Totem and Taboo:

Depolarizing the Space Weaponization Debate

By Karl P Mueller

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The debate over space weaponization is typically cast in simplistic, unidimensional terms, while many participants caricature their opponents as naive pacifists or rabid warmongers. This article redraws the subject more realistically. First, it surveys the question of what systems are truly space weapons and what developments would constitute weaponization. Second, it describes six distinct schools of thought regarding weaponization: idealist, internationalist and nationalist sanctuary theories, and preemptive, utilitarian and hegemonist pro-weaponization perspectives. Third, it analyzes and largely debunks the leading arguments which hold that space weaponization is inevitable. Finally, it suggests reforms to make the debate more sensible and productive.

Space militarization is not a simple linear path along which a phase change occurs at some fixed point and space suddenly becomes weaponized

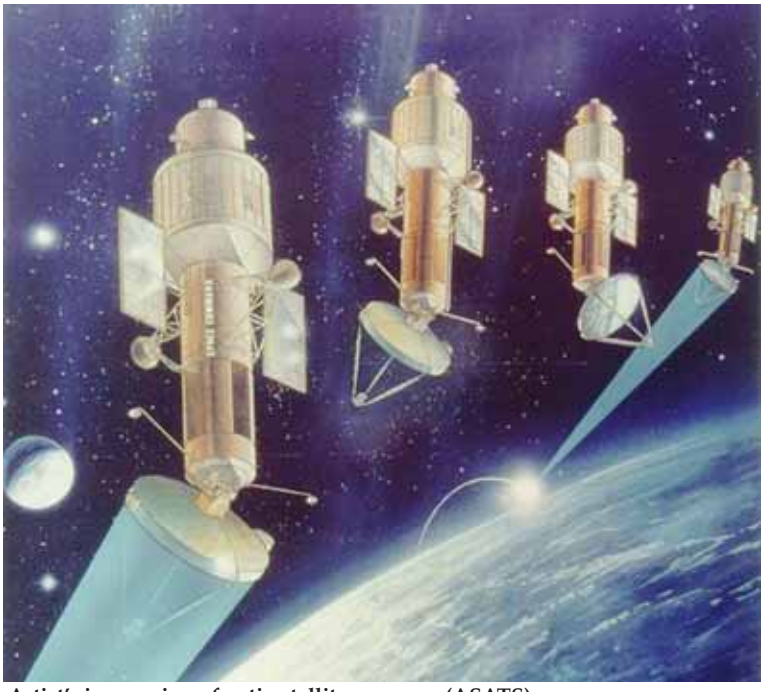
Should the United States place weapons in space? This question, long neglected in most discussions about US defense policy except where it touched upon arguments about ballistic missile defenses and Cold War nuclear stability, is now at last becoming the subject of active and serious debate in the United States and abroad. Many factors are contributing to this trend, including the growing economic and military importance of satellites, renewed US interest in national missile defense, and the work of the Space Commission chaired by Donald Rumsfeld prior to his appointment as Secretary of Defense.[1]

The US policy debate about space weaponization is often portrayed as a fight pitting idealistic arms control enthusiasts who oppose all weapons against warmongering militarists who never saw a weapon they did not like. Although there are people who do fit one or the other of these stereotypes,[2] most serious opponents and advocates of space weaponization do not. Moreover, positions on this question do not always fall along a simple left-to-right or liberal-to-realist continuum, so these caricatures fail to capture the key elements of the debate even when treated as polar extremes between which more moderate opinions are possible.

This article seeks to describe the principal schools of thought regarding space weapons (this term will be used in its widest possible sense for the sake of simplicity) in a way that better corresponds to reality, suggesting a way forward to distinguish amongst six different positions regarding the question of whether and when the United States ought to build space weapons. In order to do this, the preliminary problems of defining and characterizing space weapons and space weaponization are first addressed. Following the subsequent discussion of weaponization perspectives, the questions of whether space weaponization is inevitable, and whether this matters, is examined; the article then returns to the subject of how all participants in the weaponization debate might move beyond their current polarization to make greater progress towards developing sound policy in this increasingly important arena.

What is space weaponization?

Space weaponization is a subset of space militarization. If one envisions a natural sequence ranging from space systems not being used for any militarily useful purposes at all, to satellites providing services to support terrestrial military operations (from the late 1950s for the United States), to satellites being integral parts of terrestrial weapon systems (from the 1990s), and finally to weapons themselves being deployed in



Artist's impression of anti-satellite weapons (ASATS)

Both the United States and the Soviet Union developed and tested rudimentary ASAT systems during the Cold War. Some insist that this means space has already been weaponized, rendering the subject of this discussion irrelevant

space, weaponization occurs when the upper range of this sequence is reached. At its most extreme, space weaponization would include the deployment in quantity of a full range of space weapons, including satellite-based systems for ballistic missile defense (BMD), ground- and space-based anti-satellite weapons (ASATs), and a variety of space-to-Earth weapons (STEW), and these would play a central role in any type of military operations conducted by their owners.

However, space militarization is not a simple linear path along which a phase change occurs at some fixed point and space suddenly becomes weaponized. Instead, there are a number of intermediate steps along the way, and how politically significant each will be is not only unclear, but must necessarily be unclear prior to the event because it is a matter of social construction. For example, both the United States and the Soviet Union developed and tested rudimentary ASAT systems during the Cold War.[3] Some insist that this means space has already been weaponized, rendering the subject of this discussion irrelevant, but this is clearly a fallacious argument: we have not yet crossed the principal space weaponization threshold precisely because almost everyone believes that we have not.

GPS navigation satellite

In some respects a satellite-guided bomb or cruise missile is thus very much a space weapon, although policy makers and the public clearly do not consider the deployment of such weapons to constitute space weaponization

Thus, there is no single definition of 'space weapons' that is appropriate in every context.[4] Instead, there are a number of dimensions of weaponization along which a given development may resemble more or less closely an idealized version of space weaponization. For each it is possible to identify a number of steps on the ladder ranging from qualities that do not look very much like those of a 'space weapon' to ones that seem quite extreme. However, in exactly what order the steps should be placed is not always apparent, as will be discussed below. At least six of these dimensions are worth considering in some detail (see *Table 1*), although others could certainly be identified as well.

Basing

The most basic dimensions are where the weapon is based and what sort of targets it can attack. The basing dimension ranges from purely terrestrial weapons, such as land-based ASAT lasers or terrestrial weapons for attacking space launch and support facilities, to true space-based weapons, satellite weapons platforms placed in orbit for the long term well before a crisis or conflict.

Table 1: Dimensions of space weapon-ness

- Basing (terrestrial, direct ascent, suborbital, launch-on-demand, long-term orbital)
- Potential targets (location and type)
- Attack mechanism (non-weapon, electronic, KE, conventional, DE, nuclear, etc.)
- Weapon effects (nature, severity, duration)
- Discrimination (including collateral damage and orbital debris)
- Potential utility (especially in offensive and defensive scenarios)

Weapon effects are an obvious and a relatively simple matter: does the weapon destroy, damage or merely disrupt the activities of the target?

Intermediate steps along this continuum include direct ascent ASATs (which are launched into space but not into orbit), suborbital weapons including ballistic missiles (which travel through space en route to their targets but do not linger there), and launch-on-demand orbital weapons (which are deployed into space only when needed, thus perhaps avoiding crossing the weaponization threshold during peacetime). Somewhere along the way, fall weapons such as today's global positioning system (GPS)-guided munitions, in which a terrestrial weapon depends upon space systems in order to operate; in some respects a satellite-guided bomb or cruise missile is thus very much a space weapon, although policy makers and the public clearly do not consider the deployment of such weapons to constitute space weaponization.

Potential targets

Two features about the targets that candidate space weapons could attack are important: their location and their nature. Target locations include the land and sea surface, objects aloft in the atmosphere, and objects (satellites and suborbital projectiles) in orbital space, where it is important also to distinguish among different orbital altitudes, especially low, medium and geosynchronous Earth orbit (LEO, MEO and GEO respectively).[5] Among space-based weapons, the ability to attack terrestrial targets ('space force application' in US military doctrine) is usually taken to be a more extreme form of weaponization than being able to attack other space vehicles, although a case can be made that the former actually represents far less of a departure from current military capabilities than does the latter, and therefore this conventional intuition should be reversed. The types of targets that can be attacked is a fairly straightforward matter, relating to how hard, small, fast, agile, distant and stealthy a target the weapon is capable of striking. To this list could be added the question of how many targets could be attacked, either in total or during a specific opportunity, particularly for the rare weapon system that cannot simply be scaled up to increase the number of targets it can strike.

Together, the basing and target location variables, along with the attack mechanisms discussed below, define the major categories of space (or not-quite-space) weapons.[6] The hierarchy of 'space weapon-ness' among them can be ambiguous – for example, is deploying a direct ascent ASAT a more limited or more extreme step towards weaponization than deploying a space-based laser for ballistic missile defense? In general, it can be said that space-to-space and space-to-Earth weapons are generally considered to be space weapons, that terrestrial ASATs sometimes (but not always) are,[7] and that terrestrial and purely suborbital systems (including ICBMs) for striking terrestrial targets usually are not.

Muddled as this picture can be, it is further complicated by the fact that some weapons have the ability (often termed 'residual capabilities') to attack secondary targets. For example, nuclear-tipped anti-ballistic missiles and even short-range ballistic missiles can potentially be employed as powerful ASAT weapons. This does not make a Scud missile a space weapon for most political purposes, but it would certainly have to be taken into account in any arms control effort to prohibit the possession of anti-satellite weapons. Much the same is true of the limited but potentially significant anti-satellite capabilities of the US Space Shuttle and many other space systems designed to perform purely non-violent functions.

Attack mechanism

Space weapons can employ a wide range of mechanisms to affect their targets. The most obvious are conventional explosive, kinetic energy and directed energy (e.g. laser and radio frequency) weapons, which together occupy the middle range of this chain, and clearly qualify as weapons. Above these are nuclear weapons (and perhaps biological and chemical weapons, though the latter are especially unlikely for space weapons employment), the only category of weapon whose deployment in space is proscribed by international law or treaty.[8]

More interesting in political terms is the other end of the spectrum: devices or techniques that could have weapon-like effects but whose status as weapons is ambiguous. These include such things as electronic jamming of communications and telemetry, barriers with which to shade satellite solar panels or obstruct the view of space-based

sensors, and space 'special forces' capabilities, including direct human or mechanical interference with or sabotage of satellites in orbit.[9]

The remaining dimensions are less significant with respect to defining whether a system is a space weapon, and thus whether deploying it would constitute space weaponization. However, they might potentially be very important in determining the political significance of the deployment of such a weapon.

Weapon effects
Weapon effects are an obvious and a relatively simple matter: does the weapon destroy, damage or merely disrupt the activities of the target,[10] and to what degree of severity? If less than destruction, how long lasting are the effects, will they abate on their own, and/or how easily can they be repaired or circumvented? Finally, will the effects cost lives, either directly or indirectly, or only damage property or cause other economic harm?

Discrimination
The extent to which the effects of a weapon can be confined to its intended target is also likely to play an important part in shaping perceptions of the system, with more discriminate weapons appearing on the whole to be less objectionable if not necessarily less weapon-like.[11] This is most obvious, perhaps, with respect to the creation of orbital debris by kinetic energy ASATs and the widespread damage that would be produced by using exoatmospheric nuclear detonations for anti-satellite purposes or to inflict electromagnetic pulse damage against terrestrial targets. At the lower end of the damage scale, a device to deny GPS signals to a narrow area or certain categories of receivers would be more discriminate than one which produced a similarly disruptive effects over a broad region. For space-to-Earth weapons, of course, traditional concerns about discrimination and collateral damage concerning the effects of such-weapons would apply.

Potential utility
Finally, the scenarios in which a weapon would or would not be effective or useful would be likely to affect the political implications of developing it. A weapon which would be powerful if used in a first strike but highly vulnerable to pre-emption by an enemy who struck first would probably create more furor or discontent than one that would work well on the strategic defensive. Because of the relative visibility of satellites and the predictability of their orbits, many space-based weapons would tend toward the offensive end of the scale rather than the defensive, but a variety of factors would enter in to this equation. Similarly, weapons that could be deployed or employed without detection (or anonymously) would likely offer more to an aggressor than ones whose use and ownership would be obvious. Clearly, if a weapon is effective only against a certain class of targets, say long-range ballistic missiles, this would have a considerable effect on how it was perceived, depending in large part upon which states expected to possess such targets. Similarly, whether a system would be capable of attacking many targets or only a few (a major consideration for missile defense systems in particular[12]) would likely have considerable importance in determining the events in which it would or would not be valuable.

Together, all of these factors would shape the political impact of any particular decision to develop or deploy space weapons, potentially including, but not limited to, whether the action in question would or would not be considered to constitute the profound violation of the current space sanctuary norm with which many space weaponization discussions are primarily concerned.

Six perspectives on space weaponization
As the introduction to this article suggested, the space weaponization debate often appears at first glance to be as a classical confrontation between hawks and doves.[13] The former, now apparently in the ascendancy within the US government under the George W. Bush administration, are said to believe that space weapons should and will be deployed more or less as soon as they can be, and that the United States must lead the way down this path lest another state do so in our place. The other side of the debate is typically portrayed, at least by their opponents, as starry-eyed arms control enthusiasts who believe space should be preserved as a sanctuary free of weapons: in fact, this was the preferred policy of the US

So the absence of space weapons prevents space warfare, while their presence would not only make war in and from space possible, but would in fact encourage it

government during most of the space age, albeit usually for reasons that had little to do with idealism, although the Clinton administration was more conspicuous in its reluctance to develop space weapons than its predecessors.

Like any good cartoon, this image contains a considerable amount of truth. However, it is too simple a picture on which to base serious analysis of what is actually a far more complicated debate. There are in fact a variety of positions on both sides of the weaponization question, which the following discussion groups into a taxonomy of six basic perspectives, three of which favor a space sanctuary and three of which envision and advocate US-led space weaponization, at least under certain circumstances (summarized in *Table 2*).[14] Each of these schools of thought is at least internally consistent, although they are not all of equal intellectual merit. However, it is important to note that these categories are ideal types, and are not mutually exclusive: it is entirely possible, and even common, for individuals in the real world to hold beliefs that fall into more than one of these camps, which the reader should bear in mind throughout the discussion that follows.[15]

Table 2. Policy perspectives on US space weaponization

Pro-sanctuary perspectives
- *Idealists*: Oppose all space (and typically other new) weapons, for reasons transcending defense policy considerations.
- *Internationalists*: Oppose space weapons because they would cause or contribute to general, arms race, and crisis instability.
- *Nationalists*: Seek to avoid space weaponization because it would reduce US power and/or security relative to potential adversaries.

Pro-weaponization perspectives
- *Space racers*: Seek to avoid rivals gaining military or political advantage by the United States developing space weapons before they do.
- *Space controllers*: Favor development of space weapons when and insofar as they would usefully enhance US military capabilities.
- *Space hegemonists*: Favor intense development of US space weapons in order to make US military and political preponderance unassailable.

Sanctuary idealists

The perspective most categorically opposed to space weaponization can aptly be labeled *sanctuary idealism*.[16] Perhaps the most widely held of all the perspectives, especially outside of the United States, sanctuary idealism opposes the spread of weapons or warfare into any new realm (with outer space being the most prominent one not yet weaponized), and the deployment of new types of weapons; typically, sanctuary idealists also at least nominally favor the elimination of some or all of the types of weapons that already exist, though this is of limited relevance to the space weaponization debate.

The reasons for this policy preference vary among the idealists, but may range from aesthetic, moral or philosophical distaste for contaminating unpolluted territory with engines of war, to more instrumental fears that opening new arenas to military competition will drain scarce resources from peaceful uses or will increase the level of animosity and distrust among nations. Most typically, sanctuary idealism is based on two central political premises. The first is that weapons are necessary for — and tend, through arms races, to be a cause of — war, so the absence of space weapons prevents space warfare, while their presence would not only make war in and from space possible, but would in fact encourage it. The second principle is that minimizing the amount and the extent of warfare is intrinsically desirable. Similar themes have underlain some earlier arms control advocacy, such as the effort before and after the First World War to prohibit the use of aircraft as instruments of war.

Thus, unlike the strands of space sanctuary theory discussed below, sanctuary idealist arguments are not for the most part related to the specific characteristics of space weapons, either individually or in general, or to the physical nature of orbital space. The logic of the idealist approach applies more or less similarly to other types of weapons that might be banned (such as chemical weapons or landmines) and to other places from which weapons might be prohibited (such as Antarctica, the deep seabed or regional nuclear-free zones). However, space weapons are a natural focus for such arms limitation advocacy, since averting the

development of new weapons appears far easier than does reversing the status quo after new weapons have been deployed and integrated into military operations.

Sanctuary idealists generally advocate some variation on the same policy theme as other sanctuary proponents: the United States should work to keep orbital space free of weapons. This might be pursued through negotiating an international agreement to ban space weapons, as China and Russia have occasionally proposed in the past. Even without such an agreement, most sanctuary idealists would argue that the United States should continue to exercise unilateral restraint in the development, or at least the deployment, of space weapons, in order to reduce the incentives for other states to build their own; some sanctuary idealists also contend that the example the United States would set by unilaterally eschewing space weaponization would give significant political and moral encouragement for other states to do the same. However, although space sanctuary proponents believe that the potential costs and risks of actually weaponizing space would be high, even sanctuary idealism is compatible with 'space control' measures such as improving US space tracking capabilities or hardening US satellites to make them less vulnerable. None of the major schools of thought sees merit in American vulnerability to attack in space, though they may differ widely with regard to choosing the best ways to avert it.

Sanctuary internationalists

Where the idealists oppose new weapons, and weapons in new places, in general, *sanctuary internationalists* oppose space weapons in particular because of their potentially harmful effects on international stability. Drawing in part upon theories about the effects of offensive advantage and the security dilemma,[17] this perspective argues that the nature of space weapons makes them far better suited to offensive than to defensive warfare: weapons in orbit can strike quickly and with little warning, but are themselves vulnerable to attack because they move predictably, cannot remain over friendly territory, and are difficult to conceal. Thus, both the owners of space weapons and their enemies would have incentives to strike first in a crisis.[18] These theories predict that in addition to encouraging pre-emptive attacks and preventive wars, if states were to shift their military investments from terrestrial to space weapons the growing advantage of the offense would tend to produce other pathological political effects, heightening international tensions and further reducing stability.[19]

Sanctuary internationalism also warns of potential coupling between space weaponization and nuclear instability, on several levels. First, and perhaps least seriously in the current global environment, opponents of space-based ballistic missile defense, like generations of BMD critics before them, fear that such systems would weaken the deterrent potency of major powers' second-strike nuclear forces. Second, sanctuary advocates are concerned that anti-satellite warfare could contribute to nuclear instability by disabling space-based ballistic missile launch detection systems, reducing strategic warning and potentially allowing states to launch missile attacks anonymously, and thus with hope of avoiding retaliation. Third, they note that conventional space weapons, such as kinetic energy projectiles launched from orbit, might have considerable utility in their own right as part of a first strike against an enemy's nuclear capabilities. Finally, they argue that space weaponization might encourage nuclear proliferation, since states facing threats from space weapons but lacking the ability to respond in kind or to neutralize the danger would be likely to seek asymmetric means to shore up their security, among which the acquisition of nuclear weapons might be attractive.

For the sanctuary internationalist, the undesirability of space weaponization would depend on the particular shape it took. Some space weapons would tend to be more destabilizing than others: the more a specific set of technologies and deployment choices creates a situation in which space weapons are valuable to an aggressor but vulnerable to pre-emption, the more malignant the stability implications of space weaponization would be, and some space weapons might even enhance stability. However, since most possible space weapons would combine a high degree of first strike utility and

Artist's impression of an anti-satellite (ASAT) weapon

If satellites were subjected to substantial threat of attack or interference it would be a greater hardship for the United States than for any other major country

vulnerability relative to most terrestrial weapons, and because space weapons without destabilizing characteristics might help pave the way for space weapons with them, sanctuary internationalists are inclined to oppose space weaponization in general, although they would tend strongly to embrace other, stabilizing means of reducing vulnerability to attack in or from space. Finally, they would not necessarily favor the United States responding to another state's deployment of space weapons by doing the same: depending on the scenario, an American response in kind might either enhance or reduce overall stability.

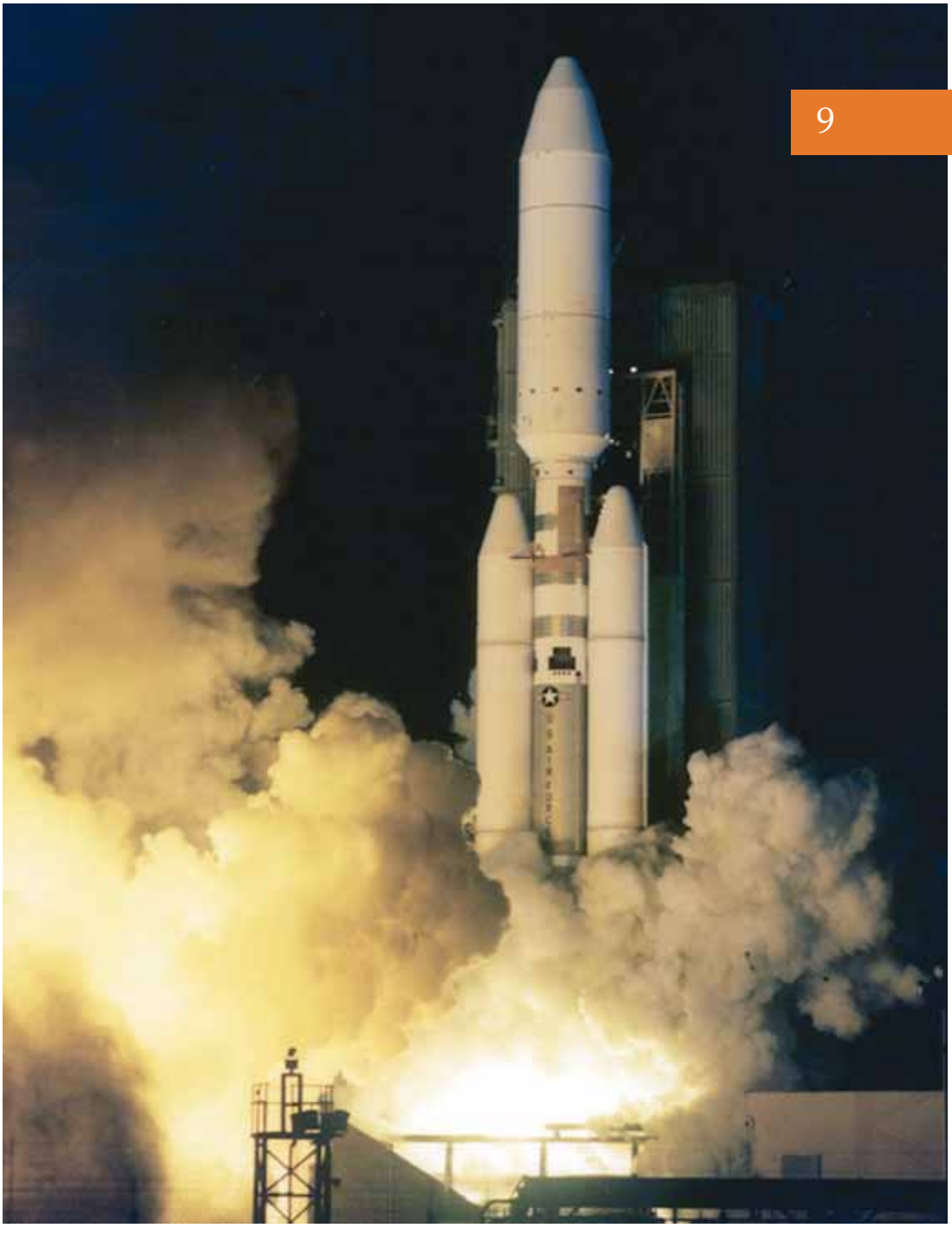
Sanctuary nationalists

The third sanctuary perspective is grounded in the tradition of classical realism. *Sanctuary nationalists* oppose space weaponization not because it would weaken global stability, but because they believe that although space weaponization might enhance American military capabilities in absolute terms, it would weaken the power and security of the United States relative to the rest of the world. Many of their arguments cluster around the theme that it is the United States, as both the dominant world power and the pre-eminent spacefaring state, which has the most to lose from space weaponization.[20]

First, and most visibly, the United States derives the greatest advantage from the space sanctuary status quo. The US military, government and commercial sectors have led the world in exploiting the potential of satellites and space technology for a host of vital functions, with satellites being particularly indispensable for US military operations. If satellites were subjected to substantial threat of attack or interference it would be a greater hardship for the United States than for any other major country.

Second, the United States enjoys an unrivaled ability to project military power around the world. Although space weapons would further increase its expeditionary military capabilities, their benefits would be only marginal in the vast majority of scenarios. On the other hand, effective space weapons might greatly enhance the military capabilities of other states, which currently have little capability to attack the United States and whose military inferiority is due in no small part to the US advantage in space capabilities. Moreover, while the United States would enjoy a large initial lead over its rivals in a space weapons competition, it already has a huge advantage in the other dimensions of military power, and there is little reason to believe that rivals would find it harder to challenge US pre-eminence in space power than in sea or airpower.

Third, sanctuary nationalists argue that the dynamics of alliance formation and maintenance



A Titan IV-B rocket carrying a Milstar II communications satellite lifts off from Cape Canaveral, Florida

If weaponization is inevitable and if leading the way is imperative, any political costs associated with being the first state to violate the sanctuary of space will have to be paid sooner or later, and delaying it will not avert having to pay the price

imply that if the US leads the way in space weaponization it would not only antagonize rivals and enemies, but would also tend to weaken the system of security ties between the United States and its large and powerful bloc of allies. The potentially oppressive proximity and omnipresence of American weapons in orbit might not actually encourage other states to align against an apparent assertion of US hegemony, but would at least make them less comfortable and cooperative with American dominance in international politics.[21] Even in the absence of such balancing behavior, a shift in US military strategy toward greater autonomy from allies and coalition partners, which is one of the principal selling points of Space-to-Earth weapons, would tend to weaken existing security relationships and increase the burden of defense on US national resources.

Some sanctuary nationalists also contend that a shift to space weapons as the key currency of

military power would weaken the global military dominance of the United States by making its currently overwhelming advantage in power projection through air and naval power obsolescent. Much as Britain's naval superiority was undermined when steam replaced sail, and again when pre-Dreadnought battleships were replaced by their steam turbine-driven, all-big-gun successors, the slate would be wiped clean and states that had previously lagged behind in the old technology would be able to compete in the new one from something closer to a neutral start.[22]

Thus, sanctuary nationalists do not think that US space weapons would be intrinsically bad, but instead that their eventual costs would greatly outweigh their benefits, particularly insofar as US space weaponization would lead to other states building their own space weapons. Although sanctuary nationalists are likely to doubt that US restraint in space weaponization would set a compelling moral example for other states to follow, or that arms control agreements would be a powerful barrier to weaponization, they maintain that other states would be more likely to embark on space weaponization if the United States does so first, for two reasons. The more obvious of these is that US space weapons would give other countries more valuable and threatening targets to attack in and from space, creating greater incentives for ASAT and even STEW development.

The other reason is more subtle: a belief that by leading the way in space weaponization, the United States would not only encourage other states to follow suit, and shield them from any political stigma that might be associated with being the first state to weaponize space, but would actually make it easier for them to do so. By serving as the technological innovator, and paying the costs of developing new technologies, the United States would reduce the technological and cost barriers for the states that followed. Such 'advantages of backwardness', well-recognized in economists' studies of the product cycle, are consistently visible in the development of military technologies, including aircraft, missiles and nuclear weapons.[23]

The prescription that emerges from nationalist sanctuary theory is that the United States should avoid taking actions that will motivate or facilitate adversaries' development of space weapons, or cause other effects that would tend to reduce US military advantages over other states. In general, this would point towards avoiding space weaponization, whether through multilateral regimes or unilateral restraint – either one conditional on the actions of other countries – or other means. However, as for the internationalists, the specific features of potential space weapons would affect whether and to what extent the development in question would endanger US security. To take one example, some but not all of the effects that nationalists seek to avoid would probably be less serious if the US built suborbital rather than long-term orbital space weapons.

Space racers

Of the three pro-weaponization perspectives, the one that generally appears least extreme, though it is not necessarily the one that shares the most common ground with space sanctuary theory, is that of the *space racers*. These are more or less reluctant space weaponization advocates, and may accept that sanctuary is desirable in the abstract, but who believe that space weaponization is inevitable, and that this makes it imperative for the United States to lead the way in the development and deployment of space weapons.[24] The space racer perspective is shared by many, including academic theorists who are attracted to restraint in armament but pessimistic about its prospects, and military leaders who are reluctant to see defense resources diverted from other areas into space weapons, but who are similarly skeptical about the chances of avoiding this.[25] Because the thesis that space weaponization is inevitable is tied to many of the pro-weaponization perspectives, the next section of this article will examine it in some detail, and the present discussion will focus simply on its implications.

For space racers, the most important consideration with respect to space weapons is that the United States should not allow other countries to surpass, or even to rival it in this sector of military competition. Being the leading space power may offer significant military advantage, or it could simply

If space weapons will enhance the nation's power, the United States should not squander the opportunity to develop them while waiting for a challenger to appear on the horizon

be an important source of national prestige and international political influence.[26] In either case, the United States must be at the forefront — and in the end — be the first state to weaponize space, for even if that is unpleasant, it will surely be better than being the second state to do so. Moreover, if weaponization is inevitable and if leading the way is imperative, any political costs associated with being the first state to violate the sanctuary of space will have to be paid sooner or later, and delaying it will not avert having to pay the price.

According to this perspective, the correct time for the United States to weaponize space will depend at least in part on the behavior, capabilities and intentions of other countries. If the threat of a rival state weaponizing space were remote, the United States would have the option of moving relatively slowly down this path, as long as it carried out sufficient research and development efforts to remain squarely in the forefront of this dormant arms competition. Many space racers are far from sanguine about the prospect of space weaponization by other states, especially in light of China's rapidly advancing space program, and anticipate that it will not be very long before the United States is compelled to deploy weapons in space. Others see the threat of space weapons rivals as less imminent, but in either case the space racer perspective is essentially threat based.

Although it can be described as the most 'middle of the road' approach to space weaponization policy – or perhaps because of this – the space racer perspective is arguably also the least intellectually satisfying. Its central weakness, though it is not necessarily a fatal one, is the contention that space weapons will be so irresistible that states will not be able to refrain from building them, and so powerful that it would be catastrophic for another state to build them before we do, yet not so attractive that the United States should build them as fast as possible in the absence of a military space challenger. Most sanctuary theories reject the first or the second (or both) of these propositions; the other two pro-weaponization perspectives accept these but reject the third.

Space controllers

Within the US military space community, the dominant attitude regarding weaponization is probably what has become known as the *space control* perspective. Space controllers believe that space will necessarily be an important arena of future conflict due to the great military benefits that space systems will provide to states that operate them. Some military missions, such as boost-phase intercontinental ballistic missile defense against large adversaries, can feasibly be conducted only from space, while the ever-increasing importance of satellites for communications, targeting and other essential military functions will make both attacking enemy satellites and defending one's own satellites (for which space controllers believe that space weapons will be required) a matter of leading strategic priority. In addition, as the relevant technologies improve, space-to-Earth weapons will become a potent military instrument.

Space controllers may accept the proposition that weaponizing space will be politically costly – though many in this camp tend to ignore such political variables in their enthusiasm for the development of American spacepower,[27] not all do – but in addition to agreeing with the space racers that any such costs will have to borne sooner or later, they believe that these will be outweighed by the benefits of any space weapons that are militarily worth deploying. Moreover, they are highly skeptical of the suggestion that US restraint in space weapons development would significantly reduce the inclination of other states to weaponize space as soon as doing so appears to be militarily advantageous to them, and of the prospects for negotiating feasible limitations on space weapons.

For space controllers, the right time for the United States to weaponize space will be as soon as doing so appears to be useful, whether or not other states are moving in the direction of doing the same. The key criterion for such a decision will not be a comparison of potential US space weapon capabilities with those of rival states, but a comparison of future US military capabilities with and without the potential space weapons. From the space controllers' perspective, space racers

If space weapons are too powerful not to build, they must also be too powerful to allow our potential enemies to possess

seem to lack the courage of their own convictions: if space weapons will enhance the nation's power, the United States should not squander the opportunity to develop them while waiting for a challenger to appear on the horizon.

Space hegemonists

Finally, at the most pro-weaponization end of the spectrum, are the *space hegemonists*. Where space controllers believe that space will be an important arena of conflict in the future, space hegemonists argue that space will be *the* critical battlefield, the 'ultimate high ground'. In the tradition of Mahan and Douhet, space hegemonists believe that he who controls space will control the world.[28] In the words of then-Senator Bob Smith, the most prominent if not the most persuasive spokesman for this perspective, concerted American development of space weapons

"will buy generations of security that all the ships, tanks, and airplanes in the world will not provide . . . With credible offensive and defensive space control, we will deter and dissuade our adversaries, reassure our allies, and guard our nation's growing reliance on global commerce. Without it, we will become vulnerable

With respect to the development of space weapons themselves, space hegemonists differ from space controllers only in matters of degree. Where the controllers favor deployment of weapons as soon as it is militarily advantageous, the hegemonists tend to advocate an even more aggressive weaponization program, with little consideration of the possibility that space weapons might not prove to be the optimal solution to most military problems. Space controllers tend to envision space weapons complementing terrestrial weapons, as well as offering unique capabilities that would be impossible or difficult to provide without them; space hegemonists are more inclined to envision space weapons as supplanting most terrestrial weapons, and dominating the traditional battlefields as well as the new ones in space, in a genuinely transformational revolution in military affairs.[30]

Where the space hegemonists stand out most fundamentally from other weaponization advocates is on the political dimension, where controlling space becomes controlling the world. One explanation for how this is to occur, as Smith has suggested, is that overwhelming US spacepower will be unassailable, so that the rest of the world will not challenge American hegemony. Either they will perceive it to be benign, or they will be so intimidated by it that defiance of the United States will appear pointless. The weakness of this argument lies in the tension between believing that there are rival states strong enough to become the space hegemon if the United States fails to do so, and believing that these same rivals are too weak or too meek to develop dangerous space capabilities in the face of US spacepower.

The other scenario, couched in less optimistic *realpolitik* terms, is that space weapons will be so powerful that the United States must exploit its current lead in space technology to seize control of the high ground and actively deny its use by unfriendly states.[31] According to this point of view, rival powers will indeed have incentives to challenge US dominance in space, and since the United States will not be able to afford to have its control of space contested, it will need to quash any such challenges before military space races develop, including pre-emptively destroying any space vehicles launching without US authorization and any terrestrial ASAT weapons that unfriendly states might build. This vision of the future represents the core elements of the other pro-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[29].

Is space weaponization inevitable?

As the preceding discussion described, the belief that space weaponization is, or is not, inevitable looms large for several of the major perspectives. It is most central for the space racers, for it is the expectation of inevitable weaponization that drives them into the pro-weaponization camp. The other pro-weaponization perspectives are not based on such an inevitability belief, but their adherents routinely invoke it as an argument against a sanctuary approach. For their part, all three of the sanctuary perspectives presume that weaponization is avoidable, or at least that

Whatever threats may be posed by enemy space systems, invasion is very low on the list. In short, satellites have more in common with lighthouses than with oceangoing ships, and space commerce resembles telegraphy or terrestrial radio more than it does maritime trade

American actions can affect how soon and in what form it occurs. Therefore the following discussion will briefly examine the four principal arguments for the thesis that space weaponization is inevitable.[32]

Specifically, the question here is whether there is good reason to believe with certainty that space weapons will be built and deployed to a substantial degree in the near-to-medium term, say the next 50 years, regardless of the behavior of the United States.[33] There are four prominent arguments which hold that this is true: that human nature predestines weaponization, that historical analogies with the sea and air prophesy it, that the growing economic importance of satellites mandates it, and that the military utility of space weapons will make not building them strategically irrational. This section will consider each of these propositions in turn, arguing that the first three are thought provoking but ultimately weak, while the last is more powerful but less than conclusive.

Human nature

The simplest inevitability argument is that warfare and armaments are intrinsically uncontrollable because people are warlike: weapons and warfare abhor a vacuum, and will spread wherever humanity goes.[34] This assertion is often accompanied by arguments that arms control never works, although it is possible to argue more narrowly that only space arms control is infeasible.[35]

This generalization is not far from the truth, yet it is far enough from truth that it can and should be considered invalid. For example, although the longstanding success of the 1957 Antarctic Treaty's proscription of military bases in Antarctica, often cited as an example of an effective sanctuary regime, would be far more impressive if the signatory powers actually had strong incentives to establish bases on that continent, it still flies in the face of the idea that weaponization must always follow wherever people go (the argument that space weapons in particular will have military utility too great to resist is a different proposition from the contention that weapons always spread everywhere). Similarly, some types of weapons have fallen into disrepute over the last century. While they have not yet disappeared, it could be argued that chemical and biological weapons have been shunned by all but renegade states and terrorists, and anti-personnel land mines are following in their wake. Many states that could easily have developed nuclear weapons have opted not to do so, in some cases in spite of apparently very good military reasons to go nuclear.[36] Perhaps most strikingly of all, even among space weapons advocates one does not find voices arguing that the placement of nuclear weapons in orbit is inevitable based on the rule that weapons always spread. The fact that this has not happened is due to many factors other than the 1967 Outer Space Treaty's prohibition on such weaponization, but if some weapons do not necessarily follow wherever people go, the idea that a law of human nature requires that others will do so should not be seriously embraced as a basis for national policy.

Historical analogies

The second argument that space must inevitably be weaponized is that the evolution of sea and airpower reveal a striking historical pattern leading inexorably in this direction, which the exploitation of space is also following. According to an influential recent commander of US Space Command, for example:

"If we examine the evolutionary development of the aircraft, we see uncanny parallels to the current evolution of spacecraft . . . The potential of aircraft was not recognized immediately. Their initial use was confined to observation . . . Until one day the full advantage of applying force from the air was realized and the rest is history. So too with the business of space . . . [Military] space operations, like the land, sea, and air operations that evolved before them, will expand [into] the budding new missions already included in the charter of U.S. Space Command of space control and force application as they become more and more critical to our national security interests".[37]

The parallels between the early days of space flight and, especially, the early development of

It was the value of being able to destroy enemy surveillance satellites that drove the ASAT programs in both the Unites States and the Soviet Union

aerial flight are indeed striking, at least at first glance. Yet upon closer examination, it is clear that the spread of weapons into the three previous environments into which human activity has so expanded – the seas, the air, and the undersea world – has been far from identical, raising serious doubts about the soundness of drawing such deterministic analogies when predicting the future of military space exploitation.[38]

Sea power. The first new realm into which human enterprise expanded was the surface of the oceans and other bodies of water, initially along the coasts and later onto the high seas. Maritime transport offered many advantages over land-bound alternatives, especially prior to the invention of the railroad, and armed conflict followed commerce onto the seas. Navies soon developed to protect merchant vessels from pirates and other enemies, to prey on enemy shipping and to attack or defend coastlines and sea lanes.

In spite of the intuitive similarities between seafaring and spacefaring, however, there is one fundamental difference between them which makes the sea–space analogy very weak: ships primarily transport goods and people, while spacecraft (with only minor exceptions) are built to collect, relay or transmit information. This means that space piracy is not a problem, so space navies are not required to suppress it, while 'commerce raiding' threats to space systems can be ameliorated by building redundant, distributed systems of satellites; for merchant shipping this is obviously not an option. It also means that whatever threats may be posed by enemy space systems, invasion is very low on the list. In short, satellites have more in common with lighthouses than with oceangoing ships, and space commerce resembles telegraphy or terrestrial radio more than it does maritime trade.[39] This does not mean that our knowledge of sea power couldn't be applied to space, or that space strategists should not study the works of Julian Corbett and Alfred Thayer Mahan. However, there is little reason to conclude from the evolution of naval forces either that the weaponization of space is inevitable, or that it is not.

Air power. The parallels between military use of the air and of space are far more impressive. Both balloons and airplanes were used for military observation soon after they were first invented, and because aerial observation was so powerful in the First World War, armed aircraft were soon employed as interceptors and then as escorts. Airplanes and airships were also used for bombing even before the dawn of air-to-air combat, and by 1918 virtually every modern military air mission had been undertaken or proposed.[40] Serious commercial exploitation of the air came only later. In space, strategic reconnaissance was the purpose of most early satellites, and intelligence collection remains the most well-known military space application;[41] it was the value of being able to destroy enemy surveillance satellites that drove the ASAT programs in both the Unites States and the Soviet Union.[42]

However, the evolution of air and space power has not been as similar as space weapons advocates' analogies often suggest. For example, less than a decade elapsed between the Wright brothers's first flight and the first aerial combat missions, while in the fifth decade after *Sputnik* space remains unweaponized. Of course, the occurrence of a major war in the 1910s had much to do with the rapid evolution of airpower, and spacepower might look very different today if the Third World War had broken out in the 1960s. But with no major wars now on the horizon, this caveat hardly makes the parallel between the two cases look like a strong basis for space policy in the early twenty-first century. In fact, both superpowers did develop anti-satellite interceptors, but then abandoned

Both superpowers did develop anti-satellite interceptors, but then abandoned their ASAT programs, something utterly without precedent in the history of airpower that casts further doubt on the soundness of the air-space analogy

The Resurgam, an early British submarine from 1879

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their ASAT programs, something utterly without precedent in the history of airpower that casts further doubt on the soundness of the air-space analogy. Naturally, it would be foolish to conclude from the history of the last fifty years that space will definitely not be weaponized during the next fifty, but it would also be reckless to deduce the opposite from the history of flight between 1903 and 1915.

Submarine power. Space weaponization advocates rarely mention the third new environment into which human activity has expanded: the undersea world. In this case, although there are many similarities between submarine and space operations, the two weaponization histories have little in common. Warfare was the sole purpose of the first generations of subsurface vessels, joined only much later and on a vastly more limited scale by scientific research, while submarines have so far been of virtually no commercial significance. This says little about what the future of spacepower will look like, but it provides one more reason to be skeptical about the proposition that weapons spread into new environments according to a consistent and deterministic pattern.

It is also worth noting that one of the most striking commonalities among the three historical precedents is rarely if ever predicted to hold true for space as well. Nuclear weapons were deployed in each of these environments by all the major nuclear powers more or less as soon as each was capable of doing so. Yet not only has this failed to happen in space, but those who make analogical arguments for the inevitability of space weaponization conspicuously fail to claim that the nuclearization of space will occur in the future, raising doubts about the extent to which even its supporters actually believe in these assertions.

Economic vulnerability

The third inevitability argument is that as space systems become more and more economically

Attacking satellites is certainly possible, but crippling or destroying a small object hundreds of miles overhead moving at 17,000 miles per hour (to say nothing of satellites at far higher altitudes, where most communications and navigation satellites reside) is considerably more challenging

important to the United States, these assets will naturally become attractive targets of attack for rival states, terrorists and other enemies, and therefore it will be necessary to place weapons in space in order to protect them.[43] American industry, commerce and civil society do indeed depend heavily and increasingly on space systems for communications, navigation, weather prediction and many other functions.[44] However, it is far from clear that attacking US commercial space assets would automatically appear worthwhile to an enemy seeking ways to hurt the United States, or that protecting them would necessarily require weapons in space.

In the abstract, it is apparent that an enemy seeking to harm or to intimidate the United States might want to attack important satellites, potentially causing disruption of the services they provide, destroying expensive pieces of American infrastructure, and possibly even causing significant damage to the US economy. However, an enemy that wanted to achieve such a result against the United States could do so far more easily by attacking something other than satellites in orbit, and unlike satellites, most of these targets can be attacked without first developing or acquiring specialized weapons for one exotic target set.[45] Attacking satellites is certainly possible, but crippling or destroying a small object hundreds of miles overhead moving at 17,000 miles per hour (to say nothing of satellites at far higher altitudes, where most communications and navigation satellites reside) is considerably more challenging than doing comparable damage to targets such as ships, airliners, bridges, dams, pipelines, computer networks, office buildings — the list could go on almost indefinitely.[46] That such targets are not attacked on a regular basis is due mainly to the relatively small numbers and limited capabilities of serious terrorist enemies, not to any great degree of protection for these assets. Increased defensive measure since 11 September 2001 have done little to alter the relative difficulties of attacking space and terrestrial targets. Moreover, if an enemy did want to disrupt the use of American satellites, attacking their ground control stations and launch facilities might well be more effective than striking satellites in orbit, as well as much easier.

If an adversary did wish to attack US satellites rather than something else in order to hurt the United States,[47] space-based lasers or kinetic energy weapons would be useful for defense against direct ascent ASATs or 'space mines' that were detected before attacking, but they would provide no protection against attacks by ground-based lasers or covert mines already positioned near their targets, against electronic jamming or against attacks on the infrastructure that supports satellites.[48] Instead, the greatest improvements in the security of valuable US space assets might be achieved by making satellites less vulnerable to attack and, especially, by making them individually less valuable through the construction of satellite systems that are more distributed and redundant, with more smaller satellites doing the same jobs as fewer large, expensive ones.[49] The ultimate goal would be for the communications and other satellite infrastructures to become like the US interstate highway system: economically vital, but not worth attacking because its resilience means that none of its individual components is critical.

Military advantage

The best argument for the proposition that space weaponization is inevitable is that the military utility of space weapons will soon be so great that even if the United States chooses not to build space weapons, other countries will certainly do so, in large part because of the great and still growing degree to which US military operations depend upon what has traditionally been known as 'space force enhancement': the use of satellites to provide a vast array of services including communications, reconnaissance, navigation and missile launch warning, without which American military power would be greatly diminished. This parallels the argument that the importance of satellites to the US economy will make them an irresistible target, except that military and intelligence satellites are far more indispensable,

The ultimate goal would be for the communications and other satellite infrastructures to become like the US interstate highway system: economically vital, but not worth attacking because its resilience means that none of its individual components is critical

and successful attacks against a relatively small number of them could have a considerable military impact, for example by concealing preparations for an invasion or by disrupting US operations at a critical juncture.[50] Rivals of the United States might also find space-to-Earth weapons to be a very attractive way to counter US advantages in military power projection.

This is a reasonable argument, but to conclude for this reason that space weaponization is inevitable, rather than merely possible or likely, is unwarranted, for several reasons. There is no question that space systems are critical to US military capabilities. An enemy that attacked them might be able to impair US military operations very seriously, but while this ranks high among threats that concern US strategists, it need not follow that enemies of the United States will do so, or will invest in the weapons required to do so. The US armed forces possess many important vulnerabilities that adversaries have opted not to attack in past conflicts, typically due to resource limitations, a desire to avoid escalation, or fear of the reaction of third party audiences. For example, during Operation Allied Force in 1999, Serbia apparently did not attempt to mount special forces attacks against key NATO airbases in Italy or to use man-portable missiles to shoot down aircraft operating from them, although such an action could have profoundly disrupted the alliance's bombing campaign.[51] Moreover, it is quite possible that if a potential enemy did want to develop the ability to attack US space systems, it would choose to do so in ways that would not involve weaponizing space – such as investing in computer network attack capabilities, non-space weapons to attack the terrestrial elements of space systems, or ASAT capabilities that are not weapons in the conventional sense – and against which the logical defensive countermeasures would not involve deploying US space weapons. For military as well as commercial satellites, a transition to redundant networks of satellites would do much to reduce their vulnerability, perhaps together with supplementing satellite platforms for some military functions with new types of terrestrial systems, such as high endurance unmanned aerial vehicles (UAVs).[52]

In the end, most of the inevitability arguments are weak. Even the best one, that space weapons will provide irresistible military advantages for those who employ them, is plausible but not decisive, and many of those who assert it probably harbor exaggerated expectations about the capabilities that space weapons will offer. In spite of the many people who apparently believe the inevitability thesis to be true, there is good reason for prudent policy makers to assume that the weaponization of space is not in fact predestined, and that US military space policy is one of the factors, though not the only one, that will shape the likelihood of space weaponization by other countries.

Inevitability versus primacy and urgency

The prominence of the inevitability question within debates about space weaponization is not surprising, but too often it distracts attention from two far more important issues: whether it is in fact desirable and important for the United States to be the first country to weaponize space and/or for weaponization to occur sooner rather than later. If so, an aggressive effort to develop space weapons may be called for even if weaponization is not strictly inevitable. If not, a space sanctuary strategy may be appropriate for the United States even if it is certain that space will eventually be weaponized.

For space racers, primacy is what matters most, because they believe that the first state to deploy space weapons will have a great, and perhaps insurmountable, advantage over its rivals, though they may not in fact be eager to see the disappearance of the existing space sanctuary. Knowing simply that weaponization is inevitable is of little value from this perspective, though having a reasonable idea of when it would occur would be important. For many more ardent weaponization advocates, in contrast, the right time to deploy space weapons is immediately, or at least as soon as possible, regardless of what other countries may or may not be likely to do later on. Thus, although they often make inevitability arguments, these are essentially tangential to the real basis of their policy prescriptions. Finally, for space sanctuary advocates who fear that weaponization will cause

Spacepower advocates who make space weapons their totem distract both themselves and others from the fact that many, even most, of the important space policy measures that are needed now and in the near future do not involve building space weapons per se

international instability or will erode US dominance, and who doubt that a rival could in fact establish a decisive lead over the United States by taking the first step in a space weapons race, averting the deployment of at least some types of space weapons as long as possible appears desirable even if they are only temporarily delayed.

Beyond totem or taboo

The polarization of the space weaponization debate – treating a complex, multidimensional policy question as a simple all-or-nothing choice in which weaponization advocacy and opposition take on extreme, almost theological qualities – produces several seriously malignant consequences. The most obvious of these is that it discourages real dialogue among those who favor alternative military space policies. Many of the participants in the debate appear to be interested only in preaching to their fellow believers, treating their adversaries' arguments so dismissively that they cannot possibly change the minds of those who view the issues differently from themselves. Ideas break down when contending camps turn inward from healthy competition to mercantilist isolationism.

But this extreme polarization also harms the interests of the individual camps themselves. Weaponization opponents who treat space weapons as an absolute taboo risk squandering opportunities to establish potentially worthwhile restraints on space weapons development, prohibition. They also preclude the possibility of supporting forms of weaponization that might enhance global stability or further their ultimate policy objectives in other ways.

Of course, it can be argued that compromise will invite predation by one's adversaries, so that supporting benign weaponization would backfire over the long run, but such a position should be based on open and rational debate of its merits, not on doctrinaire faith that more arms control is always better less, or that armament and security are incompatible.

Conversely, spacepower advocates who make space weapons their totem distract both themselves and others from the fact that many, even most, of the important space policy measures that are needed now and in the near future do not involve building space weapons *per se*. Better space tracking networks, systems to detect attacks against satellites, passive defenses and more effective exploitation of space-dependent terrestrial weapons such as satellite-guided munitions all promise to dramatically enhance US spacepower — and US national security. Becoming 'shooters' might make it easier for space operators to win full citizenship rights alongside pilots in officers' club bars, but in the end, with or without space weapons, they will need to make the rest of the armed forces understand that today all United States airmen, sailors, soldiers and Marines are 'space warriors'.

Beyond calling for moderation and for taking the views of others seriously, what can be done to make the space weaponization debate more intelligent and productive? A good place to start would be for all sides in the debate to acknowledge four simple but important truths about space weaponization that are often overlooked in polemical arguments about the subject.

First, space weaponization is inherently political, a fact that space weapons advocates sometimes seek to ignore – though, happily, this is gradually becoming less common. This is not a question simply, or even primarily, of science and engineering. Whether space weapons will make the United States more powerful or secure, or less, depends on political variables: how other countries will react to them, what resources we will have to redirect to build them, and so on. Military capability can be measured in static, absolute terms, but power is relative and dynamic. Moreover, the effects that weaponization would have on international politics, and even what actions would be considered to constitute weaponization, depend upon subjective and perhaps malleable perceptions, both of space weapons and of American military power.

Nobody actually knows with confidence what will happen if and when space is weaponized – and what shape weaponization takes, and what happens between now and then, will certainly affect its consequences

Second, however, the military and technical details of space weapons do matter a great deal, though weaponization opponents – and enthusiasts as well – often paint their arguments with too broad a brush. Although all satellites do share certain important properties, the specific features of particular space weapons must be taken into account when assessing their strategic, and even their broader political, implications. This became second nature during Cold War debates over nuclear weapons and strategic defenses, when the minutiae of warhead accuracy, basing modes and command and control systems were in the forefront of most nuclear policy discussions, and even ardent doves could couch their arguments in the language of throw weights and equivalent megatonnage.[53] Space weapons (like conventional weapons more generally) are a far more complicated and diverse subject, and require much effort and attention to debate satisfactorily, yet surprisingly little work has yet been done to describe and analyze them in adequate detail.[54]

Third, because of the previous point, many participants on both sides of the space weaponization debate harbor what are likely to be quite unrealistic expectations about the capabilities of space weapons, and to a lesser extent about their costs.[55] It is easy to speak in general and often glib terms about global reach, the importance of holding the high ground, and revolutions in military affairs, but it is important to develop and debate a more nuanced understanding of the ways in which space weapons truly are and are not likely to alter the strategic landscape if they are built.

Finally, everyone involved in the debate should remain aware that their arguments are necessarily based on educated speculation, not certainty. This is particularly true with respect to the political implications of weaponization. Would US space-to-Earth weapons cause other states to be more or less friendly towards the United States, for example? Theorists on all sides of the debate offer answers to this question. These should be evaluated against relevant historical experience, for there is evidence that can shed light on the question, and some of these arguments appear better than others upon careful consideration. However, at the end of the day a considerable degree of intellectual humility is in order: nobody actually *knows* with confidence what will happen if and when space is weaponized – and what shape weaponization takes, and what happens between now and then, will certainly affect its consequences.

These are burdensome calls to action. It is more work to develop analyses and recommendations about policy that are well informed by the physical and social sciences than it is to offer ones that are not. However, as in debates about nuclear weapons and strategy during the Cold War, this is an area of policy that is too important to be guided by anything less.

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Notes

1. On the latter, formally named The Commission to Assess United States National Security Space Management and Organization, see Peter L. Hays and Karl P. Mueller, 'Going Boldly – Where? The USAF, Aerospace Integration, and the U.S. Space Commission', *Aerospace Power Journal* 15/1 (Spring 2001), pp.34–49.

2. See Sigmund Freud, *Totem and Taboo: Some Points of Agreement Between the Mental Lives of Savages and Neurotics*, trans. James Strachey (New York: Norton, 1950 [1913]), pp.199–200.

3. For the history and details of these programs, see Paul B. Stares, *The Militarization of Space: U.S. Policy, 1945–1984* (Ithaca: Cornell University Press, 1985).

4. See, for example, Bob Preston et al., *Space Weapons, Earth Wars*, Rand MR-1209-AF (Santa Monica: RAND, 2002), p.23.

5. To this list could be added potential systems for destroying or diverting interplanetary objects threatening to collide with the Earth, some of which might have secondary military capabilities. For an overview of orbital characteristics, see, for example, *Joint Publication 3-14: Joint Doctrine for Space Operations*, 9 August 2002, Appendix F. In general, attacking a satellite in MEO or GEO is far more difficult than attacking one in LEO due to the longer ranges involved.

6. For technological details, see *New World Vistas: Air and Space Power for the 21st Century*, Space Applications Volume (Washington, DC: USAF Scientific Advisory Board, 1995); William L. Spacy II, *Does the United States Need Space-Based Weapons?* (Maxwell AFB, AL: Air University Press, 1999); Preston et al. (note 3), esp. ch.3; Ashton B. Carter, 'Satellites and Anti-Satellites: The Limits of the Possible', *International Security* 10/4 (Spring 1986), pp.46–98; US Congress, Office of Technology Assessment (OTA), *Anti-Satellite Weapons, Countermeasures, and Arms Control* (1985), reprinted in *Strategic Defenses* (Princeton: Princeton University Press, 1986).

7. See, for example, Karl P. Mueller, 'Is the Weaponization of Space Inevitable?', paper presented at the International Studies Association Annual Convention, New Orleans, LA, 27 March 2002.

8. Under the terms of the 1967 Outer Space Treaty, which prohibits the placement of weapons of mass destruction in space. The 1972 ABM treaty also prohibited space-based weapons that could be used for ballistic missile defense, at least according to most interpretations, until the United States withdrew from the treaty in 2002.

9. See, for example, Simon P. Worden, 'Space Control in the 21st Century', in Peter L. Hays et al. (eds), *Spacepower for a New Millennium* (New York: McGraw Hill, 2000), pp.225–38.

10. US military doctrine classifies space control effects into a hierarchy of five alliterative categories (deception, disruption, denial, degradation and destruction); see *JP 3-14* (note 4) pp.IV-6–8.

11. This generalization might be offset in certain cases by more discriminate weapons appearing to be more useful for aggressive purposes.

12. See Preston et al. (note 3), Appendix A.

13. For example, James Oberg, *Space Power Theory* (Washington, DC: Government Printing Office, 1999), pp.146–7.

14. The most widely used such typology at present is that provided in David E. Lupton, *On Space Warfare: A Space Power Doctrine* (Maxwell AFB, AL: Air University Press, 1988), more recently summarized and updated in Hays et al., *Spacepower* (note 8), pp.3–4. Lupton describes four categories of policy preferences, which he calls Sanctuary, Survivability, Control and High Ground, but defines these primarily in terms of the relationship between space systems and the strategic nuclear balance, which limits the utility of his framework for understanding the current weaponization debate (for example, he characterizes his Sanctuary school as favoring vulnerable space systems, which makes it little more than a straw man). However, the discussion of pro-weaponization perspectives below does draw heavily upon the more useful parts of his framework.

15. This is equally true of many of the citations in the following discussion. The fact that an example is used below to illustrate an argument from one of these perspective should not be taken to imply that everything in the cited work, or in other works by the same author, falls into the same category as they are defined here.

16. The 'idealist' label is not intended to imply that this perspective is unrealistic, but rather that it is guided by larger normative principles, in keeping with the classical idealist tradition in international political theory.

17. For example, Robert Jervis, 'Cooperation Under the Security Dilemma', *World Politics* 30/2 (January, 1978), pp.167–214; Steven E. Miller, Sean M. Lynn-Jones and Stephen Van Evera (eds), *Military Strategy and the Origins of the First World War* (Princeton: Princeton University Press, 1991); Sean M. Lynn-Jones, 'Offense-Defense Theory and Its Critics', *Security Studies* 4/4 (Summer 1995), pp.660–91.

18. Bruce M. DeBlois, 'Space Sanctuary: A Viable National Strategy', *Air Power Journal* 12/4 (Winter 1998), pp.42–44, 52. In fact, different types of space weapons would vary greatly in their ability to strike quickly; see Preston et al. (note 3).

19. For further discussion, see Stephen Van Evera, 'Offense, Defense, and the Causes of War', *International Security* 22/4 (Spring 1998), pp.5–43.

20. See David W. Ziegler, *Safe Heavens: Military Strategy and Space Sanctuary Thought* (Maxwell AFB, AL: Air University Press, 1998); Karl P. Mueller, 'Space Weapons and U.S. Security: The Dangers of Fortifying the High Frontier', paper presented at the American Political Science Association Annual Meeting, Boston, MA, 6 September 1998; Charles S. Robb, 'Star Wars II', *The Washington Quarterly* 22/1 (Winter 1999), pp.81–6.

21. The key presentation of these arguments is Stephen M. Walt, *The Origins of Alliances* (Ithaca: Cornell University Press, 1987); they are challenged in Randall L. Schweller, *Deadly Imbalances: Tripolarity and Hitler's Strategy of World Conquest* (New York: Columbia University Press, 1998). For the proposition that the United States won the Cold War because it was a relatively unthreatening superpower, see John Lewis Gaddis, *We Now Know: Rethinking Cold War History* (New York: Oxford University Press, 1997).

22. On the Royal Navy, see, among others, Paul M. Kennedy, *The Rise and Fall of British Naval Mastery* (Atlantic Highlands, NJ: The Ashfield Press, 1983 [1976], esp. pp.205–37; Mueller, 'Space Weapons and U.S. Security' (note 8), pp.13–15; DeBlois (note 17) p.51.

23. See Robert Gilpin, *War and Change in World Politics* (Cambridge: Cambridge University Press, 1981), pp.176–9; Alexander Gerschenkron, 'The Advantages of Backwardness', in his *Economic Backwardness in Comparative Perspective* (Cambridge, MA: Harvard University Press, 1962), pp.5–11. However, following a technological trailblazer, especially one with greater resources, does not necessarily guarantee the ability to catch up

with or surpass it, as demonstrated, for example, by the US–Soviet competition in submarine and anti-submarine warfare capabilities.

24. For example, CINCSPACE Gen. Ralph Eberhart, speech to the Unified Aerospace Power in the New Millennium conference, Alexandria, Virginia, 8 February 2001; James H. Hughes, 'Warfare in Space', *Journal of Social, Political and Economic Studies* Monograph Series 28 (2000), pp.7–10.

25. 'The logic essentially boils down to a belief that weapons in space are an inevitability. Since weaponization of space is inevitable, the United States, as the country with the historical opportunity to be the first to field them, would be foolish not to do so. And should it not afford itself of the opportunity, it will likely find itself hostage to the state that does' Oberg (note 12), p.147.

26. This is analogous to arguments of reluctant nuclear arms racers in the 1970s and 1980s that having a large nuclear arsenal than one's adversary might be militarily irrelevant in a world of mutual assured destruction, yet still be important because of the political effect of appearing to be the dominant nuclear power. See Charles L. Glaser, 'Why Do Strategists Disagree about the Requirements of Strategic Nuclear Deterrence?', in Lynn Eden and Steven E. Miller (eds), *Nuclear Arguments* (Ithaca: Cornell University Press, 1989), pp.109–71.

27. A prominent example is the strong and unconditional recommendation in the USAF Scientific Advisory Board's *New World Vistas* study (note 5), p.164, that 'the Air Force should broaden the use of space to include direct force projection against surface, airborne, and space targets', in spite of the fact that the study included no analysis at all of the potential consequences of pursuing such a policy.

28. This geopolitical argument is made pre-eminently in Everett C. Dolman, *Astropolitik: Classical Geopolitics in the Space Age* (London: Frank Cass, 2001).

29. Sen. Bob Smith, 'The Challenge of Spacepower', *Airpower Journal* 13/1 (Spring 1999), p.33.

30. For example, *New World Vistas* (note 5), p.xviii: 'In the next two decades, new technologies will allow the fielding of space-based weapons of devastating effectiveness to be used to deliver energy and mass as force projection in tactical and strategic conflict. This can be done rapidly, continuously, and with surgical precision, minimizing exposure of friendly forces.'

31. Dolman (note 27).

32. For a more detailed examination of this issue, see Mueller, 'Is the Weaponization of Space Inevitable?' (note 6).

33. It is possible to argue that weaponization is inevitable because the United States will certainly build such weapons for reasons internal to itself, but this is not a useful meaning of 'inevitability' when seeking to guide US policy.

34. See Michael V. Smith, 'Ten Propositions About Spacepower', Master's thesis, School of Advanced Airpower Studies, June 2000, Proposition 10; Oberg (note 12), pp.147–9; Gen Chuck Horner, in Tom Clancy and Chuck Horner, *Every Man a Tiger* (New York: Putnam, 1999); *Report of the Commission to Assess United States National Security Space Management and Organization* (Washington, DC: The Commisson, 2001), p.100.

35. For an example of the former, see Steven Lambakis, *On the Edge of Earth: The Future of American Space Power* (Lexington: University of Kentucky Press, 2001). For a sober overview of arms control issues related to space weapons, see Peter L. Hays, *United States Military Space: Into the Twenty-First Century* (Maxwell AFB, AL: Air University Press, 2002), pp.49–114.

36. See Mitchell Reiss, *Without the Bomb: The Politics of Nuclear Nonproliferation* (New York: Columbia University Press, 1988), and *Bridled Ambition: Why Countries Constrain Their Nuclear Capabilities* (Washington, DC: Woodrow Wilson Center Press, 1995).

37. Gen. Howell M. Estes III, Commander, Air Force Space Command, speech to the Air Force Association Annual Symposium, Los Angeles, 18 October 1996 (some ellipses in the original). Available at <http://www.spacecom.af.mil/usspace/>. See also Thomas D. Bell, *Weaponization of Space: Understanding Strategic and Technological Inevitabilities*, Occasional Paper No. 6 (Maxwell AFB, AL: Center for Strategy and Technology, US Air War College, 1999), pp.16–20; Lambakis (note 34), pp.140–41; USAF Chief of Staff Gen. Michael Ryan, keynote address to the Unified Aerospace Power in the New Millennium conference, Alexandria, Virginia, 8 February 2001.

38. Regarding the dangers of faulty analogical reasoning in general, see Richard E. Neustadt and Ernest R. May, *Thinking in Time* (New York: Free Press, 1986) and Yuen Foong Khong, *Analogies at War* (Princeton: Princeton University Press, 1992). One could potentially argue that cyberspace represents a fifth environment worth considering in this context. The shape of the weaponization story for this case would depend on exactly how one defined the arena in question, and what constitutes a weapon within it. Again, some interesting parallels with the development of space technology would appear, and the overall pattern would not correspond to that of any of the other four cases.

39. As space travel expands beyond earth orbit into interplanetary space, where the transportation of material goods may finally become one of its major functions, the parallels between sea and space power may become more pronounced.

40. For discussion of this evolution, see Lee Kennett, *The First Air War, 1914–1918* (New York: Free Press, 1990). An analogy can also be drawn between airborne spotters enhancing the effectiveness of artillery in the First World War and contemporary use of GPS guidance for aerial munitions.

41. On the evolution of satellite reconnaissance, see William E. Burrows, *Deep Black: Space Espionage and National Security* (New York: Random House, 1986); Jeffrey T. Richelson, *America's Secret*

Eyes In Space (New York: Harper and Row, 1990) and *A Century of Spies: Intelligence in the Twentieth Century* (New York: Oxford University Press, 1995). On the evolution of the US and Soviet space programs, see Walter A. McDougall, *...the Heavens and the Earth: A Political History of the Space Age* (New York: Basic Books, 1985).

42. Of course, there are important physical differences between air and space warfare, such as air being territorial while low Earth orbital space is not, but these do not in themselves prevent drawing parallels between the evolution of air and spacepower. See Bruce DeBlois, 'Ascendant Realms: Characteristics of Airpower and Space Power'. in Phillip S. Meilinger (ed.), *Paths of Heaven: The Evolution of Airpower Theory* (Maxwell AFB, AL: Air University Press, 1997), pp.529–78; Michael Smith (note 33), esp. pp.43–50.

43. Bell (note 36), pp.6–7; Oberg (note 12), p.147; Thomas S. Moorman Jr, 'The Explosion of Commercial Space and the Implications for National Security', *Air Power Journal* 13/1 (Spring 1999), p.19. Worden (note 8) provides one of the more sophisticated versions of this argument.

44. Although this is true in the aggregate, it is less true than most analysts expected it to be a few years ago, and more true in some functional areas than others. Most notably, the satellite communications boom of the 1990s has substantially leveled off due to the growth of long distance fiber optic cable networks, and the anticipated rise of commercial satellite telephone networks has been overtaken by advances in terrestrial cellular telephony; see Barry D. Watts, *The Military Use Of Space: A Diagnostic Assessment* (Washington, DC: Center for Strategic and Budgetary Assessments, 2001), pp.49–56, and Hays, *U.S. Military Space* (note 34), pp.8–18.

45. A partial exception to this generalization might be the possibility of detonating an exoatmospheric nuclear explosion, which would not only destroy nearby satellites but also energize the Van Allen radiation belts, drastically reducing the lifespan of all un-hardened satellites orbiting at the affected altitudes. Such an attack – which would be of dubious short-term military value – might appear to be a way to use a single nuclear weapon to produce massive economic damage without causing many human casualties (at least directly). However, it presumably would not be a way to use a nuclear weapon free from fear of retaliation.

46. It is not particularly difficult compared to building, launching and operating satellites, however. The relative difficulty of attacking satellites in orbit is even more pronounced for non-state terrorist organizations, which are unlikely to be even remotely as capable of conducting ASAT attacks against satellites as they are of striking a wide range of terrestrial economic targets.

47. It remains difficult to envision a motive for such a course of action, however. Although attacking satellites might provide an opportunity to cause economic harm without directly injuring anyone, there are plenty of terrestrial targets where this would also be true. Satellites might be attacked more covertly than most terrestrial targets (though the opposite is more likely to be true), but terrorists or other coercers would have to reveal their actions in order to achieve their goals, and any concerted anti-satellite campaign for economic warfare purposes would quickly become visible to the victim.

48. Spacy (note 5), pp.25–6, 33–7. Terrestrial ASAT lasers could be counter-attacked by space-to-Earth weapons, but would also be vulnerable to attack by other means.

49. Robert B. Giffen, *U.S. Space System Survivability: Strategic Alternatives for the 1990s*, National Security Affairs Monograph Series 82-4 (Washington, DC: National Defense University Press, 1982); Ziegler (note 19), p.30.

50. The greatest damage might be achieved by disabling a large part of the global positioning system satellite network, which would have a wide array of devastating military (and also economic) effects, especially now that many US weapons are guided to their targets by GPS signals, but this would be difficult to achieve since the GPS constellation is large, hardened, and operates in relatively high altitude orbits.

51. Many other examples will spring to mind upon contemplating the matter, but I am reluctant to compile target lists for potential enemies.

52. Ziegler (note 19), pp.28–9.

53. See Karl Mueller, 'Strategic Airpower and Nuclear Strategy: New Theory for a Not-Quite-So-New Apocalypse', in Phillip S. Meilinger (ed.), *The Paths of Heaven: The Evolution of Airpower Theory* (Maxwell AFB, AL: Air University Press, 1997), pp.279–320.

54. Notable recent exceptions include Preston et al. (note 3) and Spacy (note 5).

55. It is widely accepted among military space professionals that such expectations, along with many other popular beliefs about space operations, are also powerfully and unrealistically shaped by the portrayals of space warfare in movies and television. This is by no means a new or surprising pattern: expectations about air warfare both before and after the First World War had much to do with the works of H.G. Wells and other authors of speculative fiction, see, for example, Michael Paris, *Winged Warfare: The Literature and Theory of Aerial Warfare in Britain, 1859–1917* (Manchester: Manchester University Press, 1992).