work which transposed Corbettian seapower concepts to outer space, which has already featured in the previous chapter and will continue to appear throughout the thesis.[10] The third is Trevor Brown's transposition of Mahan's lesser-known passages on seapower to outer space, which is a valuable contribution towards rehabilitating Mahan for the final frontier.[11]

The seven propositions represent new vistas in spacepower theory in three ways. First, they collate and engage with existing spacepower theory by harmonising them into a more coherent body and curbs some of their excesses. Second, the seven propositions develop a new view of spacepower through analogies to seapower theory that have re-examined Mahanian and Corbettian theories to show how they are complementary, not contradictory. This is most important in how it 'rehabilitates' Mahan from his dismissal in John Klein's space warfare text, and both Mahan and Corbett are repurposed following specific criticisms on economic warfare by John Sheldon. This rehabilitation uses, but places limits on, bluewater seapower theory as a source for spacepower theory and opens up the field to continental seapower theory (which includes Mahan's and Brown's work). The continental approach to seapower theory produces a major analogical source for spacepower that is a new approach to thinking about spacepower. The sum of the seapower concepts used across Propositions I

[7] Everett C. Dolman, *Astropolitik: Classical Geopolitics in the Space Age* (London: Frank Cass, 2002); Colin S. Gray, *Modern Strategy* (Abingdon: Oxford University Press, 1999); 'The Influence of Space Power Upon History' *Comparative Strategy* (15:4, 1996); idem and John B. Sheldon, 'Space Power and the Revolution in Military Affairs: A Glass Half Full?', *Airpower Journal* (Autumn 1999); Michael V. Smith, *Ten Propositions Regarding Spacepower* (Montgomery, A.L.: Air University Press, 2002)
[8] Sheldon, *Reasoning…* p. 41
[9] Charles D. Lutes and Peter L. Hays, with Vincent A. Mazo, Lisa M. Yambrick, and M. Elaine Bunn, ed., *Toward a Theory of Spacepower: Selected Essays* (Washington, D.C.: National Defense University Press, 2011)
[10] John J. Klein, *Space Warfare: Strategy, Principles, and Policy* (Abgindon: Routledge, 2006)
[11] Trevor Brown, 'Space and the Sea: Strategic Considerations for the Commons', *Astropolitics* (10:3, 2012) pp. 234-247

to V lead to a metaphor of Earth orbit as humanity's celestial coastline (Proposition V), and not as an expansive ocean where great distances separate belligerents as commonly seen in bluewater-inspired thinking about spacepower. Finally, the seven propositions produce usable, interrelated, and interdependent ideas that explicitly and intentionally focus critical thought on a relatively lesser-known strategic environment that may be, at first, overwhelming to think of holistically. No spacepower theory so far has explicitly discussed Clausewitzian methodology and pedagogical intent beyond an introductory remark. By making such pedagogical intentions obvious, and through the first four propositions below, it will become evident that a good 'Mahan for space' is Mahan himself. This spacepower theory as a whole should go some way to providing a 'Mahan for space.'

## Spacepower Theory Propositions I-IV

## 4.1 Proposition I: Space warfare is about the command of space

"Space power suffers from an unusual malady—an acute shortage of space focused strategic theory and the lack of a binding concept to aid understanding of what it is all about." – Colin Gray[12]

Space warfare is 'all about' the command of space. Space warfare, however it may be waged, are actions committed in order to influence the condition of the 'command of space.' As the command of space is a central concept and the first proposition, it needs considerably more detail to be able to fulfil two goals. First, it must be educative to assist thinking about any number of possible responses to any number of actual real-world contingencies. Second, is must also help individuals to make some (rapid) strategic sense of any contingency that might, at first, seem overwhelming. Without the idea of the command of space, the connection of space warfare (and spacepower as a whole) to the highest levels of politics and strategy – or grand strategy – may be too subtle. Without this proposition, the remainder of the spacepower theory would flounder in its attempt to educate non-space specialists in spacepower and how it relates to politics and war as a whole.

War is always connected to political ends, and as explored in the previous chapter, spacepower must be made useful to an overarching objective in a grand strategy. The command of

[12] Gray 'The Influence…' p. 304

space is the concept that connects space warfare efforts – whatever they may be – to grand strategy, of which space is but one source of power, threat, and theatre of operations. It allows a strategist or historian to ask why space warfare may be waged, how so, and to ask 'so what' if a power commands space during a war by connecting it to terrestrial warfare and the political conditions and outcomes of a war that involves space systems (also discussed further in Proposition VII). The seven propositions help impress upon the strategist or historian key elements to consider when exploring these question in any given case or scenario they are interested in.

Any conflict which seeks to use or deny space systems must do it with regard to who commands space to what degree. The command of space is an overarching concept that includes a spectrum of possessing some measure of space control at one end, and confidently exercising space denial at the other end. Control and denial are not mutually exclusive. The command of space gives strategic meaning to actions, objectives, or ideas that secure a command of space for oneself (space control) and deny command to another (space denial or counterspace). The command of space is operationalised through the use and denial of celestial lines of communication, and the ways of visualising and manipulating them are discussed in Propositions IV and V. Proposition I proceeds as follows. First, it explains the basic concepts of the command of the sea and the command of space. Second, it rehabilitates Mahan as a useful source of strategic analogy for spacepower alongside Corbett's ideas. Third, it relates the command of space to events on Earth and to existing work in spacepower theory.

### 4.1.1 Proposition I Part 1: Commanding the sea and commanding space

Space warfare, as a means to secure the command of space, is the very first proposition because it makes one imagine what space warfare could look like on the strategic level, and to begin to consider why it matters in a particular case, if at all, through its relations to the other six propositions. Julian Corbett's base ideas on the command of the sea and the purpose of naval warfare can be comfortably transposed to outer space. John Klein's work with Corbett's concepts was

undoubtedly inspired by the apparent resonance of this thinking.[13] The object of space warfare must always be directly or indirectly to secure the command of space (space control) or to prevent the enemy from securing it – to dispute command (space denial).[14] Corbett continued, with the relevant terms of the sea being changed for those that refer to space:

> "By winning [the] command of [space] we remove that barrier from our own path, thereby placing ourselves in position to exert direct military pressure upon the national life of our enemy [on Earth], while at the same time we solidify it against him and prevent his exerting direct military pressure upon ourselves…. [The] command of [space,] therefore, means nothing but the control of [celestial] communications, whether for commercial or military purposes. The object of [space] warfare is the control of communications, and not, as in land warfare, the conquest of territory."[15]

It is crucial to note that the immediate object of space warfare is to control or deny celestial communications; to struggle over the command of space.[16] That statement not only gives 'space warfare' its defining feature but also the burden of making it relevant to warfare as a whole to the astrostrategist. Trevor Brown made the same argument by analogising from Mahan's work, arguing:

> "it follows that because the inherent value of space is as a means of communicating a range of highly sophisticated capabilities, in addition to regular communications, the object of space warfare must always be to either secure the command of the medium by securing [celestial lines of communication] or to prevent the enemy from securing his [celestial lines of communication]."[17]

The command of space is about who can control, deny, and exploit the varying degrees of space control and denial to influence events on Earth. Understanding the strategic efficacy of the command of space to a war as a whole is necessary to ascertain the probable value of engaging in 'space warfare.' In other words, if there is a lot to be gained from commanding space, space warfare is more

[13] So was John Fox, in: John G. Fox, 'Some principles of space strategy (or 'Corbett in Orbit')', *Space Policy* (17, 2001) pp. 7-11
[14] Julian S. Corbett, *Principles of Maritime Strategy* (Mineola, N.Y.: Dover, 2004) p. 87
[15] Ibid., p. 90
[16] Paraphrasing ibid. p. 116
[17] Brown, 'Space…' p. 237

likely to ensue. If a command of space is sufficient at the onset of hostilities for a belligerent, and the enemy has little to no 'counterspace' capabilities (such as radio jamming, missile-launched antisatellite weapons, Earth-based lasers, terrestrial attacks on Earth-based space infrastructure), resources can be spent on cutting off an enemy's access to and use of space without having to worry about reconstituting one's own satellite networks. These two outcomes lead to notions of blockading strategies which is explored in Proposition IV. Conversely, facing an enemy that can dispute or deny one's space capabilities may necessitate the spending of resources on space-redundancy programmes and annihilating the enemy's means of counterspace operations. These are illustrations of possible ways of applying this first proposition, and not an exhaustive taxonomy of the forms of doing so.

The term 'command of space' is used, rather than 'space control,' in order to (a) distance the concept from the narrow confines of the American space weaponisation debates and military doctrines, within which one school of thought or doctrine is termed 'space control',[18] and (b) because space control and space denial are useful categorisations of activities and conditions that are tied together by the bigger concept of the command of space. Geoffrey Till makes the argument that the concept of the 'command of the sea,' has been mistakenly taken to mean commanding all or none of the sea at all times, rather than some command in selected areas and at specific times.[19] As Till corrects these understandable but erroneous presumptions about the 'command of the sea,' he usefully insists that "the concept is as relevant to small navies as it is to big ones."[20] Command, therefore, is not an absolute quality, and the concept of the command of space is for all controllers and deniers of outer space. Furthermore, achieving or disputing various degrees of a command of space should never be seen as ends in themselves – the command of space is pointless if such a command is not exploited to influence events on Earth that meet grand strategic objectives.[21]

'Space control' is one form of the command of space, where one possesses or attempts to possess an ability to use its celestial lines of communication without fear of *major* disruption at its

[18] Klein, *Space Warfare*… p. 60, especially endnote 1, p. 175. On the control school in general, see: David E. Lupton, *On Space Warfare* (Montgomery, A.L.: Air University Press, 1998) pp. 60-69
[19] Geoffrey Till, *Seapower: A Guide for the 21st Century*, 3rd Edition (Abindgon: Routledge, 2013) p. 145
[20] Ibid., p. 148
[21] Paraprasing Ibid., p. 151

most important points. Visions of space control tend to gravitate towards a relatively more dominant space power, or a power that intends to exploit comprehensive space systems afterwards. When a good enough degree of space control is achieved by a space power, it can sustain its presence *in* space and make its spacepower felt on terrestrial conflict.[22] Again, the consequences of the use of celestial lines of communication (IV) points towards Proposition VII, through a dispersing effect on Earth as a consequence of a dominant spacepower having a general and persistent command of space.

At the other end of this spectrum within the command of space is the idea of space denial which lends itself to the notion of a relatively weaker power attempting to deny control to a superior space power, and after or during a successful space denial campaign, can exploit the compromising of the 'space flank' to carry out its objectives on Earth. The notion of outer space as a 'coastal' flank is explored in Proposition V in the next chapter. Space control and space denial are different but highly complementary ideas to visualise the more nuanced and varied realities that we may see in actual space warfare. Space control and space denial objectives will quite often involve aspects of the other – much like the mutuality of offence and defence explored in the previous chapter. For example, the United States may engage in space control as well as space denial operations against any foe that may have any access to space-derived data or capabilities to interfere with its space systems.

Space denial fits well with the use of the term 'counterspace' – as counterspace weapons allow one to harass or destroy enemy satellites, but not necessarily to use space systems for oneself or base weapons in space.[23] In practice, however, the effects of a successful counterspace or space denial campaign can have effects for a space control campaign, if they are to be treated separately, as done in military jargon. The best example of this would be counterspace weapons disabling satellites that enable the enemy to better command its entire satellite constellation or provide space situational awareness – thereby impairing the enemy's measure of space control. As it has an increasingly space-dependent economy, military, and terrestrial infrastructure, China should have a blend of space control and denial operations in any comprehensive campaign to secure its command of space and

[22] In other words, an exploitation of the space segments of one's spacepower.
[23] An extreme caveat here would be cyber-infiltration of enemy space systems, where hijacking could occur, turning an enemy's space system against them and in support of one's own forces.

contest that of the U.S. This is not to say that the U.S. is the only possible target in Chinese space warfare thinking, but it does set the bar in strategic thinking in terms of attacking and resisting the most capable spacepower on Earth.

The command of space offers a term that helps bridge the complementary and circular dualities of space control and space denial – they signify different activities, yet they often impact each other and no strict categorisation should be made. Whether an action fits more into a denial or control framing could depend on its context and particular effects, rather than on the means used. This is especially important given the use of 'control,' 'denial,' 'offensive' and 'defensive counterspace' in space doctrine language.[24] The symbolic ambiguity of weapons systems, and consequently military action, makes any *declaration* of a military action as a defensive campaign or an offensive manoeuvre a highly charged political act in the public sphere, and threatens to blinker strategic analysts by disguising the intimate connections between offence and defence, as raised by Clausewitz. These terms all fit within the general notion of the command of space and how it is secured, maintained, and challenged.

The command of space is a common idea among spacepower theorists. John Klein declares that the:

> "command of space entails the ability to ensure access and use of celestial lines of communications [CLOC] when needed to support the instruments of… power… It also includes the ability to prevent or deny the enemy's access to and use of his celestial lines of communications, or at least minimize the most severe consequences an adversary can deliver along them."[25]

The idea of being able to control space or deny it to others is widespread and has obvious parallels to the command of the sea and the air. Indeed, the pioneering Italian airpower theorist Giulio Douhet, analogised from the sea to explain his first concept of airpower, when he wrote that:

[24] For example, see: U.K. Ministry of Defence (MoD), 'UK Air and Space Doctrine', Joint Doctrine Publication 0-30 (Shrivenham, 2013) pp. 7-7 – 7-14; U.S. Joint Chiefs of Staff, *Joint Publication 3-14: Space Operations* (Washington, D.C.: 2013) pp. II-8 – II-9

[25] Klein, *Space Warfare*… p. 60

> "It is now axiomatic… that coastlines are defended from naval attacks, not by dispersing ships and guns along their whole extent, but by conquering the command of the seas; that is, by preventing the enemy from navigating. The surface of the earth is the coastline of the air. The conditions pertaining to both elements, the air and the sea, are analogous; so that the surface of the earth, both solid and liquid, should be defended from aerial attack, not by scattering guns and planes over its whole extent, but by preventing the enemy from flying. In other words, by "conquering the command of the air."[26]

This passage shows that the core strategic concepts of seapower and airpower theory – of commanding a medium and exploiting it through its lines of communication in relation to land warfare and ultimate political objectives – are complementary, not competitive, when thinking about the command of space. Proposition V mimics Douhet's metaphor of Earth's surface as a 'coastline of the air' by analogising the Earth's surface and atmosphere to resemble a celestial coastline. Given this crucial basic resonance from the sea to the air, seapower theory is a fruitful source of strategic analogies for outer space based on influencing the communications of a geographic medium.

### 4.1.2 Proposition I Part 2: In defence of Mahan

Mahan is in general agreement with Corbett when it comes to the command of the sea's nuanced traits. John Klein avoided Mahanian theory when he used a seapower analogy to form his space theory. He argues that "Mahan's strategic theory insists that the "proper sphere" of the fleet is offensive operations. Additionally, he gives little attention to matters that are outside the direct action of navies and fleets."[27] Such comments are misleading when taken outside the context in which Mahan made such claims about decisive battle, as explored in Proposition III. In *Space Warfare*, Klein does not seem to encounter Mahan's own caveats on his apparent preference for battle fleets. Klein's theory also ignores much of Mahan's wider view of the economic, bureaucratic, and cultural aspects of seapower, which brings Mahan's theory closer to Klein's interpretation of Corbett's theory.

[26] Giulio Douhet, *The Command of the Air*, Dino Ferrari, trans., Joseph Patrick Harahan and Richard H. Kohn, ed. (Tuscaloosa, A.L.: University of Alabama Press, 2009) pp. 18-19
[27] Klein, *Space Warfare*… p. 20

Like Corbett, Mahan was fascinated by politics, economics, history, and seapower.[28] That is self-evident in Mahan's historical narratives.

Five further points can be made in defence of Mahan's relevance to a spacepower theory. The first three come from Jon Sumida who, frustrated by persistent misunderstandings of Mahan within academia, wrote three basic summaries of his interpretations of Mahan's ideas. First, joint operations between the land and the sea *could* determine the victor in a major war with the relevant geography. Second, the expense of maintaining navies meant that a general command of the sea would have to be maintained by a transnational consortium of navies for global coverage. Third, technological change does not diminish the need for good judgment and an excellent executive command class.[29] Moving on from Sumida, a fourth point in defence of Mahan would be that he recognised the permeable nature of the command of the sea, where weaker parties could evade battle and contest the superior enemy's general command at select times and places.[30] Finally, Mahan wrote that a vastly distributed system of wealth (for example a large merchant navy with each ship carrying but a small fraction of the total wealth via sea) may be able to withstand repeated shocks as wrought by commerce raiding; and the distributed system of wealth could only be overcome by decisively overcoming an enemy's ability to put to sea to defend that system at key points.[31] These five general Mahanian ideas are useful across the entirety of the seven propositions of spacepower theory. Of most relevance for Proposition I is the fourth point, where Mahan acknowledges fully that the command of the sea is not necessarily absolute in practice and not solely the concern of larger powers. The first point appears again in Proposition III, whilst the second and fifth points are of use in Proposition V. The third point from Mahan refers back to methodology and the value of teaching command from theories that are useful in the face of technological change. This is how the value of referring back to the command of the sea helps for spacepower theory; it binds many aspects from different propositions back to the

[28] Mahan, *The Influence of Sea Power…* pp. 53-55, 225-226, 514; Alfred Thayer Mahan, *The Influence of Sea Power Upon the French Revolution and Empire 1793-1812: Volume II* (Sampson Low, Marston & Co.: London, 1892) p. 386
[29] Jon T. Sumida, 'New insights from old books: The case of Alfred Thayer Mahan', *Naval War College Review* (54:3, 2001) p. 110
[30] Mahan, *The Influence…* p. 14
[31] Ibid., pp. 539-540

*ultima ratio* of space warfare which is the struggle over the command of space and its exploitation elsewhere.

This is an adequate juncture to dispel the notion that Mahan's theory centred upon the pursuit of the enemy for seeking decisive battle at sea which would then confer a total command of the sea. Yes, battle *could* produce a decision. But Mahan had a mountain of qualifications that should have cast doubt on a belief that seeking battle was always the right decision or whether a victorious battle at sea was always decisive. This is useful to remember when we consider the near future of space warfare; combat *in* orbit may be unlikely between space-based platforms, relative to combat or hostile interactions between Earth-based weapons and satellites. Even if combat *in* space was feasible, seeking battle in space, or eliminating the space forces of the enemy, may be subject to similar conceptual qualifications as Mahan and Corbett saw under command of the sea. Although preferable, destroying enemy forces is a rare opportunity and it should not blind commanders to believe it is *always* worth pursuing at all cost.[32] It is in applying the principle of destroying enemy forces afloat that critical thought and command judgments are needed the most. For example. Trevor Brown's analogies offer a misleading vision of seeking 'battle' in space warfare as taking place between 'space fleets'; an unfortunate but understandable analogical misfire in the midst of many analogical resonances with Mahan and Corbett in his article.[33] Thinking about space warfare must escape the notion that 'battle' or destruction *must* take place between space-based assets alone, and recognise the role of Earth-based capabilities and the non-battle aspects of spacepower and the wider effects of space warfare. Propositions III and V examine these further.

Mahan did not ignore naval operations that were not centred upon an enemy's fleet. Mahan's criticisms of British amphibious operations were based on the precondition that if a belligerent possessed a general and persistent command of the sea, one should undertake amphibious operations and other joint operations when appropriate.[34] However, if the enemy had a significant 'fleet in being,' amphibious operations should be put on hold until *significant* enemy forces were dealt with.

[32] See: Mahan, *Influence of Sea Power…* pp. 338-339; Corbett, *Principles…* pp. 99-100, 103-104, 113-118
[33] Brown, 'Space and the Sea…' p. 243
[34] Sumida, 'New Insights…' p. 102

As is well known, Mahan believed that the best way of attaining this general command was to decisively defeat the enemy fleet, which has shaped Mahan's legacy as a 'bluewater tendency' gearing naval forces for big battles at sea.[35] The command of space must therefore still accommodate the possibility and potential of decisive engagements against specific space systems. But seeking battle must remain a possibility, not an inevitability or a guarantee for success. In a scathing criticism of the U.S. Navy's pursuit of the Spanish fleet whilst neglecting the protection of the U.S. Army's passage to Cuba in the Spanish-American War, Corbett uses *Mahan's* criticisms of the decision to seek battle against the Spanish fleet to condemn the notion of seeking battle as an unassailable maxim.[36]

Despite this, Sheldon criticises Mahan's theory for fixating upon decisive battle. According to Sheldon, "Corbett instead asserted that sea control… was the object because such control was local and temporary, then decisive battle for it was not always, if rarely necessary."[37] This is a false dichotomy between Mahan and Corbett. Mahan and Corbett agreed that decisive battle yielded the most significant results in naval warfare, but it was often difficult to impose on the enemy. Mahan acceded to the possibilities of weaker naval forces harassing and disputing command, and recognised wars where "navies were of great direct military value, though they fought no battles."[38] Corbett indeed was bolder on the point when he asserted that the 'normal condition' of the command of the sea was to be in dispute, and that "theory and history are at one on the point. Together they affirm that a Power too weak to win command by offensive operations may yet succeed in holding the command in dispute by assuming a general defensive attitude."[39] Corbett was open to securing command by battle – or by 'decision' as he referred to it.[40] Mahan and Corbett are at one on the point of battle at sea *potentially* being decisive in influencing events ashore, but as it is not always appropriate or even feasible, good judgment is needed to make the appropriate calls to secure a command of the sea to a level that is desired. Despite a critique of the British failure to pursue an aggressive naval offensive in

[35] Geoffrey Till, *Seapower: A Guide for the 21st Century*, 2nd Edition (Abingdon: Routledge, 2009) p. 52
[36] Corbett, *Principles…* pp. 170-171
[37] Sheldon, *Reasoning…* p. 150
[38] Mahan, *The Influence…* pp. 14, 193
[39] Corbett, *Principles…* p. 211
[40] Ibid., pp. 113-118, 168-210

the American Revolutionary War, the principle of seeking battle has to be taken into account of Mahan's qualifications that such battle is difficult to bring about.[41] Furthermore, Charles Callwell is clear on the need to qualify the principle of seeking out battle, and Raoul Castex adds more to the nuance of the practical applicability of the idea of the command of the sea.[42] Mahan lamented that the Havana division of the U.S. Navy had not had good enough judgment to see how the principle of seeking battle was not in accordance with conditions in that particular campaign.[43] Corbett bounced off this judgment from Mahan and described the Cuban experience as "an attractive maxim being permitted to shut the door upon judgment."[44]

Sheldon amends his own statement on Mahan's apparent fixation on decisive battle and absolute command by ceding the reality that Mahan knew that the command of the sea was never complete. This then proceeds to another problematic criticism of Mahan's work by Sheldon when he argues that "the problem is that even this acknowledgement by Mahan does not begin to address the complexities and uncertainties involved in achieving decisive space control over another space power."[45] As explored in Chapter 3, uncertainty is something that cannot be 'addressed' in any great detail beforehand, especially for the purposes of developing sound universal strategic theory. Corbett argued that naval factors – among which was uncertainty – had to be related to many others to improve naval judgment; accepting the generalist and abstract character of strategic theory.[46] The charge of being unable to address 'complexity' is a moot point – no seapower theory will be able to speak to the *particular* complexities of any scenario on its own terms in naval warfare if it is to retain validity across time and space. Little more can be said other than to stress the problems that may arise by dealing with a multitude of factors in a complex and non-linear reality in conjunction with a multitude of paradoxical possibilities. Mahan raised the idea of the 'peculiar uncertainties' of conducting war at sea, which raises an open question: how is modern complexity different *in any*

[41] Jon T. Sumida, *Inventing Grand Strategy and Teaching Command: The Classic Works of Alfred Thayer Mahan Reconsidered* (Washington, D.C.: Woodrow Wilson Center Press, 1997) pp. 42-44
[42] Charles E. Callwell, *Military Operations and Maritime Preponderance: Their Relations and Interdependence* (London: William Black and Sons, 1905) pp. 1-3, 52-63; Raoul Castex, *Strategic Theories*, Eugenia C. Kiesling, trans., ed. (Annapolis, M.D.: Naval Institute Press, 1994) pp. 46-48
[43] Corbett, *Principles…* p. 171
[44] Ibid.
[45] Sheldon, *Reasoning…* p. 180
[46] Corbett, *Principles…* pp. 236-237

*conceptual sense* to the complexities warned of by Mahan?[47] Mahan's generic musings over the chances of success of a French invasion of Britain can apply to any war plan today when asked: "what… were the chances of success? To a purely speculative question, involving so many elements and into which the conditions of sea war then introduced so many varying quantities, it would be folly to reply with a positive assertion."[48]

What does this mean for spacepower theory? Sheldon's two criticisms of Mahan are problematic. The first accuses Mahan's thinking of lacking nuance in the command of the sea and, second, in characterising his concepts as being unable to consider 'complexity.' This section has portrayed Mahanian notions of the command of the sea as permeable and not as *always* achieved by seeking decisive battle at sea as a response to that criticism. Sheldon's second criticism implies that the past was simplistic for strategic planners and decision-makers or that the theory used does not accommodate changes in the character of war. Indeed, there may be quantitatively more uncertainties for decision-makers and planners to deal with today – but the core qualitative principle and conceptual utility of dealing with uncertainty is still useful for planners and commanders today. To 'address' particular concerns would damage the universality of the propositions used here and amount to an exercise in futility. This means that destroying the enemy's space systems may not always be a high priority for the exercising of spacepower and the use of celestial lines of communication in a war. Sometimes enemy spacepower may be so irrelevant or a minor threat that hostile action in space would be a waste of resources or too risky a plan, when defending one's own space systems may be sufficient. In practice, this could make an enemy's counterspace weapons a good target to achieve a working command of space, but the enemy's space systems may be left undisrupted because their use may not make a difference to conditions on Earth.

The core ideas of the command of the sea have utility for thinking about spacepower and space warfare through its critical analysis and application. Belligerents may have varying degrees of

[47] On examples of Mahan's encounters with chance and complexity, see: Mahan, *The Influence. French Rev. Vol. I...* pp. 335-336; Alfred Thayer Mahan *The Influence of Sea Power Upon the French Revolution and Empire 1793-1812: Volume II* (Sampson Low, Marston & Co.: London, 1892) pp. 152.
[48] Idem., *The Influence of Sea Power Upon the French Revolution and Empire 1793-1812: Volume II* (Sampson Low, Marston & Co.: London, 1892) p. 182

control and varying successes in denial *in certain orbits and certain times with certain space systems*. The general idea of bringing space warfare into how it affects the command of space is the value of using Mahanian and Corbettian foundations from the command of the sea. The ultimate aim of the war "will always obtrude itself" in naval warfare, Corbett claimed.[49] Analogically, the same is true of space warfare. The maxim of seeking battle, for its own sake and without qualification, is wrong. Corbett, reflecting on the Spanish-American War and the Russo-Japanese War, wrote:

> "What the maxim really means is that we should endeavour from the first to secure contact in the best position for bringing about a complete decision in our favour, and as soon as the other parts of our war plan, military or political, will permit. If the main offensive is military [i.e. land-based], as it was in the Japanese and American cases, then if possible the effort to secure such control must be subordinated to the movement of the army, otherwise we give the defensive precedence of the offensive."[50]

Joint operations ties the navy's objective to that of the land forces which would prioritise the protection of amphibious forces over the pursuit of the enemy fleet. But that necessitates a good enough degree of a control of the sea and, if needed, the denial of its use to the enemy at the right time and place (in this case to where the land forces are and where they need to be). The command of space, then, is not focused on decisive space battles, as Sheldon's treatment of Mahan may have one believe. Space warfare, whether it be piecemeal attacks or a decisive engagement, is waged for the command of space, which is only of relevance in how it influences the wider war at hand. The command of space is a concept that makes operations with and against space systems strategically relevant and useful to operations on Earth. Sometimes the destruction of enemy satellites or a 'space blockade' (see Proposition IV) may be necessary, but sometimes not.

### 4.1.3 Proposition I Part 3: Spacepower theorists and the command of space

Colin Gray made a useful analogy between sea control and space control, claiming that "this elementary, even elemental, definition accommodates the minor qualifications both that our space/sea

[49] Corbett, *Principles…* p. 209
[50] Ibid., p. 182

forces will suffer some harassment and losses in space/at sea, and that the enemy will be able to secure erratic and minor-scale access to some orbits/put to sea in a small way."[51] Space control is his first point on the significance of spacepower in future warfare,[52] and defined 'space control' as a "condition wherein friendly forces can use the space environment on a reliable basis, but enemy forces cannot. Control, disputed or otherwise, is the idea that most usefully directs attention to the emerging status of the space environment as a (global) combat "theatre.""[53] Sheldon defined space control – meaning the command of space in this thesis - as possessing access to space, freedom to conduct operations in space, and the ability to deny the same to others.[54] Gray, like Klein, stressed the importance of the interdependence of spacepower with those of the other media and theatres of war.[55] Indeed it may be the case that few analysts and practitioners now deviate from the notion that sea power only retains its relevance insofar as it affects landward events.[56] Spacepower's strategic relevance insofar as it influences warfare on Earth is, conceptually, no different.[57]

Michael V. Smith and James Oberg are U.S.-centric and more assertive over the importance and decisiveness of a command of space, relative to the views of Sheldon, Klein, and Gray above. Smith argues that 'space control' is not optional: "If you fail to achieve a healthy measure of space control in the larger of the possible wars of the twenty-first century, you will lose."[58] Oberg describes space control as "the linchpin upon which a nation's space power depends."[59] Sheldon and Gray criticise Oberg for not going *further* on this point: "because terrestrially based armed forces have become so space-dependent, the control of space will become critically important for a nation's land, air-, and seapower, not just spacepower."[60] *Astropolitik* rests upon the notion that the control of Earth

[51] Colin S. Gray, *The Navy in the Post-Cold War World* (Pennsylvania University Press, 1994) pp. 156-157
[52] Colin S. Gray, *Another Bloody Century: Future Warfare* (London: Weidenfeld & Nicolson, 2005) p. 308
[53] Gray, *The Navy…* p. 147
[54] Sheldon, *Reasoning by Strategic…* p. 106
[55] Gray, *The Navy…* pp. 157-158
[56] M.L. Smith, Matthew Uttley, 'The Changing Face of Maritime Power', in: Andrew Dorman, M.L. Smith, Matthew Uttley, eds. *The Changing Face of Maritime Power* (Basingstoke: Palgrave Macmillan, 1999) p. 186
[57] This assertion can reasonably be expected to remain valid until Earth is dethroned from its status as the major (let alone only) habitat and political-economic node of humanity.
[58] Smith, *Ten Propositions…* p. 74
[59] James Oberg, *Space Power Theory* (USAF Academy, 1999) p. 130
[60] John B. Sheldon and Colin S. Gray, 'Theory Ascendant? Spacepower and the Challenge of Strategic Theory', in: Charles D. Lutes and Peter L. Hays, with Vincent A. Mazo, Lisa M. Yambrick, and M. Elaine Bunn, ed., *Toward a Theory of Spacepower: Selected Essays* (Washington, D.C.: National Defense University Press, 2011)

orbit by a state will confer dominance over the Earth through the use of the solar system's resources and securing access to them - in other words, commanding space, or securing celestial lines of communication between Earth orbit and solar resources.[61] Reconciliation is needed on how strategically 'decisive' the command of space can be, which is found in Proposition III. The command of space will not be as important in every different circumstance, and it depends greatly on the armed forces and other particulars of the conflict in question. For example, Raoul Castex's entire perspective of seapower theory was shaped by a continental power's possible needs and composition which all modulate the importance and decisiveness of commanding the sea.[62]

The theories proposed by Smith, Oberg, and Dolman,[63] though extreme and centred upon the U.S., are useful to encourage critical strategic thought. But, as this thesis is a contribution to a universal space power theory and not a space strategy for the U.S., the theory has to allow for conditions where the command of space may not be as decisive nor the most efficacious strategic objective in a grand strategy. There may be times when it is an ancillary matter or secondary theatre, which is a subject in Proposition V.

The concept of the command of space exposes the reader to the potential of denial being the *objective* in a particular case.[64] Beyond his seminal text, Smith also allows for the ability of less than total space control to be able to confer *effective* measures of the command of space for the exploitation of spacepower.[65] Denying the use of space to another is different to being able to use space systems – that is, counterspace is a different capability to 'force enhancement' via satellite data. If a state had only counterspace capabilities, it need not necessarily be the case that it had satellite constellations of its own or space-enabled terrestrial forces. The opposite can apply to some space

[61] Dolman, *Astropolitik*…, esp. pp. 8, 70-75, 130-134
[62] Castex, *Strategic Theories…* esp. pp. xxx, 46-48
[63] For example, see: Matthew Burris, 'Astroimpolitic: Organizing Outer Space by the Sword', *Strategic Studies Quarterly* (Autumn 2013), esp. pp. 109-110. It is not only the strategists that deal in inevitabilities – for an excellent critique of logical absolutism among the space arms control proponents, see: Laura Delgado Lopez, 'Predicting and Arms Race in Space: Problematic Assumptions for Space Arms Control', *Astropolitics: The International Journal of Space Politics and Policy* (10:1, 2012)
[64] Denial is also referred to as anti-access and area denial (AA/A2) in contemporary jargon.
[65] Michael.V. Smith, 'Security and Spacepower', in: Charles D. Lutes and Peter L. Hays, with Vincent A. Mazo, Lisa M. Yambrick, and M. Elaine Bunn, ed., *Toward a Theory of Spacepower: Selected Essays* (Washington, D.C.: National Defense University Press, 2011)

powers as well. This means that denying the command of space to another does not immediately result in an ability to exploit space systems for oneself. For a relatively weaker spacepower, it may suffice only to deny the control of space to the superior spacepower because it has no need or means to exploit celestial lines of communication for itself other than to deny space to others. Should a dominant power lose a degree of a control of space, it may still be able to deny its use to others simultaneously. This shows the value of noting the distinctions between space control and space denial, but connecting them through the idea of the command of space that may employ both control and denial.

The potential utility of Earth-based counterspace weapons means that a state does not have to have a large *space-based* presence in order to contest the command of space. Analogising from bluewater seapower theory that is restricted to experiences of the imperial competition of Britain and France sometimes has a distorting consequence on spacepower theory by thinking of satellites in orbit as battleships at sea. Like Brown above, Klein, too, falls victim to this misleading analogy, never defining clearly what 'space forces' are, and sometimes uncritically analogising un-weaponised satellites as battleships in his concepts. Such a narrative of seapower is based upon armed ships at sea with seapowers' interests separated by large distances that *only* the sea lines of communication connect. This seapower vision goes so far as for Klein to create a principle of spacepower that has no precedent other than through maritime experience whilst disguising a facet of experience in space that has a precedent in continental seapower experience. Using *only* a bluewater vision of seapower creates a distorted view of spacepower, resulting in an illusion of something's presence and obscuring something else that more accurately resembles spacepower on Earth and in orbit.[66] This 'something else' is illustrated in Proposition V.

The command of space is apt for bringing together the duality of control and denial because all forms of space warfare are waged in order to do either or both of the following two general

[66] Klein, *Space Warfare…* pp. 111-113. Klein calls for the necessity of 'space cruisers' to protect space commerce, and fails to realise the ramifications of Earth-based counterspace weapons. This is not the first time this analogical error has been noted: Simon P. Worden, 'Space Control for the 21st Century: A Space "Navy" Protecting the Commercial Basis of America's Wealth', in: Peter L. Hays, James M. Smith, Alan R. Van Tassel, Guy M. Walsh (ed.) *Spacepower for a New Millennium* (London: McGraw-Hill, 2000) p. 233

objectives: establish and secure space control for oneself and deny the control and use of space to another. Both of these objectives are about commanding space in one way or another. The command of space has constituent elements and consequences beyond the purely military, as Mahan and Corbett noted about the command of the sea. The consequences of a dispute over command could be systemic if a conflagration involves the largest space powers. The command of space is a struggle to settle or protract disputes between belligerents over who commands space to the most effective degree, and the control of space reverts to denial if it cannot be secured.[67] The control of space means denying its use to an enemy, and the successful denial of space intends to take control and the ability to exploit space away from another. This is the heart of the concept of the command of space, and to make the command of space strategically relevant, one needs to be prepared for space control, space denial, *and* exploiting those campaign's effects for terrestrial operations. The command of space is the first and last port of call when connecting any aspect of space warfare to the rest of the war at hand, and to grand strategic considerations. It is the alpha and the omega of spacepower theory; by the end of Proposition VII the importance and omnipresence of the command of space, as a concept, will only be more apparent.

## 4.2 Proposition II: Space is a distinct operational medium but it is not isolated from Earth

"Geography is interested in you, whether or not you are interested in geography." – Colin Gray[68]

Although these basics of seapower thinking transpose quite well to space, Earth orbit must still be considered as a unique place that demands its own specialisms that places demands on any knowledge base and technical skills of any political entity. Space systems are not homogenous, and outer space is not a barren waste, nor a uniform geographic expanse. A condition of space control can mean *the assured use of certain space systems which are in certain orbits and transmission paths at certain times.* Concordantly, a condition of space denial can mean the successful negating of *certain*

[67] The pursuit of denial if outright control is not possible is a useful dictum from: Dolman, *Astropolitik*… pp. 41, 134

[68] Paraphrasing Trotsky: Colin S. Gray, 'Inescapable geography', *Journal of Strategic Studies* (22:2-3, 1999) p. 162

*space systems which are in certain orbits and transmission paths at certain times*. The diverse geography of Earth orbit influences what satellites typically go where in terms of altitudes and inclinations of orbit. This is a point eloquently made by Dolman when he writes that:

> "what appears at first a featureless void is in fact a rich vista of gravitational mountains and valleys, oceans and rivers of resources and energy alternately dispersed and concentrated, broadly strewn danger zones of deadly radiation, and precisely placed peculiarities of astrodynamics."[69]

Positions and paths (or orbital trajectories) in space matter, and therefore outer space cannot be treated as a homogenous realm. John Sheldon's thesis is predicated on the outlook that strategic analogies with other operating environments, whilst useful, are inherently limiting in propagating an understanding of the use of space and often disguise important and unique distinctions between space and the source environment of the analogy in question.[70] James Oberg argues that space is a distinct medium and requires astrophysical understanding, and not an application of aeronautic thinking to outer space operations.[71] In a similar vein, Gray declares that "geographically, space is distinctive, but then so is the land, the sea, the air, and even cyberspace."[72] However, as argued throughout spacepower theory, the uniqueness of every environment does not necessitate the jettisoning of all strategic wisdom from the classic theorists used in these propositions.

Chapter 1 briefed the most salient points of the unique features of the use of Earth orbit – different satellites go into different altitudes and inclinations depending on their purpose. Different locations on Earth provide different advantages in terms of efficiencies in launching objects into orbit. As well as physical constraints, political geography matters too. Sheldon makes an excellent point regarding Israel's problematic geostrategic location when he points out that:

> "The launching state can resort to some innovative launching methods that can avoid over flight of neighbouring territories… Israel is unable to launch due East should the SLV [space launch

[69] Dolman, *Astropolitik*… p. 61
[70] Sheldon, *Reasoning by Strategic Analogy…* esp. Chapter One, and p. 22
[71] Oberg, *Space Power…* p. 126
[72] Gray, *Modern Strategy* (Oxford: Oxford University Press, 1999) p. 258

> vehicle] and its payload come down in unfriendly territory, or worse still, shot down by an unfriendly state. Nor can it launch reconnaissance satellites due north or south, again for the same reasons. Instead, it has perfected a method of launching its satellites in a westerly direction out over the Mediterranean Sea from its Palmachim Air Base south of Tel Aviv. The satellite is launched into a transitional orbit that is costly in [fuel and acceleration] expenditure, and then manoeuvres into a stable, east-west LEO."[73]

The Israeli example demonstrates a manifestation of spacepower as a product of politics, geography, and economics. None of these factors are necessarily fixed. Political upheaval can change astrostrategic considerations overnight. With the breakup of the Soviet Union, Russia had to negotiate over the Baikonur spaceport in Kazakhstan and cooperate on its future development.[74] China's new Wenchang spaceport on Hainan Island, coupled with the debut of the Long March 5 heavy lift rocket, opens new vistas for Chinese spacepower in orbit, and perhaps for interplanetary exploration. The new southerly position of the island gives the Long March 5 more of a gravitational boost from the Earth's spin, which is useful to launch all of its large space-based platforms more efficiently. The Wenchang spaceport will free China's space programme from the 'tyranny of the railroads' due to the Wenchang spaceport being the first Chinese site to have a seaboard, giving more terrestrial logistical flexibility to some aspects of Chinese spacepower.[75]

The diversity of space systems, space infrastructure, political and geographic endowments, all influence space access. Different satellites perform different functions in different places, each with varying degrees of relevance to war planning and 'grand strategic' thinking. Spacepower theory does not assume all space systems and infrastructure are vital or worth defending, or those of an enemy always worth attacking or ignoring. Understanding the character of one's own and an adversary's space infrastructure and weapons capabilities is a task requiring good intelligence capabilities (using

[73] Sheldon, *Reasoning by Strategic…*

[74] However, Russia may in future be increasingly reliant on its own spaceports, such as the northern Plesetsk Cosmodrome and the planned Vostochny space centre in Russia's Far East. See: *Space.com*, 'Kazakhstan wants rocket launch site back from Russia', *space.com*, 10/12/2012, http://www.space.com/18838-baikonur-cosmodrome-kazakhstan-jurisdiction.html (accessed /02/08/2014)

[75] Leonard David, 'China's new spaceport to launch country's largest rocket yet', *space,com*, 02/04/2014, http://www.space.com/25323-china-new-spaceport-rocket-launches.html (accessed 02/08/2014). However, maritime access to space launch sites makes them more vulnerable to maritime attack – something to consider for the U.S. Navy and other powers in the South China Sea.

no small amount of satellite intelligence) and analytical judgment. For anyone wishing to control or deny certain space systems, especially if the space segment is the target, the diversity of space systems means that there may not be a simple kill-switch for a major spacepower's entire space infrastructure *in orbit*. However, some specific systems may have greater susceptibility to single points of failure than others, depending on their redundancy planning. For example the GPS constellation "was designed to operate with only 21 satellites in orbit… up to three satellites could malfunction before serious degradations took place."[76]

Redundancy is not only a risk in the space segment: disabling key nodes in ground segments such as Schriever Air Force Base in the U.S. would take out a major control node of the GPS constellation. Severe disruption can also come from the cyber intrusion of control mechanisms and from simple software or programming errors. For example, a small input error which lasted six seconds on one GPS satellite's timing service caused 110 of 800 cellular phone sites in the eastern U.S. to crash for a few hours in March 1997.[77] Another example would be reducing Inmarsat's London headquarters to rubble, which may put significant strains on maritime satellite communications and may end the lives of many 'subject-matter experts.'

Experts in space systems were singled out in the declassified 2012 Schriever Wargame report as being very valuable to form ad-hoc space integration into NATO military operations in the absence of structural NATO-level support.[78] This demonstrates not only a need for space specialists but also for their skills, knowledge, and presence to be integrated into the wider military structure. Against a small and self-reliant spacepower, targeted assassinations of these experts may be a feasible option, like a small state's nuclear, biological, or chemical weapons communities. As space is a distinct operational medium, it requires a space-specific professional class, like land, sea, air, and cyber realms, to understand the unique ways that space is used, and how best to target enemy systems and protect one's own, or make up for service loss. Smith makes this point on space education and space

[76] Scott Pace, Gerald Frost, Irving Lachow, David Relinger, Donna Fossum, Donald K. Wassem, Monica Pinto, *The Global Positioning System: Assessing National Policies* (Washington, D.C.: RAND, 1995) p. 48
[77] Worden, 'Space Control…' p. 228
[78] Headquarters Supreme Allied Commander Transformation (HQSACT), 'Schriever Wargame 2012 International HQ SACT Report', (NATO 2012) p. 4

professionalism, where one of his ten propositions regarding spacepower is the need for career-long specialisation in space activity.[79] Smith's frustration with non-space professionals in the U.S. Air Force (USAF), some of which are appointed to high ranking positions in space-specific departments, is evident.[80] Oberg too, refers on several occasions to the area of space education and expertise.[81] This may seem banal, but ensuring a continuing supply of space professionals as personnel retire or leave for other work requires deft management and the existence of a large professional base in a high-complexity sector is not a given.[82]

That said, as well-educated technical or operational staff may be, they should not become dominated by their own unique areas. Sheldon made such a point clearly: the human element of good strategy-making and execution cannot be dominated by the needs of technology and operational requirements.[83] The skills and talents of humans, least of all in multi-environment strategic thought, should not be ignored, even in such a high-technology dominated realm as outer space. This resonates with the element of 'genius' in Clausewitz's trinity in the previous chapter and strategic culture in Proposition VI.

Spacepower, therefore, is not a panacea from terrestrial security concerns, strategic logic, and the wider politics, economics, and culture of the human societies that use spacepower. Sheldon's point on the continuing human element of spacepower makes a timely interjection into the necessity of tying together the uniqueness of the demands of operating with space systems in orbit into a common unifying 'logic' of strategy. Again, Gray was erudite on this point in 1999 when arguing that "the unique geography of space must find expression in unique technology, operations, and tactics. That unique geography does not, however, point the way to some unique logic of strategy, let alone a

[79] Smith, *Ten Propositions…* p. 74
[80] See anecdotal evidence of airmen having mistaken understandings of how space operations work: Smith, *Ten Propositions…* pp. 74-75
[81] Oberg, *Space Power…* pp. 46, 128, 131
[82] As exhibited by difficulties in the USAF, see: Scott Pace, 'Merchant and Guardian Challenges in the Exercise of Spacepower', in: Charles D. Lutes and Peter L. Hays, with Vincent A. Mazo, Lisa M. Yambrick, and M. Elaine Bunn, ed., *Toward a Theory of Spacepower: Selected Essays* (Washington, D.C.: National Defense University Press, 2011). On a scathing criticism of the state of education in the American national space security community, see: Simon 'Pete' Worden, 'Future Strategy and Professional Development: A Roadmap', in: Charles D. Lutes and Peter L. Hays, with Vincent A. Mazo, Lisa M. Yambrick, and M. Elaine Bunn, ed., *Toward a Theory of Spacepower: Selected Essays* (Washington, D.C.: National Defense University Press, 2011)
[83] Sheldon, *Reasoning by Strategic Analogy…* pp. 310-315

unique irrelevance of strategy."[84] Six years later, in 2005, Gray returned to the topic of strategic thought about space and railed against taking single-environment analyses too far, saying that understanding warfare must be done in the context of war as a whole. No element can be appreciated in total isolation; "single-environment views, theories, and doctrines, continue to harass sound strategic debate."[85] Indeed, for all its physical uniqueness, there may be a problem in "the inability or unwillingness of people to approach space as just another geographical environment for conflict."[86] Although Earth orbit has its unique features, it is still subject to the parameters of human socio-political activity as understood through Clausewitzian theory. Even if spacepower is exercised prudently with talented personnel, Proposition III stands ready to apply friction – for all the value of space systems, there may be terrestrial workarounds and redundancies for forms of communication should space systems fail.

Again, seapower theory can assist in illustrating this proposition. Gray makes a point in a discussion of seapower's influence that the sea-, air-, land-, and spacepower of a state are bounded by people and politics; and goes on to argue that policy and strategy are not unique in space, insofar as they all exist within a unity of strategic logic of marrying violent means with political ends.[87] Mahan was no stranger to emphasising the importance of people in his narratives of great sea clashes and in his ideas of seapower.[88] As explained in Chapter 3, Mahan was concerned with the qualitative education of officers to improve their command judgment. But also relevant for space warfare and spacepower, especially in protracted conflicts where attrition bears heavily on warring belligerents, would be the ability of a power to turn its demographic weight and science and technology expertise to a war effort. Mahan wrote that: "It is equally the nature of a merely military navy (i.e. no merchant marine) like that of France to be strongest at the beginning of hostilities; whereas that of the allied sea powers grew daily stronger, drawing upon the vast resources of their merchant shipping and their

[84] Gray, *Modern Strategy…* p. 259
[85] Gray, *Another Bloody…* p. 312
[86] Colin S. Gray and John B. Sheldon, 'Space Power and the Revolution in Military Affairs: A Glass Half Full?', *Airpower Journal* (Autumn 1999) p. 27
[87] Gray, *The Navy…* pp. 99, 126
[88] The centrality of people and judgment in Mahan's works is a major theme throughout Sumida, *Inventing…*

wealth."[89] For spacepower theory, Mahan's comments mean that if there is a population familiar with the needs and skills of the medium that is important to a war, given enough time (and ability to weather the initial blows), a spacepower can turn demography and wealth into a long-lasting strategic advantage. Trevor Brown adapted this Mahanian drive to make one's people and economy geared towards space in much the same way, "so that when their forces go to war, they go with the best equipment and training that only a nation for whom the medium had become second nature would naturally produce."[90] A spacepower with time, resources, and plentiful experts with command judgment and an eye for material profits (or leaders that guided them) could be a potent mix.

Proposition II asserts that although outer space is a unique realm in its own right, and requires expertise in the science and technology needed to utilise it, it is still a medium that humans use. Humans take their socio-political baggage with them, and space activities are not divorced from political considerations on Earth. Terran politics continues in astropolitics. It is not different to the sea and air in the sense that particular skills and technologies are needed to harness them, but are influenced by human activities as well, and vice versa. Gray and Sheldon lamented the problem of "the inability or unwillingness of people to approach space as just another geographical environment for conflict."[91] This proposition addresses that problem and encourages such strategic thought. Great technical skill is needed to master modern maritime demands, aircraft engineering and piloting, and land warfare, as well as cyber demands. But in all these, they possess strategic meaning in how they relate to quintessentially human affairs.

[89] Mahan, *Influence of Sea Power…* p. 180
[90] Brown, 'Space and the Sea…', p. 240
[91] Gray and Sheldon, 'Space Power…' p. 27

## 4.3 Proposition III: A command of space does not equate to a command of Earth

"It is fitting indeed that a brilliant though indecisive naval victory should close the story of an essentially naval war." – Alfred Thayer Mahan[92]

What is the role of battle in spacepower theory, in the context of multi-environment warfare? Is spacepower a centre of gravity to strike or defend? The seapower analogy certainly allows for the role of decisive battle and the dominance of outer space, but even in scenarios where there is no battle in orbit, seapower theory brings useful insights because they are focused on commanding a medium's lines of communication for a range of effects, and not on battles in that medium for their own sake. Conversely, even when there are 'decisive' battles in orbit, it may not translate into decisive action on Earth. Theory must reflect the *possibility* of decisive action following the dominance of space or 'decisive battle' in orbit, but it must also accommodate the possibility that it may not be case. Smith declares that spacepower is a centre of gravity *for the United States*, and Gray says that spacepower enhances an ability to target enemy centres of gravity.[93] Such declarations are problematic in a universal spacepower theory. The decisiveness of attacking space infrastructure in a war is a particular detail, and spacepower will not always be as decisive to a every war's outcome. Furthermore, Gray's assessment assumes that an enemy has a centre of gravity that is susceptible to detection and destruction by weapons that are enabled by spacepower.

For Clausewitz, the centre of gravity was "the hub of all power and movement, on which everything depends. That is the point against which all our energies should be directed." The good strategist had to constantly seek out what the enemy's centre of gravity was and strike at it, which did not necessarily mean enemy forces or a capital city. It could also mean attacking something tangible that supports the enemy's will to fight.[94] It is understandable, and useful for practitioners, to think of U.S. spacepower as *a possible* centre of gravity – but it is an act of political judgment and net

[92] Mahan, *Influence of Sea Power…* p. 469. Mahan refers to British French naval warfare during the American war in the late 1770s and early 1780s.
[93] Smith, *Ten Propositions…* pp. 64-69; Gray, *Another Bloody…* pp. 311-312
[94] Clausewitz, *On War…* (H/P) pp. 595-596

assessments to do so.[95] Theory must accommodate the possibility that spacepower may be a centre of gravity that gives a belligerent its cohesion, but also the possibility that attacking an enemy's spacepower may not seriously undermine the enemy's entire war effort. The centre of gravity as a concept may have been abused to the point that it should be discarded, as Lawrence Freedman argues.[96] Spacepower theory should not claim that spacepower is *inherently* a centre of gravity because determining a centre of gravity is an assessment of a particular belligerent in a particular scenario. A constructive application of the centre of gravity is in Proposition VII, which examines the cohesion spacepower gives to dispersed terrestrial forces that are stitched together into a cohesive whole.

Whilst it is true that events on Earth are not immune from events in space, Proposition III counters the extreme version of this, which can be called astrodeterminism. Astrodeterminism is the view that events in space will determine those on Earth or any other celestial body; that dominating space leads to the domination of Earth, as declared in *Astropolitik*. Trevor Brown follows this logic of attaching an inherently decisive quality to spacepower. For him, "space dominance heavily shifts the balance of forces tactically, operationally, and strategically."[97] Proposition III argues that this is not necessarily the case, and space dominance certainly does not guarantee success. Strategic preponderance in space does not equate to strategic preponderance on Earth. The command of space does not necessarily mean the command of the Earth. Even if a power has mastered space, it may not master the Earth. That said, however, there is a kernel of truth in thinking that spacepower helps one to succeed in warfare on Earth, like in the 1991 Gulf War. The indeterminate role of spacepower's dispersing influence on terrestrial warfare is examined in Proposition VII.

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[95] For example, see: Howard Kleinberg, 'On War in Space', *Astropolitics* (5:1, 2007) pp. 9-10; Steven Lambakis, *On the Edge of Earth: The Future of American Space Power* (Kentucky University Press, 2001) p. 101; Marc J. Berkowitz, 'National Space Policy and National Defense', in: Peter L. Hays and James M. Smith, Alan R. Van Tassel, Guy M. Walsh (ed.) *Spacepower for a New Millennium* (London: McGraw-Hill, 2000) pp. 50-51; Benjamin S. Lambeth, *Mastering the Ultimate High Ground: Next Steps in the Military Uses of Space* (Washington, D.C.: RAND, 2003) p. 99

[96] Lawrence Freedman, 'Stop looking for the center of gravity', *War on the Rocks*, 24/05/2015 http://warontherocks.com/2014/06/stop-looking-for-the-center-of-gravity/ (accessed 31/08/2015)

[97] Brown, 'Space and the sea…' p. 239

Spacepower as a "team player" in 'joint warfare'[98] is an *enabler* for the person "on the scene with a gun."[99] It should not be viewed as a silver bullet to strategic problems. The challenges facing spacepower - if it is ever to be considered as an independent war-winner - are similar to the great debate over airpower's strategic efficacy. Sheldon argues that "if anyone were to claim for space power an ability to independently win wars and to do so quickly they would do much to hamper its strategic value and evolution by making promises that it could not possibly keep."[100] Spacepower gets its strategic value in how it assists in achieving terrestrial political objectives as a team player. Smith advocates a combined arms approach to space warfare, as well as insisting on the coercive and compellent elements of spacepower.[101] Gray believes that:

> "No one is going to fight a space war… Space warfare will have a political and strategic context. To claim otherwise would be identical to an argument for sea war or air war… Warfare inherently is a joint undertaking."[102]

What is added to Gray's comments here is the integration of such an argument into a wider body of theory (in this case the seven propositions). Yes, spacepower is a team player in joint warfare but one must not lose sight of what makes spacepower unique in its contributions (e.g. Proposition II, V, and VII). Any judgment on how decisive spacepower *can potentially be* in a war should be the sum of assessments of all relevant dependencies on space systems, which in turn influence which space systems are targeted for hostile actions in any given war plan. Different wars may make some specific aspects of spacepower, or space capabilities, more decisive or strategically effective than others. In addition, the geographies of the war matters. If a spacepower has few space assets providing relevant celestial lines of communication over a target on Earth, space-Earth power integration may be relatively ineffective.[103]

[98] Gray, *Another Bloody…* p. 309
[99] Sheldon, *Reasoning…* p. 303
[100] Sheldon, *Reasoning…* p. 261
[101] Smith, *Ten Propositions…* p. 105-106
[102] Gray, *Another Bloody…* p. 312
[103] Sumida, 'New insights…' p. 110

The interactions between terrestrial forms of power and spacepower are never fixed in their character, but the general idea of the interaction of terrestrial power and spacepower relative to the ultimate political object persists. It is a common theme among the spacepower theorists. Gray trenchantly argues that:

> "Because people live only on the land [...] military behaviour, no matter what its tactical form, ultimately can have strategic meaning only for the course of events on land. It follows that seapower, airpower, and now spacepower function strategically as enabling factors. The outcome of a war may be decided by action at sea, in the air, or in space, but the war must be concluded on land and usually with reference to the land."[104]

The wars in Afghanistan and Iraq after the turn of the twenty-first century should serve as recent reminders that superiority in space (effectively a near-absolute command of space) still did not translate into promising war termination for the United States despite the initial combat successes. This is not to say that spacepower does not have a role to play in winning such conflicts, or that spacepower is *inherently* less effective or less crucial in wars such as 'conventional', 'guerrilla', or 'counter-insurgency', but that the dominance of space did not automatically lead to U.S. preponderance to achieve its long-term aims in decisively ending the Taliban in Afghanistan or leaving an Iraqi state that was at peace with itself. This also illustrates the limitations of airpower as a 'war winning' factor on its own.[105] As the influence of spacepower on these particular wars is a question for another time, all that can be said for now is that superiority as a spacepower certainly was not sufficient for strategic 'victory', but it may have been necessary for the U.S. as a part of a larger causal chain to 'victory' that has since been closed off through the tenacity of Taliban resistance and failure in the occupation of Iraq. Even in 1991, Iraq had learned to "supress the signatures that might be detected by imagery or signals intelligence" to make the coalition "Scud-hunting job… more

[104] Gray, *Modern Strategy…* p. 259
[105] On airpower and high technology as not being decisive by themselves, see: Robert A. Pape, *Bombing to Win: Air Power and Coercion in War* (London: Cornell University Press, 1996); Frederick W. Kagan, *Finding the Target: The Transformation of American Military Policy* (London: Encounter Books, 2006)

difficult than anticipated."[106] A dominant command of space does not provide omniscience and omnipotence.

Spacepower must ultimately be complemented by an appropriate strategy 'on the ground' to the peace that would follow war, to occupy territory or influence daily life, or at least threaten actions that influence the behaviour of the adversary in a desirable way. Spacepower has been embedded in Cold War 'strategic' nuclear warfare detection, support, and reconnaissance roles, but for the past thirty years it has become more widely used in conventional support roles.[107] This is what Sheldon means by spacepower coming out from under the shadow of the nuclear revolution.[108] Oberg is correct to point out that "space power, alone, is insufficient to control the outcome of terrestrial conflict or ensure the attainment of terrestrial objectives."[109] The significance of spacepower's interactions with terrestrially-based forces and targets is heightened by the assessment that space-to-space and space-to-Earth hostilities are probabilistic outliers for the near-term future. That is, engaging in space warfare using terrestrially-based weapons and operations are most likely going to be necessary – these may be termed counterspace operations. Single-environment blinkers should be discarded.

This means that Earth-to-space and terrestrially-bound operations are the most likely forms of 'space warfare' – meaning the struggle for a measure of a command of space – we will see in the near term, and raises the salience of this third proposition. An air-launched attack on a groundstation can be considered part of a campaign to influence the command of space, just as a land-based operation to secure a naval port for naval forces can be deemed part of maritime warfare and a campaign requiring the command of the sea. Yet the paradoxes of strategy may make the outlier a preferred choice to surprise the enemy. The connections between Earth and space operations are explored more in Proposition V and VII. Proposition III places these established joint warfare views of spacepower and

[106] Jeffrey T. Richelson, *America's Space Sentinels: DPS Satellites and National Security* (Lawrence, K.A.: Kansas University Press, 1999) p. 172
[107] Smith, *Ten Propositions…* pp. 57-59; David N. Spires. *Beyond Horizons: A Half Century of Air Force Space Leadership* (Montgomery, A.L.: Air University Press, 1998) pp. 174-269
[108] Sheldon, *Reasoning…* p. 317
[109] Oberg, *Space Power…* p. 127

space warfare as a precursor to examining the more in-depth examination of exactly how space behaves as a contributor to warfare on Earth in Propositions V and VII.

This proposition of the inefficacy of using spacepower *by itself* is fairly uncontroversial, but not unchallenged in terms of existing spacepower theory. Contrary to this view, Everett Dolman employs astropolitical dicta: "he who controls low-Earth orbit controls near-Earth space. Who controls near-Earth space dominates Terra. Who dominates Terra determines the destiny of humankind."[110] Dolman's theory challenges the proposition that preponderance in space does not necessarily mean preponderance on Earth. The key difference between the outlook of Dolman's *Astropolitik* and the spacepower theories examined here is temporal and is related to the intent of his theory. The spacepower theorists, other than Dolman, take a view closer to the present in forming their views on the employment of spacepower and the parameters of spacepower theory.[111] Dolman takes his readers to an indeterminate future where humans are harvesting essential resources from beyond Earth, whilst intentionally pushing *realpolitik* logic to its extreme to develop theory and astropolitical thinking.

Everything that matters in strategic history, and near-future strategic history, has to eventually impact humans on Earth - and more specifically - the landmasses of Earth upon which humans inhabit. This is the general premise that makes Proposition III tenable – dominating space means nothing unless it contributes to achieving a political objective in a grand strategy, and dominating space may not equate to dominating Earth. However, *Astropolitik* takes the view that "the resource potential of space, like Mackinder's heartland, is so vast that, should any one state gain effective control of it, that state could dictate the political, military, and economic fates of all terrestrial governments."[112] As bold and crystallising as such an assumption is, and indeed useful for a valuable thought exercise in astropolitics and strategic thought, it requires many qualifications to be realised and is a useful reminder for spacepower theory to be mindful of changing astropolitical and

[110] Dolman, *Astropolitik…* p. 8
[111] In Dolman's defence, his intent was not to create a spacepower theory per se, but his work is essential for gleaning some principles of a spacepower theory and furthering discussion and self-education.
[112] Ibid., p. 68; For a similar view of the future of spacepower, see: Martin E.B. France and Jerry Jon Sellers, 'Real Constraints on Spacepower', in: Lutes and Hays, ed. *Toward a Theory…*

astroeconomic conditions. Gray and Sheldon are sympathetic to such long-term thinking, when they claim that in "the long run, the very long run indeed, the security of the human race most likely will depend upon its space power."[113] They go on to argue that human spacepower will be needed to see off space-based threats such as asteroid collisions and hostile alien contact.[114] Dolman believes an extra-terrestrial contact scenario may unite humanity into a single political entity.[115] Such thinking shows only one scenario of extra-terrestrial contact where an alien force has greater capability for space-based strategic effect as well as the ability through its mere existence to politically unite humanity.[116]

With sympathies to longer-term thinking about the human future (or lack of it) in the cosmos, this thesis must return to the present and humanity's presence and dependence on Earth alone.[117] As space activity "is not a major economic force, but […] a potent economic enabler"[118] for the foreseeable future, grandiose visions akin to Dolman's remain as flights of fancy, theoretical testing grounds, and engaging thought exercises. Continental seapower thought contributes theoretically to scenarios where economic activity on a medium is an enabler but not a crucial lifeline in Proposition V. As long as human life clings to the landmasses of Earth, and the resources that feed civilisation come from Earth, spacepower by itself may struggle to be decisive, no matter the level of preponderance or ability to deny space by any state or entity in Earth orbit.

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[113] Gray and Sheldon, 'Space Power…', p. 25
[114] Ibid.
[115] Dolman, *Astropolitik…* p. 15
[116] Systematic, critical thought and inspiration from popular culture can provide challenges to such technological and politically idealistic assumptions of alien contact, much in keeping with the critical thought encouraged by strategic theory. For example, see: Michael A.G. Michaud, *Contact with Alien Civilizations: Our Hopes and Fears about Encountering Extraterrestrials* (New York, N.Y.: Springer, 2010) esp. pp. 279-323, 358-376; Harry Turtledove, *Worldwar: In the Balance* (Hodder and Stoughton, 1994), the first in the *Worldwar* series, and idem. *Colonization: Second Contact* (Del Rey, 2001); *Stargate: SG-1*, 'Disclosure', Dir. William Gereghty, Season 6: Episode 17 (Gekko Film Corp, MGM Worldwide, 2003)
[117] On the potential political-economy of the solar system, see: Marilyn Dudley-Flores and Thomas Gangale, 'Forecasting the Political Economy of the Inner Solar System', *Astropolitics* (10:3, 2012) pp. 183-233; Dennis Wingo, 'Economic Development of the Solar System: The Heart of a 21st Century Spacepower Theory', in: Charles D. Lutes and Peter L. Hays, with Vincent A. Mazo, Lisa M. Yambrick, and M. Elaine Bunn, ed., *Toward a Theory of Spacepower: Selected Essays* (Washington, D.C.: National Defense University Press, 2011); Ken Murphy, 'The cislunar econosphere (part 1)', *The Space Review*, 20/02/2012, http://www.thespacereview.com/article/2027/1 (accessed 03/08/2014)
[118] Joseph Fuller, Jr., Jeffrey Foust, Chad Frappier, Dustin Kaiser, and David Vaccaro. 'The Commercial Space Industry: A Critical Spacepower Consideration': in Charles D. Lutes and Peter L. Hays, with Vincent A. Mazo, Lisa M. Yambrick, and M. Elaine Bunn, ed., *Toward a Theory of Spacepower: Selected Essays* (Washington, D.C.: National Defense University Press, 2011)

Seapower theory assists in the exploration of this proposition. Mahan and Corbett dealt extensively with questions of the decisiveness of seapower. Corbett rather famously said that land power is needed if seapower is to have any decisive capability from an island power perspective.[119] If it is accepted that seapower is about the command of the sea, and spacepower is about the command of space, then the object of command is over their respective lines of communication along which information and effects travel (and material transportation in the case of seapower). Blockade is the idea of denying most, if not all, sea lines of communication to an enemy, and analogically, denying most, if not all, celestial lines of communication to the enemy. These lines of communication, blockade, and economic warfare will be returned to in Propositions IV and V.

Even should there be a spectacular conflagration in orbit, it does not *necessarily* make spacepower any more strategically decisive or useful to a war's objectives. This includes a possible future where states have deployed space-based weapons or fully armed and operational battle stations in orbit.[120] Seapower history is rife with strategically indecisive battles at sea. Spacepower, therefore, should not treat battles in space or the destruction of satellite systems as inherently decisive, either. For the near-future, 'decisive battle' in orbit between space platforms may not be that useful a vision for spacepower theory. But in terms of giving fair treatment to Mahan and Corbett's qualified desire for battle at sea to achieve preponderance, it is a useful thought exercise, and may perform some function as future-proofing and to allow strategic creativity to encompass a possibly decisive battle in orbit. Transposing Mahan's ideas of decisive battle into space would mean that significant, or the most threatening, enemy space forces should be destroyed where and when such targets and opportunities exist. Enemy space systems should be put out of action through destructive or non-destructive methods for at least the expected duration of hostilities to ensure the greatest degree of probability in maintaining a general command of space to enable space systems to support operations on Earth. If this action is feasible and judged appropriate to the scenario at hand, it should be pursued.

[119] Corbett, *Principles…* p. 14

[120] In response to an online petition, the U.S. White House has outlined its case against the construction of a Death Star inspired by the *Star Wars* saga. See: The White House, 'This Isn't the Petition Response You're Looking For', 11/01/2013, https://petitions.whitehouse.gov/response/isnt-petition-response-youre-looking (accessed 31/10/2015)

Following Mahan's approach does not mean blindly chasing what may be a forever-illusory grand battle or a 'decisive' counterspace strike against space systems.

In today's character of space warfare, one could anticipate comprehensive strikes on an enemy's launch capabilities and facilities, space-capable missile batteries, major airfields, 'missile defence' ships, space surveillance network (SSN) nodes, and the neutralisation of key enemy satellites and ground stations. Of course the exact manifestation of decisively crippling an enemy's space warfare capabilities and the sources of its spacepower, and then to press home the advantage of securing a greater degree of the command of space, may change dramatically as technological, political, and economic conditions vary across time as well as among the belligerents involved. For example, should Skylon spaceplane technology become feasible and proliferated, it could make most international airports on Earth potential spaceports and launch sites, and those who possess spaceplane technology may enjoy some logistical advantages over those that only rely on expendable rocket technologies.[121] It is important to acknowledge that decisive as well as indecisive action *may* occur in orbit, but even a dominance of Earth orbit may not confer dominance on Earth. This illustrates why Mahan should not be discarded on account of an interpretation of his ideas as being preoccupied with the 'big battle': a decisive battle is *possible* and should be accounted for. Mahan is useful in how his seapower theory allows one to consider the possibilities of decisive naval engagements, whilst simultaneously alluding to the possibility of the indecisive result of maritime dominance in a continental war, which is explored more in Proposition V. Conversely, we should not think that Corbett was adverse to the utility of 'big battles'. As Geoffrey Till argues that:

> "it is important… not to exaggerate the extent of Corbett's scepticism about 'command of the sea' and 'decisive battle'. He acknowledged that the concerted pursuit of these two central objectives of 'Mahanian' [seapower theory] was usually valid. It was only his willingness to say that sometimes it might not be that got him into trouble with the Admiralty."[122]

[121] This should be borne in mind on discussions of blockade and commerce warfare, seen in Propositions IV and V, respectively.
[122] Geoffrey Till, *Seapower…* 2nd Edition, p. 62

On this issue, Corbett himself wrote that "for most practical purposes the rough generalisation that the command depends upon the battle fleet" is a *usually* a constructive one, if only to help discern when an enemy fleet needs action to be taken against it.[123] For Corbett, British commanders and strategists were often caught between the choice of seeking battle or imposing blockade in order to secure a dominant command of the sea for the British Empire, arguing that the Royal Navy tended to prefer to seek battle although it was less achievable than blockading in order to secure command.[124] Corbett went on:

> "The most thorny questions [British commanders] had to decide were these. In the normal case of strength, it was not how to defeat the enemy, but how to bring him to action; and in casual cases of temporary weakness, it was not how to sell your life dearly, but how to maintain the fleet actively on the defensive so as at once to deny the enemy the decision he sought and to prevent his attaining his ulterior object [i.e. a fleet in being]."[125]

Despite analogising from Corbett's work, Klein seems to miss the tensions between seeking battle and denying it. Klein does not qualify his comments – the enemy *may* seek to deny battle in space, but Klein implies it is an inevitability.[126] This is problematic for spacepower theory. By missing the nuance within Mahan's and Corbett's views on seeking battle, where they agree on most points, Klein's theory does not take note of the pedagogical nature of Mahan's and Corbett's seapower theory. Successful naval command relied on *good judgment in applying the principle* of seeking decisive battle or avoiding it, to reflect upon the many imponderable variables that confront commanders at every turn in every war where no two particular circumstances are ever the same. Klein's principles of space warfare lack an explicit discussion of the pedagogical role of strategic theory, as opposed to the practical and real-world instructional roles of policy and actual strategies. Because of this, Klein's work is at times too prescriptive for a universal spacepower theory.

[123] Corbett, *Principles…* p. 113
[124] Ibid., p. 165
[125] Ibid., p. 166
[126] Klein, *Space Warfare…* p. 74

Spacepower has to be related to events on Earth. Preponderance in space does not guarantee a masterful use and integration of celestial lines of communication to the wider war effort on Earth, or an effective exploitation of the command of space for strategic effect. This concept has resonance when looking at the success of the French in battle against England at the battle of Beachy Head in 1690 in the Nine Years' War (1688-97). This decisive battle was followed by inaction by the French to make such a dominance of the sea felt on the land theatres of that war.[127] Louis XIV failed to perform a second task that *in those circumstances* could only be done after achieving naval superiority. If the French fleet had committed to separating Ireland from Britain, cutting off William III's lines of communication with Ireland, the war may have gone very differently. Mahan noted that "the English communications were not even threatened for an hour." The French Navy did not stop William III from transporting troops to Ireland and winning the Battle of the Boyne, more significantly influencing the outcome of the war than the Allied fleet's defeat in battle.[128] The potential strategic effect of Louis XIV's naval victory was squandered. An effort has to be made to relate seapower to the land. In space, it is important to bear this strategic analogy in mind. A combat superiority against space assets (or a command of space) has to be actively exploited under the conditions that superiority creates. This resonates with Sergei Gorshkov's argument that a victory over an enemy fleet merely creates the preferred prerequisites for the aim of supporting territorial tasks and operations against the shore towards victory.[129]

So what? This theorising about seeking battle *in* space, and to what extent it can be decisive, is not idle-future gazing as it has a useful conceptual value. There are no obvious weapons platforms in space – which if they existed, would be a useful point of strategic analogy for sea and spacepower. Despite this, when we consider hostile coastal fire (featured in Proposition V), the conceptual utility of this analogy becomes more apparent. Counterspace operations are meant to influence the command of space, usually through Earth-based weapons. Violence, or battle of some sort, may be used to secure that command, or dispute it – without the need for space-based weapons. Once the desired state

[127] On a short introduction to the Nine Years' War and its context in international history, see: Derek McKay and H.M. Scott, *The Rise of the Great Powers: 1648-1815* (London: Longman, 1983) pp. 43-50
[128] Mahan, *Influence…* pp. 180-187
[129] Sergei G. Gorshkov, *The Sea Power of the State* (Oxford: Pergamon Press, 1979) pp. 213-214

of command is achieved, the resulting use, or denial, of the relevant celestial lines of communication must be exploited for spacepower to be used meaningfully for the terrestrial war. It is *conceptually* irrelevant that the form of battle, and securing or disputing the command of space, comes from Earth-based space warfare systems ('coastal space weapons') or space-based weapons platforms. They are campaigns in order to secure or dispute varying degrees of the command of space, in order to set up the exploitation of the result of those spacepower struggles.

Securing the command of the sea by decisive battle is of less *direct* analogical use to characterise space warfare today, but the consequences of harnessing celestial lines of communication – or failing to do so - are just as useful. The enabling or paralysing effects of controlling or denying lines of communication are exemplified by Mahan's narrative of British forces in the American Revolutionary War. The French Navy had secured the command of the seas between the British strongholds in New York and Chesapeake long enough to help force a capitulation of British forces. Although the Royal Navy was not annihilated in a decisive battle, France was able to exercise its local and persistent command of the sea in the North American theatre for long enough against the British for the French and colonial rebels to exploit a British inability to use their sea lines of communication to logistically augment their North American forces.[130] For spacepower, this can mean that even though a power's space capabilities may not be decisively put out of action, a *good enough* command of a particular area of space, or celestial lines of communication for long enough against certain deployed forces could have great strategic effect, if consciously exploited.

Without access to celestial lines of communication, space-supported armed forces are less efficient, more vulnerable to surprise attack, and *possibly* cut off from external support such as fire support from distant over-the-horizon weapons platforms. The logistical aspects of spacepower are explored further in Proposition V, and the consequences of spacepower (and its loss) on the battlefield is the theme of Proposition VII. However, for now, it is pertinent to end this proposition on decisiveness and preponderance with Mahan, in order to stress the point that Mahan was not a single-

[130] Ibid., pp. 374-397

minded naval strategist obsessed with big battles at sea.[131] On the Spanish War of Succession (1701-1714), Mahan narrated that:

> "once only did great fleets meet, and then with results that were indecisive; after which the French gave up the struggle at sea, confining themselves wholly to a commerce-destroying warfare. This feature of the War of Spanish Succession characterizes nearly the whole of the eighteenth century, with the exception of the American Revolutionary struggle. *The noiseless, steady, exhausting pressure with which sea power acts, cutting off the resources of the enemy while maintaining its own, supporting war in scenes where it does not appear itself, or appears only in the background, and striking open blows at rare intervals, though lost to most, is emphasized to the careful reader* by the events of this war and of the half-century that followed."[132]

The subtle yet potentially strategically significant effects of the exploitation of sea lines of communication can be analogised from this to space, and are done extensively in the next two propositions. A general and persistent command of space will not necessarily translate into a command of Earth, but it can help. Conversely, even relatively modest or non-dominating abilities can contribute greatly to a war, in keeping with the non-linear and disproportionate nature of war. Decisive engagements in space, if possible, will not by themselves decide a war; the consequences of space warfare on the command of space must be exploited for strategic effect. Judging the principles of battle, blockade, and superiority in spacepower should be done through understanding the relevant celestial lines of communication, their composition, locations, users, and effects on terrestrial activities.

[131] An entire book written by Mahan on the riverine operations of the Union Navy makes such accusations incredulous. See: Alfred Thayer Mahan, *The Gulf and Inland Waters: The Navy in the Civil War* (New York, NY: Charles Scribner's Sons, 1883), esp. pp. 3-4, 11-12

[132] Mahan, *Influence of Sea Power…* p. 209. Emphasis added.

## 4.4 Proposition IV: The command of space is about manipulating celestial lines of communication

"The two have to contest the one line of communications vital to both. It becomes therefore itself an objective, and all the more important because the security of military communications entails in equal measure that of the nation's commerce." – Alfred Thayer Mahan[133]

Celestial lines of communication visualise the strategic situation on Earth's cosmic coastline. In this theory, the focus is on celestial lines of communication in Earth orbit and on Earth's surface and atmosphere, and not those between and around other celestial bodies. Such a focus may be more pertinent to a 23rd century Mahan. Space powers have to account for the physical, political, and economic consequences of actions that take place in various celestial lines of communication. John Klein draws a distinction between space communications and celestial lines of communication. Space communications refer to the things that are transported, such as trade goods, materiel, spacecraft, electromagnetic transmissions, data and military effects, and the means of doing so. Celestial lines of communication refer to the actual routes and points between nodes and regions along which the various kinds of space communications travel.[134] These lines may be shared between belligerents and third parties, as many spacecraft may have similar or identical orbits, or ones that overlap and intersect at certain places. This is an extremely important factor to remember when considering the use of physically destructive methods of space warfare, as generating a debris cloud from destroying an enemy satellite may sometimes – but not always - pollute the celestial lines of communication for oneself, allies, and third parties. A hit-to-kill anti-satellite weapon may create a vast cloud of debris that threatens to indiscriminately destroy satellites in similar orbits.

These lines of communication refer to two forms. First, the routes that physical objects, like satellites, must travel according to Newtonian physics, and the consequences of physical logistical difficulties with regard to space systems. Second, it refers to lines of communications along which useful particles and energies can travel, such as wireless communications, particle effects, and lasers.

[133] Alfred Thayer Mahan, 'Globalization and the Fleet', in: Benjamin F. Armstrong, ed., *21st Century Mahan: Sound Military Conclusions for the Modern Era* (Annapolis, MD: Naval Institute Press, 2013) p. 54
[134] Klein, *Space Warfare…* p. 52, 56

Satellites are on these nodes, which move along orbital routes and serve as nodes in electromagnetic radio transmissions. This leads to two kinds of celestial lines of communication – one that rests on the gravitational laws, and another on particles that can behave independently from most gravitational forces and travel point-to-point at the speed of light.[135]

The terrestrial element of celestial lines of communication must be remembered, along with the possible flexibilities of their compositions. The fixed nature of satellite control stations and receiving stations is well-established, and form reliable and well known celestial lines of communication between Earth and space. However, receivers can be highly dispersed and mobile, if not possibly clandestine if hidden from an enemy's SIGINT and ELINT capabilities. For example, a Chinese sensor net to warn of incoming U.S. warships and aircraft in a Taiwan scenario may include a fleet of innocuous fishing vessels that have satellite phones connected to Chinese satellite networks.[136] This would provide a concentration of celestial lines on communication on Earth that may be useful to deny in some form of local 'space communications blockade'. But the users may be able to disperse and conceal themselves from enemy strikes. The risks and opportunities of terrestrial dispersal and concentration in response to spacepower is further explored in Proposition VII.

The electromagnetic spectrum is as diverse as the physical Newtonian realm of orbital mechanics. Different frequencies are used for different purposes. For example, Very High Frequency (VHF) bands are used for generic satellite uplinks, where increasing importance of satellite communications climb up the frequency bands, ending with the most survivable military satellites using Extremely High Frequency (EHF), with ground EHF transmitters able to provide microwave data links and 'active denial systems.'[137] Powerful signals can drown out weaker ones. Two signals on the same frequency being broadcast near each other can make it difficult for a receiver to pick out the correct one. Unintentional radiofrequency interference can also occur if an antenna is pointed at the

[135] With exception to the gravitational maelstrom of a black hole where conventional physical laws break.
[136] Eric A. McVadon, 'China's Navy Today: Looking toward Blue Water', in: Andrew S. Erickson, Lyle J. Goldstein, Carnes Lord, eds. *China Goes to Sea: Maritime Transformation in Comparative Historical Perspective* (Annapolis, M.D.: Naval Institute Press, 2009) p. 382
[137] Brian Weeden, 'Radio Frequency Spectrum, Interference and Satellites Fact Sheet', *Secure World Foundation*, Washington, D.C., 25/06/2013, p. 3

wrong satellite.[138] If such communications can be jammed in such a manner, and the ability to locally jam GPS signals is heavily proliferated,[139] it could have significant consequences for terrestrial forces and strategic planning, making non-physical celestial lines of communication useful to be considered as lines of communication in the first place. As examples of the integration of jamming into the many tools of the command of space, the 4th Space Control Squadron, of the 21st Space Wing of the USAF, is assigned to operating the Counter Communications System (CCS)[140], deploying in-theatre for space superiority operations, and evaluating new counterspace technologies.[141] Research continues apace, with the U.S. Air Force Research Lab's (AFRL) Advanced Novel Spectrum Warfare Environment Research (ANSWER) programme which attempts to develop electronic warfare capabilities for anti-access and area denial (A2/AD) scenarios, including for *satellite-based* electronic warfare capabilities.[142]

Jamming can be targeted at specific satellites using narrow and precise 'spot-beams,' but they can also be used as wide-area noise jamming devices to interfere with communications across a vast area. A useful metaphor could be to imagine the former as a precision laser strike, and the second as a shockwave arc. Spot-beam jamming requires more knowledge of the target to be able to launch an extremely precise electronic warfare assault, making it a more intelligence-heavy option. General and wide-area jamming requires more power, is easier to achieve, but is less discriminate. Furthermore, the larger the jamming emitter's power, the easier it is to locate and therefore destroy with 'reconnaissance-strike' systems.

Lines of communication can converge to form chokepoints. They can also accrue benefits from advantageous locations; these can form high-value positions. These are the most economical and effective locations and trajectories to achieve what is needed with the relevant satellites. For example,

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[138] Ibid.
[139] Ibid., p. 4
[140] A capability, not a specific single piece of hardware, designed to "disrupt satellite-based communications used by an enemy for military [command, control, and communications]", see: Peter B. Teets, Testimony of the Under Secretary of the Air Force to the Senate Armed Services Committee, Hearing on National Security Space Programs, 12/03/2003, http://fas.org/irp/congress/2003_hr/031203teets.html (accessed 14/07/2014)
[141] Peterson AFB, '4th Space Control Squadron', http://www.peterson.af.mil/library/factsheets/factsheet.asp?id=4707 14/07/2014, (accessed 14/07/2014)
[142] John Knowles, 'AFRL Solicits Spectrum Warfare Research', *The Journal of Electronic Defense* (December 2013) pp. 19-21

in Operation DESERT SHIELD in 1991, some satellites were moved to the GEO slot closer to the Middle East theatre to provide additional communications bandwidth.[143] Using high value positions is not limited to military systems. Any satellite constellation benefits from using them through utilising their optimal orbital altitudes and inclinations.[144] Klein makes a distinction between the physical and non-physical in terms of chokepoints. "Non-physical choke-points are locations of regions where there is a proportionally significant concentration of communications emanating from or going through them."[145] Physical chokepoints are locations such as specifically predictable orbits through which recently launched satellites must pass and could be intercepted (such as the antipodal point from a given launch centre). Some regions of space can themselves be seen as a chokepoint, such as GEO, which are fixed and predictable valuable strategic positions.[146] However, adding to this complexity, chokepoints are not the same as what Klein calls 'high-value positions,' and the distinction is best explained in his own words:

> "Whereas choke-points are locations or regions that can be exploited for military advantage, other positions may also hold strategic value without actually being choke-points. These high-value positions are commonly space-based systems performing valuable or unique services… Albeit high-value positions may also represent choke-points for space communications, this is not necessarily always the case."[147]

Systems such as satellite navigation constellations form a high-value position based on the services they provide from medium-Earth orbit (MEO). A high value position can be a large geographic realm, depending on the specific belligerent involved. It is the specific use made of an area by a certain belligerent, and not the general value of the geographic position itself, that gives it its high strategic value. Controlling all of MEO may not be feasible as controlling a definable chokepoint. The Van Allen radiation belts are a high value defensive positions for shielded satellites that can still perform its function within them and if the chances of successfully attacking that satellite are degraded by its

[143] David N. Spires, *Beyond Horizons: A Half Century of Air Force Space Leadership* (Montgomery, A.L.: Air University Press, 1998) p. 248
[144] Klein, *Space Warfare…* p. 80
[145] Ibid., p. 82
[146] Ibid., pp. 82-84
[147] Ibid., p. 84

presence within the belt. If a satellite without proper shielding is forced into these regions or orbit, they are negative value positions. A belligerent may be forced to use positions of 'negative' value if another can exclusively 'hold' chokepoints and high value positions. Negative value areas are where "a relative disadvantage is realized."[148] In other words, it is a bad orbit. For example, the Van Allen radiation belt is a negative value place for unshielded satellites, or a certain orbital path may degrade the performance of a satellite's services although it may be in a secure place away from the enemy's space warfare capabilities. The Van Allen belts are not chokepoints in today's use of orbital space, but they can present advantages or threats as potential positions for various satellites.

Being able to use or deny chokepoints and the use of high value positions ('good' orbits) would severely enhance or degrade a belligerent's celestial lines of communication. If a belligerent has a general and persistent command of space, Klein believes that it can be exercised most fully through 'blocking' and establishing space as a 'barrier'. Blocking refers to the specific practice of "disrupting, degrading, or denying an adversary's ability to use his celestial lines of communication, thus minimizing the movement of spacecraft, equipment, materiel, supplies, personnel, military effects, data, or information."[149] However, blocking does not assume the enemy is totally helpless; disputing a blocking campaign is always a possibility.[150] Celestial lines of communication may move or change their composition, so an analogy of a stationary fleet at sea conducting blockade may not be particularly apt, but the principles of denying an adversary most of the use and access of a medium are similar.[151] Turning space into a barrier is a concept that works both ways for Klein – a blocked opponent sees space as a barrier, as a wall it cannot break (in a significant manner) but behind which the enemy can enjoy great advantages with near-impunity. To the powerful belligerent that has established a general and persistent command of space, using space as a barrier enables it to "take as much or as little space warfare as [it wants]," enabling a conflict to be limited to a particular theatre

[148] Ibid., p. 88
[149] Ibid., p. 92
[150] Ibid., p. 93
[151] Ibid., p. 98

and helping prevent any space-related[152] retaliation from the enemy which may have its effects in the stronger belligerent's core territory.[153]

Gray draws attention to the general naval heritage of terms such as chokepoints and blockading with regard to space, where concentrations of celestial lines of communication or vital transit points may accrue and against which space control and denial efforts may be prioritised.[154] Dolman notes the potential of Hohmann transfer orbits to become akin to the 'strategic narrows' of Earth orbit – where a satellite must pass in its orbital trajectory to reach GEO from lower orbits, if it is to be the most energy efficient in its route to GEO.[155] Furthermore, "Hohmann transfer establishes the equivalent of the lane of commerce for space."[156] Looking at the potential of Newtonian space warfare, Dolman believes that assets deployed at the top of Earth's gravity well, or in stable Lagrange libration points (explained in Chapter 1), will enjoy great defensive advantages (through time and energy) from incoming hostile forces that are still climbing up the gravity well.[157]

Taking inspiration from the policy advocacy side of Mahan, Dolman analogised explicitly in *Astropolitik* that:

> "Since the efficient movement of goods and capital in the nineteenth century was a factor of sea capacity, the nation or nations that controlled the most modern navies and the world's critical chokepoints could dominate the lanes of commerce, and thus the economic lifelines of an increasingly interdependent globe. A modern astrostrategist can and should make similar arguments. In space there are specific orbits and transit routes that because of their advantages in fuel efficiency create natural corridors of movement and commerce."[158]

Although any further discussion by Dolman leads to futurist notions of chokepoints in cislunar (Earth-Moon) and solar space, the idea that there are points of convergence or preferable routes for celestial

[152] Space-related means from, in, and through space.
[153] Klein, *Space Warfare...*, p. 103
[154] See: Gray, *Modern Strategy…* p. 258, footnote 119
[155] Dolman, *Astropolitik…* p. 39
[156] Ibid., p. 73
[157] Dolman, *Astropolitik*… p. 75. Such thinking strikes a chord with Klein on strategic positions in orbit, Klein, *Space Warfare…* p. 157
[158] Dolman, *Astropolitik…* pp. 37-39

lines of communication is useful.[159] Weapons based on Earth that may have fields of view and lines of sight across converging points of communication in space, or the valuable lines of communication of adversaries, are undoubtedly advantageous, but the degree to which that is useful will vary with each particular war.

The strategic analogy of blockade can be taken too far. The root of this problem is that Klein's theories often rest on space-based weapons platforms performing the duties of armed vessels at sea, consequently ignoring the realities of space capabilities today where satellites tend to perform passive support roles and where space weapons systems are based on Earth, not in space. This flawed basis of a seapower analogy to space seriously undermines Klein's attempts at transposing Corbettian concepts of blockade, dispersal, and concentration into space warfare. But 'space blockade' thinking in terms of denying lines of communication at points of convergence or highly valuable celestial lines of communications is still useful. Economic aspects of space warfare are in Proposition V, and the adaptation of the principles of concentration and dispersal to spacepower takes place in Proposition VII.

Spacepower theory must consider the long and short term consequences of a disruption in the use of celestial lines of communication. Exercising or disputing the command of space is valuable in that it can enhance relative combat capabilities on Earth, and therefore the chances of success, of combat operations at sea, land, and the air (Proposition VII). Conversely, losing a preponderant command of space could degrade combat performance if a significant amount of capabilities are dependent on satellite services and if terrestrial militaries do not have easy and timely workarounds. As well as the more tactical and operational concerns of the preservation or loss of satellite services on over-the-horizon targeting munitions,[160] spacepower theory must accommodate more subtle long-term consequences of space warfare. A state may lose vital satellite intelligence capabilities, missile launch detection capabilities, and space situational awareness to track objects in space. These can

[159] Ibid., p. 76
[160] On the maritime warfare aspect of the development of over-the-horizon weaponry, see: Norman Friedman, *Seapower and Space: From the Dawn of the Missile Age to Net-Centric Warfare* (London: Chatham Publishing, 2000)

have a range of short and long term effects. A state which benefits from the taxation of space-related commerce may be targeted with a blockade or *guerre de course* (commerce destroying) strategy to inflict economic costs on the adversary.[161] Depending on the nature of the economy of the target, these could range from small scale economic annoyances to the collapse of a state's financial system over long and short timescales. Wars can be envisioned where the struggle involving space warfare can have both immediate tactical-operational effects, as well as longer term strategic effects in terms of economic costs, much like any terrestrial war. This resonates with the continuation of terrestrial experience into Earth orbit as reviewed above in Proposition II. Proposition V in the next chapter examines the efficacy of astroeconomic warfare (economic space warfare) further.

With the general themes of blockade, and how to enforce one, the roles of concepts such as concentration and dispersal of assets (or 'forces') and effects are necessary to bear in mind here. This is explored in Proposition VII in Chapter 6. On the highest strategic level, seapower, airpower, and spacepower theory is about attempting to drive out the enemy from an entire medium as far as is practically feasible and relevant to the conflict at hand. Mahan argued that:

> "it is not the taking of individual ships or convoys, be they few or many, that strikes down the money power of a nation; it is the possession of that overbearing power on the sea which drives the enemy's flag from it, or allows it to appear only as a fugitive; and which, by controlling the great common, closes the highways by which commerce moves to and from the enemy's shores. This overbearing power can only be exercised by great navies."[162]

An overbearing power on the sea – 'driving the enemy's flag from it' – means preventing the use of sea lines of communication for the enemy, and being able to enjoy it for oneself. Economic and combat efficiency costs can be exacted upon a target by denying celestial lines of communication. But in the face of inexperience spacepower theory cannot say much beyond the fact that denying celestial lines of communication to the enemy can be done through diverse Earth-based weapons systems and

[161] Klein, *Space Warfare*… pp. 49, 91-99, 123
[162] Mahan, *Influence of Sea Power*… p. 138

space-based electronic warfare, in addition to manipulating commercial information flows.[163] Analogising satellites as fleets, or future-gazing to the day of robust and matured space-based weapons platforms, does not help in the pursuit of spacepower theory and strategic education today. This notion of the power of great navies shows the inevitable break in a seapower analogy. Great space navies or orbital battle systems are not needed to drive an enemy's trade from space, or Earth orbit lines of communication at least. But this break is not fatal to the analogies, as the meanings of Proposition I and IV claim.

As satellites and the communications that travel between them and terminals on Earth are part of the global political-economy, it is not unreasonable to think of them as lanes of commerce of a sort. Warning against taking notions of astroeconomic warfare in space too far, Sheldon is insistent on the argument that the economic importance of space commerce in its current state cannot be compared to Corbettian and Mahanian notions of sea commerce in their theories.[164] It is true that fundamental energy and foodstuffs would still be transported across the sea if relevant celestial lines of communication for their support were threatened, albeit at reduced efficiency. Yet it is possible to see conceptual similarities between space commerce and maritime commerce in terms of their strategic utility – it is the particular consequences of a breakdown in the use of the respective lines of communication that vary between maritime economic warfare and astroeconomic warfare. Targets in space and at sea can be directly militarily relevant (e.g. military communications satellites or warships), or they may not be built for battle but carry out economic functions (e.g. commercial satellite networks and merchant fleets). Henry Hertzfeld argues that 'space commerce' is inherently strategically valuable when commenting that:

> "government policy and security aspects of space do not treat commercial space as they treat automobiles, soap, or furniture. Because of the strategic value of space as well as the huge

[163] Proposition V in Chapter 5 examines this further.
[164] Sheldon, *Reasoning…* p. 195

> dependence of almost every industry on the space infrastructure, space commands special importance and has become a critical national resource."[165]

Celestial lines of communication, then, do differ from sea lines of communication in terms of their economic functions and composition, but the degree of that importance to the biggest economies in that commercial system is debatable. The consequences of disruptions to lines of communication are difficult to predict, where no hard materiel travels through them, but the information they carry is often of very high importance. Furthermore, in applying any such understanding of celestial lines of communication, great detailed knowledge is needed in order to inform the pursuit of the political object of any war. As the political intensity or desire of a war's object changes, so does the tolerance of loss or pain from losing lines of communication, economic wealth, and space infrastructure.

Outer space is a place where information vital for international trade travels. According to the U.S. Department of Defense (DoD), there are approximately 60 states and government consortia owning or operating satellites, in addition to commercial operators.[166] Physically, politically, and economically, celestial lines of communication and the consequences of actions in Earth orbit may be shared among belligerents and third parties; the consequences of extensive space warfare may be felt across the political-economy of Earth. However, it is important not to assign space commerce the same degree of importance as sea-based trade. Sheldon criticises seapower analogies to outer space because too many spacepower theories possess "an implicit assumption that space power is able to exercise the same leverage as sea power. All of these assumptions are far from definitive, and often ignore crucial differences between sea and space power."[167] True, a particular reading of Mahanian and Corbettian theories about sea commerce can be taken too far, such as Trevor Brown's view that the aggregate effects of spacepower, including economic effects, may be 'incalculable.'[168] But they

[165] Henry Hertzfeld, 'Commercial space and Spacepower', in Charles D. Lutes and Peter L. Hays, with Vincent A. Mazo, Lisa M. Yambrick, and M. Elaine Bunn, ed., *Toward a Theory of Spacepower: Selected Essays* (Washington, D.C.: National Defense University Press, 2011)
[166] U.S. Department of Defense (DoD), 'National Space Security Policy: Unclassified Summary', January 2011, Washington, D.C., p. 2
[167] Sheldon, *Reasoning*... p. 146
[168] Brown, 'Space and the sea…' p. 239

are not wholly without merit or useful insight, contrary to Sheldon's view.[169] Furthermore Corbettian and Mahanian theories are not the entirety of seapower thinking on commerce. Other maritime theorists from a continental school retain the value of seapower as an analogical source for spacepower theory, as Proposition V in the next chapter shows.

## Summary of Propositions I-IV

This chapter has explained four of the seven propositions of spacepower theory, and this section serves as a brief pause for a re-convening of the fundamentals before progressing into the final three propositions, which focus more on seapower theory that are not from Mahanian or Corbettian sources. Though these two giants of seapower theory are not ignored in Propositions V, VI, and VII, they do, however, take a back seat relative to their prevalence in Propositions I, II, III, and IV. This chapter, and the four propositions, condensed existing spacepower theory, and melded it with useful insights from seapower theory to help illustrate the propositions and develop further insights that other spacepower theorists may have missed. In addition, Mahan has been re-validated as a useful source of theoretical insight for space after some mistaken readings of his work. Also, Mahan's views on decisive battle and economic warfare have been brought into line with Corbett's.

Proposition I asserted that the command of space is what space warfare is waged for; to control the use of space and/or to deny it to others. Warfare between powers, at least one of which depends greatly upon space, will need to consider the varying degrees of the command of space that different belligerents possess. Such assessments roll into Proposition II, which means that although space is a unique geography and should be treated as such, it is not a panacea from concerns on Earth and human socio-political baggage. Such interactions weigh on considerations as to the perceived value of the command of space in any contingency, and specialised individuals are needed to exploit the unique advantages spacepower offers. Proposition III then claimed that even if a dominant command of space, or preponderance, was achieved, it did not guarantee preponderance on Earth. Even small spacepowers can achieve significant results with the intelligent application of counterspace operations and combined arms. As a medium, space is not decisive by itself and needs

[169] Sheldon, *Reasoning…* p. 206

combined arms and other instruments of power to complement it. Spacepower is a team player. Furthermore, 'decisive battle' in space, even if possible, does not make spacepower a unique war-winning tool of power. Proposition IV substantiated the vision of how space warfare may look like to a strategist, and stressed that the command of space is ultimately about the use or denial of celestial lines of communication. Ideas of blockade, concentration, and dispersal were discussed and uncertainty on these topics was presented because of the myriad options for harassing celestial lines of communication from home territory that present themselves, combined with a lack of experience in space warfare. The extent to which ideas of blockade can be realised in ignorance of the challenges posed by terrestrial counterspace forces and combined arms (Proposition III) as well as terrestrial alternatives (Proposition II) serves as a reminder that analogies break at some point.

The next chapter brings the work of Raoul Castex to the foreground, a French strategist compelled to think of seapower from a continental perspective. Yet this is only half the difference with the historical bases of Mahanian and Corbettian theories of seapower. Although much of Mahan's *Influence* series was focused on French experiences as a continental sea power, much of the maritime struggles involved colonial warfare. The narratives were of clashes between Britain and France over possessions separated by great expanses of water, of distant regions far from home connected only by the sea. The seapower thinking used in the next chapter not only comes from continental thought, but of strategic thinking about *seapower when there are no distant regions* of note. Seapower still has to be relevant in wars where two neighbouring powers with coastlines are struggling with each other. This sort of thinking opens up interesting possibilities in analogising continental seapower to spacepower; Earth orbit as a shared coastline increases the value of seapower as an analogical source for strategic education about outer space. This is the third major analogy of the thesis.

# Chapter 5: War Around the Cradle: Proposition V

## Introduction

"This planet is the cradle of human mind, but one cannot spend all one's life in a cradle… Humanity… in its desire to have more light and space it will first penetrate beyond the atmosphere and then will conquer all the immense space within the Solar System." - Konstantin Tsiolkovsky[1]

The last chapter elaborated the second major analogy of the thesis – that space, like the sea and air, is a place that cannot be held and a medium through which power is exercised via lines of communication. This chapter, and therefore Proposition V, is based on a third major analogy. It envisions Earth orbit more like a coastline. It is an environment that surrounds Earth, the cradle of humanity. It is one thing to declare that the command of space is important, and is made up of celestial lines of communication. But it is another thing to theorise how it is important and what its consequences may be for warfare on Earth, which is where the next three propositions (over two chapters) takes spacepower theory. In this chapter, Proposition V – that Earth orbit is a celestial cosmic coastline suited for strategic manoeuvre – details the relatively subtle contributions of spacepower to terrestrial warfare. In the next chapter, Proposition VI examines human culture in spacepower as well as theorises the influence of spacepower on strategic and military cultures; after which Proposition VII looks at the dispersing conditions and consequences of spacepower. Being able to command space and manipulate celestial lines of communication (Propositions I and IV) may allow strategic manoeuvres to be carried out (Proposition V). Successful strategic manoeuvres should eventually, if not directly, influence warfare on Earth through imposing dispersion on terrestrial forces (Proposition VII). 'Strategic manoeuvre' is the thread that ties the components of Proposition V together and connects them to the rest of spacepower theory's propositions. Proposition V is based on an analogy that Earth orbit is a coastline and an adjacent geographic medium of warfare, much like the sea is in a war involving neighbouring continental powers. Earth orbit is, in effect, a coastal region

[1] Konstantin Tsiolkovsky, in: A. Kosmodemyansky, *Konstantin Tsiolkovsky: His Life and Work*, X. Danko, trans. (Hawai'i, H.I.: University Press of the Pacific, 2000) p. 95

above the Earth's land, sea, and air. Space envelops it all, meaning that Earth orbit is a potential flank on all three terrestrial environments.

After a review of continental seapower theory (section 5.2), Raoul Castex's concept of strategic manoeuvre is used to bind together the five parts of Proposition V and theorise how spacepower can be used in the adjacent realm of Earth orbit for terrestrial warfare. These five parts of Proposition V are:

1. First, Earth orbit being made a hostile coast.
2. Second, as alluded to in Proposition IV, economic warfare and commerce raiding in spacepower are related to the context of war as a whole.
3. Third, neutral and third parties are explored in the context of space warfare.
4. Fourth, space logistics is examined as the 'arbiter of opportunity' for action in space and on Earth.
5. Fifth, strategic depth explains the "noiseless, steady, exhausting pressure [of spacepower,] cutting off the resources of the enemy while maintaining its own, supporting war in scenes where it does not appear itself, or appears only in the background, and striking open blows at rare intervals."[2]

Mahan's words aptly describe crucial yet under-theorised aspects of spacepower, with only "sea power" being changed for "spacepower." Proposition V paves the way for other under-examined themes in Proposition VI (strategic culture and space) and Proposition VII (spacepower's dispersed condition and effects). Therefore, it is useful to see propositions I-IV to a degree more as a synthesis of existing spacepower theory which analogises from bluewater seapower theory, and propositions V-VII as new contributions to spacepower theory.

The other propositions rest more on existing literature that speaks directly to spacepower; Proposition V, by contrast, is where most original spacepower theorising takes place. Explanations of the arguments in Proposition V cannot take advantage of the succinct prose of other spacepower

[2] Alfred Thayer Mahan, *The Influence of Sea Power Upon History* (Boston: Little, Brown, 1890) p. 209

theorists. No reader should gain the impression that this is the core or the essence of spacepower theory, but it is the core of original theorising within the theory. This Proposition is important, but it cannot stand on its own. Understanding Proposition V, and how it relates to the rest of spacepower theory, requires the explanation of continental seapower theory as a source analogy to spacepower.

## 5.1 A continental seapower analogy: Commanding space from Earth

> "The service between the bases and the mobile force between the ports and fleets is mutual. In this respect the navy is essentially a light corps; it keeps open the communications between its own ports, it obstructs those of the enemy; but it sweeps the sea for the service of the land, it controls the desert that man may live and thrive on the habitable globe." – Alfred Thayer Mahan[3]

The chapter begins with a preamble to Proposition V which establishes an analogy of Earth orbit as a coastline. The preamble is necessary because the proposition's main body is broken down into five substantive parts that follow on from a basic analogy that Earth orbit is like a coastline where strategic manoeuvres take place. This preamble examines common themes among some continental seapower theorists and reviews what little engagement there has been between spacepower theorists and continental seapower thinking. Key insights are missed when describing spacepower from solely bluewater seapower analogies. A major difference occurs when comparing bluewater seapower theory to continental seapower theory. In continental maritime wars, sea lines of communication are not the only route to reach an objective and sometimes there are no 'distant regions', for example with island powers and maritime empires. Spacepower is a geographic form of power that exists alongside others, and benefits from continental seapower theory because it theorises power in one medium alongside other environments. Proposition V takes Proposition III to a new level which argued that spacepower is neither impotent nor determinant in terrestrial warfare. Strategic manoeuvre helps one to visualise the myriad forms of the indirect (and possibly direct) influence spacepower has on Earth much in the same way seapower influenced continental wars. Spacepower theory has much to gain from grasping with concepts derived from continental seapower experiences because it more closely resembles what little spacepower experiences there are. Contrary to 'bluewater' seapower thinking that focuses on

[3] Mahan, *Influence of Sea Power…* p. 329

large fleets and battles at sea, continental seapower thinking resembles aspects of spacepower that do not involve battle or destruction in orbit. Continental seapower theory highlights the more subtle, and sometimes just as significant, aspects of spacepower (e.g. logistics) that can be brought to bear during a war.

Two key observations from strategic analogising from continental seapower theory to spacepower are: (a) there are not necessarily 'distant regions' involved in space warfare around Earth; and (b) that space is viewed as one medium of many to exert power through. These two themes recur throughout this chapter. Because of the lack of distant regions and the proximity – or adjacency – of other geographies, the possibilities of commanding space *from Earth* to support terrestrial warfare and war aims on Earth is the epitome of a strategic analogy from continental seapower theory to spacepower theory. This is opposed to bluewater thinking which may lead to an analogy of satellites as battleships (as mentioned in Proposition I Part 3), and therefore of commanding space from orbit, like fleets can command the sea from the sea. Weapons platforms in Earth orbit may be more analogous to coastal attack craft rather than battleships at sea, which may correspond to weapons platforms in interplanetary space. As an analogical source, a continental seapower school is represented by Raoul Castex (a French admiral in the first half of the 20th century), Charles Callwell (a late-19th century British Army officer), Sergei Gorshkov (a Cold War era Soviet admiral), and Raja Menon (a retired Indian Navy Rear Admiral).[4] Alfred Thayer Mahan, known for his bluewater thinking, was by no means limited to thinking on the seapower of maritime empires with distant colonies, exhibited by his study (and experience) of the Mississippi campaign in the U.S. civil war (1861-65), the continental Spanish War of Succession (1701-1714), and the Dutch Wars (throughout 17th and 18th centuries). Benjamin Armstrong is prudent to observe that "because many students are taught that battleships and colonies make up the heart of Mahan's writing, he is frequently discounted

[4] Texts used from the 'continental school': Raja Menon, *Maritime Strategy and Continental Wars* (London: Frank Cass, 1998); Sergei G. Gorshkov, *The Sea Power of the State* (Oxford: Pergamon Press, 1979); Charles E. Callwell, *Military Operations and Maritime Preponderance: Their Relation and Interdependence* (London: William Black & Sons, 1905); Raoul Castex, *Strategic Theories*, Eugenia C. Kiesling, trans., ed. (Annapolis, MD: Naval Institute Press, 1994).

as being of little consequence to discussions of today's challenges."[5] Proposition III has already argued that there is more to Mahan than the offensive actions of the battle fleet and the pursuit of decisive battle. Mahan and the continental school's influence continues in Proposition VI by thinking of strategic cultures where the 'space force' is not viewed as the primary service – analogous to a continental navy struggling to find its place in a continental power.

What if there are no distant regions between coastal continental sea powers? What if the bulk of resources committed, humans killed, and decisions made are in relation to land fronts and campaigns? Bluewater seapower thinking does not highlight these problems. Using continental seapower analogies allows one to consider such conditions as these for spacepower theory: 'space powers' fighting each other on Earth are like continental sea powers fighting each other on the same continent. Modern 'space powers,' then, are actually 'Earth powers' that use spacepower like continental land powers that possess seapower (e.g. Carthage, Rome, France, India). A 'true' space power may be a space-based power that lives on the resources of the solar system, as opposed to that of Earth's – this would correlate with the seapower of an island or sea-dependent polity (e.g. Athens, Britain, or the Netherlands). If some human political-economies truly become dependent on space-based resources and habitation beyond Earth, they may claim more credibility as a 'space power'. This means that preparing for war in the Space Age is also about harnessing resources and advantages on Earth and not necessarily limited to, or having to include, building a large space-based infrastructure. Powers interested in 'space denial' more than 'space control' in their campaign for the command of space (Proposition I) will find this interpretation of spacepower more appropriate for their needs. This resonates with continental powers that may be content to invest in coastal defences and a minimal at-sea presence to secure their maritime flanks. One can ask the following questions of spacepower by analogising from continental seapower: what if spacepowers are neighbours on Earth? What if space infrastructure is in reach of space denial weapons on the other side of the globe because many powers are on a shared 'cosmic coastline'? How should spacepower be strategised when major events and violence happens on Earth, and not in space? So what if Earth orbit is a flank?

[5] Benjamin F. Armstrong, 'Introduction,' in: Benjamin F. Armstrong, ed., *21st Century Mahan: Sound Military Conclusions for the Modern Era* (Annapolis, MD: Naval Institute Press, 2013) p. 9

Clausewitz warned that any discussion of flanking must not lose sight of its cardinal principle – that flanking is not an advantage in itself. The Prussian argued that "in itself, [flanking] is as yet nothing; but it will become something in connection with other things, and something either advantageous or disadvantageous, according to the nature of these other things."[6] Clausewitz argued that "action against the lines of communication is directed against… all the means which the enemy requires to keep his army in a vigorous and healthy condition."[7] This description is very apt when considering actions to attack celestial lines of communication that support the proper function of modern militaries. What this means is that, in line with all principles elucidated in this theory, the decision to conduct strategic flanking operations or attack them is a decision that must reflect particular conditions and is not indicative of any inherent advantages or disadvantages in strategic flanking.

Crucially for spacepower theory, the sea may be commanded from the land and into the maritime flank. Seapower thinking under these conditions can yield concepts that are useful for spacepower theory, if we conceptualise Earth orbit and the Earth's surfaces and atmosphere as parts of a coastal region. Weapons can be based on Earth that target satellites in orbit – these are analogous to coastal weapons. The command of space may be fought *from* the Earth, and not necessarily with space-*based* forces or assets, just as some continental powers sought to secure degrees of the command of the sea in part from the land if they gave up on operations on the high seas.

Like all analogies, this is an imperfect one. The value of space observation is of a different quality and magnitude compared to sea-based landward observation, but the conceptual value of space-based assets for long-distance communications can be seen in a similar way to ships in the times of the imperial European Age of Sail. Denying celestial lines of communication during a battle may have more tactical influence than denying sea lines of communication for land battles. Trevor Brown's argument on the significant influence of spacepower on tactics, operations, and strategy still has merit even though claims on its inherent quality of 'decisiveness' were critiqued in Proposition

[6] Clausewitz, (Jolles) *On War*… pp. 752-753
[7] Ibid., p. 753

III.[8] Indeed, tactical and operational combat capability could be acutely diminished if a space-dependent terrestrial force lost its access to celestial lines of communication. Although this is a significant difference in terms of the degree between seapower support to land forces and spacepower support to terrestrial forces, it is not a complete break from the abstract concepts in seapower theory. Mutual support between the land and the sea can still advance thinking about the mutual supports between terrestrial forces and space systems.

Peering into the indeterminate future, moving troops and heavy materials to various points on Earth through 'spacelift' is beyond what is practical today. An example is the U.S. Marine Corps Small Unit Space Transport and Insertion concept which aims to deploy a 13-person squad anywhere on Earth within two hours.[9] The coastal analogy can resonate in a possible future for terrestrial wars where significant numbers of troops and materiel may be transported via celestial lines of communication. Dropping troops from orbit could loosely correspond to coastal raids and amphibious assaults, though without an ability for raiding parties to exit the theatre of operations in the same way they arrived. Orbital bombardment from space-based weapons could be like coastal shelling and gunboat diplomacy but with a much greater internal reach of its target, encroaching on the classic debates of airpower's 'strategic bombing' and close air support.[10]

As these space-to-Earth capabilities remain in the realm of science fiction,[11] they will not be dealt with in much more detail here. It is not unreasonable, however, to imagine the paralysing effect of the threat of amphibious assaults from sea as being resonant with the threat of orbital troop drops

[8] Trevor Brown, 'Space and the Sea: Strategic Considerations for the Commons', *Astropolitics* (10:3, 2012) p. 239

[9] On exploratory concepts of suborbital military logistics and passenger services, see: Taylor Dinerman, 'Point-to-point suborbital spaceflight and military logistics', *The Space Review*, 14/04/2008, http://www.thespacereview.com/article/1103/1 (accessed 02/09/2015); David Hoerr, 'Point-to-point suborbital transportation: sounds good on paper, but…', *The Space Review*, 05/05/2008, http://www.thespacereview.com/article/1103/1 (accessed 02/09/2015)

[10] For a concise summary of the promises and failures of airpower and strategic bombing as an independent war winner, see: Colin S. Gray, *Airpower for Strategic Effect* (Montgomery, AL: Air University Press, 2012) pp. 182-185; see also the general debate on airpower's strategic efficacy in: Robert A. Pape, *Bombing to Win: Air Power and Coercion in War* (London: Cornell University Press, 1996); Frederick W. Kagan, *Finding the Target: The Transformation of American Military Policy* (London: Encounter Books, 2006). For an imagining of close space support in terrestrial warfare, see the Jayhawk War, in: Larry Niven and Jerry Pournelle, *Footfall* (London: Sphere Books, 1985) pp.276-289

[11] Such as the Orbital Drop Shock Troopers (ODST) and space-to-surface strike capabilities of spaceships of the United Nations Space Command of the *Halo* computer game saga. Indeed, 'space marines' is a heavily recurring maritime concept in numerous science fiction tropes.

that could strike in many places. Henry Lloyd, a mercenary and "enigmatic Welshman"[12] in the mid-18th century, noted this phenomenon too when he wrote that "a fleet having on board twelve or fifteen thousand marines, is equal to almost any enterprize against the enemy's settlements, and keeps them in continual anxiety in every part of the world."[13] Allowing for the future adaptability of spacepower theory sharpens our view of today's character of spacepower. Hostile Earth-to-space activities against space systems, also known as 'counterspace' operations or weapons, are very much science fact, however. Terrestrially-based equipment, from electronic warfare weapons to dazzling lasers and kinetic-kill antisatellite weapons, have already created an analogical resonance to coastal defence and other anti-ship measures as noted in Chapter 2. Further, such terrestrial space weapons may only be able to hit specific satellites at specific orbits, altitudes, and inclinations, bringing to light the value of recognising the diverse nature of critical infrastructure in orbit as detailed in Chapter 1.

Thinking of Earth orbit as a coast, or a littoral environment, has not gone unchallenged in spacepower theory. John Sheldon criticised the use of an analogy of Earth orbit (or more specifically, LEO) to a coastline. Sheldon argued that Everett Dolman and John G. Fox were wrong to be open to such analogies because:

> "near-Earth space is not bounded by landmasses like terrestrial littorals and issues such as shallowness or deepness are meaningless in space. Indeed, it is the Earth that is bounded by space, not space bounded by Earth. Space is also unified as a physical entity; there are no isolated pockets of space… Thus the analogy is an imperfect fit."[14]

Criticisms of an imperfect analogical fit, in terms of geography, are accurate but insubstantial, as Sheldon himself says that the "existence of mismatches… does not necessarily invalidate the analogy."[15] Sheldon usefully lists the detailed *geographic* differences between a coastal environment and space, but Chapter 3 established that it is the concepts that matter most for a strategic analogy.

[12] Patrick J. Speelman, 'Editor's Preface', in: Patrick J. Speelman, ed., *War, Society and Enlightenment: The Works of General Lloyd* (Lieden: Koninklijke Brill NV, 2005) p. xiii
[13] Henry Lloyd, *A Rhapsody on the Present System of French Politics; On the Projected Invasion, and the Means to Defeat It* (1779) in: Patrick J. Speelman, ed. *War, Society and Enlightenment: The Works of General Lloyd* (Lieden: Koninklijke Brill NV, 2005) p. 340
[14] Sheldon, *Reasoning…* pp. 123-124
[15] Ibid., p. 21, Footnote 25.

These analogies arise from the resonance of using a geographic medium to command lines of communication in it. All geographic media are diverse, but the air, sea, and space are all strategically analogical at a highly abstract level through the contest over lines of communication and an inability to claim and hold solid territory (as stated in Proposition II). The fact that outer space surrounds Earth and whether the land bounds the sea or the sea bounds the land is a semantic point in this context. It does not change the fact that warfare only has significance for where and how humans live, as argued in Proposition III, and the sea, like space, is an additional medium that can transport strategic effects.

The "shallowness and deepness" of coastal regions are of little *conceptual* concern for spacepower theory. It is the coast's adjacency to another medium that is useful. What matters is that continental seapower, as a flanking tool relative to a land war, has to act with and against the influences of land-based power. Analogically, spacepower today must operate as a flank relative to 'Earth powers' that can develop systems that hold celestial lines of communications at risk. This analogy means that, if Earth orbit is viewed as a celestial coastline and belligerents can develop 'coastal space defences' for a power that is less dependent on celestial lines of communication, first-rate space systems, infrastructure, or constellations of satellites are not necessary to command space to a 'good enough' degree. Continental seapowers could achieve various degrees of the command of the sea without resorting to large bluewater battle fleets – they could instead use their land power to complement their attempts to secure a degree of the command of the sea for their more immediate landward concerns.

Therefore, the command of space can be fought for, from, and on Earth. It will be done, for the foreseeable future, by Earth-based 'space powers' (or Earth powers) after all. Earth-based weapons systems, especially those which employ directed energy or particle beams, do not suffer the same geographic and economic constraints as launch sites. Some satellites will be in the line of sight of many countries (for example those in geosynchronous orbit (GEO) and medium-Earth orbit (MEO)). LEO satellites will fly over many states in the course of their orbits compared to higher orbiting satellites. Spacepower, as it manifests itself today, is characterised by this adjacency to other, perhaps more strategically pressing, theatres. Continental seapower theory can shed some light on

concepts that explain the permanent aspects, the *nature*, of spacepower that complements extant theorising because it is characterised by an adjacency to other theatres. This adjacency and a mutual interaction between environments is much more detailed and profound for spacepower theory than Corbett's view of the interaction of land and sea power which was conditioned by the experiences of an island power that *had* to use the sea for every strategically meaningful action, unlike continental powers.

One theorist has analogised Earth orbit as a littoral, if only briefly. Everett Dolman notes the analogical value of thinking about space as a littoral region.[16] He argues that the "Earth and its atmosphere are the conceptual equivalents of a coastal area for outer space;" and that space begins at the Karmann line of 100km altitude – the lowest point at which satellites can orbit without continuous propulsion.[17] However, Dolman's analogy here does not go far enough, which is unfortunate given his understanding of the 1976 Bogota Declaration which comes closer to the analogical mark pursued in this spacepower theory. This declaration attempted to justify claims by equatorial states of their sovereignty in the transverse region and space directly above their territories and airspaces upwards to infinity, attempting to claim jurisdiction of orbital slots in GEO that was directly above their territories. According to Dolman "the Bogota Declaration is justified by the declaring states on the claim that the atmosphere is aptly described as the *coastal region* of outer space."[18] Legal debates aside, the conceptual promise of this analogy remained unexplored in terms of strategic theorising about space. Proposition V is an exploration of how spacepower depends on Earth-based power. Callwell's words strike a chord here when he argued that:

> "writers on naval subjects sometimes hardly seem to realise the extent to which fleets are obliged to lean upon land forces, and how subservient during the actual progress of a campaign the conditions of sea-power must under certain conditions be to operations on shore. If this feature

[16] Dolman, *Astropolitik…* p. 33
[17] Ibid., pp. 69-70
[18] Dolman, *Astropolitik…* p. 135. Emphasis Dolman's.

> of war be not taken into account, false strategical theories may be arrived at, and a dangerous naval policy may be adopted at a critical time."[19]

Analogically, a spacepower theory – and any derived space strategy – that ignores the dependence of the command of space on operations on Earth may promote unwise space strategies. Proposition V stresses this point through a strategic analogy to continental seapower thinking by treating Earth orbit as a celestial coastal region.

The coastal area for outer space, for the purposes of spacepower theory, includes what Dolman calls Terran (or Earth) space, which extends from 100km to around 36,000km altitude, just beyond the GEO belt, and 40,000km to include the apogees of the highly eccentric Molniya orbits. Beyond the GEO belt, going into cislunar (between Earth and the Moon) or interplanetary space, space may become more akin to the high seas where spacecraft may enjoy relative safety and obscurity away from the Earth, unlike spacecraft on Earth's 'space coast' between 100km and 36,000-40,000km altitude. Just as a coastal region includes the land near the sea and the sea near the land, a 'space coast' must include Earth, which is near space, and the parts of space which are near Earth. Of course, definitions of what counts as a coastal area will vary under material conditions, particularly on the ranges of weaponry based in either media of the coastal environment. James Oberg is correct to argue, in no uncertain terms, that "space is NEARBY. Just a hundred kilometres above us… Space is as close as your pager, your mobile telephone, your GPS navigator, and your television remote."[20] Extending the 'space coast' from the Earth's surface to approximately 40,000km altitude is ample to encapsulate the interactions between the Earth-based and space-based segments of most space systems today. Again, adjacency is the key. There are geographically-bound forms of power (air, land, sea) that can influence spacepower capabilities in Earth orbit – therefore it is akin to a coastline and serves as a juncture for continental seapower theory to be brought in under the capstone of 'strategic manoeuvre.' Strategic manoeuvre summarises the role of seapower's contributions to continental powers and land-based wars. It is analogically useful, then, to summarise spacepower that is used by 'Earth powers' in terrestrial wars. Strategic manoeuvre ties together the five sub-components of

[19] Callwell, *Military Operations…* pp. 146-147
[20] James Oberg, *Space Power Theory* (Montgomery, A.L.: USAF Academy, 1999) p. 4

Proposition V: the hostile coast, economic warfare, neutrals and third parties, logistics, and strategic depth. Attention can now turn to strategic manoeuvre as the thread that unites the five constituents of Proposition V.

## 5.2 Proposition V: Earth Orbit is a cosmic coastline suited for strategic manoeuvre

"The question [of conducting strategic manoeuvres] is simply a bit more complicated in our day, given the new weapons… Historical examples, however, remain valid. Independent of physical means, the idea of *manoeuvre* persists, reincarnated under successive and changing material conditions by a kind of metempsychosis." – Raoul Castex[21]

Castex faced similar problems raised in Chapter 3 regarding the use of history in strategic analogies, and the quest to make universal theory useful to practitioners dealing with unique and uncertain conditions. This makes his work ripe for strategic analogising. Strategic manoeuvre means moving one's forces, resources, or capabilities to various areas that are more profitable for overall strategic results, usually by resorting to gaining some measure of success in secondary theatres that can be translated into support at the main theatre of war. Raoul Castex's strategic manoeuvre is used here as the conceptual thread running through Proposition V, so that the individual parts of the proposition speak to the analogy of Earth orbit as a coastline and many aspects of spacepower resembling that of continental seapower. Spacepower takes place in an additional, but not absolutely necessary or primary, medium for the exertion of influence and power; where there are no 'distant regions' accessible only by celestial lines of communication. Spacepower theory must illustrate space as a theatre and medium that provides a useful adjunct to overall capabilities, and not as the only medium between belligerents when humanity is actually stranded on a single planet. Castex developed concepts that explicitly dealt with secondary theatres and the absence of 'distant regions' in seapower and also serves to tie in the other seapower theorists when they too thought along these lines.

[21] Castex, *Strategic…* pp. 118-119. Emphasis Castex's.

Castex put forward that: "strategic *manoeuvre* is a key element in the conduct of operations. It is a *method* used by strategy to improve the conditions of the struggle, to multiply the return on her efforts, and to obtain the greatest results, whether in the duel between principal forces themselves or to the benefit of particularly important nonmaritime requirements."[22] The sea can provide an excellent opportunity for strategic manoeuvre for two land powers with shared coastlines through coastal flanking and changing the disposition of forces. Castex's concept of strategic manoeuvre discusses the basics of being flexible, creative, and cunning in order to: (a) disperse your own forces where possible; (b) concentrate them against the enemy's 'vital points' (not necessarily meaning enemy forces) and; (c) to delineate priorities between primary and secondary theatres and distribute forces accordingly. The perceived necessity or opportunity of flanking via the sea assumes that a major land front has stabilised somewhat or does not need the totality of a power's resources, comparable to the trenches of the western front in the First World War.[23] An economy of force necessitates choosing to weaken some positions to strengthen others, and a (good) manoeuvre from belligerent A may cause belligerent B to unwisely disperse its forces in some areas to provide advantages in crucial areas to belligerent A.[24] Or, to put it in the terms of British military culture, "even if you make the wrong move, you are likely to force the hand of your opponent, who, being forced to act, is likely to make an even worse blunder that you can exploit."[25] However, there are always risks in strategic manoeuvring. Exposing a new vulnerability to an alert foe becomes a greater risk of the manoeuvre is more pronounced and entails more resources to the detriment of other fronts, theatres, or objectives.[26]

Strategic manoeuvre and Proposition V capture the unsensational but no less essential aspects of contemporary space activities, and places it as a much-needed complement to the bluewater-driven spacepower theory in propositions I-IV. The popular vision of bluewater maritime strategy as focused upon great sea battles or the actions of battleships and fleets seeking or avoiding battle distracts

[22] Castex, *Strategic*… p. 101. Emphasis Castex's. For Castex's discussion of the concept, see also: Ibid., pp. 101-126.
[23] Clausewitz stressed the necessity of stable fronts for strategic flanking to be a reasonable possibility. See: Carl von Clausewitz, *On War*, O.J. Matthis Jolles, trans. (Random House, 1943) in: Caleb Carr, ed., *The Book of War* (New York, N.Y.: The Modern Library, 2000) p. 754
[24] Castex discusses this at length. See: Castex, *Strategic*… p. 105-121
[25] Frank Ledwidge, *Losing Small Wars: British Military Failure in Iraq and Afghanistan* (London: Yale University Press, 2011) p. 144
[26] Clausewitz, (Jolles) *On War*… p. 760

attention from the mundane but crucial aspects of logistics and economics at sea. Likewise, focusing spacepower on battles in outer space through space-based or Earth-based weaponry would distract attention from the often unseen and unappreciated role of space systems as economic, logistical, and infrastructural nodes. Strategic manoeuvre is a way to bring these more subtle aspects of spacepower into line with the established concepts of the use of force in wars where spacepower is used. The component parts of 'strategic manoeuvre' for spacepower theory are the themes of hostile coasts, economic warfare, neutral and third parties, logistics, and strategic depth. These are not how Castex explored his concept of strategic manoeuvre – it is a reorganisation of the concept based upon the resonant themes within it for spacepower theory. This should serve as a reminder that this is not an uncritical exercise in strategic analogising from seapower theory.

### 5.2.1 Proposition V Part 1: Hostile coasts

Part 1 of Proposition V explores the violent aspects of hostile coasts and land-based seapower transposed to the celestial coastline of Earth orbit. If Earth orbit is a coastline, it can be a hostile and defensible one from Earth's surface. It is useful to begin thinking of hostile coasts in space by qualifying John Klein's ideas on turning outer space into a barrier, or imposing a space blockade, between belligerents from Proposition IV. John Klein transposed his interpretation of Corbettian seapower theory to outer space and produced the idea that space could be treated as a barrier between home territories and theatres of war. Such a view fails to anticipate space warfare conditions that are analogous to coastal warfare and continental maritime wars. To the powerful belligerent that has established a general and persistent command of space, using space as a barrier enables it to "take as much or as little space warfare as [it wills]," enabling a conflict to be limited to a particular theatre and helping prevent any retaliation in, to and from space which may have effects in the blockader's core territory.[27] Gray and Sheldon praise Klein for this 'barrier' concept, or allowing for the isolation of an enemy's reach from one's own core territories and interests, but that is based upon a British-

[27] Klein, *Space Warfare...*, p. 103

American notion of vast oceans and dominant battle-fleets separating belligerents' core territories.[28] This concept of a barrier falls short of being universally relevant because it does not account for the adjacency of Earth orbit, the diversity of space powers, and how viewing Earth orbit as a shared (and occasionally hostile) coast puts 'domestic' space infrastructure at risk from weapons on the other side of the globe. Establishing a barrier in space may be a peripheral option for adjacent warring parties on Earth, such as India and Pakistan. Even should India close off celestial lines of communication to Pakistan, turning orbital space into a 'barrier,' the shared land, air, and sea frontiers does not allow India to take 'as little or as much from the war as it wills.' Pakistan can still resort to other geographies for resistance and retaliation, of which spacepower is a potentially useful adjacent flank to a war on Earth. Though space *may* be turned into a barrier on some occasions between some belligerents that are distant from each other on Earth – as Klein usefully conceives - it is misleading to think of it as a universally relevant option. It overlooks the possibilities of 'coastal fire' from the Earth towards space systems, how hostile actions in the 'space coast' may not be easily contained, and how celestial lines of communication are not the only lines of communication in a war.

Continental maritime warfare often assumes the need to operate with or against the advantages enjoyed by a coastal defender. Castex believed that coastal operations should only be seriously considered once the enemy fleet or its serious naval combat capability has been destroyed or contained at port.[29] The advantages yielded to the defender in coastal warfare – such as the ability to harness internal landward communications for resupply, repair, maximum resource availability, and embedded, prepared, and specialised firing equipment and positions – could make a coastal theatre very inhospitable to the coastal attacker.[30] Some diverse examples of coastal defence are useful to illustrate coastal warfare before making the strategic analogy to space.

Today, accurate stand-off munitions and internal lines of communication, exemplified by China's sea-denial capabilities, illustrate the opportunities to specialise land and air-based weapons to

[28] Colin S. Gray, and John B. Sheldon, 'Theory Ascendant? Spacepower and the Challenge of Strategic Theory', in Charles D. Lutes and Peter L. Hays (ed.) *Toward a Theory of Spacepower: Selected Essays* (Washington, D.C.: National Defense University, 2011)
[29] Castex, *Strategic Theories…* p. 72
[30] Ibid., pp. 345-346. Menon, Gorshkov, and Callwell substantiate historical cases and thinking about this, see: Menon, *Maritime Strategy…* p. 85; Gorshkov, *The Sea Power…* p. 242; Callwell, *Military Operations…* p. 164

target naval forces.[31] In the early 1950s, United Nations (UN) forces in the Korean War may have averted a worse fate than stalemate due to almost-unchallenged naval superiority in the Yellow Sea and the lack of embedded coastal defences on the Korean peninsula. Sergei Gorshkov noted that Allied amphibious and coastal operations were successful in no small part due to the lack of opposing fire from North Korean forces ashore. He stated that the "use of ship armament against the shore" and amphibious operations were "possible only because of specific, almost perfect ground conditions."[32] An intelligence failure by communist leaders may also have played a part in the success of the amphibious assault at Inchon which resulted in not a single soldier being moved to prepare North Korean defences before the task force sailed.[33]

This illustrates the point that possibilities in continental seapower and coastal warfare vary depending on the measure of resources given to protecting maritime flanks and engaging in sea-denial activities. Callwell concluded that an inferior continental naval power's coastal defences must "compel the respect of the hostile fleets" or have its naval forces face certain destruction and its territory prepare for invasion.[34] With enough resources committed, a hostile coast can frustrate an enemy's maritime strategy that has not considered landpower's reach over the littoral, despite a preponderance earned on the high seas or the level of command of the sea enjoyed by the enemy. Till insists that "sea denial may… act as a complement to sea control" in coastal and continental warfare denial strategies and such capabilities should not be overlooked.[35] Examples of continental seapower struggles against bluewater seapower include Zamorin resistance against the Portuguese empire in the 16th century, and the Maratha repulsion of the Dutch and British fleets during the 18th century.[36] Fast coastal ships that could be made to order meant that Indian powers could resist, to varying degrees, the materially superior (in terms of technological sophistication of ships) European powers in coastal waters. This illustrates how continental seapower challenged bluewater seapowers, much in the same

[31] For a brief introduction to China's sea denial strategy, see: Geoffrey Till, *Seapower: A Guide for the Twenty-first Century,* 3rd Edition (Abdingdon: Routledge, 2013) pp. 152-154.
[32] Gorshkov, *The Sea Power…* p. 242
[33] Max Hastings, *The Korean War* (London: Pan Macmillan, 1987) p. 145
[34] Callwell, *Military Operations…* p. 164
[35] Till, *Seapower*… 3rd edition p. 152
[36] Kavalam Madhava Panikkar, *India and the Indian Ocean: An Essay on the Influence of Sea Power on Indian History* (London, George Allen & Unwin, 1945) pp. 40-63

way it is possible for powers without a great presence in space to challenge others who may have a significant presence in orbit with elaborate space infrastructures.

Coastal guns can threaten ships, and "they have always played a part in land operations for several centuries, and in most cases where such operations have led to the capture or destruction of hostile fighting-ships, artillery has exercised a special influence over the fate of the doomed vessels."[37] Indeed, in the First Sino-Japanese War of 1894, when "the Japanese captured part of the fortress of Wei-hai-wei from the land side, they succeeded in turning some of the guns of the captured batteries upon the Chinese fleet" forcing the remainder of the Chinese fleet to move into less advantageous position where Japanese torpedo boats could attack them.[38] The concept of landward guns firing towards naval vessels is analogous to Earth-based weapons system firing upon satellites.

Earth-based weapons systems can be specialised and take advantage of terrestrial logistics chains. Manoeuvres and weapons fire from Earth can be used to force enemy assets into less advantageous positions (as detailed Proposition IV) to hamper their normal celestial lines of communication for strategic effect elsewhere. This is not to say that satellites are directly analogous to ships, but it illustrates the principles of joint actions and the power of landward forces impacting on sea lines of communication and the distribution of forces. These brief illustrations tease out the coastal analogy further, where satellites in Earth orbit may be vulnerable to Earth-based antisatellite weapons. Such weapons sites or units that use them could be the targets and agents of particular space strategies that intend to use terrestrial operations to influence spacepower. As operations on land could influence the command of the sea, operations on Earth can influence the command of space. Indeed, a Chinese educational text on space warfare operations encourages thought along these lines when it declares that:

> "firepower strikes involve applying space strength and other service and branches' long-range precision strike capability against the enemy's aerospace bases in a sustained, ferocious

[37] Callwell, *Military Operations…* p. 132
[38] Ibid., p. 134

> firepower assault. The goal is to destroy key points in the base, including aerospace instruments, space launch equipment, launch facilities, and various supporting facilities."[39]

This demonstrates an important reason why any individual interested in strategic planning, arms control, and national security should not be tricked into thinking that space infrastructure is beyond the grasp of modern warfare without space-based weapons. Any study or argument on space-based weapons should bear this in mind – space-based weapons are not needed to wage space warfare; Earth orbit can be made into a hostile celestial coastline even when facing an opponent that may have little space-*based* space warfare capabilities of its own, especially when electronic warfare and cyber infiltration options are considered.

A contemporary illustration of 'space coastal fire' is Iraqi antisatellite capabilities in the Gulf War (1990-1991). It is perhaps more accurately described as an example of a missed opportunity on the part of Iraq to engage in 'coastal space warfare.' Roger Handberg believes that "Iraqi electronic countermeasures were, in principle, logistically possible early on in the conflict, but they very rapidly lost that capability during the air campaign as radar sites were neutralized."[40] Perhaps not anticipating the American response to their invasion of Kuwait, the Iraqi leadership may have decided that jamming the relevant satellites to forestall, or slow, any intervention was unnecessary. Meaning "as a result, possible antisatellite weaponry such as employment of radar sites for satellite jamming, was not attempted and those assets were quickly destroyed during the opening air campaign."[41] Harding's narrative does not enlighten us as to Iraqi intelligence capabilities regarding the finding and fixing of the correct satellites as targets, but as an illustrative example on the potential of Earth-based anti-satellite capabilities it serves spacepower theory's purpose.

Therefore, Earth-based weapons matter for spacepower like weapons, installations, and forces based on land matter for seapower. Callwell claimed that sometimes naval 'decisions' – decisive

[39] Mei Lianju, *Space Operations Teaching Materials* (Beijing: AMS Publishing House, 2013), p. 132. An excerpt of the manuscript of its translation was kindly provided by Dean Cheng of the Heritage Foundation, Washington, D.C.
[40] Roger Handberg, *Seeking New World Vistas: The Militarization of Space* (Westport, CT: Praeger, 2000) p. 102
[41] Ibid., p. 189

actions that put enemy forces out of action – can be decided by land power with no battle at sea itself. He argued that:

> "at sea there may be no field of battle to be held, nor places to be won. But even the purely naval issue may not be decided at sea. The final object of attack in maritime warfare should always be the organised forces afloat of the enemy, but those organised forces may be afloat in harbour. The enunciation of sound strategical doctrine does not necessarily establish a dogma which is infallible, nor set up an image which can under no circumstance be broken."[42]

In addition to resonating to the epistemology established in Chapter 3 and the qualifications of seeking battle explored in Proposition III, this passage is useful if we consider satellites as the targets of 'space coastal weapons' – or Earth-based counterspace weapons. Ships too close to the land or coastal fortifications are vulnerable – much like satellites that come into range of Earth-based counterspace weapons. A degree of the command of space can be won through utilising Earth-based counterspace capabilities. Terrestrial power could help decide the command of space in a time and place like seapower sometimes yields a decision over the command of the sea to land operations. Although Sheldon is correct to argue that spacepower cannot "come to grips with itself in combat,"[43] he may be wrong to argue that as more space powers emerge and mature, the need for spacepower to be able to negate spacepower will grow. In other words, Sheldon is anticipating the growth of space-based weaponry (including space-based jammers) as spacepower proliferates to more states across the world. A coastal outlook qualifies such an expectation because satellites in orbit may be vulnerable to varying degrees in a hostile coast, *but so will space-based weapons*. Hypothetically this means that A's spacepower may not be able to directly attack B's spacepower, but their respective air, land, and sea power may come to grips with each other's spacepower. Sheldon's argument is more plausible only if humanity develops a political economy with significant presence beyond Earth, as then humanity enters the 'oceans' of interplanetary space in the solar system, and away from Earth's celestial shoreline.

[42] Callwell, *Military Operations…* p. 167
[43] Sheldon, *Reasoning…* pp. 277-278

Modestly-equipped states can employ countermeasures against space assets and affect the military prowess of any modern space-augmented military, and use space assets against the interests of other powers who may be located on the other side of the globe. This means that spacepower can be useful even for states without global power projection ambitions. That said, however, the capability to fire is one thing – target acquisition is another. A large (possibly global) space surveillance network with dispersed observation sites will still be useful, if not essential, for 'space deniers.' Chapter 1 described some examples of amateur space tracking by skilled and educated individuals – a rudimentary tracking system is not beyond small states with modest resources, let alone larger ones. Though small and isolated states may face more challenges in developing a truly global surveillance capability.

The idea of Earth orbit as a hostile coast transposes to outer space to some extent within Sheldon's thesis through his engagement with the concept of the 'cone of vulnerability.' John Piotrowski coined this idea which can be blended with the idea of hostile coasts. His idea of a 'cone of vulnerability' is a zone that extends from a specific area on Earth and widens up towards various altitudes in outer space. Satellites passing through this zone that may be targeted by terrestrial counterspace weapons will be vulnerable to attack from 'coastal fire' from Earth. In addition, good surveillance and strike systems may be able to find and destroy antisatellite weapons during or after firing – altering the balances between the advantages of defence and offense on the strategic level after successive rounds of engagement. Successive satellite passes, anti-satellite weapon firing, and counter-firing in this cone will change with each instance. Sheldon, having had access to Piotrowski's unpublished manuscript, described the 'cone of vulnerability' in the following way:

> "By creating what John Piotrowski calls a 'cone of vulnerability' that encapsulates the battlespace, one can protect friendly terrestrial forces from enemy satellites by engaging those satellites as they enter the cone. The cone is inverted; being at it's [sic] narrowest on Earth, yet covering the area of the battlespace, and at its widest in orbit. As enemy satellites approach the cone, ground-

> based [antisatellite] weapons at the edge of the cone engage and destroy them. The cone of vulnerability in effect becomes a sanctuary from enemy satellites."[44]

In effect, the cone of vulnerability produces a hostile coast to the targeted satellites, meaning that hostile cosmic coastlines are not necessarily global, indiscriminate, or omnipresent. Just as space-based weapons do not herald the age of certain death from above, Earth-based weapons do not mean certain death from below. China can project a hostile coast above its territory to American satellites. Conversely, Chinese satellites can be targeted wherever enemy Earth-based antisatellite weapons are located to intercept their celestial lines of communication. This means that a space power's cosmic coastline extends to where its useful satellites travel, and not just above its home territory.

This cone of vulnerability works both ways – from Earth up to space and from space down to Earth. Forces that are caught in the crosshairs of space-based observation and their Earth-based weapons platforms must take measures to adapt to them if they cannot engage in counterspace activities against satellites, especially if the cone of communications support from space augments enemy terrestrial forces in that region. For example, Iraqi forces in 1991 and 2003 were caught within overlapping cones of vulnerability produced by space-based communications networks that supported terrestrial forces in the Persian Gulf. Directed energy and jamming weapons that are based in space can be imagined to produce cones of vulnerability with points of origin at their location in orbit, arcing out to their desired target areas along their lines of sight that could be looking down towards Earth, or to other areas of orbit, or beyond.

The idea of the cone of vulnerability visualises how 'coastal space defences' from Earth can localise firing lines or arcs on *specific* orbital paths – though care will have to be taken that lower-flying satellites do not stray into fire intended for a higher target. Debris from destroying satellites with missiles and 'kill-vehicles' will be a pressing concern in any cost-benefit analysis of space warfare. China's 2007 antisatellite test caused a great deal of destruction in orbit and produced thousands of pieces of long-lived debris, but China's two subsequent antisatellite tests, in 2010 and

[44] Sheldon, *Reasoning by Strategic Analogy…* pp. 167-168

2013, destroyed their targets but created no long-lived orbital debris, showing a learning process.[45] 'Coastal space warfare,' envisioned through cones of vulnerability, localises *some* effects. However, an indiscriminate debris event will spread out in its orbits over time around Earth. Internal lines of communication, and raising the seapower profile of a land-based power if it manages to fortify its coastal zones, is applicable to spacepower in the way that a weaker or Earth-based 'space power' can still threaten the space systems of a major space power if they invest in 'coastal space weapons' such as Earth-based lasers, cyber, and electronic warfare systems directed against satellite systems.[46] Being a second-rate spacepower on Earth need not make space warfare impossible or irrelevant against a major space power when taken in conjunction with the idea of strategic manoeuvre and the advantages afforded to a 'coastal space defender.'

In space warfare in Earth orbit, there may be no easy escape from the 'hostile celestial coast' for valuable space systems comparable to ships retreating to the high seas and away from a hostile coast. There is no direct geographic corollary to coastal forts or safe ports within which spacecraft can seek refuge – that is if we restrict the use of space to Earth orbit, or the ranges of Earth-based space weapons. Callwell believed that the ships of a weaker fleet should retire to coastal fortresses and await a better opportunity to put to sea, rather than risk certain defeat and an end to any pretence of seapower.[47] This analogy of fleets and satellites retiring to a coast may not be a helpful one given the lack of weapons-grade spacecraft and a general (but not uniform) potential vulnerability to hostile fire from Earth. There may be no obvious 'port in the storm' in orbit; safe orbits will depend on the capabilities of particular adversaries. Fixed coastal havens cannot happen in orbit – safe orbital altitudes and paths will shift with each contingency.[48]

This analogy with Callwell does improve, however, if we imagine a time when the use of interplanetary space becomes strategically useful. Here, Earth orbit, which is within immediate reach of terrestrially-based counterspace weapons, is a 'coast' around Earth. In an interplanetary war,

[45] Brian Weeden, 'Anti-satellite Tests in Space – The Case of China', *Secure World Foundation*, 18/05/2013, pp. 1-2
[46] Missile-launched counterspace weapons are another option, although more expensive.
[47] Callwell, *Maritime Operations…* p. 164
[48] Lagrange points 4 and 5 may be thought of as advantageous safe zones if they are out of the range of Earth-based weapons, but that is pure speculation.

surface-based planetary defences set up to ensure safe havens around a planet's orbit may make up a relatively safe coastal haven, compared to the 'open seas' of the vast expanses between celestial bodies where planetary weapons may not have the range to attack targets beyond Earth orbit. In interplanetary space, spacecraft may find ample opportunity to set ambushes, unlike in the close orbits of human-developed planetary bodies. Earth orbit is not the only 'coastal' region in space. Any orbit of a celestial body can potentially be considered a celestial shoreline. With such a visualisation, the solar system becomes an analogy to a collection of continents or islands (planets and large asteroids) separated by seas and oceans (inter-satellite and interplanetary space). Again, this refers to the value of understanding the diverse 'astroscape' of outer space, as argued in Proposition II.

Narrowing down to the astrographic details of Earth orbit, the higher the altitude of a target, the more technically demanding effective Earth-based counterspace systems may become. Satellites in LEO and MEO may periodically pass within range of enemy space surveillance networks (SSN) and counterspace systems, and some GEO satellites may loiter permanently in a hostile 'coast', or the line of sight of enemy counterspace weapons. Paradoxically, targets in GEO may be easier to locate and identify but harder to engage because of their distance from Earth, but targets in MEO and LEO may be harder to locate and identify but easier to engage due to their lower altitude. This however is a technological realm that is subject to great changes, especially as laser focusing and efficiency advances. This is another reason why all propositions should be critically applied to particular scenarios as the character of war is always in flux.

A hostile coast is wherever and whenever weapons are used to attack one's satellites or when spacepower in orbit enhances the lethality and chances of success of engaging enemy terrestrial forces at specific times and places. The hostile coast is not fixed in time and place in keeping with the universality of spacepower theory, but the concept is useful for strategic thinking. As an example, an American expeditionary force may be physically distant from home on Earth. But orbital space allows a space-capable enemy to threaten hostile action with counterspace assets through a shared orbital 'coast' which can affect life and infrastructure on the core territories of the United States. As this is a shared coastline, relatively distant powers on Earth may have satellites at risk: a space coast is not

restricted to the orbital space directly above a given territory that is involved in a war – it is wherever the relevant satellites of all belligerents and valuable third parties travel. The routes of crucial satellites such as GPS, Keyhole, and Defense Support Program (DSP) constitute a part of the United States' 'space coast.' Chinese Beidou and Yaogan satellites' orbits likewise form parts of the Chinese 'space coast.' These satellites fly over numerous states, some of which may be able to deploy Earth-based antisatellite technology; conceptually forming 'space coastal weapons' and a hostile cosmic coastline. With the direct warfare elements of continental seapower analogised as coastal space warfare, the proposition can move on to the next elements which are more indirect and subtle in their visibility and contributions to strategic success.

### 5.2.2 Proposition V Part 2: Astroeconomic warfare

The second element in strategic manoeuvre is economic warfare, already touched upon in Proposition IV in the ideas surrounding blockade. Sheldon notes the relative disparities in strategic value of seaborne commerce and spaceborne commerce and critiques "Everett C. Dolman, John G. Fox, Martin E.B. France, John J. Klein and John Shaw [for assuming], explicitly or implicitly, that Mahanian and Corbettian descriptions of the economic vitality and importance of the seas also applies to space commerce."[49] Sheldon is mistaken in this criticism. This part of Proposition V argues that Mahanian and Corbettian ideas on the economic importance of the sea for warfare are useful for spaceborne commerce because their seapower theories were generally agnostic on the actual importance of economic warfare in any given case. Mahan and Corbett believed that economic warfare at sea could be useful yet rarely decisive by itself. Complemented with Raoul Castex's thinking, established concepts on economic warfare transpose quite well to spacepower. This part of Proposition V looks at astroeconomic warfare (economic space warfare) which examines the efficacy of economic warfare and its place in contributing to a strategic manoeuvre. It concludes that the efficacy of astroeconomic warfare will vary, but it will always need to contribute to the overall war aims if it is to be attempted at all, much like naval-economic warfare.

[49] Sheldon, *Reasoning…* p. 155

For Castex, the most valuable outcome of a *guerre de course* (commerce destroying) campaign was its potential to divert the enemy battle fleet and other resources away from a primary theatre of operations to allow temporary disputes of the command of the sea to occur in more strategically vital areas as part of a strategic manoeuvre.[50] Despite his scepticism of a *focus* of an entire navy's strategy around *guerre de course*, Castex described such a strategy as a valuable component of a general manoeuvre strategy to trigger a preferable redistribution of enemy forces.[51] For Castex, the advantages from successful *guerre de course* operations had to be translated into tangible benefits by making offensive naval action more palatable in another theatre and lamented that *guerre de course* had generally not been integrated into wider war plans in this way.[52] It is not unreasonable to imagine space warfare, directed against targets to impose economic effects, as helping to force a distribution of resources or forces favourable to the attacker or raising the costs of resistance to the victim. Compromising communications satellites (commercial and government types) could not only cause economic costs, but their lost communications bandwidth could also hinder or even stall the operations of a spacepower-supported and information-dependent terrestrial force. This means that a *guerre de course* campaign for space may not be able to separate purely economic costs from directly military ones, however, that is not necessarily a permanent condition. This crippled force might attempt to compensate on Earth by changing dispositions which may or may not benefit enemy terrestrial forces in some places, levelling the playing field or at least giving more hopes for a successful resistance against a first-rate space-supported military machine. A previously dispersed force, having lost its celestial lines of communication, may have to respond by concentrating its forces (Proposition VII). This would present a bigger target for adversaries.

According to Castex, commerce raiders had a choice between two distinct zones within which to conduct commerce destroying: focal zones where communication routes converge, or disparate regions that have little definable traffic routes. The former has higher risk but greater rewards, and the

[50] Castex, *Strategic Theories…* p. 362
[51] Ibid., p. 136
[52] Ibid., pp. 348-349

latter less risk and fewer rewards.[53] This resonates with Mahan's comparison between dispersed British seaborne trade and the concentrated Spanish treasure ships as referred to in Proposition IV. This does not mean that either historic case is predictive of economic warfare on space systems. Not many states on Earth may be as vulnerable to *guerre de course* as Britain was, as Callwell argued,[54] and the Spanish treasure ships borne from imperial plunder may not be repeated. This means that Castex's insistence on using *guerre de course* as part of a general war plan to force a favourable redistribution of enemy forces in order to tip the balance of capabilities elsewhere may be the best rationale to utilising the method. This depends on whether the loss of targeted systems warrant a redistribution of satellites in space and forces on Earth, which will vary with each scenario. It is a useful principle to think and apply critically. What difference would economic space warfare make to the overall war effort and the distribution of forces on Earth? Strategic manoeuvre is a way to help begin to answer the question of how effective astroeconomic warfare could be.

The economic consequences of blockading or *guerre de course* will depend in part on the target's economic composition. Castex reminds us that if the target of *guerre de course* or blockading has secure internal communications, and if it is not too dependent on the sea for basic existence, then it may be able to weather the storm. The only recourse for a more strategically significant result would be the attacking the enemy's core territory.[55] Menon argues that effective blockades take time to produce any result, and for the necessity of the government or people targeted to depend on the highly valued commodities and communications that are denied.[56] However, the expectation for economic warfare to become more costly or damaging to the victim over time may not necessarily be the case. Mahan's narrative of French commerce destroying efforts during the French Revolution was that the initial shock and surprise inflicted heavy losses on the British. But over time, the surprise and efficacy of the offense was succeeded "by the more regular course of maritime war." This means that the British established preponderance and commercial convoys, with opponents resorting to

[53] Ibid., p. 365
[54] Callwell, *Military Operations…* pp. 169-177
[55] Castex, *Strategic Theories…* p. 394
[56] Menon, *Maritime Strategy…* pp. 64-86

piecemeal commerce destroying with no great strategic result.[57] Indeed, the effectiveness of economic warfare for each particular case cannot be theorised, especially if the raiders and the victims prove adept at countering each other's moves over weeks, months, and years.

Mahan examined French attempts to stifle British trade in the mid-18th century, and commented that:

> "the evidence seems to show that even for its own special ends such a mode of war is inconclusive, worrying but not deadly; it might almost be said that it causes needless suffering. What, however, is the effect of this policy upon the general ends of the war, to which it is of one of the means, and to which it is subsidiary?... In so far as this is one means to a general end, and is based upon a navy otherwise powerful, it is well; but we need not expect to see the feats of those ships repeated in the face of a great sea power."[58]

In other words, only a dominant navy should expect to conduct an effective or meaningful economic warfare campaign. Even then, the results can be inconclusive or, more importantly, only contributory towards the overall outcome. The passage above leaves Sheldon's criticism of Mahanian seapower theory as an analogical source for 'economic space warfare' in a precarious position. Sheldon insisted that space power writings have tended to assume that space "is as economically important as the sea," or that "space power is able to exercise the same leverage as sea power. All of these assumptions are far from definitive."[59] But the track record of economic warfare at sea and the overall importance of the sea are themselves far from definitive, as Mahan's reservations show. There is no reason to assume, *conceptually*, that spacepower may provide as much of an economic stranglehold on an enemy as seapower did, or still can because seapower did not always have such an economic stranglehold. Although the details change, the basic concepts of economic warfare and its place within seapower are useful to consider when planning astroeconomic warfare. Seapower does not provide a one-sided record of successful commerce destroying or blockading at sea – in that sense spacepower should inherit the same ambiguity when thinking of economic warfare within seapower.

[57] Alfred Thayer Mahan, *The Influence of Sea Power on The French Revolution and Empire 1793-1812: Volume II* (Cambridge, MA: John Wilson & Son,1892) p. 203
[58] Mahan, *Influence…* pp. 136-137
[59] Sheldon, *Reasoning…* p. 146

Any strategic decision on whether or not to employ *guerre de course* or blockade should depend on the enemy's relative vulnerability to such economic deprivation. This in turn is determined by its dependency on space commerce *and* the character of the distribution of that commercial activity. It must also be remembered that it is one of many tools, and should contribute to the attainment of the ultimate goals of a war. Castex and Mahan are as one on this point. Corbett too wrote on the pointlessness of banning the interception of commerce, meaning that he also was balancing his views between the general inefficiency of economic warfare at sea and its apparently useful annoyance towards the enemy.[60] Again, this underscores the need for good judgment on how and when to apply economic warfare – through raiding or blockade. Theory can only explore possibilities and train judgment, not predict success or failure in any particular situation.

The character of space commerce changes with the type of actor, technology, and economics in play. One way this diversity can be seen is how commercial space networks can be dispersed or concentrated. The changes in the physical distribution of satellites and ground stations modulate between dispersal and concentration. The dispersal and concentration of commercial activity is illustrated here through a simple comparison of Iridium and Inmarsat satellite constellations. Iridium's constellation of 66 communications satellites in LEO is an example of a highly distributed satellite network. Some space-dependent communications systems may use less than a dozen satellites in GEO, like Inmarsat[61], and some commercial space systems are more resilient than others in part due to dispersal and redundancy in the space and ground segments. Iridium's website recounts that:

> "in early 2009, without warning an obsolete Russian satellite collided with one of Iridium's space vehicles, SV 33, and the Iridium team replaced the damaged satellite with an in-orbit spare in 20 days. Within three days after the collision, Iridium's network operators were able to re-route voice and data traffic around the "hole" in the constellation to minimize disruptions. Iridium has

[60] Corbett, *Principles…* pp. 91-94, 113, 187, 261-262.
[61] Union of Concerned Scientists (UCS), 'UCS Satellite Database', http://www.ucsusa.org/nuclear_weapons_and_global_security/solutions/space-weapons/ucs-satellite-database.html (file used dated 01/02/2015)

> developed the process of implementing procedures to reduce this time frame from three days to 12 hours and, eventually, to single-digit hours."[62]

It is doubtful that Inmarsat could scramble such a fast response if a major failure occurred for a satellite with its own resources other than relying on its remaining satellites or what little backups there may be to attempt to make up for the loss of coverage. Although the Inmarsat constellation has fewer satellites to provide redundancy, it requires fewer satellites for complete coverage because of its greater altitude. This serves as a basic illustration of the complexities of economic space warfare, and each consideration of using *guerre de course* has to be made in light of net assessments as to whether an Earth-bound state could ever become so dependent on celestial lines of communication for bare life, as Britain was and still is, on the sea for basic energy and foodstuffs since the late 19th century. This part of Proposition V serves to show how space warfare can have economic rationales, and economic consequences (whether through accident or design). If militaries continue to use critical infrastructure in orbit that also perform economically significant tasks, astroeconomic warfare will remain a consideration within the entire ambit of space warfare. Astroeconomic warfare may have more direct military consequences for a campaign on Earth than Castex may have imagined for *guerre de course*'s possible contributions to continental wars.

### 5.2.3 Proposition V Part 3: Third parties and 'neutrality'

An aspect so far unmentioned in economic warfare is the role of non-state actors, and connectedly, third parties which may include 'neutral' states. The situation of non-state, non-governmental entities, and third parties (states and international organisations, for example) can be summarised as having to find their place between securing an armed neutrality, or suffer an abused neutrality because of the dual-use nature of space technology and celestial information flows. Other than attempting to remain neutral, third parties may always seek to abandon their aloof position and willingly commit to a party of a conflict. Such opportunities could be lucrative if the winning side is chosen – and such aid may contribute to strategic manoeuvres to the warring parties.

[62] Iridium, 'The Global Network: Life Expectancy of Iridium's Satellite Constellation', 2012, available at: http://www.iridium.com/DownloadAttachment.aspx?attachmentID=1220 (accessed 06/09/2013)

Like activities at sea, space activity is populated by dozens of states, myriad companies, and non-governmental organisations. They can be private, public, state-owned, and within military-industrial complexes. Reflecting on the then-recent Russo-Japanese war, Callwell remarked that "the rights of neutrals are still liable to be trampled upon if those neutrals are unable, or unwilling, to defend them."[63] Neutrals risk being caught up in warfare or political intrigue if their trade carries them towards the areas or interests of a conflict, if the belligerents have reason to use or deny third party assets and when their neutral guarantors cannot protect them. On a sharp offensive, Castex went further and said that:

> "some now claimed freedom of the seas to be valid in wartime… In short, all private property being sacrosanct, contraband of war no longer existed and blockade ceased to be legitimate… [N]aval war has no point if enemy property can travel without hindrance and if neutrals can supply the enemy or conduct his trade… In wars during which there are many powerful neutrals, one cannot proceed in the same manner [of seizing/attacking neutral property at will]… We can conclude with Richelieu's observation that "of all the sovereigns' domains, it is the sea on which they make the greatest claims, but the place which the rights of each are least clear. The true title to naval domination is force, not reason.""[64]

Space warfare, then, would be pointless if celestial lines of communication could be used by all, under some agreed or believed condition of self-restraint, in war. To finish his assault on the belief in militarily weak yet strategically problematic neutrals remaining unmolested in war, Castex wrote in a footnote that "we can be sure that, in the next war, the Americans, ready to fight to defend the freedom of their own commerce when they are neutral, will brutally uphold the other point of view when they are belligerents. Humanitarian imperialism is always problematic."[65]

Even if there are desires to let communications that are not military-related pass through space systems, it would be hard to separate data and satellites relevant to the war effort and those not, especially when space technology is ubiquitous in its dual-use nature. What constitutes as 'innocent

[63] Callwell, *Military Operations…* p. 44
[64] Castex, *Strategic Theories…* pp. 37, 39-40,
[65] Castex, *Strategic Theories…* p. 40, footnote 46

passage' or non-military traffic or information is a highly particular and contentious classification that fluctuates with time and with the ethics and perceived threats of the relevant polities involved in any war. The dual-use nature of many goods and equipment make any categorical statement on what is permissible to travel under a 'neutral' flag highly contentious. An example of the pervasiveness of this duality is how the Hubble Space Telescope is only a Keyhole reconnaissance satellite that looks away from Earth. The value of the technological secrets on Keyhole's systems were so great that certain problems on Hubble were not corrected by U.S. authorities that did not want to declassify the necessary technical information to engineers outside the U.S. intelligence community. Indeed, "the Hubble and its military sisters, the Keyhole series, had their lenses made by the same company, separated only by a curtain."[66] Given the use of civilian systems for military ends (like Iridium), and military systems for civilian ends (like GPS), it may be that the dual-use problem is more acute in space than elsewhere.

All this does not mean that neutrality for commercial actors is impossible. Rather, it is that well-armed neutrality is the only means to guarantee – as far as possible in the uncertain world of war and politics in an anarchical system – a neutral position that is not at the mercy of the warring parties. A neutral party must either be of marginal or no interest to warring parties, or be able to inflict massive costs on any factions that attempt to abuse or infringe its neutrality. If a war occurs between two smaller powers, and third party vessels enjoy the protection of one or more strong powers, then neutrality, profiteering, and political distancing from a conflict may be more feasible. As is so often the case in seapower theory these are not unflinching dicta and dogmas – they are flexible guidelines which illustrate the possible. There can be armed neutrality as well as abused neutrality: all depends on the character of the belligerents and other powers involved. It is reasonable to gain the impression from both thinkers that in the absence of 'armed neutrality' – the ability to inflict or threaten severe punishment in retaliation for molestation – 'abused neutrality' is always a possible threat to third parties at the sidelines of a war between stronger belligerents. Abused neutrality can mean the loss of

[66] Roger Handberg, *Seeking New World Vistas: The Militarization of Space* (Westport, CT: Praeger, 2000) p. 55

trade and assets, or co-option into facilitating the demands of a particular party of the conflict. This can apply to non-state actors as well as states.

These are recurring political and economic concerns that are worth considering for spacepower, and then translating into a concept of strategic manoeuvre within the seven propositions to give them meaning to the war as a whole. A Chinese space warfare education manual warns its readers against incurring the wrath of an otherwise-uninvolved space power by inflicting "mistaken wounds" upon its space systems. In addition, it adheres closely to the Castexian argument that blockading the enemy in space and imposing such costs should be viewed "from the high perspective of the overall strategy".[67] In other words, such actions should only be undertaken if they contribute to the overall war plan and that they do not unnecessarily escalate the conflict to bring in third parties or generate international opprobrium.

Third parties and commercial actors have been raised by Smith and Sheldon, and Dolman leaves the commercial sector to be induced and instrumentalised by a dominating state in an *Astropolitik* vision to further state interests in dominating Earth.[68] Smith argues that "all actors can become space powers through commercial space assets."[69] The proliferation of information and space technology encourages spacepower theory to be receptive to strategic conditions beyond bipolarity, unipolarity, and a state monopoly on space capabilities. Third parties, including allied states and companies registered in allied states, may complicate some matters as transparency and inter-allied dependence on space systems increases. Smith raises the case of Operation ALLIED FORCE in the Serbian war in the 1990s where Eutelsat initially leased bandwidth to North Atlantic Treaty Organisation (NATO) countries and Serbia, before Western diplomats successfully 'encouraged' Eutelsat to suspend service to the Serbian government.[70] This increases strategic transparency – open source information and analysis from satellite imagery, for example, proliferate and contribute to

[67] Mei Lianju, *Space Operations Teaching Materials* (Beijing: AMS Publishing House, 2013), p. 136. An excerpt of the manuscript of its translation was kindly provided by Dean Cheng of the Heritage Foundation, Washington, D.C.
[68] Dolman, *Astropolitik…* esp. p. 158
[69] Smith, *Ten Propositions…* p. 64
[70] Smith, *Ten Propositions…* pp. 62-63

public debate on matters of defence, security, and foreign policy.[71] However, commercial laws may hinder the spread of commercial imagery, even within the same military. In Operation DESERT SHIELD, the U.S. Army could not afford the royalty fees of *Satellite Pour l'Observation de la Terre* (SPOT) images bought by the U.S. Air Force, and as a result, they went without SPOT imagery throughout the subsequent war.[72]

Despite the problems posed by commercial entities, there are possible solutions. Smith listed three possible options to handle the commercial space sector's data and services during war. First, to buy-out satellite capacity to prevent enemy commercial access. Second, to negotiate on agreed constraints on image distribution. Third, to take direct military action against space systems that threaten military operations.[73] Yet there may be a fourth option: to neutralise or intimidate – short of violence and within legal limits – any 'problematic' individual or organisation.

Contrary to Sheldon's critique of Mahan's seapower theory as unhelpful for considering the economic aspects of spacepower and space warfare, Mahan does provide an interesting illustration of the illusions of commercial maritime neutrality being shattered when he wrote that:

> "in 1740, when war between France and England became probable, [the comte de La Bourdonnais, a commander of French ships in Indian waters,] obtained from the [French] East India Company a squadron… with which he proposed to ruin the English commerce and shipping; but when war actually began in 1744, he received orders not to attack the English, the French company hoping that neutrality might exist between the companies in that distant region, though the nations were at war… Their company accepted the proffer, while saying that it of course could bind neither the home government nor the royal navy. The advantage won by the forethought of La Bourdonnais was thus lost; though first, and long alone, on the field, his hand

[71] For example, see: osimint.com, and open-source image intelligence analysis website, and as an example of open source analysis being used in public debate, see the refutation of some allegations of a secret Iranian uranium enrichment facility: Jeffrey Lewis, 'Background on Falze Lavizan-3 Story,' *Arms Control Wonk*, 03/03/2015) http://lewis.armscontrolwonk.com/archive/7579/lavizan-3?utm_content=buffer6d4a6&utm_medium=social&utm_source=twitter.com&utm_campaign=buffer (accessed 04/03/2015)

[72] David N. Spires, *Beyond Horizons: A Half Century of Air Force Space Leadership* (Montgomery, A.L.: Air University Press, 1998) p. 253

[73] Smith, *Ten Propositions…* p. 63 Some fieldwork data may come in handy here, especially regarding UK interviewees.

> was stayed. Meanwhile the English admiralty sent out a squadron and began to seize French ships between India and China; not till then did the company awake from its illusion."[74]

This illustrates the *possibilities* of neutrality being hoped for but ultimately trampled upon. Hopes, expectations, and policies for commercial neutrality are not new to the twenty-first century. Another example would be Mahan's case of the 'Armed Neutrality' of Russia, Sweden, and Denmark in 1780, in the context of Franco-British maritime warfare during the American rebellion. Britain threatened Russian, Swedish, and Danish maritime trade because of a British intent to seize 'enemy' goods in 'neutral' ships. The eventual Dutch decision to join this Armed Neutrality led Britain to take Dutch possessions and trade.[75] Armed neutrality can lead to abused neutrality, or the end of it utterly if a previously neutral power becomes a party, through accident or design, to the conflict. The commercial sector should neither be seen as inherently neutral nor as never wishing to have a hand in profiteering from conflict; business and economics are still political. Such an open attitude can help identify assistants to one's aims, targets in the commercial sector to co-opt, or companies to prosecute, infiltrate, and conduct espionage against.

From the perspective of a 'neutral' state actor with potentially useful space systems, the four options on dealing with the commercial sector are useful to test strategic thinking. A 'neutral' or non-combatant state can still take actions in the global space market and manage information flows in ways it deems useful for its interests, taking part in the war by proxy. To what extent commercial providers registered in a belligerent host state, or a weak non-combatant state, can ever remain neutral or unproblematic to the interests of a war's belligerents is an open question. Commercial operators may face pressures from state interests if they have an influence (whether intended or not) in a conflict. Henry Hertzfeld argues that a company will need the formal approval of some state authority to operate in space, raising questions of power relations between commercial and state interests, if they are ever at cross-purposes.[76] In addition, another aspect of commercial actors is that many of its

[74] Mahan, *Influence…* pp. 273-274
[75] Ibid., p. 406
[76] Henry Hertzfeld, 'Commercial space and Spacepower', in Charles D. Lutes and Peter L. Hays, with Vincent A. Mazo, Lisa M. Yambrick, and M. Elaine Bunn, ed., *Toward a Theory of Spacepower: Selected Essays* (Washington, D.C.: National Defense University Press, 2011)

staff, owners, and principal shareholders may have allegiances to the registered state and may not pose a problem to a state's goals. Interests may even converge. Episodes of European imperial history, given the examples of the East India Companies of France and Britain above, may prove to be precedent enough of this.

As for smaller space powers, Smith proclaims that "if you have a credit card and access to a telephone or the internet, you can build your own spacepower."[77] Small space actors have been complicating what was largely a bipolar equation during the Cold War. John Sheldon picks up on an important consequence of the global proliferation of space-based reconnaissance methods when arguing that:

> "until now, it has been widely regarded that [concealment from space-based reconnaissance] have been forced upon adversaries of the United States and its allies. Yet the proliferation of these systems to more and more actors, as well as the widespread availability of quality commercial imagery, means that even the U.S. and its allies must now take steps to avoid unnecessary detection from space."[78]

The United States, as Smith alludes to, has to adapt to varying degrees of strategic transparency available to the highest bidder on the marketplace or a determined state actor, or both. But this is not a new concern for the United States. In 1990, the Soviet Union began to sell satellite imagery on the open market – allowing any buyer to access images with greater resolution than anything else that was available at the time.[79] This increasing transparency leads Sheldon to argue that spacepower can impose dispersing effects upon military activities and force structures on Earth, and is explored in Proposition VII. Sheldon notes the increasingly constrained political environment if one seeks to disrupt the spacepower of an enemy through third party service providers – repeating the sentiment of inflicting 'mistaken wounds.'[80] The difficulty of counterspace operations, the sensitivity of space services, and the multipolar political character of space activities makes unilateral action

[77] Smith, *Ten Propositions…* p. 61
[78] Sheldon, *Reasoning…* pp. 305-306
[79] Jeffrey T. Richelson, 'U.S. Intelligence and the Soviet Space Program', *National Security Archive Electronic Briefing Book* (no. 501), 04/02/2015, http://www2.gwu.edu/~nsarchiv/NSAEBB/NSAEBB501/ (accessed 20/02/2015)
[80] Sheldon, *Reasoning…* p. 322

more daunting in political, technological, and economic terms. But a political environment's character is not permanent. Political conditions can change overnight, given a potent-enough mix of events, circumstance, and leaders. The U.S. must balance its risks if its military continues to rely on unprotected commercial systems for extra bandwidth which also are used by companies that may have their own objectives.

However, restating Hertzfeld's point above, any commercial operator may be, at some point, answerable to a state. If political-economic consensus between major space powers can be achieved during a war, a belligerent enjoying that consensus may likely keep out third parties from intentionally assisting enemies. Third parties participating in a war against a cartel of major spacepowers risk incurring the wrath of that cartel. Hertzfeld makes Sheldon's point in a more detailed fashion but qualifies his earlier statements about commercial interests being subordinate to the state when he says:

> "no longer can a nation such as the United States even rationally plan for control of the [commercial communications] systems or capabilities. In time of conflict, it would be almost impossible to interrupt services because businesses and governments as customers depend on them. In fact, the government is one of the major users of commercial communications networks."[81]

This implies that Hertzfeld cannot foresee a policy being crafted to deal with this problem – in the absence of 'rational' plans, perhaps ad hoc solutions to the commercial sector is the best approach. Hertzfeld is thinking along the lines of the paradoxical logic espoused by Luttwak in Chapter 3. Indeed, with the commercial sector and spacepower characteristics perpetually in flux, such thinking is apt for spacepower theory – it can help set the terms for ad hoc thinking in crisis and war. There are always possible tensions between state interests, especially in a time of war, and the interests of commercial entities. This will be true as much as within a state as between states and foreign commercial entities.

[81] Hertzfeld, 'Commercial Spacepower…'

States may take measures to improve their economic space power if opportunities present themselves to entice a profitable space company to do business or register in a 'more friendly' state. Additionally, an adversary in a war may use third party systems as equivalents of hostage-taking, forming 'human shields' and daring others to take aim at 'innocent' third parties that are being used by the enemy. Smith characterises the problems of political shelter for third party space systems in the following way:

> "space control and space denial efforts will be complicated if an adversary is using third-party launch facilities, satellites, or ground control systems provided by commercial vendors, international consortia, or an ally. Diplomatic efforts will likely be required to eliminate third-party support to adversaries, but if the political will exists, friendly forces must be ready to expand the conflict by striking wherever adversaries receive space support. If diplomatic efforts fail and policy does not allow expansion of the conflict to strike third-party targets, then the adversary has a sanctuary they will likely exploit."[82]

What determines who carries more weight in these interactions can only be examined as individual cases, as every incidence of commercial and state interests in a particular scenario will vary. Rather, it is important to remember the tensions that *might* arise between various space capable and dependent actors and how they may influence strategic behaviour of all parties to a conflict. In some scenarios there may not be a tension between state and commercial interests in the first place. There may even be a confluence of interests. – this would depend largely on the types and cultures of the actors examined (the importance of examining the internal dynamics of strategic actors is examined in Proposition VI) Spacepower theory sharpens critical thought by exploring these possibilities and subsequently making astroeconomic warfare relevant to the overall picture (or grand-strategic level) of spacepower through strategic manoeuvre. Exploiting the promises of, or eliminating the threat from, the commercial space sector and third parties are strategic manoeuvres that will influence the rest of the war effort to varying degrees.

[82] Michael V. Smith, 'Security and Spacepower', in: Charles D. Lutes and Peter L. Hays, with Vincent A. Mazo, Lisa M. Yambrick, and M. Elaine Bunn, ed., *Toward a Theory of Spacepower: Selected Essays* (Washington, D.C.: National Defense University Press, 2011)

The issue of third parties, either as benefiting from or supplying space support, is not new. The Cold War saw a handful of alleged examples, such as Soviet reconnaissance provided to Egypt in the 1973 Yom Kippur War, Soviet space-derived information being used in the 1978 Somalia-Ethiopia war, and Argentina receiving Soviet data with Britain receiving U.S. satellite intelligence in the 1982 Falklands War.[83] In 1991, it may be that SPOT imagery was cut off from Iraq after its invasion of Kuwait only because no other company would impose opportunity costs as "at the time, the only other agency that could have made such a decision to sell to Iraq was the Earth Observation Satellite (EOS) Company that operates Landsat. According to Phillipe Renault, deputy director-general of SPOT Image, if EOS had sold Landsat images to Iraq, SPOT Image would have done likewise in the interest of business competition."[84] However, it remains to be seen if SPOT would have tolerated non-U.S. competition.

Problems from third parties have only proliferated since the Cold War. In the 2003 Iraq War, for example, the Iraqi Army had access to Russian GPS jammers, and used them with very limited localised success.[85] Sometimes allies can cause (perceived) problems in space as well. The European Galileo system can be seen as "heresy" from a particularly hawkish American perspective, such as Scott Beidleman's, when he stated that "Europe has broken ranks… in a way that seems sure to conflict with American national interests."[86] The Galileo system, according to Beidleman, directly challenges U.S. space control because of signal security issues and third-party access to Galileo.[87] With this perception, U.S. direct action against Galileo satellites during wartime may not be out of the question if U.S. adversaries threaten personnel through the use of Galileo signals.[88] Yet doing so

[83] Paul B. Stares, *Space and National Security* (Washington, D.C.: Brookings Institution, 1987) p. 121
[84] Cynthia A.S. McKinley, 'When the Enemy Has Our Eyes', in: Bruce M. DeBlois, ed., *Beyond the Paths of Heaven: The Emergence of Space Power Thought* (Maxwell AFB, Montgomery, AL: Air University Press, 1999) p. 319
[85] Klein, *Space Warfare*… pp. 59, 95
[86] Scott W. Beidleman, 'GPS versus Galileo: Balancing for Position in Space', *Cadre Paper*, no. 28 (May 2006) p. 1. On a neorealist account and critique of the GPS-Galileo negotiations, see: Iain Ross Ballantyne Bolton, 'Neo-realism and the Galileo and GPS negotiations', in: Natalie Bormann and Michael Sheehan, eds. *Securing Outer Space* (Abingdon: Routledge, 2009) pp. 186-204
[87] Ibid., pp. 51-58
[88] Agence France-Presse, 'US Could Shoot Down Euro GPS Satellites If Used By China In Wartime: Report', *SpaceDaily*, 24/10/2004, http://www.spacedaily.com/news/milspace-04zc.html (accessed 09/07/2014)

would be an act of supreme political judgment, as Clausewitz might say based on an understanding of his theory in Chapter 3. The politics of war would exert itself strongly in these considerations.

The recent war in Ukraine (2014-) has seen attempts by NATO to use satellite imagery to prove the involvement of Russian forces in eastern Ukraine.[89] The same is true for the use of spacepower in Russia's operations regarding Crimea and the separatist regions in eastern Ukraine. The Ukrainian war has had direct consequences for Russian, Ukrainian, and American spacepower and industry. Ukrainian space industry may be moving closer to a European orbit, whilst Russia is cutting its ties to Ukraine's significant space-industrial capabilities.[90] U.S. space launch capabilities that rely on the Atlas V rocket have been severely threatened by the Russian decision to stop selling RD-180 rockets for U.S. military or security launches. As the American stockpile of RD-180 engines decreases, the U.S. military-industrial complex is scrambling to develop a replacement whilst Congress and lobbyists bicker.[91]

These examples show that even in spacepower's short and secretive history, many cases of the potential problems or opportunities relative to third party space services and diffused global space capabilities are apparent in many kinds of wars. Furthermore, the influence of spacepower in these examples do not involve spectacular space battles as bluewater thinking and the space weapons literature critiqued in Chapter 2 may have readers imagine. Third parties to a conflict must find their place within it. They can be opportune allies, or liable threats to one's plans. Callwell, Castex, and Mahan make it clear that there can be armed neutrality as well as abused neutrality. This may be true of commercial actors and neutral parties in space, as well as at sea. Third parties and neutrals can be

[89] NATO Allied Command Operations, 'New Satellite Imagery Exposes Russian Combat Troops Inside Ukraine', 28/08/2014, http://aco.nato.int/new-satellite-imagery-exposes-russian-combat-troops-inside-ukraine.aspx (accessed 03/03/2015)

[90] Carol Matlack, 'Putin is Knocking Ukraine's Space Industry Out of Orbit', *Bloomberg*, 11/02/2015, http://www.bloomberg.com/news/articles/2015-02-11/putin-is-knocking-ukraine-s-space-industry-out-of-orbit (accessed 19/09/2015)

[91] For example. see *The Space Review*'s continuing debate on this, whose articles contain lengthy community discussions at the foot of each page: Jeff Foust, 'Replacing the RD-180', *The Space Review*, 12/05/2014, http://www.thespacereview.com/article/2512/1 (accessed 19/09/2015); Anthony Young, 'ULA, Blue Origin, and the BE-4 engine', *The Space Review*, 29/09/2014, http://thespacereview.com/article/2608/1 (accessed 19/09/2015); Jeff Foust, 'The aftermath of a launch failure', *The Space Review*, 29/06/2015, http://www.thespacereview.com/article/2780/1 (accessed 19/09/2015); Wayne Eleazer, 'The engine problem', *The Space Review*, 03/08/2015, http://www.thespacereview.com/article/2799/1 (accessed 19/09/2015)

persuaded, coerced, or co-opted into one's general plans for war, contributing to a strategic manoeuvre.

### 5.2.4 Proposition V Part 4: Logistics – the arbiter of opportunity

Moving on from neutrals and third parties, logistics is the fourth aspect that comes under strategic manoeuvre. Logistics matter not only at sea, but also on land, for the exercising and securing of the command of the sea and conducting a strategic manoeuvre. The same is analogically true for spacepower: logistics matter in space as well as on Earth for securing a command of space and exploiting it. Logistical support from celestial lines of communication matters for wars on Earth in a conceptually similar manner to how logistical support from sea lines of communication can matter for continental wars. Logistical capabilities – as the 'arbiter of opportunity' – allow a belligerent to throw its material weight around. Resources mean nothing if they cannot be used at the right time and place. Henry Eccles argued that logistics can be seen as "the bridge between our national economy and… the combat forces in the field… Sound logistics forms the foundation for the development of strategic flexibility and mobility."[92] Castex considered the importance of logistics when thinking of a coastal theatre - he declared that:

> "[in his own waters, the defender] will be more comfortable than anywhere else – close to his own bases. Near to necessary resupply and repair, he will be able to take advantage of all his resources, even of ships with a short range of action. He will be able to employ readily his special vessels and his aircraft. The enemy far from his bases, a bit "In the air", will be handicapped by the lack of these facilities, especially if the two belligerents are separated by a great expanse of sea."[93]

These advantages of the defence in coastal operations resonate with Clausewitz's ideas on the strengths of the defensive form of war. Transposing Castex's argument about coastal defences, terrestrially-based counterspace weapons will enjoy some logistical advantages over their orbital counterparts, and assets in orbit will have limited manoeuvrability and concealment compared to

[92] Henry E. Eccles, *Logistics in the National Defense* (Harrisburg, P.N.: Stackpole Company, 1959, reprinted 1989) p. 10
[93] Castex, *Strategic Theories…* p. 347

mobile counterspace weapons on Earth. Weapons on Earth may be able to deceive enemy sensors and conceal themselves before firing, as well as manoeuvre after firing, stop for maintenance, and resupply. For example, for targeting satellites in LEO, an air-launched antisatellite weapon (like the F-15 launched missile tested in 1985) means that there is more flexibility in terms of basing and launch times compared to the Soviet co-orbital antisatellite weapons system, which could only launch on demand twice a day to intercept a target.[94] However, this may not *necessarily* be the case should a belligerent's logistics chain be disproportionately dependent on spacelift. Some coastal defences may need a larger degree of communication by sea to remain operational – some Earth-based space weapons may need celestial lines of communication to remain operational, depending on their design, function, and location. The basic point that weapons on Earth will be easier to maintain, replace, and resupply is a useful one and may yet be largely accurate, but not universal law. Concealing and accessing a laser designed to interfere with satellites in LEO may be easier to specialise, upgrade, and operate than a similar weapon based *in* LEO.

Earth orbit may not necessarily be a realm where there is much space-to-space violence or force used as opposed to Earth-to-space weapons fire. There may be cases where the same was true for seapower. The importance of logistical support from a medium where there is no battle of importance was not lost on Callwell. Of Mehemet Ali's wars against the Ottoman Empire in the Levant in the 19th century, Callwell noted that:

> "it was a campaign in which there had been no sea-fight of importance, and in which, till just before its termination, naval operations had been entirely of a passive kind; but it was a campaign which nevertheless hinged upon the question of maritime command from the very outset, and in which, twice over, the transfer of naval preponderance from one side to the other exerted a paralysing influence over the prospects of an army."[95]

[94] Laura Grego, 'A history of anti-satellite programs,' *Union of Concerned Scientists*, January 2012, http://www.ucsusa.org/sites/default/files/legacy/assets/documents/nwgs/a-history-of-ASAT-programs_lo-res.pdf (accessed 03/03/2015) pp. 3-5

[95] Callwell, *Military Power…* p. 322.

The early section of this sentence is extremely prophetic of the strategic and operational landscape the U.S. found itself embroiled in after the collapse of the Soviet Union. Without the persistent and general command of space, and the 'passive space operations' it allowed, it would not have achieved such a significant *degree* of tactical and operational combat successes against Iraq twice over. As time progresses there may be increased efforts to dispute the United States' command of space – it remains to be seen whether Callwell will be equally as prophetic in predicting the point when a 'transfer' or change in 'space preponderance' will confer tactical, operational, or strategic paralysis to the less capable belligerent. Mahan was grasping at this possibility in his narrative of British seapower in its struggle with rebellion in North America – that without maritime superiority, British forces ashore struggled to act decisively.[96]

Seapower theory here illustrates cases where the main theatre was on land; where the majority of fighting took place. Spacepower advocates may have to be content for the foreseeable future to see such analogous strategic behaviour, where there may be little in terms of direct battle *in* space relative to the main theatres of war on Earth. Castex was thinking along these lines and argued that:

> "when the nations at war have common land frontiers, mastery of the sea is, at least in theory, no longer even a necessary condition, since the issue of the hostilities will finally depend on the result of the combat between the land armies. But the command of the sea will most often have a serious effect on the operations of these armies and it will be useful to the power that holds it."[97]

Such thinking lends itself to the Persian-Egyptian war in the 5th century BC, where support from seapower kept Egypt in the fight against the vastly superior Persian Empire until it crushed Egyptian seapower with its own equivalent.[98] Likewise, spacepower can significantly improve the chances of success in terrestrial warfare and providing opportunities to exploit their terrestrial advantages over those of the enemy, as explained in Proposition III where spacepower is an enabler for terrestrial forces and a team player. Therefore, logistical support from space can be theorised in line with the

[96] Mahan, *Influence…* p. 400
[97] Castex, *Strategic Theories…* p. 48
[98] Gregory Gilbert, 'Persia: Multinational Naval Power', in: Andrew S. Erickson, Lyle J. Goldstein, Carnes Lord, eds. *China Goes to Sea: Maritime Transformation in Comparative Historical Perspective* (Annapolis, M.D.: Naval Institute Press, 2009) pp. 5, 12

continental school, and there are some arguments already expressed in spacepower theory literature with regard to space logistics support and space as strategic depth.

Sheldon criticised many writings within a U.S. doctrinal school of 'space control' because of frequent omissions of the real-world problems of logistical shortcomings in adapting space infrastructure to any given threat.[99] In today's conditions "space power logistics is therefore concerned with the ability to launch on demand without fear of enemy interdiction, and also to freely use datalinks without fear of interference."[100] Engaging in space warfare *in orbit* – that is, with space-to-space weapons – is too logistically taxing to be reliable and responsive to operational and tactical demands. Sheldon raises the logistical burdens of running satellite constellations and space surveillance networks (SSN), with ground stations across the world having to be staffed and supplied. Such duties may become burdensome during a time of war, even though they are for the most part Earth-based.[101] The term communication, within celestial lines of communication, refers to the routes of material supply as well the routes of data transfers and satellite orbits.[102] This view of logistics substantiates Sheldon's argument that:

> "logistics are "the arbiter of opportunity," and thus "set the stage upon which strategists act, and therefore ranks among the factors which decide the course and outcome of war." As things are, the logistical chain that supports the space power of a number of states is tenuous at best, and so commanders cannot look upon current launch capabilities as an arbiter of opportunity, in the sense of "what commanders might hope to do (opportunity) and how they might assemble the means to do it (logistics)."[103]

If logistics are the arbiter of opportunity, it must be appreciated how inflexible logistical capabilities are at any given time. David Lupton argued that satellite constellations "have more of the attributes of fixed fortifications whose position is known than of maneuvering forces whose future

[99] Sheldon, *Reasoning…* pp. 47
[100] Ibid., p. 173
[101] Ibid., p. 174
[102] Ibid., p. 175
[103] Ibid., p. 318

position is in the mind of the commander."[104] Managing a comprehensive surveillance system of what is in Earth orbit can be logistically taxing, despite it being an activity that takes place with many Earth-based installations. For example, the United States Air Force Space Command Space Surveillance Network (AFSPC SSN) maintains at least 40 Earth-based sensors. Some are based beyond U.S. territory, such as in the United Kingdom, Norway, the Marshall Islands, Spain, Greenland, and Diego Garcia.[105] Russian surveillance sites tend to remain within the Commonwealth of Independent States (CIS).[106] The collection of European space surveillance sensors, other than on mainland Europe, extend to Svalbard, Chile and Tenerife.[107] It should be noted here that European spacepower thinking will have to consider that its only launch site is in French Guyana, and seapower will directly apply in keeping that spaceport strategically viable. China has a range of sensors on its mainland, operates six *Yuan Wang* space tracking ships, and has tracking facilities in Pakistan and Namibia.[108] The U.S., European Space Agency (ESA), and China all have various tracking and monitoring stations in Australia.[109] This could indicate a potential conflict of interests within Australia's space support assets and policies should the United States and China wish to undermine each other's space systems.

Many more states have space surveillance capabilities of some kind, including many dozens of satellite laser ranging sites, many of which are outside of the territories of the major space powers.[110] This brief sketch of various space surveillance network (SSN) sites, which are not necessarily control sites, demonstrates the potential problems of logistical chains in supplying far-flung outposts for spacepower. Furthermore, it also helps illuminate the potential significance of complications relating to third parties. Mahan's seapower theory did not ignore the issues of ports and

[104] David E. Lupton, *On Space Warfare: A Space Power Doctrine* (Montgomery, A.L.: Air University Press, 1988) p. 20
[105] David A. Vallado and Jacob D. Griesbach, 'Simulating Space Surveillance Networks', Paper AAS 11-580 presented at the AAS/AIAA Astrodynamics Specialist Conference. 31/07/11-04/08/2011, Girdwood, AK. Available at: http://www.agi.com/resources/user-resources/downloads/white-paper.aspx?id=144, p. 4
[106] Ibid., p. 6
[107] Ibid., p. 7
[108] Ibid., pp. 8-9; and: GlobalSecurity.org: 'Chinese Space Facilities', http://www.globalsecurity.org/space/world/china/facility.htm (accessed 10/07/2014)
[109] Agence France-Presse, 'China has Australia space tracking station: report', *SpaceDaily*, 05/11/2011, http://www.spacedaily.com/reports/China_has_Australia_space_tracking_station_report_999.html (accessed 10/07/2014)
[110] Vallado and Griesbach, 'Simulating Space…' esp. p. 13

supply stations for the logistics of a global industrial navy – but it does not substantiate it enough in such a way as to provide useful analogical strategic concepts to spacepower, unlike Castex and Callwell's ideas on the influence of sea-based logistic support to land warfare, and vice versa.[111]

When a commitment to war is made, a spacepower must fight with the space infrastructure it has and what is due to be deployed in the near future. Ad-hoc expedients and deal-making with third parties or allies may be worked out faster than developing sovereign space systems, but again any extra capability will be restricted to what third parties have and are willing to supply. The inability of space logistics to meet changing demand and respond to crises overnight was apparent in Operations DESERT SHIELD and DESERT STORM. General Horner, chief of the air component of U.S. Central Command, requested more reconnaissance satellites to help enable more flexible and responsive air operations with real time data. But it would take six to twelve months to fulfil his request as satellites were built to order along with their launch vehicles.[112] Although some emerging technologies – such as air-launched small satellites and three dimensional printing – might provide some flexibility and responsiveness in LEO – for the foreseeable future the bulk of critical space infrastructure is met by large satellites (the mass of which is measured in tons) and with highly intricate rocket systems that take years from the ordering phase to the first seconds of operation.[113] The length of time required for replacements of large, bulky, hardware for spacepower is a similar to that of contemporary seapower. Changes in logistics will alter the potential and character of spacepower, but not its nature. Limits to logistical capabilities will remain, and this aspect of strategic manoeuvre highlights such concerns to the reader. Executing a strategic manoeuvre with space infrastructure may remove options for conducting others, given the physical constraints on satellites.

Yet manoeuvring satellites is not impossible. Recently, a Russian satellite – *Olymp* (designation *Kosmos*-2501) – appears to be moving in concert with Russian warships on Earth's oceans. In February-June 2015, the *Olymp* was 'parked' in GEO at 96.4° East (off the western coast

[111] Mahan, *Influence…* pp. 8, 514
[112] Handberg, *Seeking…* p. 90
[113] That said however, investment continues in the U.S. private sector on small satellites and cheaper launch options. See: Jeff Foust, 'New options for launching smallsats', *The Space Review*, 26/08/2013, http://www.thespacereview.com/article/2356/1 (accessed 04/03/2015)

of Sumatra), which coincided with the visit of the submarine destroyer *Admiral Panteleev* to the Indian Ocean, which returned to Vladivostok in August. However, by 25th June *Olymp* had moved to 18° West, above the Atlantic Ocean and to the south of western Africa. This 'coincided' with the visit of the *Moskva* missile cruiser in a joint Russian-Egyptian naval exercise in July, which included the test-firing of a cruise missile at sea. *Olymp* began moving again after the *Moskva* returned to Sebastopol in August. Anatoly Zak concludes that if these events are not coincidental, such a satellite may be used to relay data in the Russian Navy, and to manage data from and to precision weapons.[114] Such a satellite, using low-thrust but high-efficiency Hall plasma thrusters, may be able to move slowly but repeatedly and consistently to maintain a lengthy operating lifespan for operations that can wait for satellite movement in GEO that moves by a few degrees over the Earth's surface per day. This demonstrates not only how *some* aspects of space infrastructure and logistics can be flexible, but also how strategic manoeuvre in space can support terrestrial operations. For optimal efficiency and precision strike capabilities, the Russian Navy's modernised systems may need such responsive satellites to be in place, if a permanent constellation is not to be placed in GEO.

The successful harnessing of the logistics chains contributing to spacepower allows for the greater exploitation of spacepower's enabling and enhancing capabilities for terrestrial warfare. This essentially contributes to a strategic manoeuvre that rests on a degree of the command of space (Proposition I) which uses or denies relevant celestial lines of communication (Proposition IV). Logistics, being an arbiter of opportunity, fits very comfortably within a larger notion of strategic manoeuvre, which aims to provide better chances of success in war even though logistics itself is not concerned with combat. Secure and efficient celestial lines of communication enhance the capabilities of modernised terrestrial forces, creating a form of strategic depth and more opportunities for strategic manoeuvre. This is exploiting a degree of the command of space when a belligerent depends upon an elaborate space infrastructure. But exploiting the command of space is not restricted to using an entrenched and mature space infrastructure; exploiting the command of space can also mean taking advantage of the loss of that infrastructure against an enemy that depends on it. This is a helpful

[114] Anatoly Zak, 'Proton successfully returns to flight delivering a secret Olymp satellite', *Russian Space Web*, updated 19/10/2015, http://www.russianspaceweb.com/olymp.html#mission (accessed 21/10/2015)

reminder as to why it is useful to use the term 'command of space' which also includes 'space control' and 'space denial (Proposition I).

Spacepower can be used for strategic manoeuvres (exploiting the command of space to gain logistical advantages, coercing or co-opt third parties, exploiting the economics of spacepower, and making Earth orbit hostile to the enemy) in terrestrial wars by stronger and weaker powers. Just as a stronger power may want to command space to secure logistical advantages, a weaker one may want to command space locally and temporarily in order to cut the enemy's space-dependent logistical lines. Another possibility could be a 'lucky hit' in an all-out strike on an enemy's space infrastructure at the outset of conflict to hamstring deployed forces and compromise their supporting echelons and supply routes. Strategic manoeuvre with spacepower can help increase the odds of overall success of military operations on Earth. The efficacious exploitation of a command of space for some degree of strategic result – *to conduct a successful strategic manoeuvre* – can make up for deficiencies elsewhere. In other words, strategic manoeuvre is also the exercising of strategic depth – the final aspect of strategic manoeuvre.

### 5.2.5 Proposition V Part 5: Strategic depth from space

Spacepower can form strategic depth in a strategically analogous way to seapower. Mahan provides a useful illustrative example of Dutch seapower in the Franco-Dutch War in the late 1670s. Of the war, Mahan notes that:

> "Holland, for whose destruction Louis began the war, lost not a foot of ground in Europe; and beyond the seas only her colonies on the west coast of Africa and in Guiana. She owed her safety at first, and the final successful issue, to her sea power. That delivered her in the hour of extreme danger, and enabled her afterward to keep alive in the general war. It may be said to have been one of the chief factors, and inferior to no other one singly, in determining the event of the great war which was formally closed at [Nijmegen]."[115]

[115] Mahan, *Influence…* pp. 168-169

The Netherlands' ability to harness its seapower to support its war against France prevented it from being overrun, even though France was much more powerful in every respect on land. Dutch seapower prevented the French from flanking the stalled land fronts via the sea – although the Dutch lost some colonial possessions. In addition, the alliances the Dutch had formed ensured that there would be no landward flanking which would have decisively ended Dutch resistance. Though seapower by itself was not necessarily decisive in saving the Netherlands from French invasion, Mahan's description certainly illustrates the value of seapower as strategic depth, making up for deficiencies elsewhere. As a single factor, seapower was not inferior to any other for the Netherlands' survival. The outcome was a joint effort, where seapower proved to be a crucial adjunct to dealing the landward strategic threat. Callwell was thinking along the same lines when he argued that:

> "the tactical and strategical advantages enjoyed by a military force operating with its back at the sea, in possession of a suitable port, and fortified by naval power, are immense. The flanks are secure. Retreat in case of reverse is assured. There can be little or no anxiety as to supplies. Friendly warships may be able to afford assistance in actual battle."[116]

Of course, in the case of the Dutch, retreat on land may not be a feasible option for an entire population, but the point of the sea providing numerous advantages that combine to create some strategic depth to assist in land warfare is still useful.

Israel's use of spacepower for strategic depth is conceptually analogous to the example of Dutch seapower above. Harnessing strategic depth from space can provide great advantages akin to enjoying a high ground, although "just as the advantages of operating in the orbital high ground can be exaggerated, so are the penalties."[117] Sheldon is right to criticise the use of the notion that space is a high ground. Stating it is a high ground is not enough as there are penalties and limits to achieving a presence in orbit, much like declaring spacepower as a centre of gravity, and consequently suffers the same problems, as critiqued in Proposition III. Indeed, using space can be a useful 'high ground' that provides military advantages, but there is more to winning wars and defending interests than sitting on

[116] Callwell, *Military Operations…* p. 297
[117] Sheldon, *Reasoning…* p. 76

a high hill, though the possession of that hill may certainly help. Proposition VII also uses the concept of the centre of gravity to qualify those statements further. Sheldon is right in some cases that remoteness is an aspect that limits the usefulness of Earth orbit, but that remoteness is more to do with the economic and technological limits of accessing space.[118] However, when considering Proposition VII, of the effects of spacepower on Earth, with the notion of a cosmic coastline in this proposition, Earth orbit should not be seen as remote from Earth in every sense.

The real limitation of thinking of space as a high ground is that it cannot directly apply force to wars on Earth. To paraphrase Sheldon's wording – spacepower today cannot come to grips with terrestrial power, whereas the opposite is true. But the notion of spacepower as a provider of strategic depth is extremely useful and Sheldon rightly explores it. Sheldon asserts that spacepower "can provide a global presence that can be turned into strategic depth," which is "conditional upon the occupation of the orbital high ground, and, to a degree, the extent to which global access and presence can be translated into tangible military force on Earth. Strategic depth, or lack thereof, is the ability to trade space for time."[119] Whether or not spacepower will one day be able to 'come to grips with itself', the idea of spacepower as a provider, or even denier, of strategic depth will remain useful. Indeed, a successful use of spacepower in a space denial campaign may deny an enemy's reliance on space as a provider of strategic depth.

Sheldon makes a brief land warfare analogy to the Soviet Union's ability to harness its vast geographical size to trade space for time, utilising its land-based strategic depth. Sheldon goes on, after applying a strategic depth of space to Israel, to add:

> "the type of strategic depth proposed here is one on the vertical flank that can augment, or even enhance, depth along the horizontal flank on Earth. Early thinking on space power and strategic depth took the concept perhaps too literally… Strategic depth as meant in this dissertation may have its head in orbit, but its feet are firmly rooted on the ground. This attribute exploits the

[118] Sheldon, *Reasoning…* p. 75
[119] Ibid., p. 81

> vastness of orbital space in order to augment and enhance strategic depth on Earth, and can apply to states of all kinds of geographical dispositions."[120]

Israel, a small territory in a tumultuous region where the use of force is all-too common, can make up for its small stature in territorial and demographic size through high technology armed forces that depend on spacepower – a form of strategic depth. Under present techno-economic conditions, strategic depth from spacepower does not mean a retreat into deep space from Earth orbit as land or naval forces could retreat elsewhere. Sheldon argues that the strategic depth provided by various space systems, when used competently in a combined-arms and grand strategic effort, can make up for deficiencies elsewhere through buying time, not necessarily falling back into deeper territory. Israel can make its forces more rapid, mobile, responsive, efficient, accurate and survivable. The increased speed of decision from spacepower-supported forces harnesses a faster form of the 'OODA loop' (Observation, Orientation, Decision, Action) to outmanoeuvre the enemy and increase the tempo of operations to a pace where the enemy will always be reacting to, rather than setting, the agenda on the battlefield. An OODA loop involves processing cycles of information gathering and decision-making in order to act as fast as possible with the most accurate and timely data about the enemy. The faster the loop, the more effective-per-unit that force is, or so the logic goes.[121] Another way of looking at this is through closely integrating and speeding up the "sensor-to-shooter cycle" by gathering and transmitting real-time data on mobile targets to weapons platforms and deployed forces. Between 1991 and 2003, certain U.S. reconnaissance-to-strike speeds shortened from three days to less than 40 minutes, with some specialised units being able to attack targets in less than twelve minutes after identification. Ground-attack aircraft could, for the first time, launch in the general direction of hostilities or target areas and receive target data whilst en-route.[122]

This greater speed and efficiency of terrestrial assets through space support adds to and creates strategic depth. But a faster OODA loop or sensor-to-shooter cycle does not guarantee

[120] Ibid., pp. 82-83
[121] Norman Friedman, *Seapower and Space: From the Dawn of the Missile Age to Net-Centric Warfare* (Chatham: London, 2000) p. 131
[122] Keith L. Shimko, *The Iraq Wars and America's Military Revolution* (New York, NY: Cambridge University Press, 2010) pp. 164-165

strategic success – what if the enemy can absorb the concentrated pin-pricks of a fast and lethal force? What if this fast, lethal, but light force cannot absorb the hammer blow from a large enemy force? What if the enemy disperses to the point where targets are not forthcoming for the sensors? What if winning a war depends on the occupation of a hostile population or a large territory? Whilst it is true that through relatively greater transparency on the battlefield and force enhancement, per-unit combat capability and lethality (especially in terms of stand-off munitions) increases, and can compensate for small force numbers and assist fast decision-making, it still has its weaknesses that *could* be exploited. As mentioned in Chapter 2, these possibilities for space-supported forces using miniaturised information technologies are what encouraged many analysts to claim an RMA was in progress in U.S. military forces by the 1990s, where high-technology networked forces were meant to be more lethal yet smaller in size. Indeed, space technology is integral to such a technology-driven change in the character of armed forces.[123] Early warning and information capabilities (including but not limited to space-based information) can all build strategic depth. Such an observation has clear connections to a generic idea of 'strategic manoeuvre' – turning secondary-tier theatres (e.g. Earth orbit) into advantages that can be brought to bear on the primary theatre (e.g. the land, sea, and air on Earth).

Spacepower can provide strategic depth for offensive and defensive purposes. Space systems may be able to deliver greater force protection through early warning to terrestrial forces, and spacepower may enable a more efficient deployment of forces for a general defence.[124] For example, the integration of Defense Support Program (DSP) satellite terminals with the warning systems on Patriot tactical ballistic missile defence units in the 1991 Gulf War could have reduced the time taken to assess a threat from five minutes to 90 seconds out of a total Scud missile flight time of seven minutes.[125] Although American wars since the end of the Cold War demonstrated the emergence and maturation of modernised forces enjoying space support on the offensive, strategic depth can be used as an advantage for defensive and offensive operations. The advantages gained by strategic depth (be it geographic size, hostile terrain, popular resistance, superior lethality and mobility, unassailable

[123] Handberg, *Seeking…* p. 17
[124] Sheldon, *Reasoning…* p. 86
[125] David N. Spires, *Beyond Horizons: A Half Century of Air Force Space Leadership* (Montgomery, A.L.: Air University Press, 1998) p. 255

internal or rearward lines of communication) whilst on the strategic defensive is one of the reasons why Clausewitz believed in the defensive as the stronger form of war, with the intent of weathering the initial blows to gather strength from whatever advantages and remaining capabilities one has for a devastating strategic counterattack.[126]

Strategic depth - especially in the sense it can harness superior logistical capabilities, mobility, coordination, and provide opportunities for timely and flexible responses through co-ordinated command and control - via space can be easily strategised in a notion of strategic manoeuvre, to change one's disposition favourably in one place to positively influence another theatre. Such a strategic depth requires space infrastructure to be correctly-placed and in an operational status by the time war arrives, which may not always be the case, as encountered in Proposition VII.

Harnessing spacepower within strategic manoeuvres relates a large range of space capabilities to grand-strategic thinking and planning when the bulk of today's character of spacepower is in *contributing* to force efficiency, information, and force postures on Earth. Spacepower, like the wise exploitation of seapower, and airpower, can contribute to strategic depth and chances of overall success as supplements to landpower - to influence people and their institutions where they live. Sheldon is a trail-blazer for spacepower theory with his work on strategic depth in spacepower. It is difficult to disagree with his conclusion that "the combination of critical strategic enablement, ubiquity, and the establishment of a vertical strategic depth, all ensure that the seat of space power at the strategic table is assured."[127] This part of Proposition V has fleshed out how space commerce, reconnaissance, and logistics conceptually contribute to strategic depth, and then relates strategic depth to a larger view of Earth orbit as an adjacent medium that belligerents can use to conduct strategic manoeuvres to support efforts in other theatres of war.

[126] Sumida, *Decoding…* p. 46
[127] Sheldon, *Reasoning…* p. 303

## Conclusion: Proposition V within the seven propositions

"The noiseless, steady, exhausting pressure [of spacepower,] cutting off the resources of the enemy while maintaining its own, supporting war in scenes where it does not appear itself, or appears only in the background, and striking open blows at rare intervals, though lost to most, is emphasized to the careful reader." – Alfred Thayer Mahan[128]

As argued in the previous chapter, that the 'Mahan for space' may already be Mahan himself. The passage above crystallises how significant aspects of spacepower manifest today; and illustrates a permanent facet of it. Strategic manoeuvring in the coastline of Earth orbit is the universal element of spacepower that underpins Proposition V. Castex's idea of 'strategic manoeuvre' is a thread to tie in visions of how spacepower can act as a hostile coast, how economic space warfare relates to a wider war effort, and where neutrals, logistical support, and strategic depth through spacepower fit into spacepower theory. With such a vast array of possible events and actors – a mass of phenomena – included in these parts of Proposition V, these categories help anchor strategic thought about them, to distil them to their barest essentials for critical inquiry and strategy-making. All five parts of strategic manoeuvre make sense together when space is considered an adjacent realm, and as a secondary theatre to terrestrial wars including how continental powers may view seapower. Subtle actions in one geography can affect another, as much or as little as overt and destructive acts, owing to the non-linear understanding of war as understood in Chapter 3. Astroeconomic warfare, the actions of neutrals and third parties, logistics chains, and strategic depth through space only matter in the way they act as useful tools against enemy weaknesses in any terrestrial war. This stresses the adjacency of Earth orbit. Imagining the relevant sectors of Earth orbit as a hostile coast, and Earth-based counterspace weapons (anti-satellite lasers, jammers, kinetic-kill and so forth) like coastal defences which made close-to-port operations extremely dangerous by the late 19th century, throws doubts on imagining Earth orbit as an open ocean as one would with a bluewater seapower analogy. A belligerent has a 'space coast' which can be turned into hostile zones for satellites if counterspace weapons are effectively used or threatened.

[128] Mahan, *Influence…* p. 209. "Spacepower" has replaced "sea power" in the original.

Spacepower provides a crucial connecting mesh for military capabilities that use precision weapons and networked units. Therefore, the status of the command of space and its exploitation can directly and indirectly influence the relative strategic dispositions of combat capabilities on Earth. A space-supported force on Earth that can draw on a reliable command of space and strategic manoeuvres can impose dispersal on its enemies, and is explored further in Proposition VII. Reduced combat efficiency for unsupported terrestrial forces enhance a space-supported force's combat advantages on Earth, exemplifying Castex's principle of using strategic manoeuvre to enhance prospects in a different theatre of operations.

This means that much of space warfare is about the command of space (Proposition I) in order to use (or deny) celestial lines of communication (Proposition IV) which allows (or inhibits) spacepowers to conduct strategic manoeuvres (Proposition V) in order to impose (or challenge) the dispersing effects of spacepower on terrestrial wars (Proposition VII). The logic train above is not the only order spacepower can be exercised in, but it is the clearest expression of the constructive propositions (I, IV, V, and VII) acting together. In addition, the exact manifestations of each will vary greatly like Clausewitz's secondary trinity of people, army, and government which is a particular manifestation of the primary trinity of passion, chance, and reason.

Seeing spacepower through strategic manoeuvre can be interpreted as merely a call for spacepowers to be flexible in their use of it and in their logistical management of celestial lines of communication. That is true to a certain extent. However, Henry Eccles made a vital point that such declarations of flexibility are not enough for competent strategists. He argued that "if full flexibility is to be achieved [commanders] must have the type of intuitive understanding that results from a thorough analysis of the objective and the mission of the command."[129] Strategic manoeuvre helps highlight universal themes that may improve the intuitive understanding of all that may be possible in a scenario. The fact that strategic manoeuvre, taking place in the adjacent coastal realm of Earth orbit, is virtually in the middle of the seven propositions helps underscore the point that mastering strategic manoeuvre via space is a *means* connecting the command of space (Proposition I) to tangible effects

[129] Eccles, *Logistics…* p. 118

on terrestrial warfare, usually via dispersion and strategic transparency (Proposition VII). Useful strategic manoeuvres, utilising flexibility and strategic depth through spacepower, must be mindful of the overall objectives and contributions of spacepower, and should not be done for their own sake. The success of manoeuvring is always in conjunction with other factors in a war, and is rarely in itself advantageous or disadvantageous, as Clausewitz argued. Much depends on the actual situation at hand and the people doing it. Clausewitz declared that:

> "we are convinced that there are no rules of any kind for strategic maneuvering; that no method, no general principle can determine the mode of action; but that superior energy, precision, order, obedience, intrepidity in the most special and trifling circumstances can find the means to create for themselves signal advantages."[130]

No matter how propositions I, IV, V, and VII are manifested in reality, each of them will have some form of influence on the dispersing effects of spacepower on terrestrial warfare (Proposition VII). Against propositions I, IV, V, and VII, the remaining propositions appear as caveats that are meant to prevent logical absolutism. Propositions II and III crystallise the point that although space provides unique characteristics and opportunities, it is not a panacea from terrestrial ills and is a team player. Furthermore, spacepower is not necessarily an independent war-winner. The last remaining major caveat is where the next chapter begins. Proposition VI argues that spacepower is also influenced by strategic culture and internal politics.

[130] Clausewitz, (Jolles) *On War…* p. 857

# Chapter 6: Culture, Ambition, and Space: Proposition VI

## Introduction: Proposition VI: Spacepower finds itself within a geocentric mindset, and may outgrow it.

"Whether the battleship or the submarine is the implement in use, it is on the men who handle it that everything depends in the end." – G.A. Ballard[1]

"In the United States and much of the world, both the culture and the economy are inextricably dependent on accurate, uninterrupted GPS service. Millions of people take it for granted with little or no understanding of its operation or potential problems." – Richard Easton and Eric Frazier[2]

This chapter examines the sixth propositions of spacepower theory. Proposition VI does two things: it is an exploration of the Earth-bound cultural aspects of spacepower and strategic behaviour, but it is also a signpost into the 'domestic hinterland' of inter-state wars and the internal politics of belligerents more generally. Cultural traits and the political or bureaucratic ambitions of individuals are still relevant to the space strategist. Proposition VI also raises the possibility of the emergence of space strategic culture as humans continue to operate in the unique environment of outer space. Cultural aspects of strategic behaviour matter for terrestrial warfare and politics, and the same is true for space warfare. The treatment of Clausewitz's trinity in Chapter 3 gave enough insight for spacepower theory on the psychological and political aspects of war, along with human passions, but cultural varieties in the ways and means of warfare have yet to be encountered in this spacepower theory in any great detail. In addition, these two propositions continue from Proposition V in that they are the most original contributions to spacepower theory. Proposition VI takes established thinking on strategic culture and considers their interaction with spacepower. Even in space warfare, where so much is determined by technological, industrial, economic, and scientific capabilities, humans and their cultures still matter for spacepower in the same manner that space warfare is a continuation of Terran politics in Chapter 3. Space warfare and the use of spacepower can express cultural traits.

[1] G.A. Ballard, *The Influence of the Sea on the Political History of Japan* (John Murray: London, 1921) p. 296
[2] Richard D. Easton and Eric F. Frazier, *GPS Declassified: From Smart Bombs to Smartphones* (Potomac Books, 2013) pp. 187-188

Indeed, war can be waged in surprising ways, and forecasting the character of war cannot be reduced to its technological and economic aspects.[3] As Gray argues, "future technology is no more synonymous with future warfare than past technology carried the complete story of war's history."[4]

As Easton and Frazier argue above, spacepower, and the resulting technologies outside of the military, has accelerated a global spread of communications, and accessibility to data. Politics, society, organisations, and cultures are products of humans living on Earth and dealing with its environmental constraints. Yet humanity's existence on Earth has lately been influenced by spacepower. Proposition II stressed how humanity takes its political-cultural baggage to outer space. Proposition VI argues that using the space environment, however, may simultaneously have political-cultural impacts on Earth. Despite this, what happens in space will only ultimately matter for (ways of) life on Earth. This is what is meant as a geocentric mindset. The military services that use space carry their Earth-bound cultures into space with them, and use space with Earth as their central geographic and cultural reference point. This is the cultural consequence of the continental analogy from Proposition V – that the space powers of today are Earth-based powers that use spacepower for terrestrial wars (analogous to continental powers using seapower). Cultural attitudes, constructs, and preferences pervade strategic behaviour, and the use of spacepower may allow forms of strategic and military space culture to develop – a code of assumptions, beliefs, mental toolkits and habitual thinking and practice that are formed within groups and military services through extensive practice in spacepower. This proposition is not a definitive statement on strategic culture, or the strategic and military cultures on Earth regarding space activities. Rather, it is to show how spacepower can exploit and suffer from the cultural attitudes and internal politics of any belligerent that may or may not use it. Belligerents, and the armed organisations and elites within them, can be said to have strategic and military cultures that can influence their behaviour alongside other factors such as psychology, material conditions, and chance. Geocentrism is used here as an organising term denoting the role of cultural attributes and internal politics to considerations of spacepower.

[3] Colin Gray, *Another Bloody Century: Future Warfare* (London: Weidenfeld & Nicolson, 2005) p. 100
[4] Ibid., p. 106

This proposition proceeds as follows. First, it establishes a brief exploration of ethnocentrism, and strategic and military cultures. Second, it uses the referent objects of strategic and military culture as a route into the internal politics of continental navies and their landward masters, and analogises some of those themes into potential problems for military space services in Earth-based powers. Proposition VI culminates by using the themes of parts 1 and 2 to examine the internal politics and potential sources of strategic and military space culture in the U.S. military. The United States Air Force (USAF) has an extensive space-centric body of expertise, and its interaction with the rest of the military machine is an illustration of outer space influencing thinking and practices of warfare.

## 6.1 Proposition VI: Part 1: Ethnocentrism and strategic culture

"A culture's teachings, and most importantly, the nature of its people, achieve definition in conflict. They find themselves… or find themselves lacking." – Kreia[5]

The way people, groups, and organisation do things in war, as well as why they do them, are as much cultural affairs as they are political. The cultural aspects of a polity's warfare, or even of leaders, are sometimes seen as definitive of their group's characteristics. The stresses of war can unleash powerful political forces (as explored in the Trinity in Chapter 3) that can reinforce or alter entrenched cultural attitudes to political violence and the legitimacies of any kind of government. As Kreia's words above allude to, cultural attitudes to warfare can be a help or a hindrance to a war effort. Furthermore, culture can be a consequence of strategic experience. Culture is referred to here as "ideals, attitudes, ideas, habits of mind, and… behaviour" that tend to be seen as characteristics in groups of humans.[6] In addition, "culture consists of shared decision rules, recipes, standard operating procedures, and decision routines that impose a degree of order" on the view of individuals and groups with their environment."[7] This section first outlines the problems of ethnocentrism, and then describes strategic and military culture. These three things, collectively, illuminate the useful universal observation that not all belligerents are necessarily the same and will possess degrees of

[5] Kreia, in: *Star Wars: The Knights of the Old Republic II: The Sith Lords* (LucasArts, 2004)
[6] Gray, *Another…* p. 88
[7] Alastair Iain Johnston, *Cultural Realism: Strategic Culture and Grand Strategy in Chinese History* (Princeton, N.J.: Princeton University Press, 1995) p. 35, taken from: Alastair Finlan, *The Royal Navy in the Falklands Conflict and the Gulf War: Culture and Strategy* (London: Frank Cass, 2004) pp. 3-4

uniqueness as well as similarities. This part provides the conceptual context for the next part of Proposition VI which explores the internal struggles of belligerents as strategic theory sometimes can omit politics and strife inside belligerents in favour of focusing on inter-belligerent strife.

As mentioned in Chapter 2, ethnocentrism can unintentionally shape analyses. Ken Booth argued in 1979 that "if culture is a major factor in strategy, it therefore follows that cultural appraisals (and distortions) will also be of great significance."[8] Ethnocentrism can be viewed as the perception of one's own group as being the most important, superior, or the 'normal' yardstick by which to measure others.[9] Ethnocentrism can also be unintentional. Keeping ethnocentric bias in check means that U.S. spacepower should not be seen as a gold standard by which to imagine what a comprehensive space power should look and behave like. An understanding of how the enemy may think and act is no doubt useful,[10] though it is fraught with risks of ethnocentrism, stereotype, and prejudice.

As well as the risk of mirror-imaging or using oneself as a 'normal' reference point, there is the risk of viewing the enemy as different in pejorative and condescending terms that may reflect prejudicial agendas, and at worst social Darwinism. Sometimes, diverse strategic actors may mimic one another's behaviour in war or conform to a continent-wide style of warfare, such as in the Anglo-Norman campaigns against the Welsh kings in the 11th to the 13th centuries. Welsh armies in this period have often been erroneously characterised as "ferocious but undisciplined and incapable of facing 'professional' armies," whilst historical truth may in fact be that "Welsh and Norman commanders worked along similar, recognizable strategic and tactical principles."[11] Keeping ethnocentrism in check, then, means that the best effort at understanding belligerents *as they are* must be the gold standard for analysis in strategic studies. The similarities *and* differences between actors must be recognised. Any attempt to perceive similarities should not be seen as inherently ethnocentric and any declaration of significant cultural differences in their ways of warfare as accurate, as the Welsh example shows.

[8] Ken Booth, *Strategy and Ethnocentrism* (New York, N.Y.: Holmes and Meier, 1979) p. 14
[9] Ibid., pp. 14-15
[10] Sun Tzu, *The Art of War*, Thomas Cleary, trans. (London: Shambala, 1988) p.53
[11] Sean Davies, *Welsh Military Institutions, 633-1283* (Cardiff: University of Wales Press, 2004) pp. 89, 260

Just as no strategic theory with claims to universal applicability should fixate upon any entity, spacepower theory should not be based on the notion that one kind of spacepower fits all users of spacepower. Spacepower theory itself should not become intertwined with a status quo mentality of international politics. Spacepower theory is not just for the satisfied powers of a 'global order.' Booth described "Anglo-American strategic theory [as] a coherent set of interrelated beliefs about international order and its preservation."[12] But such a view of strategic theory limits its relevance and restricts strategic creativity in the mind of the individual. Indeed, with the dominance of Clausewitzian thought in so-called 'Anglo-American' strategic theory, Booth himself falls foul of ethnocentrism by omitting a Prussian influence in strategic studies in the English-speaking world. Furthermore, strategic theory travels. Michael Handel saw more commonalities than differences between strategic theorists from diverse times and places, including the theorists Sun Tzu, Machiavelli, Jomini, Clausewitz, and Mao Zedong.[13]

Curbing one's ethnocentrism is done through appreciating the diversities and commonalities of strategic and military cultures within actors and how practicing warfare can be influenced by culture. Strategic culture is thought of here as a loose concept that refers to cultural biases that may influence preferences for certain actions over others.[14] There is no universally 'right' answer to strategic or military problems, beyond whatever gets the job done, and culture can shape such solutions.[15] This means that although all spacepowers need to develop some form of rocket vehicles and basic satellite competencies, the ultimate ways, ends, and means of all of these objects can vary. For example, there is no reason to assume that Chinese reconnaissance satellites, such as the *Yaogan* series, will mirror the United States' equivalent technical capabilities as provided through the National Reconnaissance Office (NRO). The *Yaogan* series of satellites may have been built on universal technical-economic principles. Yet the structures governing their use and the analysis of the information they collect is bound up in the practices and internal politics of the Chinese leadership and its military and intelligence community, all of which can differ greatly from U.S. practice. These

[12] Booth, *Strategy…* pp. 22-23
[13] Michael I. Handel, *Masters of War: Classical Strategic Thought* (Abingdon: Frank Cass, 2001) esp. pp. 41-80
[14] Gray, *Modern Strategy…* pp. 141-148
[15] Ibid., p. 259

reconnaissance satellite programmes are in part results of strategic perceptions of needs and threats that cannot be divorced from strategic culture. In a wider sense, the manifestations of reason, passion, and chance influence threat perceptions that are in turn factors in shaping satellite reconnaissance programmes.

Any nuanced appreciation of this spacepower theory will take into account the reason, passion, and chance of war, which means that qualitative analysis of the political realm must be included in space warfare calculations, as argued in Chapter 3. If international and domestic societies shape states in powerful ways, and that the state is a social actor that is embedded in "social rules and conventions that constitute its identity and the reasons for the interests that motivate" them, culture adds another (im)ponderable factor for strategists seeking to develop specific war plans and strategies utilising spacepower.[16] It cannot be assumed that Beijing will deploy and use its antisatellite weapons in the same manner that Washington or Moscow would, despite the basic rudimentary technologies being very similar. Norman Friedman noted how U.S. and Soviet approaches to integrating spacepower and disseminating space data in the 1980s differed between them (the former being more distributed and the latter more centralised), despite the basic space technologies being the same.[17] This demonstrates how there may be cultural and bureaucratic factors inside the mix of political, economic, and technological reasons for these preferences and differences despite many base technologies being similar.

Viewed as a toolbox or cognitive shortcuts that can influence the ways that groups and individuals make cognitive shortcuts to handle a mass of data, strategic culture becomes another factor for strategists to ponder considering how to match ends and means, and to anticipate the responses of the enemy.[18] As spacepowers, militaries, and societies at large, and more importantly, the people in them, confront strategic problems, the residual cultural attributes and experiences of those

[16] Peter J. Katzenstein, "Introduction" in: Peter J. Katzenstein, ed., *The Culture of National Security: Norms and Identity in World Politics* (New York, N.Y.: Columbia University Press, 1996) p. 23

[17] Norman Friedman, *Seapower and Space: From the Dawn of the Missile Age to Net-Centric Warfare* (London: Chatham, 2000) p. 181; on the operational turn in U.S. space support, see: David N. Spires, *Beyond Horizons: A Half Century of Air Force Space Leadership* (Montgomery, A.L.: Air University Press, 1998) pp. 209-211

[18] Alan Bloomfield, 'Time to Move On: Reconceptualizing the Strategic Culture Debate', *Contemporary Security Policy* (33:3, 2012) pp. 451-452

people, societies, and institutions, may make some courses of action easier to grasp, approve, forestall, or more difficult to adopt than others, and no entity is a cultural monolith.[19] A competition of subcultures can occur alongside the competition of bureaucracies; diversity within entities is as important as diversity between them.[20] The importance of who the designated threat or enemy is cannot be understated in terms of shaping useful responses to the problems they pose. Space capabilities are not immune from such concerns. Who owns what still matters with space technology.[21] Weapons are ambiguous symbols; politics and culture alter and differentiate what various material capabilities mean to the observer.[22]

Military institutions can also be influenced by culture, and have different attributes to the prevailing strategic cultures of their governments, people, and other military services. Alastair Finlan states that: "the key difference between military and strategic culture is one of scale. The former refers to culture within specific military institutions rather than states."[23] Strategic and military cultures pervade spacepower, like land, sea, and airpower. Military cultures can be seen as sub-cultures, and military services can have numerous different cultures as internal debates on doctrine and force planning attest to.[24] These sometimes draw on, and conflict with, prevailing strategic cultures within a society or state. As an example of culturally-informed attitudes to space launch, Sheldon noted some

[19] Ibid., p. 452

[20] On reflections from a practitioner on managing distinct 'air' and 'space' communities in the USAF, see: Howell M. Estes III, 'The *Aerospace Force* of Today and Tomorrow: Transforming the Air Force Control the Vertical Dimension', in: Peter L. Hays, James M. Smith, Alan R. Van Tassel, Guy M. Walsh (ed.) *Spacepower for a New Millennium* (London: McGraw-Hill, 2000) pp. 165-174

[21] For example, see contrasting accounts of space technology development between the two Koreas: Jack Kim, 'North Korea rocket launch raises nuclear stakes,' *Reuters*, 12/12/2012, http://www.reuters.com/article/2012/12/12/us-korea-north-rocket-idUSBRE8BB02K20121212 (accessed 20/03/2015); ibid., 'South Korea launches first civilian rocket amid tensions with North,' *Reuters*, 30/01/2013, http://www.reuters.com/article/2013/01/30/us-korea-rocket-idUSBRE90T0A320130130 (accessed 20/03/2015); Choe Hang-Sun, 'North Korea Plans Rocket Launch That Could Lead to Missile', *New York Times*, 14/09/2015, http://www.nytimes.com/2015/09/15/world/asia/north-korea-plans-rocket-launch-that-could-lead-to-missile.html?rref=collection%2Fsectioncollection%2Fscience&_r=1 (accessed 15/09/2015)

[22] Ken Booth and Nicholas J. Wheeler, *The Security Dilemma: Fear, Cooperation, and Trust in World Politics* (Basingstoke: Palgrave Macmillan, 2008) p. 43

[23] Alastair Finlan, *Contemporary Military Culture and Strategic Studies: US and UK Armed Forces in the 21st Century* (Abingdon: Routledge, 2013) p. 7

[24] For example, the French Army's doctrinal debate in the 1920s and 1930s, see: Elizabeth Kier, 'Culture and French Military Doctrine Before World War II', in: Peter J. Katzenstein, ed., *The Culture of National Security: Norms and Identity in World Politics* (New York, NY: Columbia University Press, 1996)

different attitudes to space launch between US-European methods and Russian ones – the former seeing each launch as unique and the latter seeing it as more of a routine industrial process.[25]

Spacepower theory is not interested in the specifics of any actor's strategic space culture or a specific service's military space culture in themselves for these are specific forms of the *character* of spacepower. They are illustrated here in spacepower theory for their explanatory power over the nature of spacepower as something that contains and shapes human culture. As an example, spacepower can be perceived to play its part in an American 'way of war'. Space capabilities are relied upon to provide enhanced speed, manoeuvre, precision, and force protection for deployed military forces. Illustrating this, Robert Citino argues that during the 1991 Gulf War:

> "the constant updating of real-time intelligence from JSTARS [Joint Surveillance Target Attack Radar System], as well as satellite surveillance and GPS, was a quantum leap in the quick flow of information, always the thorniest command and control issue. Above all, the plan aimed at a quick and decisive victory, combining maneuver, firepower, attrition, and destruction into one potent and distinctly American package."[26]

The American 'way of war', however, has become extremely politicised and polemical in its use, and great caution must be used in elaborating from any conclusions as to the cultural preferences of any entity of individual.[27] This, however, is but one brief example and interpretation of how space capabilities can, as in this case, further a pre-existing U.S. desire to increase firepower and effects of mass on the enemy and to reduce casualties and deployment size.[28] The point is that cultural attitudes and internal political processes still matter in the high-technology realm of space activity.

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[25] Sheldon, *Reasoning…* pp. 318-319

[26] Robert M. Citino, *Blitzkrieg to Desert Storm: The Evolution of Operational Warfare* (Lawrence, KA: Kansas University Press, 2004) p. 290

[27] Antulio J. Echevarria II, *Reconsidering the American Way of War* (Washington, D.C.: Georgetown University Press, 2014) pp. 10, 17

[28] On American strategic culture, see: Thomas G. Mahnken, 'US Strategic and Organizational Subcultures', in: Jeannie L. Johnson, Kerry M. Kartchner, and Jeffrey A. Larsen, eds., *Strategic Culture and Weapons of Mass Destruction: Culturally Based Insights into Comparative National Security Policymaking* (London: Palgrave Macmillan, 2009) pp. 69-84; On the classic text of American strategic culture, see: Russell Weigley, *The American Way of War* (Bloomington, I.N.: Indiana University Press, 1973)

Seapower is still useful to illustrate some aspects of strategic and military culture as described above. Mahan's narrative of Admiral Pierre André de Suffren's, a French navy commander, decision in the British-French competition over India provides an illustration of a commander overturning a dominant military sub-culture in the French Navy. For Mahan, the War of 1778 between Britain and France showed how Suffren overturned the 'usual' French naval policy of seizing enemy ports and territories before seeking to destroy or contain the enemy's fleet. Suffren sought to engage the British ships rather than seize ports to great strategic effect.[29]

Certain passages from Mahan's historical narrative and his attempt to grapple with the application of the principle of seeking battle show how French naval military culture, or at least a sub-culture of it, sometimes hindered the execution of the most effective stratagem *at that particular moment* against the British.[30] Suffren is portrayed as being a rare French commander that overturned this cultural-institutional bias of seizing ports rather than contesting the enemy fleet. Indeed, it seems Suffren was more attuned to a kind of 'British way of naval warfare', that of the Royal Navy's Nelsonian spirit of 'engaging the enemy more closely.'[31]

So what? Strategic and military cultures, as toolkits for analysis, action, and decision-making will be in play during space warfare. These cultural lenses may be a product of specific military cultures and more nebulous strategic (sub)cultures that interact with perceptions and realities of operating with and against spacepower. Sometimes such cultural toolkits may help achieve strategic effects; sometimes they may not. Some military space cultures may eschew one target for another as the best means of organising for space warfare based on experiences and analysis. This, over time, could form habitual thinking for better or ill. Experience may reinforce such preferences, or challenge them. Whatever gives one the best chance at the most meaningful command of space in any given scenario to support an overall war aim should be the immediate objectives in space warfare, within what is deemed politically and ethically viable by a military or authority's rules of engagement and

[29] Mahan, *Influence…* pp. 433-469
[30] Ibid., pp. 339, 376-478
[31] Frank Ledwidge, *Losing Small Wars: British Military Failure in Iraq and Afghanistan* (London: Yale University Press, 2011) p. 141

commitments to laws in war. What is deemed politically and ethically acceptable is in part a decision reflecting cultural values and experience. Examining propositions I, IV, and V are attempts to provide a useful approach to identify what those specific objectives could be in any scenario – regardless of the their material and cultural diversity. However, culture, both military and strategic, can influence decision-making and analysis on what constitutes the best way of undermining the enemy's, and protecting one's own, celestial lines of communication. Luttwak's paradoxical logic should be remembered here. If one side thinks the other is bound to be true to itself an take a particular action, the other side might respond by doing something considered 'out of character', like Israel's frontal armour assault in the Golan Heights in the 1973 Yom Kippur War.[32]

Despite the potential diversity in strategic cultures, the recognition of strategic culture is not merely the recognition of cultural diversity. Finlan believes that USAF's adoption of certain values from the Army indicates "that though the material and surface components of the service, uniform and technology for instance, have changed, the embedded cultural wiring remains largely intact, and traditional concepts, taken from the army, still flow strongly through the system."[33] Imagining strategic and military cultures as prevailing ideas and conceptual toolkits that hard-wire people and groups to think and act in some ways *more than others* is as useful a definition of the cultural element of militaries in warfare one is likely to find. The legacies and heritages of the cultures of military services – and all actors that use space – will inform behaviour in space warfare and in making spacepower a constituent *and* consequence of strategic cultures. They too, however, may in turn be influenced by their experiences of using space, as explored in Part 3 of Proposition VI below.

Strategic and military culture is useful for spacepower theory in two ways, beyond using it as the recognition of a culturally-bound toolbox to help analyse strategic problems, make decisions, and keep ethnocentrism in check. It is (a) an opening into the internal composition of spacepowers and (b) a launchpad for theorising human culture as being determined in part by Earth and outer space. Bureaucratic strife, domestic politics, and power struggles of governments, militaries, states,

[32] Edward N. Luttwak, *Strategy: The Logic of War and Peace* (Cambridge, MA: Harvard University Press, 1987) pp. 16-18
[33] Finlan, *Contemporary…* p. 62

leaderships, and societies are important considerations for space strategists – and therefore spacepower theory – as they will shape, to varying degrees, any manifestation of the character of spacepower. Since strategic and military culture invite analysts to examine the internal compositions of belligerents, it is important to recognise that how those military services and related institutions and organisations behave with each other can impact overall strategic performance. The next section uses the bureaucratic and cultural struggles of continental navies as a base analogy to explore some actual and potential problems facing Earth-bound military space services.

## 6.2 Proposition VI: Part 2: Continental mindset and internal politics

> "These questions about space priorities and space systems costs… exacerbated interservice rivalries related to space, a sentiment well captured when an anonymous Navy Admiral quipped that "[o]ur idea of a joint program is one the Air Force pays for and the Navy uses."" – Peter Hays[34]

This second part of Proposition VI provides some insight into Earth-based thinking about spacepower, before Part 3 theorises about space culture beginning to influence Earth-bound militaries. As indicated by Peter Hays, a senior American military space and policy academic, there are aspects of culture and internal politics from Earth that are relevant for illustrative purposes in spacepower theory. In addition, U.S. military space organisation is used to present a more direct illustration of one manifestation of military space bureaucracy and culture today. Continental navies sometimes struggled to find their place in a land-dominated strategic or military culture, and this can be a useful indirect insight into military space culture today. Proposition VI allows for the problems that may arise from Propositions V and III – if space is a secondary theatre for subtle support operations (V) and it does not lend itself to anything approaching spectacular decisive engagements (III), it may be more difficult to convey the value of space services to an Earth-bound state or leadership that may have more pressing concerns on the Earth's surface rather than above the atmosphere.[35] Space services may struggle to find their place in Earth-bound powers and mindsets. Caught up in such concerns are domestic and bureaucratic politics. It is a useful truism that "all warfare has a domestic

[34] Peter L. Hays, *Struggling Towards Space Doctrine: U.S. Military Space Plans, Programs, and Perspectives During the Cold War* (PhD Thesis, Tufts University, 1994) p. 442-443
[35] This resonates with the challenges of space education in Chapter 1 and Proposition II.

hinterland, usually several such."[36] Spacepower theory and its users must account for the internal dynamics of whatever group it is applied to or used by, where 'domestic politics', inter-service rivalries, or internal power struggles influence (in)action in wars between states, militaries, and other armed groups.

If a force has been long-dominant in a medium or has never been challenged, be it the sea, air, or space, it may be difficult to explain how important the command of that medium may be since no dramatic actions have taken place there recently. Continental navies can illustrate such problems, and the requirements and often subtle contributions of seapower are more esoteric.[37] It is not difficult to argue the same for spacepower. Menon believes that a bluewater strategy – envisaged by him as patrolling sea lines of communication and preparing for big battles at sea between fighting formations in order to remove the most potent threat to friendly maritime traffic – tends to be less visible because it is less likely to trigger those battles in the first place if there is a decisive advantage with one surface fleet over another. It is therefore less impressive upon a joint military staff and the civilian leaders of a continental power. Menon warned of the dangers for navies in a continental mindset of political masters and military planners. The navy was endangered to become 'just' a transport wing of the military, or a logistics corps, or an amphibious force alone. This is not to say that all states need or should have ocean-going capabilities, but such tendencies would be, for example, detrimental to India's feasible oceanic strategic possibilities as Menon argues.[38] Having borders in the Himalayas 'loom large' may be a significant cultural inhibitor towards seapower thinking in Indian strategic cultures, posing challenges to bluewater Indian Navy advocates.[39] Indeed, deliberating the Indian Navy's contribution to a war with China would be an interesting discussion owing to the land border in the mountains, but with Chinese vulnerability to energy supply routes traversing the Indian Ocean and the Straits of Malacca.[40] Menon, himself a retired Rear Admiral in the Indian Navy, wrote that "for a continental power to see the possibilities of maritime strategy is… difficult because the

[36] Gray, *Another…* p. 91
[37] Menon. *Maritime Strategy…* p. 21
[38] Ibid., p. 172
[39] James R. Holmes, Andrew C. Winner, and Toshi Yoshihara, *Indian Naval Strategy in the Twenty-first Century* (Abingdon: Routledge, 2009) pp. 22-23
[40] On China in the Indian Ocean, see: Ibid., pp. 127-149

problems of the land frontiers are much too immediate."[41] Analogically, if Earth orbit is an adjunct to Earth-based powers' main media of threats and fighting capabilities, it would not be without precedent that the role of spacepower may be hard to explain and promote in the strategic and military cultures of Earth-bound states.

Although not mentioned in negative terms, Soviet Admiral Gorshkov offered some insight into this vicious cycle of reduced visibility and reduced perceptions of value of navies. In the Second World War, the Soviet Navy was hollowed out for the more pressing needs of the territorial defence of the *Rodina*.[42] This demonstrates how seapower can contribute to a predominantly land-orientated war but not necessarily in a way that showcases a navy's best contribution as an independent service in a continental war. The repurposing of naval personnel to land operations could be interpreted both ways in the pressures of highlighting the use of a navy to a continental power, but also showing the more immediate need of a land front. Gorshkov maintained that this demonstrated the need for common efforts between all branches of the armed forces for 'complete victory.'[43] Yet, spacepower is already pressed into closely serving the needs of terrestrial warfare, which may handicap attempts to develop a space-centric approach, service culture, and force development for space systems that exploit the unique attributes and opportunities of space in ways that remain unforeseen when only satisfying the immediate needs of terrestrial forces.

Gray and Sheldon made a similar point with regard to spacepower, which "is discrete… and does not attract much attention in the way that armies, navies and air forces do… Indeed, spacepower can be likened to intelligence operations: one only hears of it when something goes wrong."[44] It seems that the character of spacepower, like Mahan's narrative of seapower in the 18th century Spanish War of Succession, will be subtle and relatively unspectacular (compared to operations on Earth) for the foreseeable future.[45] In a possible future of space-based weaponry and scenes reminiscent of popular

[41] Menon, *Maritime Strategy…* p. 21
[42] Sergei G. Gorshkov, *The Sea Power of the State* (Oxford: Pergamon Press, 1979) pp. 146-147
[43] Gorshkov, *The Sea…* p. 148
[44] Colin S. Gray, and John B. Sheldon, 'Theory Ascendant? Spacepower and the Challenge of Strategic Theory', in Charles D. Lutes and Peter L. Hays, with Vincent A. Mazo, Lisa M. Yambrick, and M. Elaine Bunn, ed., *Toward a Theory of Spacepower: Selected Essays* (Washington, D.C.: National Defense University Press, 2011)
[45] Mahan, *Influence…* p. 209. This was quoted in the previous chapter.

culture tropes such as *Moonraker* or *Star Trek*, it may be easier to fly the flag for spacepower if combat operations became the 'norm.' In that sense, it may serve some objectives of the USAF to seek space weapons in order to secure more funding and visibility for spacepower. However, gathering more resources is unnecessary and may not be an omnipresent or eternal goal of bureaucrats and military leaders.[46]

A transposition of Menon's concerns for a continental seapower mindset might pose a problem for the advocacy of spacepower. As mentioned in Proposition II, Smith's anecdotes of non-space experienced USAF leaders placed at the helm of the USAF's space activities is one manifestation of an Earth-based mindset failing to grasp accurately what spacepower can and cannot do. On a more optimistic note, Castex made seapower relevant to the war plans of continental powers such as his native France. Just as continental thinking and culture can hamstring the utilisation of seapower, it can be a boon if argued and managed coherently as aspired to in Proposition V which relates strategic manoeuvres in a secondary theatre or medium towards a main war effort elsewhere. The same is true, and acts as a qualification, for spacepower in an Earth mindset. Like so much in strategic culture, spacepower can be at once an advantage or a hindrance. Spacepower should not be dominated by space-based thinking at the expense of ignoring the connections between space, Earth, and the human condition as explored in Propositions II and III. However, spacepower's uniqueness should not be ignored either – not only in what the utilisation of spacepower brings to the table in terrestrial warfare (seen next in Proposition VII), but how it may impact our own perceptions and cultures.

The internal political and bureaucratic problems facing continental powers' armed forces, institutions, and geopolitical outlook can resonate with spacepower in states or armed groups that are still bound, materially, culturally, and psychologically, to Earth. Bureaucratic turf wars, whether in the

[46] Elizabeth Kier, 'Culture and French Military Doctrine Before World War II,' in: Katzenstein, ed., *The Culture of National Security…* pp. 186-211

USAF in the 1950s or in China today, strengthen the argument that spacepower is in part conditioned by terrestrial politics as a whole, and concerns on terra firma which spacepower is adjacent to.[47]

Michael Smith trenchantly argues over the necessity of resolving the issue of bureaucratic and resource management regarding spacepower. It is hard to dispute that clear chains of command, areas of authority, and inter-service cooperation are needed. Smith contends that spacepower, at least in the way it manifests itself in the United States military, demands a centralised outlook because of its global nature and the regional demands of the military's services, as well as demands from civilian departments, the Intelligence Community, and the Executive branch.[48] Perhaps it is only a USAF officer that could say the following:

> "The idea that an airman with a *theater* perspective should ever control space assets, which are properly "tasked and assigned from a *global* perspective," should send shivers up the backs of military leaders… Just as the expanded mind-set of airmen drove their need for centralized theatre-level control of airpower by an airman, so too, the further expanded mind-set of space professionals drives their insistence that spacepower must be centrally controlled by a space professional."[49]

Smith makes an analogy to support the case for the centralisation of American spacepower, to use spacepower without an airpower mindset. Indeed, this may be a severe problem if the USAF persists in culturally dividing personnel between those who fly and those who do not, and specifically with fighter pilots sitting at the top of the former group[50] especially as spacepower is strategically relevant with virtually no requirement for a human presence in space itself. Furthermore, if the USAF's "key criterion for ranking within the institution, as with soldiers and sailors, revolves around the issue of

[47] On USAF turf wars, see: Hays, *Struggling Towards…* pp. 25-30, 66-101, 113-127, 210-211; Benjamin S. Lambeth, *Mastering the Ultimate High Ground: Next Steps in the Military Uses of Space* (Washington, D.C.: RAND, 2003) pp. 9-59. On China's bureaucratic turf wars and dysfunction, see: Mark A. Stokes and Dean Cheng, 'China's Evolving Space Capabilities: Implications for U.S. Interests,' Project 2049 Institute, 26/04/2012. pp. 44-45; Bates Gill and Martin Kleiber, 'China's Space Odyssey: What the Antisatellite Test Reveals About Decision-Making in Beijing,' *Foreign Affairs*, May/June 2007, http://www.foreignaffairs.com/articles/62602/bates-gill-and-martin-kleiber/chinas-space-odyssey-what-the-antisatellite-test-reveals-about-d (accessed 14/02/2015)
[48] Smith, *Ten Propositions…* pp. 53-56
[49] Ibid., pp. 54, 56. Emphasis Smith's.
[50] Finlan, *Contemporary…* p. 68

combat,"[51] it may be difficult for spacepower to be appreciated in its own right as a medium and theatre where they may be little to no direct violence. Like third parties in Proposition V, militaries and other state organs must be co-opted, if not coerced, to push in the desired direction by top-level leaders in the face of inter- and intra-service arguments. Arguments over contrasting theatre and global perspectives of U.S. spacepower with systems such as the Counter Satellite Communications System, or Counter Communications System (CSCS or CCS respectively) are illuminating examples.[52] This highlights how spacepower is influenced by cultural, political, and bureaucratic elements, and is by no means a subject reduced to technical considerations alone.

It is unwise to generalise too much from the U.S. experience. To do so would display blatant ethnocentrism. However, American bureaucratic and domestic politics, as well as military cultures, allows spacepower theory to consider them as more general recurring themes. No strategist or theorist should assume that a space power is interested in lavish firepower and casualty-reducing high-technology warfare just because the United States is Earth's most capable space power.[53] Indeed, that assessment of U.S. strategic culture is itself debatable.[54] Rather than disband the notion of strategic culture altogether because of the ease at which strategic culture can be conceptually deconstructed, it is a useful pointer into understanding the relevant belligerents and leaders in a war on their own terms, in contrast to approaches that may to too technologically determinist. As institutions, services, and people grasp with the new challenges of spacepower, they may develop their own unique approaches to them, and space may impose some cultural adaptations and evolutions in return.

[51] Ibid., p. 69. Finlan also notes that this culture may be in the process of change with the absence of enemy fighter pilot threats in recent USAF combat operations, see p. 69-70

[52] See: Tyler M. Evans, 'Space Coordinating Authority: Information Services from Space', in: Kendall K. Brown, ed., *Space Power Integration: Perspectives from Space Weapons Officers* (Maxwell AFB, AL: Air University Press, 2006) p. 7; Mark A. Schuler, 'It Isn't Space, It's Warfare! Joint Warfighting Space and the Command and Control of Deployable Space Forces', in: Brown, ed., *Space Power Integration*… pp. 71-73. See also: Jeffrey Lewis, 'Counter Satellite Communications System Deployed', *Arms Control Wonk*, 02/10/2004, http://lewis.armscontrolwonk.com/archive/25/counter-satellite-communications-system-deployed (accessed 11/02/2015)

[53] See: Thomas G. Mahnken, *Technology and the American Way of War Since 1945* (Chichester: Columbia University Press, 2008) pp. 3-6

[54] Echevarria, *Reconsidering*… p. 33

## 6.3 Proposition VI: Part 3: Strategic and military space culture?

"The military space career field is a unique culture that needs cultivating in its own right both in the Air Force's and the nation's best interest." – Benjamin Lambeth[55]

If space is a unique environment but still subject to humans and their terrestrially-bound culture and politics, as explored in Proposition II, space may yet be able to allow humans to develop space-based culture as humans continue to harness the astrographical features of operating in Earth orbit and beyond. A brief glimpse of the military space organisation of the United States shows how space cadres may be emerging within an Earth-bound military space community. An element of geodeterminism in the shaping of culture is proposed here. Yet, as Dolman argues with an analogy to the different characterisations of Athens and Sparta in the ancient world, geographic influences are not the only ones impacting on how a society or state behaves and organises itself. Geographic influences and cultural habits can still be overcome as Sparta did with its 'maritime moment' by building a fleet to decisively crush Athenian naval power.[56] Technology, society, and physical and economic structures are important additional factors for Dolman.[57] He writes sharply on the possibilities of geodeterminism on the human condition if humanity establishes itself in space, and what it may mean for humans as socio-political animals once colonies or regular crewed expeditions beyond Earth are realised.[58] The first communities to live in space will undoubtedly have impacts on the cultures that emerge from space colonisation. Contemporary space travel in Earth orbit may already be imposing changes in worldviews and cultural attitudes.[59]

'Space culture' is forecasted by some for the USAF. As an example, Benjamin Lambeth argues that USAF space personnel may be uniquely positioned to rise above the divisions among military services (and within USAF) and the intelligence community because U.S. spacepower is

[55] Lambeth, *Mastering…* p. 134
[56] See: Barry Strauss, 'Sparta's Maritime Moment', in: Andrew S. Erickson, Lyle J. Goldstein, Carnes Lord, eds. *China Goes to Sea: Maritime Transformation in Comparative Historical Perspective* (Annapolis, M.D.: Naval Institute Press, 2009) pp. 33-57
[57] Dolman, *Astropolitik…* pp. 16-22
[58] Ibid., pp. 26-31; see also: Gerard K. O'Neill, *The High Frontier: Human Colonies in Space* (Princeton, N.J.: Space Studies Institute Press, 1989)
[59] See: Frank White, *The Overview Effect: Space Exploration and Human Evolution* (Reston, V.A.: American Institute of Aernoautics and Astronautics, 1998)

inherently valuable in how it enhances and enables joint warfare. The space professionals, whose job is to provide military space capabilities and services to all who need it, will mature and develop on their own if they are allowed to. If "an interconnected center of space excellence able to speak credibly about what space brings to joint-force employment" is realised, a unique military space culture may develop further.[60]

As spacepower pervades all of terrestrial warfare, it is unsurprising that the U.S. military's branches all have offices that conduct their own space operations in addition to the USAF. All U.S. military services contribute and integrate through U.S. Strategic Command (USSTRATCOM), which merges the space and cyber warfare capabilities of these services into a joint C4ISR system, a contribution to the Department of Defense's (DoD) Global Information Grid (GIG).[61] The GIG intends to allow deployed forces to have easy access to the information they need that come from and through a wealth of disparate systems, of which space assets and celestial lines of communication play an important data-gathering capability and connecting mesh.[62]

The following examples serve as a brief illustration of the diversity of military space actors that shows the potential for their respective military cultures to engage with spacepower and vice versa, in a context of joint operations in the U.S. military. The U.S. Army Space and Missile Defense Command/Army Forces Strategic Command (SMDC/ARSTRAT) uses space capabilities for its missile defence functions and "serves as the Army force modernization proponent for space."[63] The U.S. Navy's Naval Network Warfare Command (NETWARCOM) provides "tactical-level command and control of Navy Networks and to leverage Joint Space capabilities for Navy and Joint Operations."[64] The United States Marine Corps Forces, U.S. Strategic Command (MARFORSTRAT) acts as the integration of the U.S. Marines into USSTRATCOM and "advises and assists other Marine

[60] Lambeth, *Mastering…* p. 135
[61] U.S. Strategic Command (USSTRATCOM), 'History', August 2014, http://www.stratcom.mil/history/ (accessed 24/03/2015)
[62] Global Security, 'Global Information Grid,' http://www.globalsecurity.org/intell/systems/gig.htm (accessed 24/03/2015)
[63] U.S. Army Space and Missile Defense Command/Army Forces Strategic Command 'About – U.S. Army Space & Missile Defense Command/Army Forces Strategic Command,' http://www.smdc.army.mil/2008/about.asp (accessed 24/03/2015)
[64] NETWARCOM, Home Page, http://www.netwarcom.navy.mil/ (accessed 24/03/2015)

Corps commands and supporting establishment in the development of concepts, education, training, doctrine, and capabilities in space, cyberspace, [and] electronic warfare (EW)".[65] The Air Force has two service components that contribute to USSTRATCOM, broken down into the Air Force Global Strike Command (AFGSC) and Air Force Space Command (AFSPC). This demonstrates that 'space cadres' can be developed in all U.S. services and bring various needs and also perhaps different military sub-cultures to the table.

Looking at the space components of USSTRATCOM itself (as opposed to the service contributions) a joint picture appears, but still apparently dominated by the USAF in terms of the basing of USSTRATCOM's space components. The Joint Functional Component Command for Space (JFCC SPACE), which was established in 2006, "coordinates space operational-level planning, integration, and coordination to ensure unity of effort in support of military and 'national security' operations, and support to civil authorities."[66] As a single point of contact for the bulk of space operations in USSTRATCOM, this means that it integrates ubiquitous space services from, for example, securing the celestial lines of communications for a Stryker column touring eastern Europe and the Baltic states[67] to detecting and responding to missile launches, satellite intercepts, and re-establishing communications after infrastructure collapse in a civil disaster. Within JFCC SPACE is the Joint Space Operations Center (JSpOC) which, among other things, conducts space surveillance, offensive and defensive 'space control' and specific space situational awareness (SSA) missions, which means on-demand reconnaissance about the space environment, as opposed to persistent and routine surveillance.

Not all in JFSCC SPACE is restricted to the USAF. The Joint Navigation Warfare Center (JNWC), as a staff element in JFCC SPACE, is made up "of approximately 65 personnel drawn from the US Army, Navy and Air Force, Canadian and Australian armed forces, DoD civilians and

[65] U.S. Marines, 'U.S. Marine Corps Forces, U.S. Strategic Command,' http://www.marforstrat.marines.mil/ (accessed 24/03/2015)
[66] USSTRATCOM, 'Joint Functional Component Command for Space (JFCC Space)', http://www.stratcom.mil/factsheets/7/JFCC_Space/, December 2011, (accessed 24/03/2015)
[67] See Operation Dragoon Ride: Michelle Tan, 'Strykers begin 'road march' across Eastern Europe,' *Army Times*, 21/03/2015, http://www.armytimes.com/story/military/2015/03/21/operation-dragoon-ride-kicks-off/25027691/ (Accessed 24/03/2015)

contractors."[68] This blending of officers from all U.S. services and select Allied officers, that deal specifically with enabling "Positioning, Navigation, and Timing (PNT) Superiority" through navigation warfare (NAVWAR) support across the DoD, the U.S. military, and its allies, can provide additional potential for multi-national and multi-service cultures to engage with spacepower, and vice versa. NAVWAR is intended to secure GPS signals for U.S. and Allied use, whilst preventing their use by the enemy, which resonates conceptually with the use and denial of celestial lines of communication in Proposition IV. As spacepower interacts and integrates with terrestrial warfare and cyberwarfare, the resulting military subcultures that may develop from space experts and non-space experts in the military coming to depend on them may be the origins of a more robust military space culture.

This brief glimpse of the labyrinthine military space organisation in the United States illustrates one case of how 'space cadres' within militaries may develop and progress in their careers. If these space cadres become prestigious, or able to hold high office, rising to the top of the command chain (such as in the U.S. Joint Chiefs of Staff) a space-centric or space-specialist view of warfare, if not a military space culture, may become more influential and pronounced. Spacepower theory must be open to this possibility of spacepower influencing terrestrial strategic and military culture, as well as the strengths and limitations of approaching spacepower with a geocentric mindset.

This brings Proposition VI to a head – spacepower theory must appreciate how cultural attitudes to military space (as well as political violence in general, or the consideration of the trinitarian elements passion and reason as explored in Chapter 3) may shape perceptions and decision-making tendencies in whatever relevant actor in whatever contingency they face. Different actors with different needs and perceptions may develop and exercise spacepower according to their technological and economic capability, but also according to their own cultural styles. Yet, the more space is used, and if it becomes more salient and prestigious in the use of force, space-specific military cultures may develop, in turn influencing terrestrial human culture. An additional aspect that

[68] USSTRATCOM, 'Joint Navigation Warfare Center (JNWC),' January 2014, http://www.stratcom.mil/factsheets/8/Joint_Navigation_Warfare_Center/ (accessed 24/03/2015)

should be considered is a cultural response to the *loss* of spacepower support on terrestrial forces, be it temporary or longer term. Would U.S. marines fight harder if they were cut off and expected an attack? Would other forces lose their will to fight without connections to their fellow dispersed forces and were surrounded and faced a hopeless fight?[69] These are open questions at present, but hardly novel in terms of military culture and leadership. Sun Tzu was clear in his mind on this topic when troops had been cornered:

> "Put them in a spot where they have no place to go, and they will die before fleeing. If they are to die there, what can they not do?... If they have no choice, they will fight... When people fall into danger, they are then able to strive for victory."[70]

Cultural attitudes to life, death, the politics of a given cause, and camaraderie cannot be ignored in these situations. Cutting off space support to enemy forces may make them less efficient and more vulnerable, but that is no guarantee of an easy fight or certain victory.

## Summary

All of spacepower's propositions' manifestations in reality can be influenced by cultural factors and internal politics – not only the politics between belligerents. Today, organisations and military space forces may approach outer space with Earth-bound mindsets, like some continental minds may approach seapower. However, spacepower will influence the continuing evolution in strategic and military cultures as an astrographic environment. This is the sum of Proposition VI in its crudest form. Proposition VI, in sum, has argued that the actual use and deployment of spacepower can vary because of cultural aspects of belligerents and the politics that takes between factions and organisations within them. This is not too different to experience with terrestrial power and strategic and military cultures. Strategic and military cultures can 'hard-wire' people and organisations to approach strategic problems in certain ways. These same people, services, or organisations must compete with others within the state (or any relevant umbrella entity) for resources and prestige as space services inside and Earth-based power and Earth-centric mindset. Space services may struggle

[69] Credit to Scott Pace for bringing these questions to light in a conversation with the author, Washington D.C., February 2014.
[70] Sun Tzu, *The Art…* pp. 147, 157

in a similar fashion to continental navies. In addition to opening the door to analysis within belligerents, spacepower theory must help prevent unchecked ethnocentric bias. Examining the cultures and internal political divisions of friends as well as foes is not only an exercise in recognising diversity or an excuse to unleash prejudiced analyses. Finally, although military space services and leaders take their Earth-based culture and politics with them to spacepower, spacepower can generate its own culture in humans with more and more unique operations occurring in orbit to form guides of best practice and organisation. Strategic space culture is something spacepower theory should be open to, as more military personnel are exposed to spacepower. The potential cultural impact of space upon Earth-bound human ideas, and of Earth-bound cultures on exercising spacepower then, has now been noted in this final caveat of the seven propositions. Now spacepower theory must examine the more material consequences of the successful realisation of Propositions I, IV, and V on terrestrial warfare. This is the next and final Proposition.

# Chapter 7: Dispersal, Concentration, Resistance: Proposition VII

## Introduction: Proposition VII: Dispersion is a condition and effect of spacepower

"Because the ocean is so vast, reconnaissance or targeting has always been a key problem. Long-haul communications connects widely-dispersed sources of information and their users. Quite naturally, then, the new style of space-oriented warfare began with navies." – Norman Friedman[1]

Proposition VII explores the dispersing effects of spacepower on Earth, and what this means for the concentration and dispersal of military forces on Earth. While Proposition VII builds on John Sheldon's work on dispersal in spacepower,[2] it offers originality by fleshing out some of its logic with examples, and relating it to spacepower theory as a whole. Proposition VII uses the dispersed condition of satellites in orbit, the dispersed nature of the terrestrial forces they permit, and the influence of dispersal they impose on the victims of superior space-supported forces, as a point of departure to consider how spacepower influences the push and pull of dispersing and concentrating forces, effects, and efforts in warfare on Earth. Proposition VII is the ultimate answer to the 'so what' question of spacepower's relevance for terrestrial warfare. The conditions of dispersal and concentration of forces on Earth in the Space Age in any form (Proposition VII) is the consequence of exploitation of the attainment of the relevant degree of the command of space (Proposition I), brought about by successful strategic manoeuvres to manipulate celestial lines of communication for the terrestrial war effort (Propositions IV and V). Spacepower theory now comes full circle with the final proposition outlined.

As a starting point for specific analyses, this proposition should trigger thinking on the dispersal and concentration of three things: (a) the assets and infrastructure in and adjacent to Earth orbit; (b) of space-enhanced forces that can concentrate or disperse with great speed, precision,

[1] Norman Friedman, *Seapower and Space: From the Dawn of the Missile Age to Net-Centric Warfare* (London: Chatham Publishing, 2000) p. 302

[2] That is dispersal is inherent to spacepower because of the physically dispersed nature of satellite constellations and the dispersing effects their services have on Earth, as coined by John Sheldonin: *Reasoning…* pp. 305-306

mobility, and synchronicity; while at the same time considering (c) the risks and opportunities of concentration and dispersal for forces and belligerents that fight and react against a space-enhanced enemy, with or without their own space support. In addition, this proposition makes spacepower relevant to joint or combined arms warfare in a more detailed manner than Proposition III which noted the abstract multi-geography nature of modern warfare and the illusion of controlling Earth from space. Spacepower is increasingly tactically and operationally significant to the forces that use them when it is integrated into airpower, seapower, landpower.

Proposition VII proceeds as follows. Part 1 examines how modern C4ISR imposes dispersing effects on the forces that use them and their foes. Part 2 examines how the principle of concentration works as 'mass effect' when spacepower is integrated into terrestrial warfare. Finally, part 3 looks at how belligerents on Earth may respond to the dispersing pressures of the hostile cosmic coastline, and how some terrestrial forces may turn space into a hostile coast for satellites so that their forces may concentrate whilst enemy spacepower in orbit is neutralised, in this sense space may constructively be seen as a possible centre of gravity. This is no axiomatic declaration that dispersal and concentration hold the keys to success in warfare in the Space Age. Rather, the command of space influences the abilities of forces to concentrate and disperse, and those of the enemy, and both parties are continually reacting and adapting to each other's abilities to concentrate strengths and disperse to compensate for weaknesses.

## 7.1 Proposition VII: Part 1: Dispersing conditions

"Such is concentration reasonably understood – not huddled together like a drove of sheep, but distributed with a regard to a common purpose, and linked together by the effectual energy of a single will." – Alfred Thayer Mahan[3]

The distributed sources of an effectual energy of a single will may aptly described how satellites are dispersed in orbit, yet the effects of their signals can be concentrated in time and place. Conversely, antisatellite weapons on Earth could be distributed but coordinated into overlapping kill-

[3] Alfred Thayer Mahan, *Sea Power in its Relation to the War of 1812: Volume I* (Boston, MA: Little & Brown, 1905) p. 316, taken from: Corbett, *Principles…* p. 131

zones and communications jamming arcs towards orbit. Although Proposition VII focuses on dispersal in its titles, it cannot do so without referring to concentration, much like the classical strategic thinkers could not discuss concentration without thinking about dispersed forces. One influences the other in a mutually-interacting dialectic between thinking and reacting opponents, creating paradoxical logics. Despite its dispersed condition, spacepower can still be concentrated in terms of its effects. The concentration of forces and effects can be difficult, not to mention counterproductive in some circumstances, so there is always a degree of dispersal and flexibility required in an overall war plan even if ultimate success rests on the concentration of effort at some point.[4] Dispersal is the declarative theme for this proposition because spacepower's physical condition in orbit is inherently dispersed, and the threat and use of spacepower encourages dispersing behaviour on Earth. Dispersion occurs in two places: in orbit through dispersed satellite constellations, and the potential dispersing effects of spacepower on Earth.

The proliferation of space-based communications, reconnaissance, surveillance systems, and the data from which are integrated into operational-level commands and tactical combat units, encourages targets to resort to dispersal, concealment, or flight from battle – involving large degrees of co-ordination and deception. Furthermore, space-enabled forces can disperse more easily without sacrificing lethality, security, and firepower. Dispersal is a major theme running throughout John Sheldon's thesis; it is a condition in space and an effect on actors on Earth. Satellites of the same constellation in general do not cluster together. Although satellites in GEO may appear to cluster together around the same orbital band, their sibling satellites in their constellations will still be dispersed along the belt. Transparency from space surveillance systems, and the threat of it, encourages dispersion, concealment, and deception on Earth because high-technology militaries with reconnaissance-strike systems, or locally deployed spacepower-integrated terrestrial forces, can potentially attack whatever is in 'sight'. In addition, one can *only* attack something in space that has been detected and tracked by sensors, and deemed to be the right target via human analysis. Smith,

[4] Clausewitz, *On War*… p. 80

Oberg, and Lupton allude to the concept of dispersal through spacepower. Smith notes that spacepower is characterised by its global access and global presence.[5]

This effect of transparency - whether real or perceived - at strategic, operational, and tactical levels will influence behaviour. Although targets may not be always caught in the act by spy satellites, it may force them to take elaborate measures to avoid detection nonetheless.[6] Actors that cannot afford to be seen to be doing something, such as India's nuclear testing, must conceal their activities or conduct diversions. India succeeded in surprising the U.S. intelligence community in 1998 by foiling American space-based reconnaissance efforts to predict nuclear tests.[7] That said, better human intelligence might have provided some warning. Although much of this proposition focuses on operational and tactical consequences of Earth observation from space, the continuing grand strategic and political effects of the degrees of transparency provided by space systems should not be forgotten.

The ISR technologies in space systems are becoming ever-more relevant to combat operations. Oberg makes the same point as Smith on the viewing abilities of space systems, and makes it his first principle of spacepower theory: "the primary attribute of current space systems lies in their extensive view of the Earth."[8] Furthermore, "while all other forms of power are effectively regional, space power allows worldwide access in time spans measured in minutes as opposed to hours and days."[9] Space capabilities can make the world relatively smaller and more transparent through the greater speed, visibility, and scope that space-based C4ISR systems can allow – provided that the infrastructure necessary to sustain and utilise it is in place.

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[5] Smith, *Ten Propositions…* pp. 44-48; Oberg, *Space Power…* p. 124; David E. Lupton, *On Space Warfare: A Space Power Doctrine* (Montgomery, A.L.: Air University Press, 1988) pp. 19-20
[6] Sheldon, *Reasoning…* p. 78
[7] See reaction to the 1998 Indian nuclear test: *Los Angeles Times*, 'Indian Test Deception Reported', 20/05/1998, http://articles.latimes.com/1998/may/20/news/mn-51736 (accessed 22/09/2014); Federation of American Scientists, 'India blasts take U.S. intelligence by surprise', *Washington Times*, May 1998, taken from: http://fas.org/irp/news/1998/05/980512-wt.htm (accessed 22/09/2014); and on the shortcomings of satellite reconnaissance in predicting the Indian nuclear test preparations in 1995-1996, see: William Burr, 'U.S. Detected Indian Nuclear Test Preparations in 1995, but Photo Evidence was "Clear As Mud"', 22/02/2013, http://www2.gwu.edu/~nsarchiv/nukevault/ebb412/ (accessed 22/09/2014)
[8] Oberg, *Space Power…* p. 124
[9] Ibid.

The United States has no monopoly on such systems, or at least the core technological competency that allow for future development. The Soviet Radar Ocean Reconnaissance Satellite (RORSAT) is an example of an early tactically and operationally relevant reconnaissance-strike space system. This Soviet electronic intelligence (ELINT) system could potentially make U.S. Navy surface vessels 'acquired targets' for Soviet Earth-based weapons systems.[10] The European Copernicus programme's (previously called Global Monitoring for Environment and Security – GMES) Sentinel division is a more contemporary example of using a diverse range of satellite sensors (see Chapter 1 on critical infrastructure) to form a comprehensive surveillance architecture that can be integrated into strike weapons systems.[11] Copernicus is not unlike the U.S. DoD's GIG in its attempt to bring together diverse information sources into a single accessible database, though with not as much overt tactical-operational military focus as the GIG. As another example, Japan has deployed SAR satellite technology since the early 1990s, and today, Japan's space sector is increasingly geared towards its modernising military forces.[12]

As these systems mature and proliferate, fewer bolder or overt actions can be taken on the Earth's surface (or in space) without being detected, and concentrated forces can be more easily spotted and targeted by their potential victims, as well as by third parties. That said, without integrated destructive capabilities and the political will to use them, all a good observation capability may allow is a view to a slaughter from orbit, rather than allow a more effective participation in the violence for

[10] On RORSAT, see: Herbert F. York, "Nuclear Deterrence and the Military Uses of Space", in: Franklin A. Long, Donald Hafner, Jeffrey Boutwell, eds. *Weapons in Space* (New York, NY: W.W. Norton, 1986) p. 22; Paul B. Stares, *Space and National Security* (Washington, D.C.: Brookings Institution, 1987) p. 132

[11] On Copernicus, see: Copernicus Programme website, 'Copernicus in brief', at: http://www.copernicus.eu/pages-principales/overview/copernicus-in-brief/ (accessed 24/02/2015). Indeed, the Steering Committee of GMES/Copernicus has not been coy about its military applications since the early 2000s. See: Gerard Brachet, 'From initial ideas to a European plan: GMES as an exemplar of European space strategy', *Space Policy* (20, 2004) p. 13

[12] On Japanese SAR satellites, see: Geospatial Information Authority of Japan, 'Monitoring the Earth Deformation from Space', http://vldb.gsi.go.jp/sokuchi/sar/mechanism/satellite01-e.html (accessed 02/04/2015); on Japanese military space, see: Saadia M. Pekkanen and Paul Kallender-Umezu, *In Defense of Japan: From the Market to the Military in Space Policy* (Stanford, CA: Stanford University Press, 2010), p. xi ; Paul Kallender-Umezu, 'Japan Begins National Security Space Buildup,' *Defense News*, 13/04/2015, http://www.defensenews.com/story/defense/air-space/space/2015/04/12/japan-national-security-space-buildup/25412641/ (accessed 19/04/2015)

whatever objective is sought beyond the use of proxies.[13] But enemy eyes from above, or the pressures of dispersion, may not be a pressing concern in wars where the enemy has been politically isolated and has no significant third party support, such as for the United States in both of its Gulf Wars. In other words, the United States did not need to worry about enemy space systems (beyond cutting off third party imagery as explored in Proposition V) in its campaigns against Iraq.

These systems mean that dispersion on Earth, an effect of spacepower, is being imposed on the targets of the United States whilst the military units of the U.S. can disperse and retain its firepower and ability to mass and co-ordinate very quickly. Today, however, U.S. forces must disperse not only because they can, but because they must. Potential adversaries of the United States are developing space-based C4ISR systems. China's growing reconnaissance-strike capabilities makes it important for "the U.S. and Japanese militaries [to] develop the means to wage a "blinding" campaign against the sensor and communications networks that are foundational to PLA missile operations."[14] Eyes from above are proliferating – horizontally and vertically – which encourage dispersion on who or what they are looking at. The kind of dispersion imposed upon terrestrial forces can differ based on the kinds of satellite systems in use, and the kind of targets they are searching for, and the terrain they are in. To analogise from a limitation of airpower's influence on land warfare, spacepower can be of various effectiveness in providing support for operations in different landscapes. Targeting can be much easier in desert and naval warfare than in mountain, forest, or urban warfare. Ground forces can deny easy pickings for reconnaissance-strike systems by taking advantage of terrain that produces cover from satellite signals lines of sight, and threaten unacceptable collateral damage by using human shields or holding useful infrastructure at risk.[15]

Dispersal in Earth orbit, as a condition of spacepower, is not necessarily as fluid or variable on Earth, but neither is it a maxim. It is not impossible for satellites to concentrate and orbit closely together if that capability was so desired. This restates the value of taking the propositions as initial

[13] For an example of spectating via space, see: BBC News, 'Nigeria's Boko Haram: Baga destruction 'shown in images'", 15 January 2015, http://m.bbc.co.uk/news/world-africa-30826582 (accessed 24/02/2015)
[14] Easton, 'China's Evolving…' p. 20
[15] Gray, *Airpower*... p. 129

points of departure for strategic thought, and not as unassailable truths. Sheldon notes that dispersion is the general condition of satellites in orbit unless a major techno-economic shift occurs to overcome the cost and physical constraints on space-basing and manoeuvring in orbit. Furthermore, satellites are already dispersed in orbit and cannot be expected to move at any whim that policy may demand.[16] There are many different altitudes those satellites can reside in orbital paths to pass through, with exception to GEO. Depending on the constellation, there could be significant amounts of redundancy per satellite. In GEO, the relative level of dispersal may not be as great because they are in relatively fixed altitudes, and basic global communications coverage only requires a minimum of three satellites in GEO. This provides fewer points of failure that could threaten a system. There is some limited scope for manoeuvre in orbit, as seen below with GPS satellites during the 1991 Gulf War. The concentration of satellites is possible, if not essential, if they must fly over specific ground stations, targets, or orbital waypoints and in the process forming paths of heavier traffic, as explored in Proposition IV. A theory of spacepower must be open to space systems becoming more agile and responsive – if they do, the opportunities for the concentration of satellites will increase.

Proposition V established logistics as an arbiter of opportunity. Spacepower will rely on space infrastructure being configured the way it is for peace as well as war when a crisis occurs. Space infrastructure's dual-use nature means that any spacepower wishing to build a space network useful for both wartime and peacetime military and civilian needs will not be as flexible or optimised for every demand. Space surveillance and reconnaissance systems do not appear in wars on demand – they are deployed regardless of rapid political changes on Earth. Satellites are built with a calculation over long term needs in mind because of the long design and construction processes, and long lifespan of many satellites. Consequently, the loss of some space systems in war may influence peacetime activity for many years to come. By and large, and barring any major breakthrough in the economic costs of accessing space, or the long construction and launch schedules for satellites and launch vehicles, a highly adaptive physical space infrastructure (known as Operationally Responsive Space) will remain a remote possibility in the near future.

[16] Sheldon, *Reasoning…* pp. 180-181

If dispersal in space begets dispersal on Earth, there may be a reinforcing logic at work. Sheldon observes a 'paradox' that only increases in its importance with the proliferation of space systems. He argues that:

> "the proliferation of these systems to more and more actors, as well as the widespread availability of quality commercial imagery, means that even the U.S. and its allies must now take steps to avoid unnecessary detection from space… The paradox is that having to face space-enabled forces may actually encourage adversaries to transform themselves similarly, leading to a situation where the inherently dispersed nature of space power is reflected in the disposition of forces on Earth. Dispersed forces require robust command and control and synchronisation."[17]

What Sheldon calls a paradox is more like a circular and reinforcing logic. John Fox grasps at this as well from the perspective of satellites responding to dispersed Earth-based antisatellite weapons – to answer dispersion with dispersion.[18] Regardless, this is not fanciful theorising. The PLA's analyses of space-related tasks include "collecting information regarding an opponent around the clock and providing commanders with the early warning necessary to respond to enemy activities."[19] War planning against China must take into account Chinese space-based reconnaissance and surveillance capabilities.[20]

As the ability to detect more from space systems proliferates, more of the major powers' forces and strategically valuable activities can be counteracted. This puts the pressure of dispersal on otherwise-concentrated terrestrial forces during campaigns to disguise mass manoeuvres and dispositions and to prevent an opportunity to launch a crippling volley of precision guided munitions

[17] Sheldon, *Reasoning…* pp. 305-306
[18] John G. Fox, 'Some Principles of Space Strategy (Or "Corbett in Orbit"),' (National Defense University, National War College, Washington, D.C., 2000). p. 13
[19] Dean Cheng, 'Spacepower in China', in: Charles D. Lutes and Peter L. Hays, with Vincent A. Mazo, Lisa M. Yambrick, and M. Elaine Bunn, ed., *Toward a Theory of Spacepower: Selected Essays* (Washington, D.C.: National Defense University Press, 2011)
[20] China's potential was demonstrated with 10 satellites' operations being 'adjusted' to assist in the search for the missing airliner, Flight MH370, in March 2014, with possibly up to 21 satellites being used. See: China Military Online, 'China deploys satellites for missing plane search', 10/03/2014, http://eng.chinamil.com.cn/news-channels/2014-03/10/content_5804060.htm (accessed 07/08/2014); *Xinhua*, 'China deploys 21 satellites in search for MH370', 18/03/2014, http://www.chinadaily.com.cn/world/2014planemissing/2014-03/18/content_17357970.htm (accessed 07/08/2014)

(PGM). The experiences of the United States' spacepower in Afghanistan and Iraq may have accelerated defence modernisation drives in the PLA and the civilian leadership.[21] With spending in the PLA being directed in part towards modernisation and professionalisation, joint operations, and increased C4ISR,[22] the PLA might move away from traditionally large ground forces and onto a smaller, space-enabled dispersed and networked professional force. That said, previous Chinese attempts in the 1990s to modernise missiles with spacepower support may have gone awry. In 2009:

> "a retired People's Liberation Army colonel told a reporter that since the 1996 missile crisis in the Taiwan Strait, China had been committed to building its own GNSS. During the standoff the Chinese army fired three GPS-guided missiles toward Taiwan as a warning against seeking independence, and the second two missiles went awry. Military officials suspected someone disrupted the GPS signals, and the retired colonel called the incident an "unforgettable humiliation.""[23]

*If* GPS signals were 'spoofed' or denied to the PLA by the United States, Taiwan in this instance may not have suffered too much from the pressures of dispersal on its terrestrial forces from Chinese attempts to harness (American) spacepower against it should the crisis have escalated to a general war. However, with Chinese space infrastructure increasing in quantity and quality, including the deployment of its own navigation system, Chinese missile forces need not be as concerned about dependence on GPS for accurate strikes. As the reinforcing logic put forth by Sheldon works, the PLA – as it modernises and integrates spacepower into its planning and capabilities – may become more vulnerable to disruptions or attacks on its own celestial lines of communication in specific military operations. Because of American reconnaissance-strike systems, dispersing and hiding in rough terrain is even more important for Chinese units. Taiwanese forces must disperse more if Chinese missiles are integrated into Chinese spacepower. This would increase the potential payoff of engaging in space warfare against China, especially if such forces were to be highly dispersed on Earth, and

[21] David Lai and Marc Miller, 'Introduction', in: in Roy Kamphausen, David Lai, Andrew Scobell, (ed.) *Beyond the Strait: PLA Missions Other Than Taiwan* (US Army War College, 2009) pp. 7-8
[22] See: Paul H.B. Godwin, 'The PLA Faces the Twenty-First Century: Reflections on Technology, Doctrine, Strategy, and Operations', in James R. Lilley and David Shambaugh (ed.) *China's Military Faces the Future* (Washington, D.C.: East Gate, 1999) p. 55; Adam P. Liff and Andrew S. Erickson, 'Demystifying China' s Defence Spending: Less Mysterious in the Aggregate', *The China Quarterly* (iFirst, 25 March 2013) p. 3
[23] Easton and Frazier, *GPS*... p. 180

without the connecting mesh of computing technology and celestial lines of communication such forces may be far easier prey to other terrestrial forces that may have just levelled the tactical or operational playing field somewhat. This weakness is also true of U.S. forces relying on spacepower for networked forces and Prompt Global Strike capabilities.

Deception in the Newtonian world as well as in the electromagnetic spectrum will be useful in wars that require mitigating the space-based reconnaissance and surveillance capabilities of an enemy. Sheldon agrees with David Lonsdale that full battlefield transparency is a fantasy and that the Fog of War will remain present, but the effects of proliferated space reconnaissance capabilities cannot be dismissed.[24] Sheldon's points on dispersal assumes that the belligerents in question *could* be targeted by enemy terrestrially-based PGMs and deployed forces, or that a space-enabled or supported power is actively working against them.[25] With ELINT satellites proliferating, more pressure will accrue for high-technology and concentrated forces to either disperse from space-enabled foes or develop ELINT *maskirovka* techniques, or mitigating electronic emissions through reducing the use of wide-area electronic communications. The point here is that this dispersal logic *can* be in effect. Whether or not it is, and how it effects the situation at hand, is a task in the critical and intelligent application of this proposition.

Dispersion is not the whole story. Dispersion is an accomplice to concentration. Spacepower plays a role in the risks and opportunities of concentrating forces on Earth, and spacepower's *effects* in and from orbit can be concentrated whilst its physical infrastructure might be dispersed. However, if spacepower imposes dispersion on a military that is only effective when concentrated, that military will have even more incentive to assault the enemy's spacepower and celestial lines of communication to enable it to concentrate and dispel the dispersing effects of the hostile cosmic coastline.

[24] Sheldon, *Reasoning…* pp. 308-309; referring to: David Lonsdale, *The Nature of War in the Information Age: Clausewitzian Future* (Abingdon: Frank Cass, 2004)

[25] Tangentially, the compulsion to disperse that may be caused by the exploitation of spacepower and a command of space will only increase if space-to-Earth weapons and reusable spaceplanes or hypersonic strike vehicles are ever deployed. See: Sheldon, *Reasoning…* pp. 310-312

## 7.2 Proposition VII: Part 2: Mass effect[26]

"Cut off support from space, the small high-tech transformational force capable of subduing larger less advanced opponents becomes just a small military force, overburdened with expensive but now useless equipment." – Wilson Wong and James Fergusson[27]

Concentrating forces to achieve a decision through battle, and dispersing to deny that decision, is an old canon in strategic theory, and is already featured in Proposition III through seapower theory.[28] Antoine-Henri Jomini, although known for his precept of throwing the mass of an army against the enemy's decisive points, allowed for a concerted yet dispersed effort to resist an enemy.[29] Confronting concentrated forces that have integrated the effects of spacepower into their combat capabilities means that dispersal is the only reasonable immediate response to escape a 'hammer and anvil' assault. Ground forces engage the enemy in battle and pin them down – the anvil – to prepare for an airstrike and heavier ground forces to destroy them – the hammer. Close coordination of airstrikes and land battles, especially at close ranges, depends today on space technology's integrations into communication systems and precision weapons.[30] This means that the concentration of spacepower capabilities is still possible, but it is not necessarily achieved through the concentration of satellites, but through a concentration of their effects (signals, data management, and information analysis services) into specific times and places.[31] Concentration is still a useful principle, but it does not take the same forms as in other media, like the sea or the air.[32] However, David Lupton is still right to state that, because of the unique characteristics of outer space satellites can have a congregational tendency to cluster at popular orbits, such as in geosynchronous orbit which can form

[26] Inspired by the name of the computer game series, *Mass Effect* (Bioware, Electronic Arts, 2007-2013)
[27] Wilson W.S. Wong and James Fergusson, *Military Space Power: A Guide to the Issues* (Oxford: Praeger, 2010) p. 95
[28] On Sun Tzu, Clausewitz, Jomini, and Mao on concentration of forces, see: Michael I. Handel, *Masters of War: Classical Strategic Thought* (Abingdon: Routledge, 2001) pp. 155-164.
[29] Antoine-Henri Jomini, *The Art of War*, G.H. Mendell and W.P. Craighill, trans. (Westport, C.T.: Greenwood Press, 1862, 1971) pp. 70,176
[30] However, laser-painted targeting can still create precise air support for land forces, see: Stephen Biddle, 'Afghanistan and the Future of Warfare,' *Foreign Affairs* (82:2, 2003) pp. 31-46
[31] Sheldon, *Reasoning*… pp. 164-165
[32] Ibid., p. 267

advantageous positions and chokepoints (see Proposition IV).[33] But that depends on the satellites being targeted and the effects sought. This proposition is meant to trigger thinking on dispersal and concentration of infrastructure and effects in spacepower.

Satellites can be based very far apart in different orbits, yet they can impose their effects on a concentrated area and time. Concentrating these effects can create a kind of mass, or the potential to create a mass effect, when the effects of satellite support (celestial lines of communication that provide force enhancement) are combined with terrestrial forces. Those employing standoff weapons can also disperse more but retain the mass effect of concerted concentration of weapons effects if their weapons can be guided by satellites. Concentration of effects can include the direct impact of weapons fire or the massing of celestial lines of communication so that terrestrial forces can themselves mass and fight with greater safety and efficiency. Sheldon described this ability to enable concentration of mass and firepower at the last moment as a unique principle of concentration for spacepower. Although spacepower, "itself unable to [physically] mass, will theoretically enable the massing and concentration of air and sea [and land] power at the last possible moment through its ability to provide a real-time depiction of the battlespace, connectivity, positioning, and timing."[34]

By harnessing celestial lines of communication (Proposition IV) and enjoying a friendly celestial coastline (Proposition V), terrestrial forces may be able to outmanoeuvre and out-coordinate their enemy that does not enjoy such support and suffer the penalties of operating against a hostile celestial coastline. GPS signals, now ubiquitous, forms mass through effects on Earth.[35] It is one consequence of the exploitation of a degree of the command of space (Proposition I). The integration of spacepower and information technologies into operational and tactical levels of war have made forces that use them lighter and more precise, forcing enemies on the receiving end to disperse and hide or face destruction. Massing troops for an attack against spacepower-supported forces risks being spotted by ISR systems, and therefore makes only piecemeal attacks on detached units by a dispersed

[33] David E. Lupton, *On Space Warfare: A Space Power Doctrine* (Montgomery, A.L.: Air University Press, 1999) pp. 20-21
[34] Sheldon, *Reasoning…* p. 165
[35] Ibid., p. 266

military force the most successful kinds – unless a massive force is successfully concealed in advance of the attack. Responses to spacepower-supported warfare is explored in the final part of Proposition VII.

Effects can be concentrated into 'cones of vulnerability' as described in Proposition V, especially through the overlapping of different cones (arcs of fire that can form kill-zones or lines of sight that provide targeting data) with dispersed points of origin (distributed satellites or weapons platforms on Earth or in space).[36] This is particularly true of lasers which are additive in their effects. Should a beam's intensity and focus be sufficient to cause the required damage or interference, coordinated targeting from dispersed ground-based or space-based lasers with enough overlapping lines of fire can add to the heating effects at the point of contact with the target. Such weapons systems can be made individually redundant if they were to develop networked accuracy and tracking capabilities, and if they are cheap enough to produce and deploy *en masse* compared to missile-launched antisatellite weapons. A highly redundant antisatellite system may make it a difficult one to defeat when it is used for the first time, as any comprehensive system without a single point of failure will take time to locate, degrade, and destroy. As well as concentrating effects in places, activities can be concentrated in time to capitalise on surprise – but that is not unique to spacepower.

Dispersed weapons systems will necessitate coordination and information gathering capabilities, often brought through space systems they are dispersed far and wide across a continent, a sea, or several of each, to concentrate fire to form a mass effect. Effects from space-based systems and antisatellite weapons can be concentrated in time and place. The status of the then-incomplete GPS constellation during the 1991 Gulf War is a useful illustration of the constraints that can be put on terrestrial action should a space system not be working to its full potential. During Operation DESERT SHIELD, where coalition forces were assembling in Saudi Arabia, some existing GPS satellites were tinkered with in order to increase their orbital times of over the Persian Gulf.[37] Such tinkering allowed "round-the-clock two-dimensional coverage (latitude and longitude, needed for

[36] Ibid., p. 167
[37] Easton and Frazier, *GPS*... pp. 124-125

ground and ocean-surface operations)… three-dimensional coverage (latitude, longitude, and altitude, needed for airplanes) for about eighteen hours a day."[38]

This illustrates aspects of both Propositions V and VII. The GPS satellites formed a hostile celestial coastline above Iraq by enhancing U.S. terrestrial forces and enabling them to disperse and advance through a featureless desert with great accuracy, and more importantly, synchronisation between advancing units. However, this could only be done for set amounts of hours every day. For its part, Iraq failed to make this celestial coastline hostile for the United States. The U.S. exploited its command of space (Proposition I) to great effect and could perform subtle strategic manoeuvres with its spacepower (Proposition V) to increase its overwhelming military effectiveness through integrated spacepower against Iraq, which could not keep its forces concentrated in open ground (Proposition VII). GPS-enabled Special Forces Pave Low helicopters from the USAF were used to lead eight Army Apache attack helicopters (which did not have GPS receiving devices) on below-radar flights to simultaneously attack two Iraqi early warning radar installations that were *forty miles apart but struck within twenty seconds of each other*.[39]

Without the guidance and synchronisation from GPS that enabled the success of this operation, Iraqi air defences may have been able to offer greater resistance to the main airstrikes on Iraq which immediately followed this Special Forces and Army aviation operation.[40] In the 2003 Iraq War, however, "contrary to Saddam's expectations, the Americans made use of a strategy that did not necessitate a preliminary air strike." Ground forces crossed "more than 500 kilometers in less than 20 days, with the loss of only 60 soldiers."[41] Precision airstrikes are not always a preamble to a larger military assault, even with spacepower's support. Nevertheless, the success of such a *well-timed, precise, and geographically distributed* strike operation in 1991 is impressive in itself.

[38] Ibid., p. 125
[39] Ibid., p. 118
[40] However, whether there may have been a workable alternative to destroy those installations, or whether the U.S. would have tolerated attrition in the USAF, is another matter for another study on speculative military space history.
[41] Itai Brun, 'While You're Busy Making Other Plans' – The 'Other RMA', *Journal of Strategic Studies* (33:4, 2010) p. 558

This is what is meant by the ability of spacepower, which is dispersed in orbit, to allow for the concentration of effects in time and place when it is successfully integrated with existing (in this case) airpower and landpower capabilities. Against a hostile celestial coastline, Iraq in 1991 was at the mercy of synchronised, precise, and rapid forces; any fixed and obvious targets were at high risk of destruction.[42] This realisation leads to cover, concealment, *and dispersion* under the condition of space superiority in conjunction with deployed terrestrial forces and superiority at land, sea and air. It must not be assumed from this narrative that the 1991 Gulf War had no pitched battles – for example attacking the Iraqi Republican Guard on 26th February proved challenging and included close combat. Overwhelming coalition airpower, armour, and artillery did not quickly break the Republican Guard's strong defensive positions.[43] This illustrates how dispersal from spacepower in principle may not come about exactly as described in practice. However, at the same time, in the Battle of Madinah Ridge between the 1st U.S. Armoured Division and the Iraqi Madinah Division, the detection of 'concealed' Iraqi T-72 tanks on a defensive high ground allowed them to be destroyed at a safe distance by coalition tanks, artillery, and airpower with 300 Iraqi armoured vehicles destroyed and only two American armour losses.[44] This illustrates the consequences of failing to conceal or disperse heavy forces that have been detected by a spacepower-enabled foe that also enjoys air superiority. The next section examines Iraqi adaptation to their experiences in fighting U.S. forces, framed under the notion of dispersal in the face of spacepower. This is an exploitation of spacepower by a dominant space power against a very weak foe. Forcing the enemy to disperse so that you can concentrate your own military units is one consequence of spacepower and one way to exploit spacepower. It is not the only way to exploit it, but this historical example illustrates a part of Proposition VII to further critical engagement with the consequences of spacepower's dispersing qualities.

There is no intent here to claim the apparent successes of U.S. airpower in striking targets and imposing dispersion, and in the case of aerial bombardment in Iraq, coercion, as those of spacepower *alone*. In terms of understanding wars in their entirety, it is wrong to claim that any one form of

[42] Furthermore, this analysis does not begin to question the quality of the Iraqi Army in 1991.
[43] Alistair Finlan, *The Gulf War 1991* (Oxford: Osprey, 2003) pp. 62-64
[44] Ibid., pp. 64-65

geographically-categorised power was responsible for the strategic outcome. Contrasting Colin Gray's short summary of the role of airpower in the 1991 Gulf War with that recounted on GPS and the assault on radar sites above is illuminating. Gray argues that "coalition airpower achieved control of the air by fatally disabling Iraq's air defense system in the first 24 hours of the war" and the subsequent 26 days of aerial bombardment.[45] This air-centric view is not necessarily wrong, but it does contrast with the space-centric one above. Neither air nor spacepower alone could have achieved the stunning successes against the Iraqi air defence system. But a space-centric narrative does show the influence of spacepower in joint operations in a way that an airpower-centric one may not.

Regardless, asking the question of whether airpower *alone* causes the capitulation of enemies, ignores the reality that the U.S. military has tried "to think in terms of joint operations-the synergistic integration of air, land, space, and sea forces-and move away from service-specific perspectives."[46] Whether or not the airstrikes toppled the Serbian regime regardless of the risks posed by the Kosovo Liberation Army (KLA) or the lack of Russian support, those airstrikes required spacepower to be so precise and (allegedly) effective. The practice of U.S. airpower, like U.S. seapower and U.S. landpower, have been integrated with U.S. spacepower.

This proposition claims that spacepower, and the exploitation of space technologies through successful strategic manoeuvres via the cosmic coastline (Proposition V) has allowed for a degree of transparency and battlefield efficiency that cannot be ignored, least of all by belligerents that possess terrestrial forces but lack any significant form of tactically-operationally useful spacepower of their own. It is the consequences of the *space-basing* of this sensor and computer technology that concerns spacepower theory most. The same technology based on Earth could not have as far-reaching effects because of the potential global reach and loitering presence of satellite constellations (Proposition II). The dispersing effects that spacepower enables, when it enhances terrestrial forces (land, sea, and air, and through no small amount of computing technology) in conjunction with the dispersed condition of space systems provides a good starting point to consider the possibilities of concentrating forces,

[45] Gray, *Airpower*... p. 212
[46] Daniel L. Byman and Matthew C. Waxman, 'Kosovo and the Great Air Power Debate,' *International Security* (24:4, 2000) pp. 6-7

assets, and effects when spacepower can be applied – or needs to be denied. Failing a space denial option, elaborate deception will be needed like in waging warfare under a sky dominated by enemy air observation. In addition, terrestrial forces may still need to concentrate on Earth in terms of geographic regions. Spacepower's concentration of effects imposes dispersal and the challenge of resisting spacepower to those on the receiving end.

## 7.3 Proposition VII: Part 3: Resisting spacepower

"A general uprising… should be nebulous and elusive; its resistance should never materialize as a concrete body… On the other hand, there must be some concentration at certain points: the fog must thicken and form a dark and menacing cloud out of which a bolt of lightning may strike at any time." - Clausewitz[47]

"The difficulty [of the Scud hunt in 1991] was the result of…: the time it took for coalition aircraft to arrive at the estimated launch point…; the ability of the Iraqi Scud teams to "fire a missile, drive away, and hide in a culvert all within five minutes"; the difficulty of detecting or distinguishing launcher infrared and radar signatures from those of other vehicles; and the Iraqi use of decoys." – Jeffrey Richelson[48]

Those at risk of being on the receiving end of this dispersing effect of spacepower and integrated weapons systems may learn to adapt through thinking of how to attack foes that use spacepower (looked at first in this section), and/or how to mitigate the benefits they derive from it (explored afterwards). If spacepower forms a means of massing effects through concentrated celestial lines of communications at specific times and in specific places, then space can be thought of as a centre of gravity under *particular* conditions, accepting the limitations of the idea of the centre of gravity as mentioned in Proposition III. *If* space is a centre of gravity, its possession is very important, but it does not guarantee victory. Likewise, striking at this centre of gravity does not guarantee success, and if not, it may not be a centre of gravity in the first place. This nuance is lost in the 'high ground' American space doctrine, which believes that wars on Earth will be won or lost in space.[49]

[47] Clausewitz, *On War…* p. 481
[48] Jeffrey T. Richelson, *America's Space Sentinels: DPS Satellites and National Security* (Lawrence, K.A.: Kansas University Press, 1999) p. 173
[49] Lupton, *On Space Warfare…* p. 38

Some belligerents could afford to take losses or lose a command of space and focus on resources and operations elsewhere – but the consequences of enemy spacepower on terrestrial warfare will still need to be considered and the general idea of strategic manoeuvre against a spacepower that enjoys a friendly celestial coastline is still a useful frame to view such a situation. The idea is meant to aid thinking about dispersing and concentrating mass, effect, and forces. Clausewitz described a centre of gravity as "where the mass is concentrated most densely. It presents the most effective target for a blow; furthermore, the heaviest blow is that struck by the center of gravity… the fighting forces of each belligerent… have a certain unity and therefore some cohesion. Where there is cohesion, the analogy of the center of gravity can be applied."[50]

If mass is taken in Sheldon's sense – that mass forms through the enabling, enhancing, and supporting functions of GPS signals – the GPS network can be seen as *a* centre of gravity. This line of thinking is apparent within Steven Lambakis' concerns about U.S. naval, ground, and air forces being paralysed should they lose space support.[51] Furthermore, space support does provide a degree of cohesion and unity to U.S. military forces, and this cohesion allows them to disperse themselves yet concentrate effects, resonating with Clausewitz's description of a centre of gravity. If it is denied in a struggle over a degree of the command of space (Proposition I), it may give enough of a window of opportunity for meaningful resistance as a result of a contributory strategic manoeuvre (Proposition V) that degraded enemy celestial lines of communication (IV). If spacepower-enhanced forces are distributed, there may be opportunities for concentrated attacks on them if they were to lose their networked support, precision firing, and early warning capabilities. This is a path that the seven propositions anticipate when considering resisting a foe with a large space infrastructure and modernised forces at its disposal. All of these points should help creative strategic thought to emerge from critically engaging with them towards specific scenarios.

Such thinking can produce hard strategic choices for any belligerent when thinking about centres of gravity, or at least the most lucrative targets of an enemy. Again, Clausewitz is useful to

[50] Clausewitz, (H/P) *On War*... pp. 485-486
[51] Steven Lambakis, 'Space Control in Desert Storm and Beyond', *Orbis* (Summer 1995) p. 427

illustrate the dilemmas of strategic analysis and choice through concentration and dispersal when he argued that:

> "on the one hand then, the force at which our blow is to be aimed requires that our strength be concentrated to the utmost; on the other, any [strength in] excess [towards that target] is to be regarded as a decided disadvantage, since it involves a waste of energy, which in turn means a *lack of strength* elsewhere. It is therefore a major act of strategic judgment to distinguish these centres of gravity in the enemy's forces and to identify their spheres of effectiveness."[52]

Antulio Echevarria explains that the centre of gravity is found in *what allows forces to concentrate themselves and their effects, and what gives them their unified direction and purpose*, and not necessarily the concentrated forces themselves.[53] In pure conceptual terms, a declaration of a centre of gravity is not necessarily a source of combat strength or weakness, meaning that if spacepower is a connecting force for an enemy, it is not necessarily a weak point (it may be well-guarded) nor a fountain of strength (connected forces do not inherently mean that troops know how to fight).

Spacepower, then, may be deemed a centre of gravity for the United States with some initial plausibility. However, such a declaration relies on knowing whether the United States could not recover and persist in spite of a loss of a command of space. That is a question for another matter, but it illustrates a constructively critical use of the idea of the centre of gravity for resisting major space powers. This does not mean that U.S. space infrastructure is inherently vulnerable, or the only source of strength for its combat capability. However, if its spacepower is challenged there may be systemic consequences. If its spacepower is what holds together U.S. military might, then it must be targeted if it is possible to strike. But a strategist's mind cannot be closed to the diversity of potential centres of gravity in existence between belligerents and at different times.[54] If an enemy's centre of gravity (or one of a few[55]) is deemed to be its space infrastructure, and if it is feasible to assault it, the other

[52] Clausewitz, (H/P) *On War*… p. 486. Emphasis Clausewitz's.
[53] Antulio J. Echevarria, *Clausewitz and Contemporary War* (New York: Oxford University Press, 2007, 2013) p. 181
[54] Such as leaders, political structures, and other military elements. See: Echevarria, *Clausewitz*… pp. 182-183
[55] Clausewitz argued that analysis must reduce the enemy's centres of gravity to as close to one as possible, to allow for the greatest amount of concentration against sources of power. See: Carl von Clausewitz, *On War*, O.J.

propositions in this spacepower theory help visualise how it could be done and where to draw priorities in where to assault the enemy's command of space (Proposition I) by examining its celestial lines of communication (Proposition IV) and its means of response to adapting its capabilities to new realities through strategic manoeuvre (Proposition V) and drawing on its strengths in other media (Proposition III). The mutually-interacting propositions should become clearer in their meanings now that Proposition VII is itself becoming clearer and the whole theory begins to interact as a single complex ecology. Referring to one proposition alone is difficult without referring simultaneously to others.

GPS service gaps could leave some hours in every day available to exploit against the enemy that depends on it. In 1991, the then-incomplete GPS constellation provides a tantalising insight into a possible terrestrial consequence of a successful space denial campaign targeting the GPS service. With less effective forces that would otherwise need GPS for protection, precision, co-ordination, and mobility, gaps – or disruptions to – celestial lines of communications could be an opportunity for an attack. This gap in coverage could be brought about by weapons fire from Earth's surface based on land, sea, the air, and through cyber infiltration, turning the cosmic coastline into a hostile zone for specific GPS satellites. Major-General Patrick Cordingley, then commander of the British Army's 7th Armoured Division (the 'Desert Rats'), recounted a useful episode regarding the (foreknown) loss of full GPS coverage during the war. A battlegroup "got lost when the GPS… ceased to work. First thing in the morning, and then just after dark, the satellites that provided the signals would go out of range. As a result every morning and evening for about fifteen minutes we would get lost."[56] These gaps were not capitalised upon by Iraqi resistance possibly because they did know of them, but it does show the dependence ground forces may have on spacepower in the desert for their operations, and the potential opportunities for organised resistance against forces cut off from celestial lines of communication.

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Matthis Jolles, trans. (Random House, 1943) in: Caleb Carr, ed., *The Book of War* (New York, N.Y.: The Modern Library, 2000) p. 948-949

[56] Patrick Cordingley, *In The Eye of the Storm: Commanding the Desert Rats in the Gulf War* (London: Hodder and Stoughton, 1996) p. 204

Any successful denial operation may provide a window of opportunity to conduct terrestrial operations (including a concentration of mass) against modernised forces that may otherwise be unthinkable when resisting a spacepower-supported opponent. However, this does assume that such operations are easy. Developing space observation is necessary to plan and execute a space denial campaign, so that space warfare can be waged in tandem with terrestrial operational needs. The U.S. Defense Intelligence Agency was able to monitor not only the launch and movements of the USSR's spacecraft, but also to track "maneuvering to lower an orbit to obtain a better photograph of a target" and ascertaining how many "camera events" occurred over a specific state.[57] Such detailed intelligence collection and analysis provides some insight into the potentials for gathering intelligence about satellites and space activity, as opposed to using satellites to gather intelligence about targets on Earth.

Not all approaches to resisting a dominant spacepower's mass effect need to assault celestial lines of communications.. One can adapt to absorb or deny spacepower-enabled heavy blows by assuming a general defensive posture and playing to the strengths of defensive warfare (as discussed in Chapter 3). Any combination of the application of these seven propositions to particular conditions can lead to a resistance of spacepower that may not necessarily involve directly attacking or denying celestial lines of communication. This can include denying space systems any obvious targets to acquire.

In his study of Arabic and Farsi sources, Itai Brun makes the argument that the 'central players' in the Middle East, by the late 1990s, were undergoing a process to adapt to U.S. military advantages.[58] There were three prongs to that process. First was the ability to absorb strikes and preserve crucial military strength in the face of precision munitions. Second was the desire to establish credible deterrence in order to prevent an open war. Third, there was a recognition of the need to move towards an attritional approach to warfare to chip away at the political resolve of

[57] Jeffrey T. Richelson, 'U.S. Intelligence and the Soviet Space Program', *National Security Archive Electronic Briefing Book* (no. 501), 04/02/2015, http://www2.gwu.edu/~nsarchiv/NSAEBB/NSAEBB501/ (accessed 20/02/2015)

[58] Itai Brun, 'While You're Busy Making Other Plans – The 'Other RMA', *Journal of Strategic Studies* (33:4, 2010). Brun refers to, among others, Iran, Iraq, Syria, Hezbollah, the Taliban, and Al-Qaeda.

Western leaders and populations, rather than seeking a decisive combat victory against U.S. or modernised Western militaries.[59]

Of most relevance to the discussion of dispersal here is Brun's noting of the improvement of survivability, which includes "the use of protective means (bunkers and especially tunnels), camouflage and deception, scattering military forces, deliberate obfuscation of military and civilian facilities." Furthermore, he cites an extensive use of "low-signature systems… and low-signature forces," meaning personal anti-tank and anti-aircraft missiles, commando units, paramilitary forces, and guerrilla fighters.[60] This is in conjunction with investments in better air defences to counter "the massive dominance of the West's airpower."[61] This adaptation is a response to U.S. capabilities across the board for many decades, which have been supported by space technology, and more recently, computer networks and miniaturised electronics. This shows how spacepower, in conjunction with other aspects of the contemporary character of warfare and the asymmetries of precise standoff munitions, instils a dispersing principle on terrestrial forces. This is not wholly new, as dispersal and concentration tend to occur between points of superior and defective strength through strategic history. But this proposition shows spacepower's hand in influencing modern warfare and tactical, operational, and strategic realities when space-supported forces are in play, and consequently, it illustrates the potential gain of disrupting celestial lines of communication, or making them impotent by hiding what the eyes from above are seeking.

In 2003, Iraqi forces caused "shocks" to Donald Rumsfeld's plan to invade Iraq. The decision-makers in Washington had wrongly assumed that enemy forces would crumble in the face of a light, precise, and rapid force, and that Iraqi forces would not have learned from the experiences of 1991.[62] Spacepower had been integrated to a much larger degree in U.S. military forces by 2003, yet Iraq's use of paramilitary forces and the lack of human intelligence by American and allied sources led to a surprise for coalition forces in the theatre. Irregular forces, the Fedayeen, continued to harass

[59] Brun, 'While…' pp. 548-549
[60] Ibid., p. 549
[61] Ibid., p. 550
[62] Alastair Finlan, *Contemporary Military Strategy and the Global War on Terror* (London: Bloomsbury, 2014) p. 135

U.S. forces outside of Baghdad with great ferocity, and the Iraqi armed forces had learned to put together relatively small and mobile units to intercept Apache attack helicopters. The Apache attack on the Medina Division involved 32 helicopters, of which 31 had sustained serious damage and one was shot down and captured by Iraqi forces.[63] This illustrates the need to apply such principles of dispersion and concentration with critical thought – if what has caused dispersion in the past fails to work again, the enemy may find more opportunities for counterattack, and perhaps, concentration of mass and/or effects of their own. Again, Luttwak's paradoxical logic is at work. However, U.S. spacepower had another trick up its sleeve that may have finally broken the Republican Guard: multispectral satellite imaging data and GPS allowed U.S. airpower to effectively target and destroy the Guard *during* a sandstorm, and broke their will to fight.[64]

This highlights a weakness of space surveillance – there is a dependency on acquiring intelligence about targets that are amenable to being detected by technical means. In the early years of ISR from airpower, ground forces learned to fool or deny giving away their intent to air-based observers.[65] Competent foes can hide and conceal their assets (like the Fedayeen), increasing the risks of harming vulnerable political will in the face of casualties, poor target acquisition, or moving in to close combat with enemy forces that risk losing more troops in the process.[66] Al-Qaeda forces in Afghanistan in 2001 adapted to American surveillance and reconnaissance-strike capabilities. Biddle narrates that, after the initial shock and surprise of the precision American bombardment, "with proper cover and concealment, the defenders were able to prevent American commandos from locating the entirety of their individual fighting positions, many of which could not be singled out for precision attack."[67] Space surveillance does not provide a panacea for the detection of targets; neither will it provide omniscience to its bearer.

Concentrating and dispersing spacepower may increase the chances of success in some areas whilst opening vulnerabilities elsewhere. Strategic manoeuvring (Proposition V) can make some areas

[63] Ibid., pp 135-136
[64] Ibid., p. 141
[65] Bob Preston, *Plowshares and Power: The Military Use of Civil Space* (Washington, D.C.: National Defense University Press, 1994) pp. 41-54
[66] Brun, 'While…' pp. 546-547
[67] Biddle, 'Afghanistan…' p. 36

more likely to be successfully resisted than others, in different places as well as at different times. For example, on 10th-12th May 1940, the Luftwaffe left a key vulnerability above the Ardennes forest in order to concentrate in their feint against the Low Countries to disguise the German panzer thrust through the Ardennes. This episode illustrates the value of knowing when and where to concentrate and disperse, and in making the right judgments in where the enemy is concentrating its efforts, effects, and conducting diversions. In concentrating in some places, the enemy does offer vulnerable areas elsewhere.[68] In modern warfare, these vulnerable areas could be on Earth or in space (or reached through them), and spacepower can help or hinder efforts to target them via strategic manoeuvre. If spacepower is being concentrated towards a specific objective somewhere at a specific time on Earth, there could be gaps in coverage and analysis of data in other places, leaving gaps for exploitation in other places where an enemy's spacepower may be spread thin. One side's strategic manoeuvring can give away signals for the other side to figure out where to disperse and concentrate their forces and effects.

Proposition VII has explored thinking of spacepower's condition as being dispersed in orbit, and how it encourages dispersal on Earth. Dispersal in space begets dispersal on Earth, as Sheldon would argue. However, this does not forgo the existence and possibilities of concentration. The effects of spacepower from orbit can be concentrated, and the harnessing of celestial lines of communication at major points of effort can form a mass effect if executed with weapons systems on Earth. In addition, the political dimension influences whether an actor can be seen to be doing something within view of space surveillance systems, regardless of whether there are open hostilities or not. Proposition VII is about the exploitation of the command of space (detailed in Proposition I) to use or deny celestial lines of communication (Proposition IV). For any comprehensive space power such as the United States, Russia, or China, the means of securing a command of space and making it contribute to the wider war through strategic manoeuvres (Proposition V) is effected by influencing the concentration and dispersal of efforts on Earth (Proposition VII). Without the means to exploit what the command of space provides, a space warfare campaign may lose its strategic value. Securing

[68] See: Karl-Heinz Frieser, , *The Blitzkrieg Legend: The 1940 Campaign in the West*, John T. Greenwood, trans., ed. (Annapolis, MD: Naval Institute Press, 2005) pp. 2, 48, 88, 143, 179-180, 200-204, 263-287

a command of space for its own sake is not enough – it must translate into effects on the movement of forces and the use of violence on Earth.

## Summary

Proposition VII, argues that spacepower's physical characteristics on Earth's cosmic coastline is usually dispersed, but their effects can be concentrated in select times and places for terrestrial forces. This, in turn, can encourage space-supported force to become more dispersed in their postures and retain their lethality by co-ordinating efficient and accurate long-range destructive capabilities. High accuracy targeting imposes dispersion on the enemy – as any superior force may do. This pushes the enemy to adapt to the sharp end of spacepower-supported forces on Earth by either striking at the spacepower of the enemy (a *possible* centre of gravity) or adapting to it and denying the targets that such systems seek. Another possibility is that militaries that prefer to mass on Earth must do so only after the enemy's spacepower is dealt with. Proposition VII explores the 'so what' questions for terrestrial warfare of securing the command of space (I) and using celestial lines of communication (IV) to conduct supporting strategic manoeuvres (V) in support of warfare on Earth (VII). Propositions VII completes the circle of spacepower theory. However, in keeping with the non-linear view of war and politics as outlined in Chapter 3, connections are apparent between the Propositions in any number of combinations and particular manifestations. Their elements, however, persist.

# Application and Conclusion: The Sins of Solar Empires?[1]

"We have learned now that we cannot regard this planet as being fenced in and a secure abiding-place for Man." – H.G. Wells[2]

Although H.G. Wells was writing in reference to the Martian threat to human civilisation in the last years of the 19th century, his words echo strongly with the precariousness of the human political economy on a planet that still lives under a nuclear shadow and faces ecological destruction. Few may have seriously considered the possibility that, like Wells' Martians, humans may have to find the survival of their species across the gulf of space and beyond their homeworld, if only to harvest the resources of the solar system to support life on Earth. Whether or not human political-economies remain in Earth orbit or grow outwards, spacepower theory (and many others) will remain useful as a guide for thinking and research on the competitive and violent aspects of power in the cosmos. This thesis has moved the frame of debate on spacepower, strategy, and politics away from an excessive focus on space-based weapons and to the development of a broader theory of spacepower. This theory incorporates space-based weapons, but is not dominated by them, unlike much of the literature critiqued in Chapter 2. This spacepower theory sets out seven distinct yet mutually interacting and constituting propositions that are meant to be applied critically to the case at hand to further the self-education of the individual in matters of strategic thought in the Space Age.

This concluding chapter does two things. First, it applies spacepower theory through illustrative logic trains. It shows the entire spacepower theory working as a single entity made up of seven propositions that help in the self-education of the individual to think more creatively and constructively about spacepower. Second, it draws out larger arguments from the spacepower theory which also summarise and emphasises the contributions of the research. In sum, this thesis not only provides a heuristic spacepower theory, it also provides three wider yet tentative arguments about

[1] Inspired by the title of the computer game *Sins of a Solar Empire* (Ironclad Games, Stardock/Kalypso Media, 2008)
[2] Herbert George Wells, *The War of the Worlds*, Patrick Parrinder, ed. (London: Penguin, 1898, 2005) pp. 178-179

astropolitics that are of possible interest beyond strategic studies and to larger discussions within International Relations (IR).

## Applying spacepower theory

The use of space in warfare and the use of weapons against space systems are "both historical fact and current reality."[3] This point was argued throughout chapters 1 and 2 before the thesis moved to theory-building from Chapter 3 onwards. The spacepower theory built in this thesis has articulated the possibilities and potentials of space warfare as well as the influence of spacepower in warfare as whole. This thesis has marginalised space-based weapons somewhat, reflecting a preoccupation for theorising the main substance of extant contemporary space activity rather than exotic and unproven space-based weapons capabilities. Propositions V and VII epitomises the extent to which the seemingly mundane, but defining, aspects of spacepower have gone untheorized in spacepower theory so far. Propositions V and VII rectify this situation by theorising the support roles and their relation to warfare as a whole respectively.

This section provides three illustrative logic trains showing spacepower theory at work in making sense of the possible influence and forms of spacepower in a Terran conflict. This shows the versatility of the theory, and how the same universal elements can manifest in different ways in their application. Doing this defies a general Clausewitzian hostility to mechanistic approaches. However, if there is an understanding that mechanistic logic is used as a starting point, and a springboard for further critical and intuitive strategic thinking (as with Dolman's *Astropolitik*), it can be very useful to crystallise not only the purpose of this theory but also its major content. These logic trains are brief and concluding *examples of applying the theory* – they are not the totality of the theory as the chapters demonstrated in detail. Unpredictable and unexpected action from all belligerents are possible, and owing to Luttwak's paradoxical logic, sometimes the least expected action may be the most likely to occur. However, this logic train is a constructive base to strategise about spacepower and terrestrial warfare. Much like the three elements in Clausewitz's trinity, all propositions are partly defined by

[3] Bob Preston, Dana J. Johnson, Sean J.A. Edwards, Michael Miller, and Calvin Shipbaugh, *Space Weapons, Earth Wars* (Washington, D.C.: RAND, 2002) p. 2

their interaction and blurred boundaries with their counterparts.[4] This means that no single proposition should be considered without its interaction with all other propositions. The following logic trains are tentative examples of the spacepower theory being used to categorise and explore events and themes in various scenarios.

A comprehensive space power without a peer competitor, with modernised and space-integrated terrestrial forces and a truly global expeditionary reach (such as the United States for an illustrative example) must ensure a persistent and general command of space (Proposition I) by manipulating its celestial lines of communication (Proposition IV) for the continued use of a large range of space systems and lines of communication. This amounts to a more space control-orientated space warfare campaign, and depending on the adversary, will include space denial aspects as deemed necessary. Securing the command of space can include the destruction or disabling of enemy spaceports and satellites that can threaten U.S. command of space through 'hard' kinetic and 'soft' electronic warfare methods, as well as moving friendly satellites into safer or more useful orbits if possible. Doing so amounts to strategic manoeuvres (Proposition V), because improving the situation in Earth orbit, the celestial coastline, will increase the effects of U.S. spacepower for its own and allied terrestrial forces (Proposition VII), which enables a degree of dispersal in structure by concentration in effort and weapons effects. Spacepower then fulfils its role in an important part of dominating all the environments of warfare. However, the U.S. must grasp the unique merits of operating in space (Proposition II); understand that dominating space does not give a free strategic hand on Earth (Proposition III); and that all international politics and warfare has a domestic hinterland and reflects the cultures and interests of the enemy and oneself, which casts a sceptical view of a mechanistic logic train such as this (Proposition VI). In the midst of this, U.S. spacepower will be tirelessly but noiselessly supporting its military, economic, and diplomatic plans as far as strategic manoeuvres in the celestial coastline allow (Proposition V).

Conversely, a lesser space power, which may not be that dependent on spacepower for terrestrial warfare, may feature the following particular manifestation of the universal elements of

[4] Waldman, *War…* p. 173

spacepower. For example, China may not need to secure the same degree of the command of space as the United States if they were to come to blows against each other over Taiwan. China may pursue a denial-orientated space strategy, attempting to deny as much of the command of space to the United States as possible (Proposition I). But it might do so at select times so that specific American celestial lines of communication (Proposition IV) are deprived to American forces *at a critical moment in the terrestrial campaign*. This would be so that Chinese forces can concentrate their terrestrial efforts on their objective whilst the dispersing effects of American spacepower-enhanced terrestrial weapons platforms have been mitigated (Proposition VII). This would be an exemplary strategic manoeuvre in the celestial coastline (Proposition V). The moment to take such action could be at any point in a conflict, not necessarily at the start or close to its termination. Space denial operations may be a once-only option for some belligerents, and not a robust and durable capability. China, like the U.S., must have integrated the particular advantages of space (Proposition II) into its war plans, understanding that denying celestial lines of communication to the U.S. military does not make it a redundant force that guarantees success to China (Proposition III). Like the caveat on the mechanistic logic train above, the American response to such efforts may be unpredictable, especially if the humorous and (probably) apocryphal note that American military forces do not read their own doctrine manuals has any merit (Proposition VI).[5] Furthermore, the two space powers may emulate each other, depending on the various technological systems used and the prevailing strategic and military cultures involved that shape decision-making and combat operations. Given time, cultural traits and habitual practices specific to experiences with spacepower may develop in line with internal Chinese power politics.

A final example of spacepower theory's application in the ever-diverse character of war can be non-state actors responding to aggression by space powers. In the final chapter, it was mentioned that Al-Qaeda and the Taliban's could merely adapt to, and undermine, the advantages that spacepower provides on Earth (Proposition VII) because they have had no ability to contest the command of space (I). Concealment and camouflage can deny sensors the information they can give

[5] This notion was derived from a Soviet author in the Cold War, see: James R. Holmes, 'Unorthodox and Chaotic: How America Should Fight Wars', *The Diplomat*, 27/09/2013, http://thediplomat.com/2013/09/unorthodox-and-chaotic-how-america-should-fight-wars/ (accessed 02/10/2015)

to shooters, which was also true in countering coalition aerial and Special Forces reconnaissance. The United States had an unquestioned command of space (Proposition I) and unmolested celestial lines of communication (Proposition IV) for its Afghanistan campaign in 2001 This meant that U.S. forces could force dispersal and concealment on opposing forces in open terrain (Proposition VII) through its space-enabled precision firepower. It could utilise the celestial flank at its leisure (Proposition V). However, the constraints of sensors in space, the efforts of the opposition in adapting to them, (Proposition II) and the limits of dominating space mean that strategic success on Earth is not guaranteed (Proposition III). Despite the occupation of Afghanistan, the Taliban regrouped, adapted, and returned as a significant faction in Afghanistan by the late 2000s. In this episode of counterinsurgency, space warfare may have taken a back seat as a dependable utility and the influence of spacepower became harder to visualise relative to the U.S. Army's then-heightened importance in a land war (Proposition VI). Although spacepower continued to provide essential support through logistics and communications (Proposition V) for dispersed and networked coalition forces (Proposition VII), it became less visible in a land and Earth-dominated war against a cunning low-technology opponent, much like the indirect support roles of continental navies vying for attention in land-orientated military cultures. It remains an open question here as to how significant, let alone visible, spacepower can ever be in a counterinsurgency, a war of occupation, or a pacification of a people. Any answer to such a question will reflect the political, geographic, and cultural factors relevant to the scenario and the character of the war at hand.

These three logic trains are examples of spacepower theory working as a whole through its application. All seven propositions are in constant interaction, and in no linear order, like the elements of Clausewitz's trinity. They are not definitive. As long as these logic trains are viewed as constructive departures for strategic thinking and education, that must be critically applied and amended as necessary through experience and historical evidence, spacepower theory will fulfil its task as a guide to action and analysis through critical thought.

## Closing remarks: Astropolitics – the sins of solar empires

"Short of a revolution in the heart of man and the nature of states, by what miracle could interplanetary space be preserved from military use?" – Raymond Aron[6]

Zooming out from the spacepower theory itself, which is the primary theoretical contribution of the thesis to the intersecting fields of strategic studies, spacepower, and astropolitics, three wider arguments can be tentatively made based on the empirical information and concepts used for spacepower theory. The three arguments are derived from the three core strategic analogies embedded within the spacepower theory. The first is that space warfare, and indeed all of astropolitics, is the continuation of Terran politics by other means. The second argument is that space is a place and a medium defined by the use of lines of communication where territory cannot easily be 'held', and if so, only transiently and in constant motion, like the sea and the air. Third, it is argued that Earth orbit is more akin to a coastline, rather than an open sea. These three arguments also act as summaries of each of its parts to the whole of spacepower theory. Taken as one, the three arguments urge the reader to consider the bulk of spacepower and space activities beyond the possibilities and problems of space-based weaponry and the policy environment of the United States. Furthermore, any discussion on space-based weapons has to account for the ambiguities of politics in strategy and technological devices, as well as to the strategist's question of 'so what' in order to consider the ultimate significance of a deployment of arms in outer space relative to Earth-based weapons and terrestrial wars.

The first argument – that space warfare is the continuation of Terran politics – demonstrates how old theories and concepts regarding the human political experience can be given new life in the most alien or novel of environments, and that systemic and unquantifiable political considerations must accompany analyses of space warfare – not sterility in technical and mechanistic considerations of space-based weapons. Not only does this allow for Clausewitz's ideas, and the canon of strategic theory, to be intelligently transplanted into astropolitics, but can also point the way towards the

[6] Raymond Aron, *Peace and War: A Theory of International Relations*, Richard Howard and Annette Baker Fox, trans. (London: Weidenfeld & Nicholson, 1966) p. 664

continuing exploration of outer space with IR theory. Indeed, work here has already begun[7], and feeds into narrower space policy debate and research which are emerging and have already featured in Chapter 2.[8] The resonance of Clausewitzian theory only substantiates the connections between astropolitics, strategic studies, and IR theory. Pfaltzgraff notes that:

> "as in the case of Earth-bound geopolitical theorizing, the significance of space will be determined by technologies that facilitate the movement of people, resources, and other capabilities. Those technologies may be developed as a result of our assumptions about the geopolitical or strategic significance of space extrapolated from IR theory and the requirements that are set forth in our space-power strategy."[9]

Politics influences the funding, development, and use of space technologies; space is not a vista reserved for scientists and engineers alone.

Space is a political place; it is not devoid of political life. The connections that strategic theory makes between war and politics – regardless of environment – makes spacepower theory useful to consider the more violent and power-political aspects of life in the Space Age. The most abstract forms of strategic intuition, especially in terms of the human and uncertain elements of war, are still useful to inform thought and action regarding competitive and violent human activity in the cosmos. This demands a holistic view of everything spacepower has to offer to decision makers and grand strategists, as well as a grasp of what changes in war and what does not. Helping provide such a view is the role of spacepower theory. This theory attempts to broaden the reader's conceptual grasp of space power beyond the narrow space weaponisation debate and the shadow of the RMA (Chapter 2).

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[7] See: Michael Sheehan, *The International Politics of Space* (Abingdon: Routledge, 2007); Natalie Boormann and Michael Sheehan, eds., *Securing Outer Space* (Abingdon: Routledge, 2009)

[8] For example: Damon Coletta and Frances T. Pilch, eds., *Space and Defense Policy* (Abingdon: Routledge, 2009); Robert C. Harding, *Space Policy in Developing Countries: The search for security and development on the final frontier* (Abingdon: Routledge, 2013); Eligar Sadeh, ed., *Space Strategy in the 21st Century* (Abingdon, Routledge, 2013); Sheng-Chih Wang, *Transatlantic Space Politics: Competition and cooperation above the clouds* (Abingdon: Routledge, 2013)

[9] Robert L. Pfaltzgraff, Jr., 'International Relations Theory and Spacepower', in: Charles D. Lutes and Peter L. Hays, with Vincent A. Mazo, Lisa M. Yambrick, and M. Elaine Bunn, ed., *Toward a Theory of Spacepower: Selected Essays* (Washington, D.C.: National Defense University Press, 2011)

Furthermore, Jon Sumida argues that Clausewitz's concepts can be used as theoretical guides for military history.[10] The same is logically true for the study of strategic space history with spacepower theory, owing to the Clausewitzian heritage of the theory. This has its connections to wider debates of the role of history in the traditions of IR theory.[11] However, political discussions of spacepower have to acknowledge (from the limited history available, and the theory constructed in this thesis) that the influence of spacepower upon history and the present is through the relatively subtle and unspectacular supporting space infrastructure, not by cyclically debating whether the United States should deploy weapons in orbit at the expense of every other aspect of astropolitics and space power. Spacepower theory stresses this in large part through the review, critique, and for the most part, omission of the space weapons debate.

Like any other aspect of human interactivity, the fields of security studies, IR, historical inquiry, sociology, philosophy, and so forth will find just as welcome a home in the analysis and sometime prescription of space activity. Should permanent peace break out on Earth, the prospects for space warfare should evaporate owing to the changed headwinds of human political affairs in an anarchical system. Spacepower theory's utility as a strategic theory rests on astropolitics reflecting and continuing the use and threat of violence on Earth – but it makes the assumption of this clear to the reader in Chapter 3. If terrestrial politics changes, so would astropolitics. Debate is still open as to what extent astropolitics *can* be done differently than terrestrial politics, and there is no intention to disagree with the agreeable hope that international actors "ought" to do things "differently" in space.[12] Spacepower theory would argue, according to Clausewitz's concepts, that it is a forlorn hope that astropolitics can be isolated or changed in its nature from Terran politics, much like politics at sea or in the air cannot be separated by that of the land (Chapter 4). Jill Stuart is right to argue that our approaches to space reflect our views on wider politics as a whole. Interestingly, Stuart anticipates

[10] Jon T. Sumida, *Decoding Clausewitz: A New Approach to On War* (Lawrence, KA: Kansas University Press, 2008) pp. xx, 1-4, 45-50, 57-60
[11] George Lawson, 'The eternal divide? History and International Relations', *European Journal of International Relations* (18:2, 2010) p. 206
[12] Michael Sheehan, *The International Politics of Space* (Abgindon: Routledge, 2007) p. 183

Proposition VI by arguing that space itself prompts unique traits for human political thought.[13] Indeed, altruistic or genuine cooperation in space would be an outgrowth from a benevolent form of political intercourse on Earth. Earth is where humanity makes its stand, and spacepower will serve the purposes of political entities based on Earth. Such is the implication of the first two major analogies within spacepower theory for a wider discussion or IR, politics, and outer space. Should astropolitics become a distinct kind of politics, however, Clausewitz's dictum would still hold – any decision on the use of force (or its absence) will be in large part conditioned by politics as a whole.

The second and third arguments and major analogies – that power travels along celestial lines of communication, that are akin to traveling in a coastal and adjacent realm – speak to discourse in space security studies that continues to neglect events and technologies *on Earth* that have consequences for space warfare and the space security of all space-faring powers. Spacepower theory poses the question of 'so what?' on the issue of space-based weapons to this literature, reviewed in Chapter 2. Why do space-based weapons matter, if at all, when Earth-based weapons systems are proliferating? So what if a power puts weapons in orbit? It may not usher in a period of hegemony and strategic impunity for the first power to do so, as some may fear or hope (Proposition III). These considerations are rare, but necessary, in debates over space security and space-based weapons.

According to the second major argument and strategic analogy, like the sea and the air, the commons of space may be too strategically important to allow the free use of or passage on the lines of communication to any entity and taking action against these lines of communication is desirable or necessary to prepare for. Seizing or blocking traffic and data along celestial lines of communication in a time of war should be expected between space powers and their opponents. If free use and passage in space was available to all in space at any time, space warfare would become meaningless, as Castex argued for free shipping at sea during war as seen in Proposition V. The right to 'self-defence' in

[13] Jill Stuart, 'Unbundling Sovereignty, territory, and the state in outer space: Two approaches', in: Bormann and Sheehan (eds.) *Securing Outer Space* (Abingdon: Routledge, 2009) p. 21

space may not be curtailed so that denying lines of communication to an adversary in wartime remains a legally viable[14] option to suit strategic needs.

The third strategic analogy argues that Earth orbit is a celestial coastline (Proposition V), and it can be a hostile coast for terrestrial militaries and polities. This analogy begs the question of 'so what?' to contemporary thinking and practices about land warfare, naval warfare, and air warfare. Spacepower influences all terrestrial warfighting media (Proposition VII in Chapter 7), just as they influence spacepower. No matter the entanglements the major powers of Earth will find themselves in in the 21st century, the celestial coastline will be a factor as it can be an adjacent flank. It will at least be a significant supporting medium to achieve combat victories, at possibly a theatre where violence and destruction takes place as adversaries deploy and use counterspace capabilities. How the dispersing effects of spacepower (VII) influence a polity's geopolitical concerns and preferred medium of fighting (like the Chinese PLA's heritage in land warfare) is as much a question of technology, geopolitical foresight, and cultural and bureaucratic activity (Proposition VI in Chapter 6). Chapters 5 through 7, based on the third major strategic analogy, stress the interconnections and relationships between not only space and Earth, but also differing themes of activity such as strategic perception, cultural curiosities, and domestic politics.

In addition, through the second and third major strategic analogies, Chapter 4 has made a contribution to strategic studies beyond spacepower by rehabilitating the works of Mahan (especially over the question of seeking decisive battle) to demonstrate coherence between some of the major seapower theorists. Indeed, the seapower theorists often grappled with the same problems and produced similar pedagogical arguments and theoretical constructions. The 'Mahan for space' is Alfred Thayer Mahan himself and his fellow travellers in seapower theory. By co-opting the major concepts of the seapower theorists, the commonalities among the spacepower theorists also become apparent over central concepts such as the ambiguities of the command of space and the potent visualisation of lines of communication in, to, and from orbit. This thesis has contributed to existing literature on spacepower theory through the second strategic analogy of sea lines of communication to

[14] Legal viability does not equate to legitimacy.

celestial lines of communication. It brought together much of what has already been said on spacepower theory and corrected some theoretical missteps from some misapprehensions of seapower theory.

To conclude, this thesis and spacepower theory does not provide silver bullets or axioms for space strategists and doctrinaires. It does, however, offer constructive terms of debate about the meaning of space warfare and spacepower in a wider strategic context to anyone willing to self-educate themselves on such issues. Most importantly, the theory stresses a more holistic view of spacepower in the sense that it puts space-based weapons in a larger context of Earth-based space weapons and the support roles and services that spacepower is mostly used for in warfare and state security practices today. Spacepower theory, and the wider arguments from the three strategic analogies, is there to be used and criticised by those willing to consider them. The seven propositions set points of analytical departure for any analyst or student willing to apply them to any given case. Spacepower theory charts the possibilities and strategic relevance of spacepower and space warfare, and will no doubt help doctrinaires form their own ideas on space warfare particular to the needs of their military services. Even if this spacepower theory is deemed 'wrong,' it may still be useful if it triggers better strategic thought or spacepower theory in its wake. Spacepower theory not only posits seven abstract propositions to throw empirical information against, but it also encourages particular ways of thinking, of strategic learning, and critical thinking. Space activity is the continuation of Terran politics with the addition of other means, and humanity's use of outer space invokes the familiar ambiguities of strategy, politics, war, and peace. Thus decrees the art of astropolitics.

Spacepower theory bases itself on the view that humans continue to be unambiguously political animals in space, but the particular character of that politics is infinitely variable. Exploring outer space may be a road to absolution for humans – there is no need to deny such a hope so long as it does not compromise accurate strategic threat assessments. Learning to use space with the species or Earth's entire ecology as a referent point of security may save humanity from self-inflicted catastrophes on Earth. But whichever way human polities decide to develop the use of space and the solar system, it will be a *political* activity. Terran politics constitutes and influences astropolitics. But

as humanity continues to develop outer space, the distinctions between Terran and astropolitics – of Earth and space powers – may break down. It will then simply be the sins of solar empires.

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