SPACE WEAPONIZATION
REEXAMINING THE HISTORICAL AIR ANALOGY TO SPACE

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A history of airpower that sources airpower's origin to the late eighteenth-century introduction of balloons rather than to the early twentieth-century introduction of airplanes provides an accurate and pertinent analogy for states' development of space domain use and, in particular, the weaponization of space. Airpower experienced gradual growth throughout the nineteenth century. In the early twentieth century, the nexus of technological, geopolitical, and legal conditions facilitated the air domain's rapid and intense weaponization. This history of airpower is analogous to what has occurred in space beginning in the early 1960s, leading to the current emerging era of rapid and intense space weaponization.

In 1962, Air Force Chief of Staff Curtis E. LeMay faced the challenge of navigating decisions on space weaponization. He reasoned that spacepower, analogous to twentieth-century airpower, would rapidly transition from serving primarily reconnaissance purposes to serving primarily offensive ones.[1] Yet his assessment proved wrong less than a year later when the Kennedy administration reaffirmed the "space for peace" policy, and the interagency committee reviewing disarmament negotiations and the peaceful uses of space decided against the military pursuit of any deliberate space weaponization efforts.[2]

As a result of these decisions, the United States prioritized space-based reconnaissance throughout the twentieth century. Contrary to LeMay's thinking, although individual offensive-focused space weaponization efforts certainly materialized to some degree throughout the Space Age, the pace and extent of the development of space weapons did not fully resemble the rapid and intense development of air weapons during the early twentieth century, in the period leading up to and through World War I.

Yet LeMay and others who have since thought about the development of spacepower are fundamentally mistaken in comparing this with the currently accepted but

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1. David N. Spires, *Beyond Horizons: A Half Century of Air Force Space Leadership*, rev. ed. (Maxwell AFB, AL: Air Force Space Command in association with Air University Press, 1998), 102.

2. Spires, 104–12.

incomplete view of the historical development of airpower. In fact, the evolution of airpower did not begin with the Wright brothers' first mechanized flight in 1903; it began over a century before in the same way spacepower developed—when humans could exploit the air domain to achieve real benefits, such as cartography, urban planning, and military reconnaissance.[3] Thus, according to visionary Billy Mitchell's simple definition of airpower as the "ability to do something in the air," the origins of airpower can be traced back to the first true aircraft—the balloon.[4]

The evolution of airpower, marked from the beginning of the human-flight era in balloons, appropriately informs how space strategists and policymakers should think about the evolution of spacepower, and more specifically, space weaponization. For the purposes of this analysis, a space weapon can be defined as "any space-based or terrestrial-based weapon that achieves kinetic or non-kinetic destructive effects in space, conflicts with the peaceful uses of space, and threatens to destabilize space security."[5]

Tracing the origins of airpower to the advent of the balloon illustrates that the progression and nexus of technological, geopolitical, and legal conditions in the early twentieth century do in fact mirror an identical progression and nexus of such conditions today, giving rise to the emerging era of rapid and intense space weaponization. As states overcome technological limitations and exploit the space domain to achieve political objectives within a permissive legal environment, they set conditions for a new era of greater weaponization. That moment for space was not 1962 as LeMay had reasoned; instead, as a revised view of the history of airpower illustrates, the moment for this new era of space weaponization is now.

Space weaponization has certainly advanced over the past few decades, but the coming era will be characterized by even more rapid and intense progress. Moreover, the United States must anticipate this increased pace of weaponization and pursue deliberate geopolitical options to mitigate the risk of conflict escalating into and through space.

Reexamining the Airpower Analogy to Space

Some experts have questioned the validity of drawing any kind of strategic or historical analogy between the evolution of airpower and spacepower; however, such a comparison can help inform the ongoing development of spacepower and

3. Jason Pearl, "The View from Above: Satiric Distance and the Advent of Ballooning in Britain," *Eighteenth-Century Studies* 51, no. 3 (Spring 2018): 275.

4. William Mitchell, *Winged Defense: The Development and Possibilities of Modern Air Power—Economic and Military* (Tuscaloosa: University of Alabama Press, 2010), xii.

5. Crockett L. Grabbe, *Space Weapons and the Strategic Defense Initiative* (Iowa City: Iowa State University Press, 1991), 13.

space weaponization.[6] The generally accepted historical analogy itself is not problematic; it is simply incomplete. Rather than beginning in the twentieth century with the airplane and the first powered flight, the evolution of airpower and the air domain actually began in the late eighteenth century as states and militaries attempted to militarize and weaponize the air domain with balloons.[7]

A more historically complete analysis of the evolution of airpower and air weaponization uncovers a number of parallel developments across theory, militarization, and weaponization in the nascent history and evolution of spacepower and space weaponization not previously realized. Specifically, the actual evolution of airpower and air weaponization, dating back to the 1790s, remedies three common concerns raised when comparing the evolution of airpower to spacepower.

Concern 1: The air and space domains evolved at drastically different paces.[8] In fact, it took well over a century from the first organized, trained, and equipped company of French military aérostiers (airmen) who conducted military aerial reconnaissance in battle in 1794, until military airpower and the air domain became fully weaponized in the early twentieth century.[9] This contrasts with the historical view of rapid airpower evolution in the twentieth century myopically focused on airplane evolution. In actuality, the air and space domains evolved at very similar paces.

Concern 2: The temporary abandonment of space weapons has no parallel precedent in the history of airpower.[10] In reality, however, many states engaged in efforts to weaponize the air domain prior to the twentieth century with balloons and dirigibles. For example, Austria successfully launched over 200 balloon bombers over Venice in 1849, yet it did not attempt to employ similar efforts again until decades later with bomber planes.[11] Throughout the nineteenth century, other states, such as Russia and Germany, attempted to weaponize balloons and dirigibles in one way or another, but those advocating for such efforts never achieved the political will or senior military

6. James E. Oberg, *Space Power Theory* (Washington, DC: Government Printing Office, 1999), 121–22; Karl P. Mueller, "Totem and Taboo: Depolarizing the Space Weaponization Debate," in *Space Weapons: Are They Needed?*, ed. John M. Logsdon and Gordon Adams (Washington, DC: Space Policy Institute, Elliot School of International Affairs, 2003), 21–22; and Barry D. Watts, *The Military Use of Space: A Diagnostic Assessment* (Washington, DC: Center for Strategic and Budgetary Assessments, February 2001), 32–33.

7. Caren Kaplan, "The Balloon Prospect: Aerostatic Observation and the Emergence of Militarized Aeromobility," in *From Above: War, Violence and Verticality*, ed. Peter Adey, Mark Whitehead, and Alison Williams (London: C. Hurst & Co., 2013), 19–20.

8. Watts, *Military Use*, 33; and Mueller, "Totem and Taboo," 21–22.

9. Charles Coulston Gillispie, *Science and Policy in France: The Revolutionary and Napoleonic Years* (Princeton, NJ: Princeton University Press, 2004), 371–72.

10. Mueller, "Totem and Taboo," 22.

11. Charles A. Ziegler, "Weapons Development in Context: The Case of the World War I Balloon Bomber," *Technology and Culture* 35, no. 4 (October 1994): 751–52.

leader buy-in.[12] Thus, there were periods throughout the history of airpower when air weapons were temporarily abandoned.

Concern 3: A lack of codified spacepower theory followed the Persian Gulf War in 1990. The fact that no formal spacepower theory exists presumably and conclusively distinguishes spacepower evolution from airpower evolution, which does have a generally accepted collection of theories beginning with mechanized flight.[13]

Yet airpower theory can be traced back to its beginning with balloons, more than a century prior to current formal airpower theory. Several strategists and statesmen, including Benjamin Franklin and Thomas Jefferson, as well as one of the first aeronauts, André Giraud de Villette, began writing about airpower theory following the first human balloon flight in 1793. These writings discussed the utility of balloons for reconnaissance in addition to issues such as communications, troop transport, siege support, and even strategic bombing.[14]

In contrast to the assumption that airpower thought emerged rapidly following the first mechanized flight, following World War I, visionaries Giulio Douhet and Mitchell therefore had an entire century of experiences and history, in addition to a world war, to substantiate their theories. Thus, airpower and spacepower evolution generally mirror each other in that their first 60 or so years witnessed the emergence of their theoretical foundations.

In addition to the insights above, several other parallel themes support the accurate evolution of airpower as a legitimate historical analogy to the development of spacepower.

Reconnaissance

The primary purpose of airpower throughout the first century of airpower evolution was reconnaissance. Similarly, reconnaissance was, and arguably still is, the primary purpose of spacepower.[15] Moreover, the reconnaissance mission evolved and expanded in respective airpower and spacepower histories. In the Civil War, various Union Army commands employed military balloons to complement tactical ground reconnaissance efforts. Additionally, these commands conducted untethered deep/strategic reconnaissance and employed them to direct artillery and mortar fire.[16]

In the evolution of spacepower, satellite reconnaissance missions have evolved and expanded from strategic reconnaissance to the US military employing a range of

12. Alexander Rose, *Empires of the Sky: Zeppelins, Airplanes, and Two Men's Epic Duel to Rule the World* (New York: Random House LLC, 2020), 45–46; and Charles M. Evans, *The War of the Aeronauts* (Mechanicsburg, PA: Stackpole Books, 2002), 61–62.

13. James Andrew Lewis, "Neither Mahan or Mitchell: National Security Space and Spacepower, 1945–2000," in *Toward a Theory of Spacepower: Selected Essays*, ed. Charles D. Lutes and Peter L. Hays (Washington, DC: National Defense University, Institute for National Strategic Studies, 2011), 286.

14. Kaplan, "Balloon Prospect," 26, 39; and Clare Brant, "The Progress of Knowledge in the Regions of the Air?: Divisions and Disciplines in Early Ballooning," *Eighteenth-Century Studies* 45, no. 1 (Fall 2011): 74–76.

15. Simon P. Worden, "Future Strategy and Professional Development: A Roadmap," in *Theory of Spacepower*, 569; and M. V. Smith, "Security and Spacepower," in *Theory of Spacepower*, 331, 349.

16. Evans, *Aeronauts*, 112–13, 130–34, 159–60.

space-based sensors to provide intelligence, surveillance, and reconnaissance (ISR) in support of operational and tactical military operations, including the integration of sensor-to-shooter concepts.

Operational Constraints

Early reconnaissance balloons and satellites achieved unintended psychological effects and placed constraints against opposing forces.[17] A Confederate artillery chief, Edwin Porter Alexander, described the Union Army's employment of balloons as such:

> I have never understood why the enemy abandoned the use of military balloons. . . . Even if the observers never saw anything, they would have been worth all they cost for the annoyance and delays they caused us in trying to keep our movement out of their sight.[18]

Reconnaissance satellites have had the same effects. States regularly change their conduct of military and other security affairs to avoid satellite detection.[19]

Institutional Structures

Finally, governments and militaries worldwide have created institutions and programs specifically for air and space domains, with air domain examples dating to the late eighteenth century. The French Proving Grounds of Meudon, a weapons research and development site, established the first military unit designated to train for aerial warfare in 1793. Less than a year later, France deployed a company of aérostiers and their balloon, L'Entreprenant, into battle in 1794.[20] In another example, President Abraham Lincoln established an air institution, the Army Aeronautics Corps, by presidential directive during the Civil War.[21]

Likewise, in the late 1950s, the United States established a range of space programs and institutions, beginning with the first joint Central Intelligence Agency-Air Force reconnaissance satellite programs, CORONA and WS-117L.[22] In 1961, the United States established Air Force Systems Command, followed by Air Force Space Command in 1982, while the Soviet Union launched its Soviet Space Program, which evolved into dualistic efforts of prestige and military exploitation and superiority.[23]

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17. Gillispie, *Science and Policy*, 373.

18. Ben Fanton, "View from above the Battlefield," *America's Civil War* 14, no. 4 (September 2001): 29.

19. Smith, "Security and Spacepower," 331–32.

20. Charles Coulston Gillispie, "Science and Secret Weapons Development in Revolutionary France, 1792–1804: A Documentary History," *Historical Studies in the Physical and Biological Sciences* 23, no. 1 (1992): 132; and Gillispie, *Science and Policy*, 371–72.

21. Evans, *Aeronauts*, 69–71, 86–87.

22. Bernard A. Schriever, "Military Space Activities: Recollections and Observations," in *The U.S. Air Force in Space: 1945 to the 21st Century* (Washington, DC: USAF History and Museums Program, 1998), 15–16.

23. Spires, *Beyond Horizons*, 90, 194, 205–8; Walter A. McDougall, *...The Heavens and the Earth: A Political History of the Space Age* (Baltimore, MD: John Hopkins University Press, 1997), 237, 273–75.

Airpower and spacepower histories clearly evolved similarly regarding pace, weaponization, and theory development. Both histories illustrate how air and space systems generated effects against opponents as they altered other states' behavior. Both histories also show the deliberate establishment of military organizations to exploit their respective domains.

Thus, as the nature of analogy is defined, if two or more of the aspects between air and space evolution agree in some respects, then they are likely to agree in others. And although historical analogies can lead to "insidious fallacies," when aligned appropriately, as in the case of airpower and spacepower, these analogies can provide important insights into how spacepower and particularly the weaponization of space might continue to evolve, including major determinants for potential challenges.[24]

Keys to Rapid and Intense Weaponization

Given it took well over a century until air platforms completely transitioned from serving primarily reconnaissance purposes to serving offensive purposes, it may take a similar timeline for space. As LeMay thought, this transition may, however, be characterized by the same rapid and intense weaponization as the air domain saw in the early twentieth century. Indeed, the right set of conditions appear to be converging to cause that situation to unfold. Reconsidering the evolution of airpower reveals three key factors were necessary for the rapid and intense weaponization of the air domain, all of which are mirrored today in the space domain: overcoming technological limitations, achieving political objectives, and having a permissive legal environment.

Technological Limitations

States demonstrated it was technologically challenging to weaponize the air and space domains throughout history because of technological immaturity and the resulting employment of more feasible alternative domain options. But both histories also reveal that as technology advanced and the costs and risks associated with the technology decreased, it became easier to weaponize domains.

Throughout the nineteenth century, states invested in proposed balloon bomber plans only to realize the primitive technology available at the time resulted in ineffective weapon platforms. For example, Denmark attempted to use handheld dirigibles, or balloons with propulsion, against a British naval blockade in 1807, but the plan failed.[24] Five years later, Russia initiated the design of a dirigible to bomb Napoleon's camp, but it also failed because of multiple design problems.[25] Russia's attempt to develop an offensive airship proved unsuccessful again in the 1890s, along with the first

24. Tyler Morton, *From Kites to Cold War: The Evolution of Manned Airborne Reconnaissance* (Annapolis, MD: Naval Institute Press, 2019), 28.

25. Ziegler, "Weapons Development," 751.

versions of the German Zeppelin airship bombers, which had no real developmental success until the eve of World War I.[26]

Technological limitations stifled the weaponization of the space domain as well. The Dyna-Soar manned space bomber (X-20) and its follow-on replacement program, the National Aerospace Plane, both faced considerable technical problems.[27] Other space-based weapons, such as a kinetic bombardment from space—the so-called "Rods from God"—and Space Defense Initiative (SDI) space-based missile interceptors named "Brilliant Pebbles," faced technical challenges related to reentry, flight control, and guidance.[28] Space-based chemical lasers and mirrors associated with SDI also proved to be highly challenging to such an extent that some concluded the weapons were unachievable at any cost.[29]

As a result of technological limitations, more feasible alternative domain weapon options overshadowed the need to advance the immature technology needed to weaponize the new domains. Other weapon technologies could more effectively achieve near-identical effects, ultimately stunting the necessary investment to overcome the technological limitations needed to weaponize the respective domains. Throughout the nineteenth century, there was little incentive for this investment with balloons when artillery employment techniques, ranges, precision, and other related gun technologies continued to improve, offsetting the need for an aerial bomber.[30] Further, throughout the nineteenth century, the preponderance of military generals presumed ground-based reconnaissance was significantly more reliable than reconnaissance via balloons, undermining any further investments and support to the latter's development.

Similarly, regarding the advancement of space weaponization, the development of ground, sea, and air-based weapons in the twentieth century provided alternative options that were supposedly much more affordable and politically risk averse.[31] For example, ground- and sea-based missile interceptors could destroy ballistic missiles—at least to a capacity that was politically acceptable—and ground-based antisatellite weapons (ASATs) could feasibly destroy enemy satellites. Despite the successful testing and validation of many Brilliant Pebbles technologies necessary for space-based interceptors, such as new sensors in space via the NASA Clementine program, it appeared challenging to justify continuing investment when other domain weapon technologies could achieve similar effects, whether or not this was actually the case.[32]

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26. Rose, *Empires*, 46–47.

27. James Moltz, *The Politics of Space Security: Strategic Restraint and the Pursuit of National Interests*, 2nd ed. (Redwood City, CA: Stanford University Press, 2011), 152, 194.

28. Moltz, 295.

29. Moltz, 201.

30. Ziegler, "Weapons Development," 752.

31. Henry F. Cooper, "Space Defense: An Idea Whose Time Has Come?," in *Spacepower for a New Millennium: Space and U.S. National Security*, ed. Peter L. Hays et al. (New York: McGraw-Hill, 2000), 129–37.

32. Cooper, 132–33; and Donald R. Baucom, "Space and Missile Defense," *Joint Force Quarterly* (Winter 2002): 55.

Still, the history of air weaponization demonstrates states eventually overcame these technological limitations. For over a century, balloons were the only option for exploiting the air domain. Yet two key technological breakthroughs—the refinement of lightweight aluminum alloys and the internal combustion engine—enabled the potential for future airplanes and Zeppelin airships.[33] The innovation of the airplane and the Zeppelin was still a matter of high risk and/or high cost, however, and success did not materialize until innovators gathered the time and resources to invest into their potential innovations.

Less than eight years before the Wright brothers' first flight, leaders in the scientific community deemed the airplane to be an impossible technology.[34] It is not clear what technologies, or amalgamation of technologies—for example, propulsion, energy, sensors, artificial intelligence—will enable the greater feasibility of space weaponization, but it will only be a matter of time as space-related technology continues advancing, proliferating, and diffusing. Such technology also may have already presented itself.

Political Objectives

As late as the turn of the twentieth century, states did not need to weaponize the air domain to ensure their security. For example, in the 1890s, France's military balloon development and reports of Russia's aircraft construction threatened Germany's security, triggering Germany to initiate efforts to build an airship as well.[35] Soon, however, it became evident Russia's airship was a complete failure, and France's balloons were no more effective than previous versions. This realization on Germany's part de-escalated the security dilemma and led to the Prussian Aeronautical Battalion dismissing Count von Zeppelin's airship proposal in 1895.[36]

Nevertheless, the political incentive to weaponize the air domain returned permanently by 1907 when Russia, France, and Great Britain became allied and formed the Triple Entente. In response Germany reappraised its military, including views on new military capabilities such as an offensive airship, the Zeppelin, to gain a future advantage through the conduct of strategic bombing raids.[37]

In the case of the space domain, when the United States sought to eliminate the security threat of nuclear weapons via SDI in the 1980s, the most practical and attainable solution to achieve this political objective required the employment of space-based kinetic kill vehicles—eventually the Brilliant Pebbles concept—that would have increasingly weaponized space.[38] Yet regardless of the technological feasibility of Brilliant Pebbles and other potential missile defense programs such as

33. Rose, *Empires*, 42–45.

34. Everett C. Dolman and Henry F. Cooper Jr., "Increasing Military Uses of Space," in *Theory of Spacepower*, 376.

35. Rose, *Empires*, 46–47.

36. Rose, 48–50.

37. Rose, 89.

38. Lester L. Lyles, "Space and Ballistic Missile Defense Programs," in *Spacepower*, 113–15.

space-based lasers, the United States ultimately canceled them for political reasons, given sensitivities to weaponization.[39]

Also, by the late 1800s, air weapons did not appear to enable the accomplishment of security-related political objectives because at that time they were not effective at precision strikes. For example, throughout the nineteenth century, there was a lack of strategic targets against which to employ balloon bombers, and as previously stated, artillery could achieve identical tactical and long-range precision effects. But as agrarian societies began to industrialize around the turn of the twentieth century, newly established industrial centers became potential strategic bombing targets.[40] Thus, it became increasingly evident that states needed to employ air weapons to enhance their ability to achieve political objectives tied to targeting industrial centers.

Similarly, in the early space age, the Kennedy administration demonstrated it had no political will to weaponize space because it could achieve its political objectives, specifically security, via civil competition for prestige instead. Despite a heavy push by the US Air Force to develop space weapons, the Kennedy administration reaffirmed the "space for peace" policy, and the interagency committee reviewing the program decided against space weaponization.[41] Yet space is increasingly valuable to states, and space-related infrastructure—particularly space-based infrastructure—is at greater risk as states can now target them to achieve political objectives.

Permissive Legal Environment

Even a legal framework appears insufficient to prevent space weaponization. A codified international legal framework or strong code of conduct can raise the threshold for weaponization, but the historical air domain analogy demonstrates the limitation of such. The first Hague Peace Conference in 1899 included the adoption of Declaration XIV, Prohibiting the Discharge of Projectiles and Explosives from Balloons.[42] Although this likely slowed official state-sponsored development of aerial weapons systems, it did not prevent military strategists and early airpower advocates from considering the ability of such weapons to achieve military and political objectives.

When Declaration XIV expired in September 1905, technological advancements in air platforms were much further along. By 1907, the Second Hague Peace Conference met and proposed renewing Declaration XIV, but the new technological potential combined with ongoing security tensions and the formation of the Triple Entente led to most major states choosing not to sign or ratify it. To mitigate this new risk, drafters inserted Article 25 into Declaration IV, Laws and Customs in Land Warfare, which

39. Dolman and Cooper, "Military Uses of Space," 377.

40. Ziegler, "Weapons Development," 753.

41. Spires, *Beyond Horizons*, 104–12.

42. Hague Declaration (XIV) on Explosives from Balloons, 1907, ICRC [International Committee of the Red Cross] International Humanitarian Law (IHL) Databases, accessed December 2, 2021, https://ihl-databases.icrc.org/.

stated, "The attack or bombardment, by whatever means, of towns, villages, dwellings, or buildings which are undefended is prohibited."[43]

In addition, the international community reinforced this legal framework with the practice of a strong code of conduct. During this period, states adhered to generally accepted, unwritten "rules of war."[44] There was a military code and ethos that limited the number of attacks against noncombatants—unless, of course by tradition, they were in a besieged city—and states and generals perceived the strategic bombing of civilians as a violation of such.[45]

Nevertheless, Germany still developed the Zeppelins as strategic bombers leading up to World War I, while other state militaries continued to test offensive bomber capabilities with airplanes. When World War I broke out, the legal framework and code of conduct for constraining states' air weaponization collapsed, demonstrating the ultimate limitations of such efforts in the face of technological and political conditions.

The legal constraints in space law present similar themes. First, international space law legalized the militarization of space, banning only weapons of mass destruction and nuclear weapons.[46] Second, space-based weapons are not illegal, yet a generally accepted code of ethics prevails that serves to constrain those who would attempt to, at least openly, deploy space-based weapons.[47] Attempts in the 2008 Conference of Disarmament to prevent the employment of space-based weapons remain in gridlock since proposed agreements are propaganda tools that deliberately offer only politically unacceptable terms to the United States.[48] Lastly, the similar legal framework and code of ethics, along with the rising security tensions between the major space actors—the United States and its Allies, China, and Russia—present similar political dynamics combined with increasing investments in space-related technologies that will spur an era of rapid and intense space weaponization.

Certainly states will continue to overcome technological limitations to develop space weapons, as many technologies originating from benign purposes have inevitable applications as potential weapons. Given that it is irrational to constrain such technological advancements and often unfeasible to restrict weapons development, the only condition states can reasonably control is the political threshold. Consequently, this reveals that space weaponization and conflict in space are not just space policy challenges, but rather, they are fundamentally geopolitical challenges. The growing weaponization of space, described in the next section, indicates the inter-

43. Hague Convention (IV) on War on Land and Its Annexed Regulations, 1907, ICRC IHL Databases, accessed December 2, 2021, https://ihl-databases.icrc.org/.

44. Gwynne Dyer, *War: The Lethal Custom* (New York: Carroll & Graf Publishers, 2004), 76.

45. Ziegler, "Weapons Development," 754.

46. McDougall, *Heavens*, 274.

47. Michael E. O'Hanlon, *Neither Star Wars nor Sanctuary: Constraining the Military Uses of Space* (Washington, DC: Brookings Institution, 2004), 109.

48. Christina B. Rocca, "Analysis of a Draft 'Treaty on Prevention of the Placement of Weapons in Outer Space, or the Threat or Use of Force against Outer Space Objects' " (United Nations Conference on Disarmament, Geneva, Switzerland, August 26, 2008), https://undocs.org/.

national community will continue to progress toward greater degrees of space weaponization unless states pursue deliberate political decisions to avoid or mitigate it.

Expansion of Space Weaponization

Twenty years ago, space expert Everett Dolman argued the world was right in the center of the weaponization scale between the two extremes of complete sanctuary and total weaponization.[49] Whether that was accurate or not matters less so than the fact that the world is much closer to complete weaponization than it was at that time.

As the arms control community, specifically the Union of Concerned Scientists, pointed out in the 1980s, terrestrial space weapons present the same degree of threat to space security as do space-based weapons.[50] Yet while the general space community once agreed with some form of the space weapon definition provided early in the article, over the past few decades the development and deployment of terrestrially-based space weapons have somehow become more permissible than space-based weapons. Unfortunately, this goal-post shifting disingenuously obscures noncompliant applications of dual-use technology under international law and highlights the evolution of space weaponization over the past few decades. This concept becomes clear when analyzing this period of space weaponization expansion.

Cross-Domain Space Weapons

To further define what qualifies as a space weapon, one must consider that the space domain is not isolated nor inaccessible from terrestrial cross-domain weapons that are ground-, sea-, air-, and cyber-based. An increasing number of actors have either developed, tested, and/or validated terrestrial-based direct-ascent ASAT weapons, directed-energy weapons, electronic warfare, and/or cyber weapons to some degree against space-based systems.[51]

These cross-domain weapons are inherently space weapons. Many actors can now employ cross-domain weapons into the space domain, in the exact same manner as they do with weapons from one terrestrial domain into another. These weapons and their intended effects clearly illustrate that space weaponization is not only an existing challenge but also much further along than in years past.

Co-Orbital ASAT Weapons

Russia's Burevestnik and Nivelir programs deliberately test on-orbit interceptors. These systems, along with other potential co-orbital ASATs, can damage or destroy a

49. Everett C. Dolman, "Space Power and US Hegemony: Maintaining a Liberal World Order in the 21st Century," in *Space Weapons*, 48.

50. Richard L. Garwin, Kurt Gottfried, and Henry W. Kendall, *The Fallacy of Star Wars: By Union of Concerned Scientists*, ed. John Tirman (New York: Vintage Books, 1984), 227–36.

51. Todd Harrison et al., *Space Threat Assessment 2021* (Washington, DC: Center for Strategic and International Studies [CSIS], March 2021).

target using hypervelocity collision, releasing projectiles, employing a robotic arm, and/or using close-range directed-energy weapons.[52] US Space Command characterized these types of activities as hostile and aggressive and emphasized they were clear Russian efforts to develop and test space-based weapons.[53] Yet Russia claims these tests were simply inspection-related activities that did not amount to the deployment of weapons in outer space.[54] Russia's rhetoric takes advantage of the dual-use dynamic of space that increasingly facilitates the discreet weaponization of space via rendezvous and proximity operations (RPO) capabilities.

Rendezvous and Proximity Operations Weapons

Space actors are also developing and testing emerging dual-use RPO capabilities, such as active debris removal or on-orbit satellite servicing, with the potential to employ them as space weapons and threaten other space systems. Despite their often benign designs, the uncertainty regarding their intent induces ambiguity and insecurity in the space domain. For example, a Chinese civil space agency with close ties to the People's Liberation Army may operate active debris removal or on-orbit satellite servicing capabilities as part of its military-civil fusion where the army has the authority to employ an already on-orbit system as a weapon to achieve political-military objectives.

High-Altitude Nuclear Detonations

High-altitude nuclear detonations (HAND) or high-altitude nuclear explosions represent a unique cross-domain space weapon deserving of its own category. Not only have the United States and the Soviet Union tested the detonation of nuclear bombs in space, but also the first test, Starfish Prime, essentially disabled seven low-Earth-orbit satellites, one-third of the existing satellites in space.[55] Given today's modernized nuclear arsenals, radiation from just one detonation could potentially disable all nonhardened low-Earth-orbit satellites over time.[56] There are a number of geopolitical scenarios where a state conducts a HAND in response to a security threat.[57] Further, a HAND may never have to reach space or orbit to achieve some level of effect on very-low-Earth-orbit satellites as the charged particles from the blast may extend into space.

52. Brian Weeden, *Russian Co-orbital Anti-satellite Testing* (Broomfield, CO: Secure World Foundation, 2023), 1–2, https://swfound.org/.

53. US Space Command (USSPACECOM) Public Affairs Office, "Russia Conducts Space-based Anti-satellite Weapons Test," USSPACECOM, July 23, 2020, https://www.spacecom.mil/.

54. Harrison et al., *Space Threat Assessment*, 14, 22; and Brian Weeden and Victoria Samson, *Global Counterspace Capabilities: An Open Source Assessment* (Washington, DC: Secure World Foundation, April 2021), 2–9.

55. Daniel G. Dupont, "Nuclear Explosions in Orbit," *Scientific American* 290, no. 6 (June 2004): 100–102.

56. Peter L. Hays, *Space and Security: A Reference Handbook* (Santa Barbara, CA: ABC-CLIO, 2001), 88.

57. Dupont, "Nuclear Explosions," 107.

Due to technological and geopolitical conditions, the total number of these space weapons, the number of actors with access to them, and the severity of consequences they present to space security, demonstrate the space domain is indeed already weaponized to a large degree. Further, the international community places constraints only on overt space-based weapons. This situation essentially grants terrestrial-based and on-orbit dual-use, multiple-intent space weapons de jure (inherently legal) status, but applies a de facto illegal status for overt space-based weapons.[58] This places open and transparent states at greater disadvantages against states such as China whose strategies deliberately refrain from revealing specific capabilities.[59] Thus, the United States and its Allies and partners can no longer assume the survivability of their own satellites without developing capabilities to deter adversaries from attacking them.[60]

Conclusion

Although the time frame of LeMay's analogy was in error—his assessment for space weaponization was roughly 60 years early—his assumptions were right: there would come a time when the primary purpose of spacepower shifts from reconnaissance to offense.

Given the expansion of space weaponization and its continued trajectory under the nexus of the current technological, geopolitical, and legal conditions, one should expect an emerging era of rapid and intense space weaponization in the near future identical to the expansion of air weaponization in the early twentieth century. Yet while it is unrealistic to impede space-related technological advancement and constrain other states' weapons development, states can more feasibly manage deliberate geopolitical decisions as they navigate space-related strategic and security conditions.[61]

Although air weaponization and its rapid development prior to and during World War I was a means to political ends, it did not lead to the outbreak of war. World War I was a result of unstable politics, destabilizing events, miscalculations, and security dilemmas, all compounded by deliberate geopolitical choices leading up to active hostilities that locked states in an inevitable crisis.[62] Thus, despite an era of rapid and intense space weaponization, the international community must focus on taking deliberate geopolitical steps to avoid conflict escalation into space.

In spite of current levels of weaponization, space can remain relatively peaceful—an important objective for strategists and policymakers. To achieve this, the United

58. Joan Johnson-Freese, *Space Warfare in the 21st Century: Arming the Heavens* (New York: Routledge, 2017), 65–68.

59. Stacey Solomone, *China's Strategy in Space* (New York: Springer Books, 2013), 58–59.

60. O'Hanlon, *Neither Star Wars*, 26–27.

61. Colin S. Gray, *American Military Space Policy: Information Systems, Weapon Systems and Arms Control* (Lanham, MD: University Press of America, 1984), 8.

62. Kenneth N. Waltz, *Theory of International Politics*, 1st ed. (New York: Random House, 1979), 167; and Kier A. Lieber, "The New History of World War I and What It Means for International Relations Theory," *International Security* 32, no. 2 (Fall 2007): 156, 189–91.

States must take deliberate steps to minimize the chance of conflict breaking out as a result of such space weaponization, but also sufficiently prepare for conflict in space to deter geopolitical opportunities for the employment of space weapons. While many may argue these two actions will lead to an unnecessary and preventable self-fulfilling prophecy, such voices fail to understand the geopolitical realities of space.[63]

Despite decades of US national policy clearly stating space a vital national interest, potential adversaries have chosen to develop capabilities that threaten that vital national interest anyway. In addition, while transparency can help mitigate a potential security dilemma, no number of sensors can determine the intent of the increasing number of dual-use space systems and the potential threats they pose. Further, important elements of competitors' national and military strategies refute such transparency and openness, and instead embrace and leverage uncertainty as a strategic advantage.[64] **Æ**

63. Matthew Burris, "Astroimpolitic: Organizing Outer Space by the Sword," *Strategic Studies Quarterly* 7, no. 3 (Fall 2013): 116.

64. Everett C. Dolman, "New Frontiers, Old Realities," *Strategic Studies Quarterly* 6, no. 1 (Spring 2012): 83.