# 1NC vs Ayala AM Cal R6

## 1

### 1nc – t

#### Interpretation: Scientifically outer space **excludes celestial bodies**

Science Daily ND [ScienceDaily, "Outer space," https://www.sciencedaily.com/terms/outer\_space.htm]/ISEE

Outer space, also simply called space, refers to the relatively empty regions of the universe outside the atmospheres of celestial bodies. Outer space is used to distinguish it from airspace (and terrestrial locations). Contrary to popular understanding, outer space is not completely empty (i.e. a perfect vacuum) but contains a low density of particles, predominantly hydrogen gas, as well as electromagnetic radiation.

#### Violation: they don’t; the

John Carl Villanueva, 3-19-2010, "What Is A Moon?," Universe Today, https://www.universetoday.com/60072/what-is-a-moon/]/ISEE

A moon is defined to be a celestial body that makes an orbit around a planet, including the eight major planets, dwarf planets, and minor planets. A moon may also be referred to as a natural satellite, although to differentiate it from other astronomical bodies orbiting another body, e.g. a planet orbiting a star, the term moon is used exclusively to make a reference to a planet’s natural satellite.

* That was Villanueva 10

#### Limits: Allowing celestial bodies creates an unpredictable research burden – the neg not only has to familiarize themselves with the privatization of outer space but also every planet ever – this kills limits on an already large topic

#### Predictability: science concludes neg – most people define outer space as in between atmospheres– including earth guts predictability for topic lit

#### Voter for fairness and education

#### No RVI’s – you shouldn’t win just for provitng you are T Default to competing intepretations – any other interp creates a moving target

## 2

### 1nc – t

#### Interpretation: the aff cannot specify a type of space appropriation

#### Bare plurals imply a generic “rules reading” in the context of moral statements

Cohen 1 — (Ariel Cohen, Professor of Linguistics @ Ben-Gurion University of the Negev, PhD Computational Linguistics from Carnegie Mellon University, “On the Generic Use of Indefinite Singulars”. Journal of Semantics 18: 183-209, Oxford University Press, 2001, accessed 12-7-20, HKR-AM) \*\*BP = bare plurals

According to the rules and regulations view, on the other hand, generic sentences do not get their truth or falsity as a consequence of properties of individual instances. Instead, generic sentences are evaluated with regard to rules and regulations, which are basic, irreducible entities in the world. Each generic sentence denotes a rule; if the rule is in effect, in some sense (different theories suggest different characterizations of what it means for a rule to be in effect), the sentence is true, otherwise it is false. The rule may be physical, biological, social, moral, etc. The paradigmatic cases for which this view seems readily applicable are sentences that refer to conventions, i.e. man-made, explicit rules and regulations, such as the following example (Carlson 1995: 225):

(40) Bishops move diagonally.

Carlson describes the two approaches as a dichotomy: one has to choose one or the other, but not both. One way to decide which approach to choose is to consider a case where the behavior of observed instances conflicts with an explicit rule. Indeed, Carlson discusses just such a case. He describes a supermarket where bananas sell for $0.49/lb, so that (41a) is true. One day, the manager decides to raise the price to $1.00/lb. Immediately after the price has changed, claims Carlson, sentence (41a) becomes false and sentence (41b) becomes true, although the overwhelming majority of sold bananas were sold for $0.49/lb.

(41) a. Bananas sell for $0.49/lb.

b. Bananas sell for $1.00/lb.

Consequently, Carlson reaches the conclusion that the rules and regulations approach is the correct one, whereas the inductivist view is wrong.

While I share Carlson’s judgements, I do not accept the conclusion he draws from them. Suppose the price has, indeed, changed, but the supermarket employs incompetent cashiers who consistently use the old price by mistake, so that customers are still charged $0.49/lb. In this case, I think there is a reading of (41a) which is true, and a reading of (41b) which is false. These readings are more salient if the sentence is modified by expressions such as actually or in fact:

(42) a. Bananas actually sell for $0.49/lb.

b. In fact, bananas sell for $1.00/lb.

BP generics, I claim, are ambiguous: on one reading they express a descriptive generalization, stating the way things are. Under the other reading, they carry a normative force, and require that things be a certain way. When they are used in the former sense, they should be analysed by some sort of inductivist account; when they are used in the latter sense, they ought to be analysed as referring to a rule or a regulation. The respective logical forms of the two readings are different; whereas the former reading involves, in some form or another, quantification, the latter has a simple predicate-argument structure: the argument is the rule or regulation, and the predicate holds of it just in case the rule is ‘in effect’.

#### Violation—they specified lunar heritage cites

#### Vote neg for predictable limits—specifying a type of appropriation offers a huge explosion in the topic since they get permutations of hundreds of appropriations. Limits explodes neg prep burden and draws un-reciprocal lines of debate, where the aff is always ahead.

## 3

### 1nc – da

#### Russia is ravenously pursuing global space coop to erode US supremacy, undermine allied resolve, and build support for regional aggression – surrendering pressure causes future conflict and gray zone escalation – the link alone turns case

Listner 18 [Michael J. Listner is an attorney, the founder and principal of the legal and policy think-tank/consultation firm Space Law and Policy Solutions, and the author and editor of the subscription space law and policy briefing-letter, The Précis. 9/17/18, "The art of lawfare and the real war in outer space." <http://www.thespacereview.com/article/3571/1>]

A battle for primacy in outer space took place on August 14, 2018, among the Russian Federation, the United States, and, indirectly, the People’s Republic of China. This battle did not involve the exotic technology of science fiction, antisatellite weapons (ASATs), or the incapacitation of satellites; it was not part of a hot war and did not even occur in outer space. Rather, it took place in the halls of the Conference of Disarmament in Geneva, Switzerland, and concerned the interdiction of the hypothetical deployment of instrumentalities of a hot war in outer space. The carefully orchestrated arena for this battle by the proponents of banning so-called space weapons involved methodologies, institutions, and agents of international law but was undermined by a vigorous counterattack by the United States using the same forum and suite of instruments so skillfully levied against it.1 This battle, of course, is not a single instance but the latest skirmish of a much larger conflict involving real war in space.

There’s been significant attention—and overstatement— about the effect of a proposed Space Force by the United States, including an arms race and dominance as articulated by the United States,2 yet little attention has been given to the contest that continues to be fought over outer space using the tools of international law and policy, both of which are instruments of “lawfare.” Maj. General Charles N. Dunlap, Jr. (retired)3 first defined lawfare in the paper “Law and Military Interventions: Preserving Humanitarian Values in 21st Conflicts,” as “a method of warfare where law is used as a means of realizing a military objective.”4 This definition can be expanded to the use of hard law, soft law, and non-governmental organizations and institutions within the international arena to achieve a national objective and geopolitical end that would otherwise require the use of hard power. As observed by General Dunlap, lawfare imputes the teachings of Sun Tzu in particular this teaching: “The supreme art of war is to subdue the enemy without fighting.”5 Lawfare is not a new concept and has been used in many domains, but the tools brought to bear have become more prolific, and the domain of outer space has been and continues to be a theater where it is applied. The earliest example of lawfare (even though the term was not yet coined) in outer space occurred pre-Sputnik with Soviet Union attempting to use customary law to make claims of sovereignty extending beyond the atmosphere to the space above its territory. This claim was preempted by the launch of Sputnik 1 and the act of the satellite flying over the territory of other nations.6 The Eisenhower Administration saw this as an opportunity to meet a national space policy goal and likewise used customary law as an implement of lawfare and successfully created the principle of free access to outer space, which it utilized for photoreconnaissance activities in lieu of overflights of another nation’s sovereign airspace.7 The Soviet Union unsuccessfully attempted to defeat this move using lawfare in the United Nations through a proposal that would have prohibited the use of outer space for the purpose of intelligence gathering.8 Since that setback, the art of lawfare in outer space has settled on the objective ascribed to another teaching of Sun Tzu:

“With regard to precipitous heights, if you proceed your adversary, occupy the raised and sunny spots, and there wait for him to come up. Remember, if the enemy has occupied precipitous heights before you, do not follow him, but retreat and try to entice him away.”9

The second part of this teaching exemplifies the role of lawfare in the present war in outer space: to employ the tools and institutions of international law as a means to legally corner an adversary and gain geopolitical advantage in soft power, with the aim of slowing and eroding the advantage that adversary has attained through preeminence in the domain of outer space, and replace it with their own. This objective is accomplished by two general means: legally-binding measures, most commonly in the form of treaties, and so-called non-binding measures couched as sustainability.

Lawfare in space continued in the intervening years between Sputnik-1 and the signature and ratification of the Outer Space Treaty and afterward. The weapon of choice: disarmament proposals for outer space. Provisions for banning so-called space weapons in the Outer Space Treaty were rejected by the Soviet Union in favor of separate arms control measures.10 These measures included proposals, some of which related to the proscription of ASATs, designed to not only gain an advantage in outer space but to gauge political intent and resolve.11

The lawfare offensive escalated after the proposed Strategic Defense Initiative with an effort curtail space-based missile defense technology through a ban on so-called space weapons and a proverbial arms race in outer space. The Prevention of an Arms Race in Outer Space (PAROS), introduced in 1985, continues to seek a legally binding measure to place any weapon in outer space, including those designed for self-defense. It spawned measures such as the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force against Outer Space Objects (PPWT), co-sponsored by Russia and China. This and other measures have met resistance as unverifiable and certainly are not likely to gain the advice and consent of the US Senate for ratification. The end game of the use of lawfare in the form of efforts like PAROS—the latest attempt at which was defeated in Geneva—is to propose legally binding measures that proponents would ignore to their advantage in any event. The sponsors and advocates of these hard-law measures recognize they will not come to fruition but, in the process of promoting them, will enhance their soft power and moral authority, which can be applied to entice their adversary down.

Non-binding resolutions and measures in the form of political agreements and guidelines are being used concurrently in the lawfare engagement in outer space, where proposals for legally binding measures alone fall short of the goal of creating hard law and challenging dominance in outer space. These resolutions and measures, which emphasize sustainability, are designed to perform an end run around the formalities of a treaty to entice agreement on issues that would otherwise be unacceptable in a hard-law agreement. These measures have the dual effect to create soft-power support on the one hand and hard law on the other. This tool of lawfare, which uses clichés of cooperation and sustainability, is a ploy that applies the ambiguous nature of customary international law to achieve what cannot be done through treaties: to “entice the adversary away” and create legal and political constraints to bind and degrade its use of outer space or prevent it from maintaining its superiority, all the while allowing others to play catchup and replace one form of dominance with another. While lawfare is by nature asymmetric, this indirect approach could be considered a subset an irregular tactic of lawfare, as opposed to the use of formal treaties in lawfare.

#### Russian asymmetric balancing in space causes multipolarity, shreds global norms, and turns case –

Jackson 18 [Nicole J. Jackson is an international relations and security studies scholar specializing in Russia and the former Soviet Union. She is Associate Professor at the School for International Studies at Simon Fraser University. She has published on Russian foreign and security policy, regional security governance and trafficking in Central Asia. "Outer Space in Russia’s Security Strategy." https://pdfs.semanticscholar.org/40e4/d8ee5c172d547fdc4c047ff01b444b69136e.pdf]

Since 2000 Russia has actively pursued both binding laws and non-binding norms to ban and control weapons in outer space, and has advocated for non-binding, voluntary transparency and confidence building measures (TCBMs). Sometimes it has done this in cooperation with other states, sometimes in opposition to them. This diplomatic endeavour may seem somewhat at odds with Russia’s growing militarisation, however, the dual role on outer space fits well within Russia’s overall foreign and security strategy which is both reactive to US policy and simultaneously positive towards the United Nations (UN) and consensus-based multilateral negotiations. Russia is strengthening its comprehensive power, including military, diplomatic and normative global influence, in order to make its voice heard on the international stage. Russia’s diplomatic activism is that of an aspirational great power, but it also reflects the limits of its current economic and military weaknesses. International negotiations enable Russia to be recognised as a key player in global affairs, while also benefiting from an opportunity to highlight the US/West’s declining influence and the rise of a multipolar world.

This chapter examines why outer space is so important for Russia. Then, it shows how and why the Russian government’s outer space strategy and capabilities have evolved since the 1990s. The paper concludes with an appraisal of Russia’s recent diplomatic initiatives on outer space governance.2 No longer economically competitive in the race for control of outer space, Russia has attempted several strategies to enable it at least to keep in the running. It has placed its space strategy in the context of defence requirements and state military control. It is using diplomacy -- working with international organisations affiliated with the UN - to discuss, cooperate on and influence the race for the militarisation of space. It works with disarmament organisations to influence and promote a collective approach to the problem, rather than one dominated by the richer and more powerful states.

#### That causes several nuclear wars

Burrows 17 [Mathew J. Burrows, Director, Foresight, Strategy, and Risks Initiative at the Atlantic Council. Western Options in a Multipolar World. November 2017. https://www.atlanticcouncil.org/images/Western\_Options\_in\_a\_Multipolar\_World\_web\_1127.pdf]

Multipolarity has historically been less stable than when there has been a strong hegemon or even a bipolar distribution of power. Today's world is not just characterized by a growing number of state actors in the world—symbolized by displacement of the Group of Seven (G7) with the Group of Twenty (G20) leading industrialized and emerging economies—but also by a diffusion of power to non-state actors, some of whom have the means for inflicting violence on a level that used to be the monopoly of states. With robotics and biotechnology, the trend of growing non-state lethality will only grow. Terrorists and insurgents have already gained access to precision-strike capabilities and cyber instruments. The Middle East is where the better-armed, non-state actors are concentrated, but terrorism has a long arm and many groups are routinely hitting European and US targets.

Major state conflict—which has not occurred on a large scale since the Korean War—has historically occurred more often in less-stable multipolar worlds. Recent work by Harvard University’s Graham Allison points to the likelihood of challengers to any global system ending up in a fight with the declining hegemon.9 There are only a couple instances of a peaceful transition-such as happened after the Second World War—when the declining hegemon—Britain—handed off its global role to the rising star—the United States. In cases where there is not a peaceful arrangement, mounting tensions between challenger and hegemon easily tip over into open conflict.

Nuclear weapons acted to limit the scope of US-Soviet Union conflicts but the worry today is that certain nuclear-capable states—India, Pakistan, and North Korea—do not have the same built-in inhibitions that developed during the early phase of the Cold War. If the North Korean regime faced a threat to its survival, it would most likely use nuclear weapons. While the Soviet Union had a “no first use” policy, Russia has recently developed a new military doctrine that justifies a limited nuclear strike if faced with a large-scale conventional attack that exceeded its ability to reverse. To Russian thinking, the limited nuclear strike would de-escalate a conflict, but it could do the opposite.

Competing visions of how the international order should be run are a feature of the current multipolarity. Rising powers, led by Russia and China, in particular dispute Western norms and policies that undercut national sovereignty. They decry Western democracy-promotion efforts, citing the instability that has resulted from regime changes in Iraq and Libya and comparing Western unseating of rulers to the colonialism of the nineteenth century. Hence, there has been no agreement by the five permanent members (P5'°) of the United Nations Security Council (UNSC) on ending the Syrian civil war—one of the largest humanitarian disasters in modern history—because of Russian and Chinese worries that it would set another precedent for deposing an authoritarian leader.

## 4

### 1nc – da

#### We will concede lunar dust makes moon basing impossible:

#### Chinese will achieve moon dominance now, but the dust prevents it–dominance causes space control, PGS, democratic backsliding, and Taiwan invasion

Fisher 15 Testimony of Richard D. Fisher Jr. before the U.S.-China Economic and Security Review Commission, Hearing on China Space and Counter-Space Issues; Senior Fellow on Asian Military Affairs at the International Assessment and Strategy Center. ; President of Pacific Strategies, Inc. “China’s Military Ambitions in Space and America’s Response” 2/18/15 http://www.uscc.gov/sites/default/files/Fisher\_Testimony\_2.18.15.pdf

Introduction Mr. Chairman, distinguished members of the United States-China Economic Security Review Commission, it is a privilege to present testimony concerning China’s strategic and military ambitions in outer space. While China pursues a growing commercial, deep space and space science agenda, the foundation of its space program remains the pursuit of military advantage for the People’s Liberation Army (PLA). China’s space endeavors are subordinate to the PLA. While the PLA does not offer public briefings or budget information about its space combat programs, there is a considerable body of “secondary” literature presumably based on strategy or doctrine, which has long appeared to justify the development of a PLA capability to wage war in space. Occasionally, however, statements by top officials appear. According to Chinese press reports on 5 December 2012, newly elevated Chinese Communist Party (CCP) Secretary General Xi Jinping gave a speech to a Second Artillery (SA) audience. Almost nothing of the content of that speech was reported, until the late 2014 surfacing of a journal article by SA veteran General Sun Mingfu. In that speech, General Sun said that “President Xi made clear the need ‘to enhance the build-up of ground-based anti-satellite combat force to ensure the timely formation of combat capability’, and to “accelerate the development of strategic anti-missile capability.” This article quickly disappeared off of its hosting web page and a famous Chinese military-technical blog “KKTT” that gave it prominence soon disappeared as well. On 14 April 2014, Xi was reported to have given a speech before a PLA Air Force (PLAAF) audience in which he called for an “integrated air and space capability.” This phrase was also used by former PLAAF commander General Xu Qiliang during the 2009 PLAAF 60th anniversary, and by military academic commentators which listed space weapons the PLA should acquire. Perhaps Xi Jinping also gave the PLAAF specific space warfare preparation guidance. While there has been some discussion in the PLA of a new service or a “Space Force,” today it appears that current services of the PLA are being encouraged to develop individual space combat capabilities. Based on an accumulation of data, it is possible to conclude that the PLA’s apparent goal is to exercise denial and then dominance in Low Earth Orbit (LEO) and then to extend control into the Earth-Moon system. Since the early 1990s China has developed four, possibly five, attack capable space-combat systems. China may be the only country developing such variety of space weapons to include: ground-based and air-launched counter-space weapons; unmanned space combat and Earth-attack platforms; and dual-use manned platforms. It is also important to consider that the PLA’s projection into space is an integral part of China’s development of military capabilities to dominate the Asia-Pacific region, and then to project power globally into the 2020s and 2030s. The PLA requires increasing space control in order to 1 assure that space-based Information Surveillance Reconnaissance (ISR) systems can provide targeting and other and support for missile, air, naval and ground forces, future intercontinental Prompt Global Strike (PSG) forces, and for the forces of client/partner states. Sustaining superiority in LEO, in turn, will require control of the “High Ground,” or the Moon and Deep Space. The Chinese Communist Party (CCP) leadership’s intertwined pursuit of global military power and dominant space power has three main motivations: 1) to help sustain the power position of the CCP; 2) to aid the CCP’s pursuit of economic-political dominance in key regions to best assure resource/commercial access; and, 3) to eventually displace the United States from its position of global leadership. Space power will also be used to support new Chinese-led or promoted anti-U.S./anti-democratic coalitions as it will be used to crush democratic threats to its rule, beginning with the democracy on Taiwan. As with the former Soviet Union, China’s pursuit of regional and then global military power is not rooted in an existential threat, but in the CCP’s fears for its power position. This requires a CCP-led “rejuvenation” of China, entailing mobilization for greater power, ever more control over its own people, and then increasing control over others. Another result is China’s choice to be hostile to Western rules or concepts that may constrain China’s power. This justifies an essential Chinese rejection of American or Western conceptions of transparency and restraint, or verifiable weapons control in space which might constrain its power. This mirrors the CCP/PLA’s repeated refusal of U.S. requests to consider real nuclear weapons transparency and control, transparency over its nuclear and missile exports, and --from many of its neighbors and Washington -- fair settlement of territorial disputes which threaten war. The latter, especially in the South China Sea, is instructive. As it has gained military power in the South China Sea, China has sought to change the strategic environment and dictate new rules to increase its security at the expense of others. Once it gains commanding strength and position in space, will China do the same? For the United States, cooperation with China in space may yield some benefits, but it likely will have little impact on the direction and severity of terrestrial conflicts which will dominate relations with China. One can see the value of meeting with Chinese space officials, especially higher CCP and PLA leaders, to advance concerns over their actions in space and to promote transparency. But at this juncture, before China has achieved levels of “space dominance”, it is crucial to link any real cooperation with China to its behavior in space and elsewhere which threatens U.S. security. Furthermore, allowing China increasing access to U.S. space technology, space corporations, or government institutions at this time presents two risks. First it could encourage China to advance an illusion of cooperation with the U.S. and the West while differences on Earth become sharper. This could become useful for Beijing to deflect criticism on other issues, or even to obtain leverage over U.S. options and actions. Second, as has been proven repeatedly, China will exploit any new access for espionage gains to strengthen its own space and military sectors. 2 China’s increasing space power, however, like its growing economic and political power, cannot be “contained.” Russia appears ready to greatly expand space and military cooperation with China as part of a larger strategic alignment, while the European Space Agency is edging toward greater cooperation with China. These attractions may only increase if China has the only LEO manned space station in the mid-2020s. Already a top commercial space service and technology provider, China will use its gathering space diplomacy tools to aid its pursuit of economic, political and military influence in critical regions like Africa and Latin America. The challenge for the United States is to maintain the means to compete with China in space both in military and non-military endeavors. China’s potential for developing new space combat systems means the U.S. must be able to rapidly develop appropriate deterrent capabilities. There should also be a more developed U.S. capability to rapidly repopulate satellite systems taken down by PLA attacks, and there should be more terrestrial or airborne systems to compensate for lost navigation, communication and surveillance satellites. In addition, as the PLA moves substantially out to deep space, the Moon, or to the Lagrangian Points, it will be necessary for the U.S. to consider a compensating presence that is affordable, attractive to a coalition of democracies, and helps to deter China from seeking strategic advantage. Strategic priorities would suggest that a presence on or near the Moon is of greater importance than going to Mars. A multinational government-private presence on the Moon is one option, as is the likely less expensive option of a far cis-lunar presence to further develop manned deep space capabilities. As was the case with the former Soviet Union, relative peace on Earth or in space will not truly be possible until China evolves beyond its Leninist dictatorship. In its final years, the Soviet Union was on the cusp of deploying multiple space combat systems despite years of U.S.-Soviet space diplomacy. Real space cooperation between Russia the West became possible only after the fall of the Soviet Union, and may again become threatened by Russia’s slide into authoritarian aggression. Substantive cooperation with China in space offers no assurance that China will change its threatening behaviors on Earth or in space, but does create opportunities for China to exploit U.S. and Western space technology to gain potential military advantages. The following will address questions posed by the U.S.-China Economic and Security Review Commission. But first, it is necessary to reflect on the relationship between China’s pursuit of space power and its military buildup for regional dominance and global projection. Space Power and China’s Military Expansion During the 1950s and 1960s, Mao Zedong sought to quickly exploit generous assistance from the Soviet Union, and the insights of U.S.-trained engineers like Qian Xuesen, to complete the early nuclear missiles to deter feared U.S. and Soviet nuclear strikes. His 651 Program succeeded in launching the Dong Fang Hong-1 satellite in 1970, while also aiding the development of larger missiles. But Mao’s efforts to build broader space power, such as the 640 Program to build strategic missile defenses, and his early 741 Program manned space ship, faltered largely due to his destructive politics. Mao, nevertheless, realized that China required the technology and 3 prestige of space in order to increase its ability to compete with Moscow and Washington on the global stage. Fears for political survival and ambitions for global leadership remain the basis for China’s current surge for global military power and space power. The greatest impetus for the most recent phase of PLA modernization and buildup was the shock of the 1989 Tiananmen rebellion -- the only time the Party’s power position was actually threatened by popular, though unorganized, reformist and democratic demands. In addition to ruthlessly crushing any potential for democratic dissent, the transitioning CCP leadership of Deng Xiaoping to Jiang Zemin decided to begin the broad military and space modernization and buildup we see today. At first focused on coercing Taiwan and then securing control over disputed territories, the early 1990s saw the start of many PLA programs increasing its Anti-Access/Area Denial (A2AD) capability targeted on the “First Island Chain.” These include the Chengdu Aircraft Corporation’s 4th generation J-10 fighter and its J-20 5th generation fighter, and the large Xian Aircraft Corporation Y-20 heavy jet transport. China’s aircraft carrier ambitions predate Tiananmen but second generation nuclear attack and ballistic submarine programs received greater emphasis. This period also saw the beginnings of the PLA’s first “reconnaissance strike complex” of terminally guided medium-range missiles, and the ability to target them with high resolution surveillance, navigation and communication satellites. In addition, the PLA started developing its second anti-ballistic missile (ABM) system along with a new anti-satellite (ASAT) system, tested successfully on 11 January 2007. The early 1990s also saw the beginning of China’s second manned space program, code named the 921 Program. With substantial inputs from Russian space companies the 921-1 or Shenzhou spaceship made its first unmanned flight in 1999. While the PLA’s General Armaments Department (GAD) took control of the manned space program in 1998, we did not learn of this until former CCP Chairman Jiang Zemin congratulated former GAD Director and then Defense Minister Cao Gangchuan as “chief director of the manned space program” after the April 2002 landing of Shenzhou-3. The dual-use nature of China’s manned space program was starkly demonstrated by the first manned Shenzhou-5 mission in 2005, when Astronaut Yang Liwei shared his ship with two optical surveillance cameras. A little over a year later in December 2004, the current phase of PLA modernization and space development was signaled by the “New Historic Missions” enunciated by Chairman Hu Jintao, in which the PLA started preparing to defend the CCP’s global interest, in addition to its regional ambitions. Over the following decade, better combat systems for regional dominance emerged, with new aircraft carriers, amphibious projection ships, and new large airborne projection transports designed to enable the PLA to defend more distant CCP interests. Since the late 1990s, space systems have played an increasing role in the PLA’s “Informationalization” strategy, providing commanders with higher resolution optical and radar satellite surveillance, new space electronic intelligence tools, space-based data relay and new infrared-multispectral early warning satellites. Space information systems give PLA platforms global navigation and communication capabilities, as they help to target increasing numbers of precision-guided missiles and bombs. These capabilities are essential to the fulfillment of 4 Chinese objectives which include the “recovery” of Taiwan, consolidating military control over disputed regions in the East and South China Seas, and undermining and eclipsing American-led alliance relationships in Asia. China’s space ISR power will also be used to help military allies and clients. Having helped North Korea, Iran and Pakistan to become current or imminent nuclear missile powers, it makes sense that China would directly or indirectly assist their future space ISR requirements. In a scene that could be repeated elsewhere, today China is pushing to help rearm Argentina, which has already agreed to lease a critical space tracking and control facility to China. A Chinese armed Argentina with access to Chinese space ISR may be able to better threaten war to take the Falkland Islands. Even if Britain settles for a negotiated transfer, China will gain regional prestige for having “defeated” a Western power, further reducing U.S. influence in Latin America. By the 2020s and the 2030s, the PLA’s development of space projection and combat capabilities could become the leading element of the next phase of PLA modernization. Networks of larger more capable/survivable surveillance satellites, combined with networks of smaller more survivable satellites, will provide more secure navigation, communication, and targeting for larger numbers of power projection platforms such as nuclear powered aircraft carriers, large amphibious projection ships, very large military transport aircraft, and a next generation of export weapon systems. These could include a new generation of “Prompt Global Strike” systems, enabled by high data rate optical data-relay satellites. These could be joined by more ground-based or air-launched ASAT systems, new LEO-based laser or kinetic armed space combat platforms, and Space-to-Earth combat platforms. China’s political-diplomatic and military space power will be increased by the completion of a dual-use manned space station in the early 2020s and perhaps new small and large reusable dualuse unmanned and manned space planes. If the ISS winds down in the early 2020s it is increasingly apparent that Russia may seek significant space cooperation with China, replacing its space relationship with Washington. By the early 2030s, the new date for the completion of its 100-ton-plus payload heavy SLV, China may be taking its first steps on the Moon and building toward permanent bases by the 2050s or 2060s. China’s push for the Moon is prompted by a quest for prestige and to control areas that may yield potential economic/resource benefits. The PLA can also be expected to seek military benefits from its Moon presence. Should China’s emerging space and terrestrial power increasingly constrain U.S. power, then Europe and India may be tempted to increasingly “bandwagon” with China, especially in space. Question 1: Provide a net assessment of U.S. and Chinese space capabilities in a 2015 conflict scenario. How does this assessment change, if at all, for a 2030 scenario? While it is possible to better assess near term Chinese military-space capabilities due to an accumulation of Western and Chinese disclosures, assessing potential capabilities in the next fifteen years requires making estimates that could over- or under-estimate Chinese capabilities. As the PLA does not reveal its military-space intentions in public documents it is necessary to consider a body of “grey” data that offers indications of potential capability intent. This estimate 5 projects from current indicators but does not review potential major technology breakthroughs that might accelerate development projections. 2015 Conflict Scenario: The main difference in assessments of U.S. and Chinese military space capabilities in the near-term is that China has a gathering “active” space combat potential and is beginning to build “passive” mil-space capabilities, whereas it is not possible to determine whether the U.S.is developing the former, though it is interested in the latter. The U.S. is credited with over 500 military and civil satellites. While China has about 120 satellites, about 75 are used exclusively or largely by the PLA, and the PLA has access to more of China’s “civil” communication satellites. In 2015 China may be capable of strikes against scores of U.S. satellites in LEO, Geostationary Earth Orbits (GEO, 35,000km), or Medium Earth Orbits (MEO, 2,000-35,000km). In 2015 the U.S. may only be capable of limited retaliation against Chinese satellites in LEO, and would be stressed to repopulate critical U.S. satellite networks. Space ISR: By 2015 the PLA’s surveillance satellite network could comprise about 40 optical surveillance satellites, 10 radar satellites, 8 possible early warning satellites, and about 21 electronic intelligence (ELINT) counter-naval satellites. In addition there may be 4 weather satellites that assist global missile targeting. All of these use LEO polar orbits so they are more vulnerable to ground or air-launched ASATs. However, there are indications that the PLA may be developing much larger surveillance satellites, with the potential they may be placed in much higher orbits. By 2015 the PLA may have four to five dedicated communication satellites in GEO, and 16 to 20 navigation satellites in GEO or MEO. The Beidou/Compass navigation satellite system has a secondary global communication capability at a text-message level. In addition the PLA will control three TianLan data-relay satellites in GEO, intended primarily to support tracking and command of manned platforms, but could also support global military operations. Earth-based global tracking and control networks crucial to maintaining China’s space architecture include four large Yuan Wang tracking and control ships. In China there are eight tracking and control facilities and it has or will gain access to facilities in Argentina, Chile, French Guiana, Kenya, Namibia and Pakistan. In September 2013 and November 2014 China launched its Kuaizhou, a China Aerospace Science and Industry Corporation (CASIC) solid-fueled mobile SLV based on the DF-21 medium range ballistic missile (MRBM) or a larger intermediate range ballistic missile (IRBM). The model of a potential export version of this missile was displayed at the November 2014 Zhuhai Airshow. Also revealed were six new microsatellites for surveillance and communication missions for this SLV. This could be the beginning of China’s “Operationally Responsive Space” initiative to be able to repopulate satellite networks. The China Aerospace Science and Technology Corporation’s (CASC) liquid fueled small Long March-6 SLV may also be slated for this mission. Since the mid-1990s China has also invested heavily in micro and nanosatellites, detailing development work mainly to Chinese aerospace universities including the Harbin Institute of Technology, Tsinghua University, Nanjing University of Aeronautics and Aerospace, and the National University of Defense Technology. China has the capability today to rapidly develop 6 constellations of micro and nanosats that can be used to replace attacked satellites, or to succeed them with more secure but distributed satellite networks. A recent Chinese report notes that the Province of Jilin plans to loft China’s first “civil” network of four imaging microsatellites. In contrast, the more varied U.S. surveillance satellite network makes extensive use of larger systems placed in higher orbit systems in order to reduce their vulnerability. But this is now changing as the PLA develops ASATs able to attack higher orbits. Attempts to build a larger number of smaller surveillance satellites like the SBIRS series faltered due to complexity and expense. As a consequence, the U.S. has shown greater interest in even less expensive and smaller satellites like the U.S. Air Force’s TacSat or Operationally Responsive Space-1 (ORS-1). Ground Based Lasers: On 28 September 2006, the U.S. publication Defense News first reported that China had fired a “high power laser at a U.S. spy satellite” as a “test of the Chinese ability to blind the spacecraft.” While U.S. officials tried to downplay the test, China’s intent to military “blind” enemy satellites was confirmed in the December 2013 issue of Chinese Optics in an article “Development of Space Based Laser Weapons” written by three engineers from the Changchun Institute of Optics, Fine Mechanics and Physics. They stated, “In 2005, we have successfully conducted a satellite blinding experiment using a 50-100 KW capacity mounted laser gun in Xinjiang province. The target was a low orbit satellite with a tilt distance of 600 km. Over the following eight years it is likely that China has improved its ground-based ASAT lasers. In 1997 the U.S. Mid-Infrared Advanced Chemical Laser (MIRCL) demonstrated its ability to “dazzle” a LEO satellite but the U.S. is not known to have developed ground-based lasers capable of conducting ASAT missions. As far as is known publicly, the U.S. Air Force YAL-1 chemical airborne laser was not tested against LEO targets during its 2007 to 2011 testing program. Ground-Launched ASAT: The PLA’s combined ASAT and ABM program that gained momentum in the early 1990s has resulted in at least two known ground-launched ASAT systems. Derived from the CASIC KT-1 mobile solid/liquid fuel SLV, the SC-19 ASAT began a test program in 2005 that resulted in its first successful destruction of a FY-1C weather satellite at 864km in January 2007. Subsequent SC-19 tests on 11 January 2010 and 23 July 2014 were judged as ASAT tests even though they destroyed lower altitude missiles. It is possible that the PLA may now have an inventory of scores of SC-19 ASAT/ABM missiles. On 13 May 2013, China tested its larger DN-2 ASAT. Chinese sources claim it reached an altitude of 10,000km, while U.S. sources noted it nearly reached GEO. It is possible that both the SC-19 and DN-2 have been put into production although this cannot be confirmed. The DN-2 could be based on a version of the CASC DF-31 ICBM or the CASIC Kuaizhou mobile SLV. Mobility for the SC-19 and DN-2 means it can be moved to multiple locations to facilitate surprise ASAT strikes. On 20 February 2008, a U.S. Navy modified SM-3 surface-to-air missile destroyed a decaying U.S. reconnaissance satellite at an altitude of 247km. Believed to have been a counterdemonstration for China, the U.S. is not known to have put into production a ground launched 7 ASAT. The SM-3 or U.S. Army THAAD could form the basis for a LEO ASAT but no such program has been reported. Air Launched ASAT: The April 2009 issue of the journal of the Shenyang Aircraft Design and Research Institute, or 601 Institute, contained an article titled, “The Technologies of the Fighter Platform Launching Trajectory Missile Attack Satellite.” This article concludes that it is “feasible and reasonable” that an aircraft be used to attack a satellite “in the present stage.” This suggests that SAC has already adapted, or may be in the process of adapting its J-11 fighter, a clone of the Russian Sukhoi Su-27, to perform ASAT missions to attack LEO satellites. An ASAT-capable J-11 fighter would offer greater tactical flexibility and could be concealed at numerous PLA Air Force airbases. While there are no open reports of a Chinese airborne ASAT test, it is conceivable that China has developed such a system over the last six years. The Reagan Administration in 1988 cancelled the ASM-135, the second U.S. air-launched ASAT program, due to cost, technical and Congressional opposition challenges. It was tested successfully once against a satellite target in September 1985. In 2015 the Defense Advanced Research Program Agency (DARPA) reportedly will start testing its Airborne Launch Assist Space Access (ALASA) F-15 fighter-launched small SLV, which could form the basis for an airlaunched ASAT. Co-Orbital Interceptors: China apparently has developed satellites capable of co-orbital interceptions of other satellites for benign or hostile missions. On 19 July 2013, China launched three satellites, two of which, the Shiyan-7 (SY-7, Experiment-7) and Chuangxin-3 (CX-3), interacted with the Shijian-7 (SJ-7, Practice-7) launched in 2005. The SY-7 is believed to have manipulator arm that could perform maintenance or intelligence missions, or attack missions which disable without creating a debris cloud. While classified as an “experimental” system, this satellite could also be developed into a more capable co-orbital close-up surveillance or interceptor platform. In late 2010 or early 2011, China is believed to have conducted a sub orbital test of its Shenlong small space plane, a technology test bed which could also be developed into a multi-mission dual use platform similar to the U.S. Boeing X-37B small space plane. A Russian source confirmed to this analyst that the Shenlong was tested, but there is no open reporting that an operational version has been produced. Larger manned and unmanned Chinese space planes are very likely under development. U.S. experience with co-orbital inspection capabilities may extend to the Prowler satellite launched in 1990, and more recently to two XXS and two MITx satellites launched in the last decade. However, it is not known publicly whether these have been developed into operational system; most likely not. The U.S. Air Force has also built three 5-ton Boeing X-37A/B small reusable space planes which are capable of deploying micro or nanosatellites, or carrying passive or active military payloads. They have conducted three lengthy but classified missions. While small, the X-37B would be vulnerable to ground-based PLA interception systems. Dual Use Manned Platforms: While the U.S. never launched a manned military space platform, the Soviets lofted military Salyut small space stations in the 1970s, and in the late 8 1980s tried to launch an unmanned space combat platform and were considering turning their Mir space station into a base for space bombers. Perhaps influenced by this Soviet example, China could be planning for a range of military uses for its manned space platforms. The September 2008 Shenzhou 7 mission, remembered most for China’s first manned spacewalk, also saw its launching of a micro-satellite shortly before passing about 45km from the International Space Station. As far as can be determined, China provided no warning of its intention. Also, despite the potential for an accident which may have threatened the lives of two Russian and one U.S. astronaut onboard, there has been no public response to this incident from U.S. or Russian officials. Was this an early Chinese attempt to simulate space docking, or was it a simulated co-orbital attack against the ISS? Does this incident, and the previous use of the Shenzhou to carry military payloads, mean that China’s manned space platforms will be equipped to perform “active” military missions? If the PLA could equip the Shenzhou orbital module to launch the BX-1 micosatellite, could it also modify the orbital module to carry intercept sensors and kinetic kill vehicles (KKVs)? The larger Tiangong has payload bays which have used Earth observation cameras. Might China consider modifying Tiangong to be perform ASAT or orbital Earth bombing missions? U.S. programs to develop manned military-mission space platforms like the Dyna Soar space plane and the Manned Orbiting Laboratory (MOL) were cancelled by the end of the 1960s in favor of unmanned satellites for military-space missions. While both the Soviet Union and China feared that the U.S. Space Shuttle would be modified for combat missions, there is no open reporting this was done. However, the Shuttle was used on numerous occasions to deploy military payloads but was retired in July 2011. The U.S. National Air and Space Administration’s (NASA) Boeing Orion manned capsule made its first unmanned test on 5 December 2014 but may not make a manned test until 2021. The private SpaceX Corporation Dragon manned capsule may not fly until 2017 or 2018. There is no reported consideration that either may be modified for active military missions 2030 Conflict Scenarios: China’s Potential Capabilities Provided the CCP survives to expand its power, by 2030 China will require increasing space power in order to support its expanding global projection forces on Earth, and because military competition in space will have become more intense, largely due to China’s continued development of space combat capabilities. It is likely that an expansion in the number of space combat programs by individual services will have prompted the PLA to create a unique “Space Force.” While China’s first manned forays to the Moon may not occur until soon after 2030, plans will have advanced significantly toward the creation of a permanent Moon Base by 2050 or sooner. A proliferation of its space combat systems around the Earth will push China to seek increasing advantage, setting the stage for its strategic-military development of the Moon. As mentioned earlier, absent a fundamental change in the character of the CCP or its evolution in a pluralistic direction, China is unlikely to accept negotiated limits on its expanding space power. Furthermore, Russia, provided its authoritarian anti-Western character increases, may have to seek a far more deeper military relationship with China, assuming Beijing’s hunger for Russian resources can be satisfied short of taking its territory. 9 Space technology may become Russia strong suit in its military relationship with China, provided it can sustain Chinese funds to insure its space sector remains competitive. Since early in the last decade Russia has been considering its post-ISS future in space, considering alternate space station designs, Moon and initial Mars missions, manned architectures and next generation spaceships, perhaps to include nuclear propulsion. While China’s preference may be to develop its national space capabilities, as it has done repeatedly regarding weapons technology it could begin broad space technology cooperation with Russia to accelerate next generation capabilities. China’s Future Close-to-Earth Mil-Space Capabilities If current trends discernable today continue, it is likely that China will have multiple options to distribute its critical satellite service requirements to larger and deeper space platforms as well as to clouds of micro and nanosats. As it does so, it should be expected that China will develop means to both attack and defend its evolving satellite networks. Large satellites may include 5-ton and 10-ton systems able to reside in deeper space which may active and passive defenses. Chinese academic engineering literature shows some familiarity with large membrane space mirrors, for example as used by the U.S. Defense Advanced Research Projects Agency’s (DARPA) Membrane Optical Imager for Realtime Exploitation (MOIRE). Membrane mirrors can be expected to enable large deep space surveillance satellites, as envisioned by MOIRE, or to make micro and nano-surveillance satellites even more powerful. Future Chinese micro and nanosats might be able to “cleave” or double or quadruple in the event of an attack. A previously mentioned Chinese report notes that the Province of Jilin plans to have a constellation of 137 small satellites by 2030, noting this may enable a revisit time of 10 minutes. The PLA or “civil” authorities in China could be hosting scores of satellite “cloud” constellations by 2030. The potential for China to develop counters to small satellites should also be considered. Already, China is testing and considering other novel concepts for capturing/disabling small UAVs with airborne nets. Conceivably, large nets could be used to coorbitally intercept small satellite clouds. A potential Chinese leap-frog technology advance was briefed at the 2014 International Astronautical Congress (IAC) in Toronto attended by this analyst. A Chinese engineer briefed a paper proposing that China’s next generation data relay satellites use optical or laser data links, which could phenomenally increase data transfer rates. The major technological obstacle was to develop an optical/laser data transfer to Earth receivers that could overcome atmospheric distortion. If successful, such data transfer rates could go far to enable an intimate level streaming tactical imagery of targets for very distant hypersonic Prompt Global Strike systems, space bombing platforms, perhaps in multiple simultaneous combat theaters. The kicker: the engineer noted this satellite could begin development to construction in 2016 or 2021. China may be the only country investing in this capability. Occasional statements from Chinese military academics and academic engineering articles point to China’s interest in developing a range of future space combat capabilities. Asian military sources told this analyst in 2008 that an initial PLA ABM system could emerge in the early 10 2020s. This might happen even sooner. Chinese-developed ABM/ASAT capable missiles may become smaller and deployable on aircraft, ship and submarine platforms. In a December 2013 journal article, engineers from the Changchun Institute of Optics, Fine Mechanics and Physics, a leading Chinese laser weapon research body, proposed it would be possible by the mid-2020s for China to loft a 5-ton laser-armed space combat platform. A key enabling technology would be large membrane mirrors. It should be considered that by the mid-2030s might China be able to halve the size of possible laser space combat platforms so as to launch more in a single SLV. At the 2006 IAC in Valencia, engineers from the China Academy of Launch Vehicle Technology (CALT) briefed a paper on two reusable space plane concepts under consideration: a 130-ton or so manned space plane for LEO operations, and a 100-ton unmanned suborbital space plane for launching payloads on an expendable second stage. Both concepts, which could appear in the early 2020s, apparently are dependent on using the first stage of the Long March-5 heavylift SLV slated to begin testing in 2015 or 2016. The manned space plane concept carries most of its weight in fuel as a “second stage” to reach orbit. However, more reserve fuel may enable greater capability for maneuver than U.S. or Soviet space shuttle concepts, which could increase its military utility. Chinese military academics and academic engineering articles have addressed the idea of using platforms in LEO to bomb targets on Earth. This could be done with a relatively simple platform derived from the Tiangong, a manned or unmanned space plane, or a hypersonic cross air vehicle (CAV), for which there may be some interest as seen in Chinese academic engineering literature. It also has to be considered that China’s interest in manned space combat platforms may extend to its future space stations. The first 120-plus ton space station that may be completed by 2023 is based on the replaceable module concept developed in the 1970s by the Russian Energia Company. There is some reason to conclude that under the guise of goodwill, Russia was unwise enough to allow a significant Chinese espionage exercise within its space companies in the late 1990s and that Energia’s space station technology may have fallen victim. The first Chinese space station may have two experimental modules, one of which will have large imaging systems pointed out to space and at the Earth—which could be dual-use. If needed, such modules could be replaced with others equipped for combat, more capable military surveillance or command-control needed to compensate for the loss of Earth control facilities. At the 2014 IAC in Toronto, a Chinese academic told an audience that China was likely planning a larger second generation space station. Given that the first may have a life span of 10 years, the second may be ready by the early 2030s. Before the 2020s it can be expected that the PLA will also make real progress in creating “Near Space” capabilities that can compensate for the loss of LEO assets. Large UAVs or stratospheric airships capable of performing radar, optical, communication and navigation satellite functions could emerge soon. A next more capable generation of these systems may emerge in the mid-tolate 2020s. 11 Potential Deep Space Ambitions As it controls the rest of China’s space program, the PLA also controls China’s Moon program. As it has done throughout its space program, the PLA can be expected to seek dual use benefits from China’s presence on the Moon. Over a decade ago, Chinese Moon program leader Dr. Ouyang Ziyuan, highlighted the Moons military value and the need for China to be able to secure vital resources, perhaps Helium-3 to power future fusion energy reactors. Writing on 31 January 2015 on the website of the CCP Central Committee’s journal Quishi (Seeking Truth), the Chairman and CCP Party Secretary of the China Aerospace Science and Technology Corporation (CASC), Lei Fanpei, stressed that "We will adhere to the path of developing military-civil integration in our coming demonstration of deep space exploration, manned moon landing, heavy launch vehicle and other major programs, and are of major significance both to the nation's longterm development and to the task of building the nation into a strong space power." This is a strong indicator that the PLA will use its Moon and Deep Space program for military gain. While some Western analysts may scoff at the idea of the Moon having military value, perhaps PLA planners have decided otherwise. While from the perspective of current technology it may be better to invest in ISR and military capabilities closer to Earth that can dominate LEO and GEO, perhaps as ISR assets move well beyond MEO it may then become useful to have Moon capabilities to find or interfere with such assets. Early in the Change unmanned Moon probe program there was mention that the stationary Moon lander might include an experimental payload using a laser to measure distance to the Earth. While recent reporting on the December 2013 Change-3 Moon landing mission has not included mention of a laser package, at the 2014 IAC a Chinese space company official did mention that it could be included in a future landing mission. A low-power laser on the Moon could become militarily useful were it able to vibrate and thus interfere with the very thin membrane mirror of a potential MOIRE like surveillance satellite. What if, in about 100 years, breakthroughs in space propulsion make it possible to reach Mars in weeks, versus months or years? Should the Earth’s economy come to be dominated increasingly by access to resources on Mars, then the Moon and the Langrangian Points become the nearest “parking garages” to support that commerce. So from a very long term perspective it may be attractive to the PLA to secure a dominant position on the Moon in order to have the option to secure access to other potentially strategic positions in the Earth-Moon system. Question 2: Given China’s emerging counter-space capabilities, which defensive or offensive capabilities should the United States prioritize to maintain its strategic advantage in space? Assess the implications, if any, for U.S. defense budget requirements in these areas. The degree to which China, with possible Russian help, obtains “space control” will most likely be determined by the degree to which the United States rises to defend access to space by the democracies and deters attacks by China and Russia. From the perspective of the 2015 policy balance in Washington, this will require a fundamental political shift to emphasize a commitment to sustaining a broad rebuilding of U.S. power to include space power

#### The link alone turns case – Chinese control causes massive state mining that zeroes the case

Dezan Shira & Associates 19, pan-Asia, multi-disciplinary professional services firm, publishes China Briefing, citing; Bao Weimin, Director of the Science and Technology Commission of the China Aerospace Science and Technology Corporation; 11/8/19, “China Proposes Establishing Moon-Based Special Economic Zone,” https://www.china-briefing.com/news/china-proposes-establishing-moon-based-special-economic-zone/

Real intent may be to usher in lunar ownership claims.

Bao Weimin, a Director of the Science and Technology Commission of the China Aerospace Science and Technology Corporation (CASC) has been reported in Chinese and Russian state media as suggesting that China would benefit from establishing an “Earth-Moon Special Economic Zone”.

Bao said that Beijing is considering creating the first Earth-Moon economic zone by 2050. According to him, China is planning to invest in studies on how much it would cost for the idea to come to fruition, as well as for the deployment of a transportation system linking Earth and its natural satellite.

The CASC is the main contractor for China’s national space program, while the project could bring in around US$10 trillion for China, the state-linked Science and Technology Daily newspaper reported.

With an earth-moon economic zone, China aims to ensure that it has the ability and the first presence right to establish the rules of behavior for who has access and who can benefit. This also has long term implications for US-China, China-Russia, and China-India relations as well – all have moon-based exploration projects currently underway.

Bao said that the field has huge economic potential and thus the country should study reliable, low-cost aerospace transport systems between the Earth and Moon.

The basic technology is set to be finished by 2030, while the key transport technology is expected to be created by 2040. By the middle of the century, China could successfully establish the space economic zone, according to Bao.

China has been rapidly developing its space sector and studying the Moon in recent years. In July, private company i-Space (also known as Beijing Interstellar Glory Space Technology) launched a carrier rocket in the first successful orbital mission by the Chinese commercial space industry. Last year, China launched its Chang’e 4 probe, successfully landing its lunar rover on the far side of the Moon on January 3 this year.

China has already started investing in Space-Based Solar Power (SBSP) – a technology that it plans to use to power a lunar base. The SBSP’s deployment will take place in stages, with the first satellite scheduled for deployment in low-Earth orbit by 2025 and the GEO-based SBSP to be deployed by 2050.

Other important steps on Beijing’s way to establishing an Earth-Moon economic zone would be a study on the feasibility of 3D printing and lunar manufacturing by 2035 as well as a manned lunar mission, which is scheduled to take place by 2036.

China is also currently planning new lunar probe launches, as well as the deployment of satellites that will ensure a communication bridge between the Earth and Moon.

Dezan Shira & Associates’ Chris Devonshire-Ellis comments: “While the proposal sounds fun, there is a very serious component to this: ‘Who owns the Moon?’ According to the United Nations Outer Space Treaty, signed by every space-faring country, no nation can claim sovereignty over Earth’s lunar satellite. 102 countries have entered the 1967 accord; China joined in 1983. I suspect that Bao’s intent is to lay grounds for Beijing to start to erode the existing treaty and to begin the process of permitting ownership of lunar sites in future.”

#### Taiwan invasion goes nuclear

Talmadge 18 [Caitlin Talmadge is Associate Professor of Security Studies at the Edmund A. Walsh School of Foreign Service at Georgetown University. “Beijing’s Nuclear Option: Why a U.S.-Chinese War Could Spiral out of Control.” https://www.foreignaffairs.com/articles/china/2018-10-15/beijings-nuclear-option]

The most worrisome flash point for a U.S.-Chinese war is Taiwan. Beijing’s long-term objective of reunifying the island with mainland China is clearly in conflict with Washington’s longstanding desire to maintain the status quo in the strait. It is not difficult to imagine how this might lead to war. For example, China could decide that the political or military window for regaining control over the island was closing and launch an attack, using air and naval forces to blockade Taiwanese harbors or bombard the island. Although U.S. law does not require Washington to intervene in such a scenario, the Taiwan Relations Act states that the United States will “consider any effort to determine the future of Taiwan by other than peaceful means, including by boycotts or embargoes, a threat to the peace and security of the Western Pacific area and of grave concern to the United States.” Were Washington to intervene on Taipei’s behalf, the world’s sole superpower and its rising competitor would find themselves in the first great-power war of the twenty-first century.

In the course of such a war, U.S. conventional military operations would likely threaten, disable, or outright eliminate some Chinese nuclear capabilities—whether doing so was Washington’s stated objective or not. In fact, if the United States engaged in the style of warfare it has practiced over the last 30 years, this outcome would be all but guaranteed.

Consider submarine warfare. China could use its conventionally armed attack submarines to blockade Taiwanese harbors or bomb the island, or to attack U.S. and allied forces in the region. If that happened, the U.S. Navy would almost certainly undertake an antisubmarine campaign, which would likely threaten China’s “boomers,” the four nuclear-armed ballistic missile submarines that form its naval nuclear deterrent. China’s conventionally armed and nuclear-armed submarines share the same shore-based communications system; a U.S. attack on these transmitters would thus not only disrupt the activities of China’s attack submarine force but also cut off its boomers from contact with Beijing, leaving Chinese leaders unsure of the fate of their naval nuclear force. In addition, nuclear ballistic missile submarines depend on attack submarines for protection, just as lumbering bomber aircraft rely on nimble fighter jets. If the United States started sinking Chinese attack submarines, it would be sinking the very force that protects China’s ballistic missile submarines, leaving the latter dramatically more vulnerable.

Even more dangerous, U.S. forces hunting Chinese attack submarines could inadvertently sink a Chinese boomer instead. After all, at least some Chinese attack submarines might be escorting ballistic missile submarines, especially in wartime, when China might flush its boomers from their ports and try to send them within range of the continental United States. Since correctly identifying targets remains one of the trickiest challenges of undersea warfare, a U.S. submarine crew might come within shooting range of a Chinese submarine without being sure of its type, especially in a crowded, noisy environment like the Taiwan Strait. Platitudes about caution are easy in peacetime. In wartime, when Chinese attack submarines might already have launched deadly strikes, the U.S. crew might decide to shoot first and ask questions later.

## 5

### 1nc – cp

#### Spacefaring nations should:

#### - fully fund and implement the Pacific Ocean Neutrino Experiment

#### - substantially increase funding for the Lunar Hatch Program

#### Plank 1 solves neutrino research – it’s by far the consensus among astrophysicists – answers their IceCube indicts and postdates – it also answers Lee which says the barrier to research is having lots of water

Sutter 22 – PhD in Physics, astrophysicist at SUNY Stony Brook and the Flatiron Institute in New York City. Paul received his PhD in Physics from the University of Illinois at Urbana-Champaign in 2011, and spent three years at the Paris Institute of Astrophysics, followed by a research fellowship in Trieste, Italy, His research focuses on many diverse topics, from the emptiest regions of the universe to the earliest moments of the Big Bang to the hunt for the first stars [Paul, “Astronomers propose building a neutrino telescope — out of the Pacific Ocean,” 1/19/2022, <https://www.space.com/pacific-ocean-neutrino-detector-p-one-concept>, DKP]

Whispers in water

The mass of neutrinos has no explanation in the Standard Model of particle physics, our current and best theory of fundamental interactions. So physicists would really love to do two things: measure the masses of the three neutrino flavors and understand where those masses come from. That means they have to do lots of experiments.

Most neutrino detectors are pretty straightforward: You either set up a device to generate a ridiculous number of the buggers in a laboratory, or you build a gigantic array to capture some that originate off Earth.

These experiments have made a lot of progress and gotten bigger with every generation. The Kamiokande experiment in Japan, for example, famously detected the neutrinos coming from the supernova 1987A. But they needed a vat of more than 50,000 tons of water to do it.

In recent years, the IceCube Neutrino Observatory in Antarctica has upped the ante. That observatory consists of a solid cubic kilometer (0.24 cubic mile) of ice at the South Pole, with dozens of Eiffel-Tower-sized strands of receivers sunk a kilometer (0.6 mile) into the surface. After a decade of work, IceCube has discovered some of the most energetic neutrinos ever and made tentative steps toward finding their origins. (Hint: It involves really high-energy processes in the universe, like blazars.)

Why do both Kamiokande and IceCube use so much water? A large chunk of pretty much anything can serve as a neutrino detector, but pure water is ideal. When one of the trillions of passing neutrinos happens to strike a random water molecule, it gives off a brief flash of light. The observatories contain hundreds of photoreceptors, and the purity of the water allows those detectors to pinpoint the direction, angle and intensity of the flash very accurately. (If the water had impurities, then it would be difficult to reconstruct where the flash came from within the volume.)

From there, they can reconstruct the original direction of the incoming neutrino and get a handle on its energy.

The great Pacific neutrino patch

This is all well and good for normal, everyday neutrinos. But the most energetic neutrinos are extraordinarily rare. Those extremely rare neutrinos are also the most exciting and interesting, however, because they can be caused only by the most gargantuanly powerful events in the universe.

Unfortunately, the entire might of IceCube, after a decade of observation, has been able to capture a mere handful of these ultra-powerful neutrinos.

So we're gonna need a bigger boat … I mean, detector.

This is the idea behind the Pacific Ocean Neutrino Experiment (P-ONE), a new proposal described in a paper published to the preprint server arXiv in November: to turn a massive swath of the Pacific Ocean into nature's own neutrino detector.

Once again, the concept is surprisingly simple: Find a suitable, lonely part of the Pacific. Pretty easy. Construct long strands of photodetectors — and I mean long, at least a kilometer long. Sink these strands to the bottom of the ocean, preferably to a depth of over a mile (2 km). Attach floats to them so they stand upright in the water, like giant mechanical kelp.

The P-ONE design currently involves seven 10-string clusters, with each string hosting 20 optical elements. That"s a grand total of 1,400 photodetectors floating around an area of the Pacific several miles across, providing much more coverage than IceCube.

Once it's up and running, you just need to wait. Even neutrinos will strike some ocean water and give off a little flash, and the detectors will trace it.

#### Plank 2 solves by supporting the LHP – their solvency card indicates that it’s key to solve

1AC Przybyla 21, Cyrille. "Space aquaculture: prospects for raising aquatic vertebrates in a bioregenerative life-support system on a lunar base." Frontiers in Astronomy and Space Sciences 8 (2021): 107. (Studies Aquaculture Research at University of Montpellier)

Space Aquaculture: A Relevant Source of Complementary Nutrition Resupplying a base in space from Earth on a weekly basis is neither economically nor technologically feasible (a trip to the Moon takes 4–7 days, and to Mars 5–8 months). A short-term solution is to provide processed and prepackaged space food. However, lyophilized conservation is unstable, especially concerning essential nutrients such as potassium, calcium, vitamin D, and vitamin K, which is involved in muscle and bone maintenance. The micronutrients most sensitive to storage degradation are vitamins A, C, B1, and B6 after one year at ambient temperature (Cooper et al., 2017). A possible nutrition strategy for space bases could be to couple local fresh production with supplies brought by cargo spaceships. Providing fresh, nutritious and safe food is imperative for the success of a manned base on Moon or Mars. Recent studies have shown that food energy needs during a spaceflight are similar to those required on Earth. If energy intake is reduced, the human body is subjected to physiological stress causing cardiovascular deconditioning, bone demineralization, muscle atrophy and immune system deficiency. Moreover, microgravity exposure reduces the nitrogen balance in an astronaut’s body. This results in a 30% reduction in protein synthesis (Stein, 2001). A study of previous manned missions in low orbit monitored the crew’s physical performance consuming food commonly used in space missions and showed that an increase in carbohydrates (from plants) and a decrease in animal protein and fat can disturb the diet balance (Gretebeck et al., 1994). Ideally, a fresh animal-based food source should be included in the diet of space residents. Seafood is one of the healthier animal products for human nutrition. Its nutritional merits and protective benefits have been abundantly described over the last century. Like wild fish, aquaculture fish sequester digestible proteins and essential amino acids, lipids, including essential polyunsaturated fatty acids (PUFAs), essential vitamins and minerals in their muscles. Vitamins are precursors of molecules that are essential coenzymes for enzyme catalysis. When the synthesis of coenzymes is not included in an organism’s genetic heritage (this is the case for Homo sapiens), their natural synthesis must be achieved by the ingestion of living cells. These cells are provided by a diet of plants or animals. In addition to micronutrients, farmed marine, brackish and freshwater fish can sequester ALA (PUFA precursor), EPA or DHA from their diet (Tocher, 2015). Several aquaculture fish have the physiological capability to produce EPA and DHA (ALA chain elongation) and store these essential compounds (Morais et al., 2015; Gregory et al., 2016). The micronutrients commonly found in fish and their health benefits are presented in Table 1 (Tacon et al., 2020). At the beginning of the 1980s, the first study on the possibility of space aquaculture emphasized the shared points between recirculating aquaculture systems (RAS) and BLSS (Hanson, 1983). Yet although aquaculture seems to offer a relevant solution for manned long-term missions (Bluem and Paris, 2003), almost four decades later, no significant innovative solutions have been proposed for space exploration. This may be due to the international strategy of developing low orbit science over the last 30 years with the ISS program, to the detriment of more complex and ambitious projects such as trips to the Moon or Mars involving long-term stays. Why Raise Aquatic Organisms in Space? Hydrogen and oxygen are abundant in the Universe, and water molecules are everywhere in the solar system. Sub-glacial liquid water has been detected on many rocky planets such as Mars, Mercury, and Venus (Liu, 2019; McCubbin and Barnes, 2019). There is evidence of the presence of an internal ocean on icy moons such as Enceladus (Cadek et al., 2016) and Europa (Kalousova et al., 2016). Recent research has indicated the presence of water molecules on rocky exoplanets from other solar systems in our galaxy (Olson et al., 2020). Water is the main in situ resource required for a planetary mission, both for long-term human settlement or astrobiology considerations; however, most observations have revealed that this water has high mineral content or is close to brine due to geological mineralization (Orosei et al., 2018). It would need to be purified to use as a source for water of drinking quality, yet it could be primarily used for rearing marine organisms such as algae, invertebrates, or fish. Today, producing protein from farmed animals (poultry, cattle, or sheep) in low gravity does not seem feasible. A large surface area is needed for livestock rearing, which would directly compete with human space, and costly synthetized air reconditioned from precious in situ resources such as lunar or planetary water or gas produced by BLSS biotechnology would be reserved for the human residents’ artificial atmosphere. Due to their poikilothermic physiology, fish require five to twenty times less energy than mammals, and around three times less oxygen, as well as generate less carbon dioxide emissions, which is an important consideration for BLSS gas exchange management. Another issue is waste management. With terrestrial animals such as pigs, chickens, goats, or cows, feces collection is not easy to solve. However, in aquatic vertebrate production, all dissolved compounds and particulate matter are sequestered in the water and can be easily treated and removed from the system or converted by another organism. Lastly, compared to terrestrial farmed animals, aquaculture is commonly viewed as playing a major role in improving global food security on Earth because the feed conversion ratio (FCR: the feed biomass necessary to provide to a farmed organism to obtain a weight increase of 1 kg) for fish is drastically lower than for land vertebrates. The FCR for different aquaculture organisms compared to that of the main farmed land animals is shown in Figure 1. Protein and calorie retention from aquaculture production is comparable to livestock production (Fry et al., 2018). All aquatic vertebrates exhibit better feed efficiency, which implies less feed to produce in a BLSS and to manage on the Moon or Mars. Gas management in lunar or Martian bases will probably be the main challenge for engineers in the next decade. On Earth, the atmosphere sequesters a stock of oxygen, and its continuous production is provided by oceanic and terrestrial photosynthetic organisms. Before the Industrial Revolution, carbon dioxide production was balanced with oxygen consumption. Today, even with the rise in CO2 emissions, oxygen is not a limited source. In contrast, in a closed system in an extreme environment such as the Moon or Mars, oxygen is not available in its basic form and must be produced. Hence, it is a precious molecule and it is of particular interest to include low oxygen consumers–and consequently, low carbon dioxide producers–in a BLSS. Compared to animals that breathe air, fish, and more generally aquatic organisms, have the lowest oxygen requirement and are the lowest producers of carbon dioxide (Figure 2). In fish, carbon dioxide production from respiration is dissolved, concentrated and stored in the water column. Fish have been shown to maintain their oxygen consumption under conditions of elevated CO2 partial pressure (Ishimatsu et al., 2008). The dissolved CO2 from RAS effluent could be used directly by an aquatic photosynthetic organism such as algae. Collecting CO2 emitted from fish and dissolved in the water column and directing it to a secondary biological system without an additive process would be a huge advantage for BLSS gas management. In contrast to farmed poultry and mammals, aquatic organisms would also be protected from cosmic rays by the water environment, which is an intrinsic radiation shield. The first life forms on Earth developed in a brackish ocean with a salinity of around 10 mg/L (Quinton, 1912). Complex life emerged from the Earth’s oceans when the atmospheric layer had not yet been totally formed by the respiration of microorganisms (stromatolites, bacteria and microalgae) and volcanic activity. The thin atmosphere exposed the Earth’s surface to intense cosmic radiation. The hypothesis that water played a role as a radiation shield in the appearance of aquatic life is strong and plausible. In connection with the development of space aquaculture, further experiments would be needed to determine the integrity or splitting of a heavy charged particle from cosmic radiation entering the water of an aquaculture tank. Transporting any type of animal in a space mission would subject them for several minutes to hypergravity between 4 and 8 g (unit of acceleration due to gravity) depending on the space engine. But hypergravity conditions are not unknown for oceanic fish such as the bluefin tuna (Thunnus thynnus). In one stress experiment, the force required for maximal acceleration was measured in this species. The associated hypergravity applied to the tuna was around 3 g for a few seconds (Dubois et al., 1976). No experiments have been conducted on aquaculture fish, but the natural acceleration caused by an escape behavior has been recorded as between 1 and 3 g. Another argument in favor of finfish as candidates for space aquaculture is that as opposed to other reared vertebrates and humans, in the water column they can move vertically as well as horizontally. Fish use a ballast system, the swim bladder, and otolith sensitivity to move in a volume of water, experiencing gravity but also buoyancy. In the ocean, fish are already in microgravity conditions due to water density and Archimedes’ principle. Thus, altered gravity should not interfere with swimming behavior during the lifecycle of a fish. Experiments have revealed that a fish in microgravity during a space mission orients its swimming direction and body position according to the position of the light in the module without losing the ability to feed or affecting social behavior. Fish movement can also be correlated with spaceship rotation (Ibsch et al., 2000; Anken et al., 2002). Indeed, astronauts train underwater as this is the best way to imitate the weightless conditions found in space. The suits they wear in the training pool are designed to provide neutral buoyancy (like a fish’s swim bladder) to simulate the microgravity experienced during spaceflight (Otto F.Trout, 1969). Spaceflight analog missions are conducted underwater in NASA’s Extreme Environment Mission Operations (NEEMO), involving multi-hour activities at a depth of 19 m (Koutnik et al., 2021). While the hypothesis that the variation in space gravity will not drastically disturb the fish from a physical, behavioral or welfare point of view is plausible, this remains to be tested in experiments on aquaculture fish species. Ornamental Fish as a Model for Understanding Human Physiology in Space The zebrafish Danio, the medaka Oryzias, and the swordtail fish Xiphophorus have been frequently boarded on space missions as models for understanding human gravitational sensations, due to the homology with human morphological and physiological systems. These species have proved the most suited vertebrate animals for basic gravity research. The gravity-sensing system in vertebrates from fish to humans has the same basic structure. Although aquarium fish are not aquaculture fish, space missions over the last five decades have provided useful results on fish physiology, behavior and well-being in microgravity (Lychakov, 2016). The earliest spaceflight with fish occurred on July 28, 1973. Two fingerlings and fifty embryonated eggs of the mummichog (Fundulus heteroclitus) were launched by a Saturn 1B rocket. The Apollo service module joined Skylab 3 and the fish were positioned in a plastic bag filled with seawater. This American space mission preferred the mummichog, a small saltmarsh killifish, to goldfish for this experiment. This species was not well known or described at that time, but it became the first “fishonaut”. For three days, swimming in loops and circles was observed for the two fingerlings, but they gradually returned to normal swimming. The fish acclimation period was comparable to that for a human crew during a first spaceflight. This observation suggested that the vestibular function (the otolith for fish–the inner ear for humans) probably plays the same sensory role in microgravity. The Fundulus heteroclitus eggs carried aboard the Skylab station in low orbit hatched successfully during the mission with a very good hatching rate (96%). The hatched fry displayed normal swimming behavior in contrast to the first hours in microgravity for the fingerlings (Baumgarten, 1975). Fish embryos in microgravity develop a physiological strategy to compensate for the unusual environment, and the larvae formed were already adapted to microgravity, as evidenced by the lack of looping behavior. In 1975, during nine days of the manned Apollo-Soyuz MA-161 mission, a group of 21-day-old juvenile mummichogs were exposed to real microgravity, and similar irregular swimming was observed. Fish eggs were also boarded (n = 100/samples at 32 hpf [hours post-fertilization], 66 hpf, and 128 hpf stages; pre-liftoff fertilization times) and were subjected to post-flight hatching rate evaluation back on Earth. The juveniles were evaluated using light orientation tests, and no significant differences were observed in behavior, suggesting an adaption capability to the space environment. The embryo hatching rate was 75%, and hatching date monitoring showed that the three earliest stages of egg batches carried on Apollo-Soyuz hatched at 15 days (normal hatching rate is 21 days), much sooner than the latest stage batch and earlier than the control batches at 1 g. Apparently, the development of young eggs was faster under microgravity, but the embryos exhibited no abnormalities resulting from development in a zero-gravity environment. The eyes, heart, nerves, and bones were found to be the same in the flight group as in the control group. There was no evidence of calcium deficiency, except in the shorter hatching-time group (Hoffman et al., 1977). In July 1994, the 17th Columbia space shuttle mission STS-65 boarded Japanese medaka (Oryzia latipes) for 15 days of spaceflight in the second International Microgravity Laboratory (IML-2). These ornamental fish laid eggs, and normal hatching was observed in space, with the results showing that medaka fertilization and embryonic development was not significantly impaired by altered gravity (Ijiri, 1998). Probably the most impressive aquatic closed-loop experiment in low orbit and a successful demonstration of an aquatic trophic chain in space, in the 1990s, a German team from Ruhr University Bochum and the German Aerospace Centre (DLR) developed the Closed Equilibrated Biological Aquatic System (CEBAS) with fresh water, containing small aquarium fish (Xiphophorus hellerii), water snails (Biomphalaria glabata), aquatic plants (Ceratophyllum dermersum), and aquatic microorganisms. The ground-based demonstration showed that a filter system was able to keep a closed artificial aquatic ecosystem stable for several months and to eliminate waste products deriving from degraded dead fish without a decrease in oxygen concentration to less than 3.5 mg/I at 25°C (Blum et al., 1994; Blum et al., 1995). Then in January 1998, during the Endeavour space shuttle mission STS-89 to the MIR station, aquarium swordtail fish (Xiphophorus helleri) were exposed to 9 days of microgravity, with 200 juveniles and four pregnant adult fish carried in a mini CEBAS module (10 L) (Blum et al., 1994). The aim of this aquatic mini-module (Figure 3) was to record the behavior of an artificial ecological closed loop in low orbit and verify the hypothesis that aquatic life is not affected by exposure to space conditions using a complementary organism. The female fish were retrieved in good physiological condition, adult and juvenile fish had a survival rate of about 33%, and almost 97% of the snails had survived and produced more than 250 neonates in microgravity (Bluem et al., 2000). During the spaceflight, the vertebrates were video-recorded for behavioral analysis and no aberrant looping or spinning behavior was observed. Immediately after landing back on Earth, the adult fish swam vertically, head upward, to the top of their habitat, strongly beating the caudal and pectoral fins. This was due to empty swim bladders not used during the spaceflight and reuse acclimation on Earth (Anken et al., 2000; Bluem et al., 2000; Rahmann and Anken, 2002). In April 1998, another population of swordtail fish and four adult wild marine fish oyster toadfish (Opsanus tau) flew with the space shuttle STS-90 mission, hosted in the Neurolab facility. After 16 days in real microgravity, fish brain synaptic contacts were compared to a control population at 1 g on Earth. Spaceflight yielded an increase in synaptic contacts within the vestibular nucleus indicating a compensation processes for neonates swordtail fish (Ibsch et al., 2000). Results revealed a gravity compensation process and the role of the fish lateral line associated to the fish brain for appropriate swimming behavior (Anken et al., 2002). The Vestibular Function Experiment Unit (VFEU) aboard STS-95’s SpaceHab again hosted two oyster toadfish as experimental subjects. The fish were electronically monitored to determine the effect of gravitational changes on the otolith system. The freely moving fish provided physiological signals of the otolith nerves. Measurements of afferent and efferent responses were made before, during, and post-flight (Boyle et al., 2001). In January 2003, four medaka eggs laid on Earth in an artificially controlled environment were launched by the Columbia space shuttle during the STS-107 mission. For the control, four eggs in the same condition remained on the ground. No difference was observed in the time of development. In the ground experiment, the embryos were observed to rotate in the egg membrane, whereas in flight they did not rotate. One egg hatched 8 days after the mission launch in the flight unit, while four eggs hatched in the ground unit. In the flight unit, the fry was observed with its back usually to the camera and little swimming movement suggest. The results shown no appreciable difference in the time course of development between space- and ground-based embryos. (Niihori et al., 2004). The hatched medaka larva, embryos and the crew from the space mission tragically never returned to Earth alive due to the accident during the space shuttle’s reentry in the atmosphere. In 2007, dry eggs of the ornamental killifish the redtail notho (Nothobranchius guentheri) were placed into cotton-cloth bags, then into plastic Petri dishes, and fastened on the outer side of the ISS. The aim of the Biorisk-MSN mission was to expose dry incubated eggs to low orbit radiation. Unfortunately, no data is available concerning the resistance of the fish eggs as the equipment had no temperature sensor and the plastic dishes reached 95°C, deforming the plates, and the eggs died due to the high temperature and vacuum contact (Baranov et al., 2009). To study the fish response at early stage to microgravity, two missions using medaka fish were performed on ISS, in 2012 and 2014. Each time a Soyuz rocket sent 24 juveniles medaka (6 weeks after hatching, 16 mm) with the objective of rearing this population in the Aquatic Habitat (AQH) on the Kibo section of the ISS. Medaka fish in space and control fish from the same family on Earth were filmed. The movies showed that the fish became adapted to life under microgravity although despite an unusual swimming behavior. In addition, a mating behavior was observed under microgravity at day 33 and was not different from that on the Earth, indicating microgravity environment doesn’t disturb fish reproduction. The aquarium fish used for this experiment have fluorescent osteoclast cells, which makes them easier to observe. An osteoclast is a type of bone cell that breaks down bone tissue and responsible for bone loss. After 47 days in space, the fish tended to stay still in the tank. After 56 days, the mission fish group had normal growth compared to a terrestrial control. For fish in microgravity impairment of some physiological functions was accompanied by the activity of osteoclasts and a slight decrease in mineral density and vertebral bones. (Chatani et al., 2015; Murata et al., 2015; Chatani et al., 2016). Historical space missions involving ornamental fish are listed in Table 2. Missions With Aquaculture Fish in Low Orbits Very few missions involving aquaculture fish have been carried out to date (Table 3). In one of these, the common carp (Cyprinus carpio)—considered a very important aquaculture species in many countries–was chosen as a model for a sensor motor experiment by Japanese university teams and the Japan Aerospace Exploration Agency (JAXA). Two colored carp (16 months old, 26 cm and 263–270 g) were carried to the American SpaceLab in 1992. One of the two carp was given a labyrinthectomy (the otolith was removed). For both fish, swimming behavior and dorsal light response was studied and compared. As observed during the first space missions with small fish, the normal carp was unstable (associated with a kind of space motion-sickness) for the first three days, then finally recovered its Earth-based swimming behavior. The fish whose otolith was removed two months before showed a normal dorsal light response 22 h after launch, and disruption for the next two days as with the normal carp. Unfortunately, the recovery process for the fish with the removed otolith could not be evaluated due to a technical issue, but these observations provided evidence of a sensory-motor disorder during the early phase of adaption to microgravity in aquaculture fish (Mori et al., 1996). The change in body weight was monitored from two days before launch to four days after landing. Both fish recorded a weight loss around 12% in low orbit after 14 days of fasting. No conclusion can be made as a fasting replicate on the ground was not available (Mori et al., 1994). During space shuttle missions STS-55 (1993) and STS-84 (1997), tilapia Oreochromis mossambicus larvae that had not yet developed the roll-induced static vestibuloocular reflex were exposed to microgravity for 9–10 days. Young larvae (11–14 days after hatching) already exhibited the vestibuloocular reflex on the 1993 mission. Back on Earth, a vestibuloocular reflex test (fish were turned around their longitudinal axis at an angle of 15, 30, and 45°) showed that eye movement and reflex were not affected by exposure to microgravity during the two space missions (Sebastian et al., 2001). The OMEGAHAB (Aquatic Habitat) is a closed artificial ecosystem that was sent into orbit for 13 days on board the Russian satellite FOTON-M3 in 2007. The goal of the mission led by the German Space Agency was to investigate the possibility of designing a trophic chain in real microgravity using the photosynthetic flagellate Euglena gracilis as an oxygen producer and larvae of tilapia Oreochromis mossambicus as a consumer. This freshwater and brackish species is a popular aquaculture fish, with worldwide production of around 15,000 tons per year. In the 2007 experiment, 26 small larvae (approx. 12 mm in length) in the flagellate aquarium were studied in low orbit to increase knowledge about the development of the vestibular organs and enzymatic activity. The best fish survival rate (42%) ever achieved in a German experiment was recorded. Conditions of real microgravity during spaceflight induced a larger than normal otolith compared to a control maintained at 1 g. This could result in a difference in the ability to sense gravity (Anken et al., 2016). In a same ground unit, the photosynthetic producers supplied sufficient amounts of oxygen to a fish compartment with 35 larval cichlids (Hader et al., 2006). Historical space missions involving aquaculture fish are listed in Table 3. Feeding Fish in Space: Integrated Multi-Trophic Aquaculture If fish were farmed on a space base, sending aquaculture feed from Earth to Moon or Mars would make no sense from an economic or lifecycle analysis point of view. Aquatic systems contain a large diversity of species with different roles in nutrient cycles and biomass conversion that contribute to ecosystem balance. Photosynthetic organisms (algae, phytoplankton), invertebrates (crustaceans, mollusks, zooplankton), vertebrates (fish, amphibians), and microorganisms interact in a complex trophic web. By associating different complementary species such as fish, filter feeders, detritivores and primary producers, integrated multi-trophic aquaculture (IMTA) provides an innovative possibility for BLSS on the Moon or Mars. The nutritional profile of fish is closely linked to their diet quality. In aquaculture, this can be easily adjusted by ensuring a fish feed formulation that includes organisms that synthesize or sequester proteins, lipids of interest (e.g., EPA or DHA), vitamins and minerals. These aquatic organisms can be cultivated separately in a chain (from algae to invertebrates to fish) exclusively with fish waste as a fertilizer or using other available waste from human activities, such as exhaled carbon dioxide, space agriculture byproducts, or residents food waste. In the framework of sustainable aquaculture on Earth, researchers are studying trophic webs using closed or semi-closed aquatic systems that reuse fish nutrients dissolved in the water column or fish fecal matter as a fertilizer or food source for another aquatic organism. In an IMTA system, microalgae or macroalgae cultivation is easy using fish tank effluents, as the N/P ratio fits the requirements of algae: the increasing algae biomass assimilates nitrogen and phosphorus forms (Pagand et al., 2000). To return treated water back to the fish tank, it can be cleaned so it is safe for fish growth and welfare (Mladineo et al., 2010). Moreover, fish farm effluent is a suitable media for cultivating Nannochloropsis gaditana, a marine algae with a high PUFA content (Dourou et al., 2018). Several studies have reported the possibility of feeding aquaculture fish with microalgae (mostly marine) included in the fish feed formulation. Several microalgae strains have been tested successfully (they do not alter growth kinetics or organoleptic quality) with fish feed made up of 20–40% of microalgae: Crypthecodinium sp., Phaeodactylum sp. (Atalah et al., 2007) and Schizochytrium sp. (Ganuza et al., 2008; Stuart et al., 2021) have been tested for the seabream and amberjack diet; Tetraselmis sp. (Tulli et al., 2012), and Isochrysis sp. (Tibaldi et al., 2015) for European seabass; Nanofrustulum sp. for salmon, common carp and schrimps (Kiron et al., 2012); and Tetraselmis sp. and Isochrysis sp. for cod (Walker and Berlinsky, 2011). The modern feed form for aquaculture fish is dried pellets with less than 10% moisture. However, a study has shown that feeding fish using a moist formulation, such as algae or aquatic worms, with a water content around that of the natural prey profile in oceans, did not affect fish growth parameters and in fact increased resistance and immune protection (Przybyla et al., 2014). Thus, photosynthetic or invertebrate aquatic organisms produced in a Moon or Mars greenhouse could be fed directly to aquaculture fish with no transformation process. Researchers are exploring these alternatives to preserve wild fish stocks currently used for aquaculture fish feed (e.g., processed into fish meal and fish oil). Other algae sources with higher integration rates in feed formulations are the focus of future studies, while research is also investigating new types of aquatic prey compatible with fish feed, such as jellyfish (Marques et al., 2016). The algae cultivated in an IMTA system, as well as fish effluent, can also be a feed source for invertebrates, mollusks (Li et al., 2019), and sea cucumbers (Chary et al., 2020). A team from NASA is studying the possibility of using invertebrate production systems to purify water while growing protein-rich species as food/feed sources. Aquatic species such as copepods or mussels should grow rapidly, offer good protein content and have low mass for launch requirements (Brown et al., 2021). In the ocean, copepods and mussels are the favored natural prey of fish (especially seabream) and can be used as live feed for aquaculture fish. This production could also serve as food for the human crew. Thus, aquatic invertebrates and microalgae could play a key role in a trophic chain on a space base. In a recirculating aquaculture system, particulate matter is composed mainly of feces, mucus and bacterial clusters. This waste is easy to separate and remove from the RAS. Some copepods can use this media as feed, but another invertebrate is being studied for its ability to reduce this particulate matter and convert it into valuable biomass: the aquatic worm (Galasso et al., 2020). Polychaeta are detritivores and can be a feed source of interest for fish. Aquatic worms cultivated in an RAS can convert fecal matter into useful fatty acids for fish feed (Kicklighter et al., 2003; Bischoff et al., 2009; Palmer et al., 2014). Other synergies might also be possible: for example, Caenorhabditis elegans is a small terrestrial nematode already studied in space as a model for ageing in microgravity, as 35% of C. elegans genes have human homologs (Honda et al., 2014). This nematode could thus be both cultivated and observed in space in a BLSS. In wild environments on Earth, a fish’s diet is composed of its own congener, algae or invertebrates. Ground-based experiments have evaluated Nile tilapia as a bioregenerative sub-process for reducing solid waste potentially encountered in a space aquaculture system (Gonzales, 2009). The Tilapia feed formulation consisted of vegetable, bacterial, or food waste. Sulfur, nitrogen, protein, carbon and lysine content of waste residues were assimilated, sequestered and recycled in Tilapia muscle. Although Tilapia’s specific growth rate from population fed with different fibrous waste were widely inferior (1.4—89.8 mg/day−1) compared to the control population (281.6 mg/day−1), the Tilapia’s survival rate was not different. These results suggest additional research to improve feed formulation composed with fibrous residues (Gonzales and Brown, 2007). When considering formulating aquaculture fish feed on a space base using exclusively aquatic organisms cultivated in an IMTA system, it is essential to determine the digestive efficiency of the fish feed. A recent study highlighted the extreme flexibility of European seabass to feed formulations without fish meal and fish oil. In the experiment, fish were given several formulations containing 85% plant sources and 15% alternative sources (yeast, insects, and processed animal protein or Arthrospira platensis). Zootechnical results showed that three formulations resulted in a growth equal to fish fed with a traditional commercial formulation including a wild fish source. The bacterial community in the fish digestive tract adapted to the new formulation composed of alternative protein and lipid sources, and bacterial diversity was not altered (Perez-Pascual et al., 2020). This plasticity is probably common to other fish species, allowing a promising avenue to test new innovative formulations for aquaculture fish using exclusively BLSS raw matter sources such as cyanobacteria, plants, algae, and invertebrates. Applicability and Limitations of a Space Aquaculture System Like the systems for other types of food sources being studied for a future BLSS, such as those to produce microalgae and higher plants (Tikhomirov et al., 2007), the design of a space aquaculture system (SAS) is subject to various parameters, including the location in the Solar System. The size of the SAS would depend on the number of residents to feed, the other food sources necessary based on nutritionist’s recommendations, the space available on the lunar base, water availability and quality, the energy available for this activity, and the duration the BLSS will need to operate. One scenario might be to provide around 250 g of fish per person per week. The volume of the tank for rearing the fish should also be correlated to the fish growth rate and the frequency at which the fish are harvested. The diversity of fish species allows possibilities to be imagined such as using the area under the floor of the lunar base for flat fish, for example, or a tank that is not connected to the crew’s living area. On the Moon as on Earth, an aquaculture system requires water circulation. While the energy needed to pump water in an SAS with lunar gravity (one-sixth of Earth’s gravity) is yet to be defined, maintaining a set water temperature will have an energy cost. Within a window of tolerance depending on the species, fish growth directly depends on the water temperature (Handeland et al., 2008). In a context of 14 days of Sun exposure and 14 days of darkness, the latter period will require warming the water to maintain the growth rate. Thus the thermal profile of the selected species will be one of the parameters to consider. This aspect will have a direct impact on the total energy required for an acceptable growth yield in the SAS. Although fish have a low oxygen uptake compared to other vertebrates (Figure 2), a regular supply is required. Oxygen dissolution in the water from hydroxyl extraction and oxygen from the regolith and/or from photosynthesis in plants cultivated in the BLSS must be synchronized with the biological demands of the fish. This requires the capacity to regularly collect, store and dissolve oxygen in the water column. The oxygen data from the CEBAS experiment on the STS-89 and STS-90 missions was analyzed to model this concept. Results based on the experimental MINI-MODULE (8.6 L) showed different periods of oxygen accumulation and depletion in the aquatic habitat in plants (oxygen producer) and snails (oxygen consumer). Simulations from ground-based models predict the oxygen concentration and can be adapted for other species (Drayer and Howard, 2014). A trend has to be defined between the volume of oxygen instantly available or stored and the demand of aquatic consumers. This highlights the importance of an oxygen buffer tank linked to a feedback control mechanism (possibly remotely controlled from Earth) in case of a lack of oxygen. Another aspect to monitor is bacterial development inside the system. An axenic environment cannot be considered as bacteria play an essential role in all stages of a balanced ecosystem. Yet bacteria activity affects the nutrient budget and oxygen measurement and availability (Konig et al., 2001). All these parameters will drive the size of the SAS and the fish biomass allowed in an extreme environment such as the Moon. Another issue to consider is aquatic biomass extraction in the space environment. Harvesting cells such as microalgae is a current challenge, today handled using vacuum and flocculation (Barrut et al., 2012). The development of harvesting tools is required for different aquatic organisms in a limited and constrained space. Regardless of the organism, extraction is necessary when the biomass has reached its optimum growth to avoid uncontrolled water degradation and increased oxygen consumption by microorganisms that would endanger fish production. The time needed for fish management on a lunar base also depends on the size of the SAS. Current technology developed for RAS drastically reduces the time necessary to maintain the system. Most of the tasks can be automated, such as starting and cleaning the biofilter, monitoring water parameters (Konig et al., 2001), and regulating the water. Fish feeding is a time-consuming task, but this can also be automated. Fish are able to adapt to self-feeding devices (Coves et al., 1998; Di-Poi et al., 2008), which contribute to the social interaction of the population (Chen et al., 2002). As in plant production systems (Bamsey et al., 2009), several automated SAS actions could be carried out remotely from a control room on Earth. A daily routine (visual checking of the system and fish behavior and non-automated actions) could be considered to involve around 1 h every 12 h for a closed loop system composed of 16 tanks (1 m3) and 8 kg/m3 of fish biomass (based on personal experience). The energy available to power the SAS will also determine its design. A ground-based greenhouse simulation for food production with lunar constraints is necessary to study and understand gas flow management, organism interactions, and all related parameters necessary to maintain a stable and balanced ecosystem. Studying the Feasibility of Sending Aquaculture Fish Embryos to the Moon: The Lunar Hatch Program In research underway since 2019, the Lunar Hatch program is investigating the feasibility of shipping embryonated aquaculture fish eggs to space for programmed hatching in a lunar BLSS. The hatched larvae would then be fed with local resources and reared until they reached an appropriate size for human consumption. The aim of the study is proof of concept based on experimental data collected first in ground-based trials, followed by test missions in low orbit, and concluding with a real flight to space, perhaps leading to the hatching of the first vertebrate on the Moon. The program focuses on the viability of European seabass (Dicentrarchus labrax) for such a project, by analyzing the potential effects on embryos of a Moon journey and the associated environmental changes. Water found on celestial bodies in the Solar System have a saline or hypersaline profile. The choice of the European seabass in the Lunar Hatch program was based on the fact it is a marine organism with an appreciated taste, and its physiology and behavior have been abundantly described. A secondary water source for fish aquaculture could also be considered such as recycled water from a greenhouse or non-potable water from technical process or human activities. The diversity of aquaculture fish species allows the appliacation of many potential “fishonauts”, depending on the primary or secondary water resource available in situ (fresh or salt water). Other aquaculture species could equally be considered for rearing in space, such as trout, flat fish or shrimp. As mentioned, in the 1970s, spaceflight tests were carried out at the egg stage with ornamental fish (Table 2). The choice of eggs as the biological stage for space travel is relevant for several reasons. A low volume of water is required for egg incubation, so the initial launch biological payload could be less than 1 kg for around 900 future larvae. In aquaculture nurseries, European seabass egg density in the water column is around one egg per milliliter. Unlike the larval or adult stages, the embryogenesis phase is suitable for a spaceflight because embryo development does not require human intervention for several days (the duration of embryogenesis depends on the species). Although embryogenesis involves intense metabolic activity for the development of the future larva, the low biomass and the chorion limit catabolite emission as well as the self-pollution of water during the journey. This would allow either long manned spaceflights with no need for maintenance from the crew, or simply the transport of fish eggs using an automated cargo ship. Compared to normal conditions in land-based aquaculture production, during a spaceflight fish embryos would be initially subjected to atypical acoustic and mechanical vibrations caused by launcher motors and acceleration in the atmosphere. The effects of this are under study in the framework of the Lunar Hatch program (supported by the French National Institute for Ocean Science, Ifremer) using a standard qualification test commonly employed in the space industry. In a recent experiment, a vibration exciter mimicked the conditions of a SOYUZ-2/FREGAT launch on a population of fish embryos (Figure 4). In this test, two triplicates (n = 300) of embryos of aquaculture species (European seabass and meagre in two separate experiments) were submitted to the acoustic and mechanical environment of a launch for 10 min at one-third and two-thirds of their development. The hatching rate was then compared to a control triplicate (n = 300). No significant differences were observed on the hatching rate for either species whatever the stage of development when the embryos were exposed to the conditions (Figure 5). These encouraging results indicate the egg robustness of two major aquaculture species. A credible hypothesis to explain these results is that the success of the global aquaculture industry is based on the selection of aquatic species for robustness criteria to actions such as unusual and stressful handling–especially at an early lifecycle stage–such as sorting, sampling, transfer from aquarium to tank, or long transport by road or air. The aquaculture sector has selected the most biologically flexible strains with the most interesting nutritional profile for economic reasons. The resulting robustness could benefit space programs–it would not be surprising if other aquaculture species also successfully pass this qualifying test. Beyond intense vibrations, understanding the influence of hypergravity and microgravity on embryonic development is essential to evaluate the feasibility of space aquaculture. Previous studies on ornamental aquarium fish can provide some information on fish behavior and physiology in space that may be useful. Hypergravity is experienced during rocket take-off, an acceleration phase that lasts about 10 min at 4–8 g, depending on the launcher motors. This situation was tested on swordtail fish and medaka otoliths (Anken et al., 1998; Ijiri et al., 2003; Brungs et al., 2011; Anken et al., 2016) and larvae bone development (Aceto et al., 2015; Chatani et al., 2015), but its effects on early ontogeny (hatching capability) are as yet poorly described. A recent research showed that six month exposition at 5 g can induce vertebral curvatures and asysmetric otoliths (Chatani et al., 2019). However, the duration of exposure to hypergravity during a launch to the Moon or Mars will be about 10 min, the time to extract the embryos from the Earth’s attraction. Ongoing experiments are exploring the ability of aquaculture finfish embryos to develop in these conditions. It is credible to posit that hypergravity applied to a water reservoir may be less felt by a submerged embryo. In contrast to poultry eggs stored in air, the water density surrounding fish eggs may reduce the acceleration force on the chorion. Following the initial conditions of rocket vibrations and acceleration, a situation of microgravity appears beyond an altitude of 110 km. During the entire evolution of life on Earth, the development of all organisms took place under constant gravity conditions in different media (air/water). It should be noted that in the ocean, fish embryos are already in a kind of microgravity compared to terrestrial organisms due to Archimedes’ principle and other physical phenomena. This is why, to simulate partial microgravity, astronaut training exercises are carried out in a swimming pool. A study has found that embryos of Xenopus (an aquatic frog) are able to adjust to microgravity environments until hatching through an adaptation mechanism and strategy (Black et al., 1995). Might this capability be common to other aquatic organisms, including fish embryos? Supported by the French space agency (CNES), the Lunar Hatch program plans to study the embryo behavior of European seabass in hypergravity and microgravity in the Gravitational Experimental Platform for Animal Models (GEPAM), a European Space Agency platform to test different gravity environments on animals (Bonnefoy et al., 2021). Exposure to radiation during the space journey will be the last environmental change investigated in future Lunar Hatch program studies: this is probably the parameter with the most impact on fish embryo biology. Knowledge about the effects of space radiation on a variety of organisms has increased over the last decades: for bacteria (Leys et al., 2009), plant and mammalian cells (Arena et al., 2014), and amphibians (Fuma et al., 2014). A ground-based study on the influence of radiation on fish immediately post-hatching was carried out on the ornamental zebrafish (Danio rerio), in which eggs were irradiated with doses ranging from 1 to 1,000 mSv.d−1 for 20 days (Simon et al., 2011). At the stage of 3 days post-hatching, no significant difference in mortality was observed between irradiated eggs and the control. The maximum daily dose was 100 times greater than the total dose astronauts were subjected to during the Apollo 11 mission. These results are consistent with a study in which no significant difference in mortality was observed between 0.8 mGy (the threshold recommended to protect ecosystems) and 570 mGy delivered per day, but the radiation exposure induced accelerated hatching for both doses and a decrease in yolk bag diameter for the highest dose (Gagnaire et al., 2015). In contrast, another study exposing zebrafish embryos to 1, 2.5, 5, 7.5, and 10 mGy of gamma radiation at 3 hpf showed that increasing gamma radiation increased DNA damage, decreased hatching rate, increased median hatching time, decreased body length, increased mortality rate, and increased morphological deformities (Kumar et al., 2017). A higher total dose but spread over time therefore seems to be less harmful than a single high dose concentrated in the early stages of development. Gagnaire et al. also found abnormal development of the spine for individuals subjected to 570 mGy.d−1. These research results on a small fish provide useful information for countermeasures that would need to be implemented on a lunar base. Fish and crew should be protected to reduce cosmic ray damage. Fish embryos could benefit from progress in countermeasure technology developed for humans, but it would be valuable to conduct experiments on the impact of different particles and charges (separate and cumulative) from cosmic radiation on the candidate fish. Conclusion The Lunar Hatch program is investigating the prospects of lunar aquaculture based on a circular food system using a selected species at a specific stage of the lifecycle. It may be of interest to investigate other aquaculture species for other targeted planets or other lifecycle development stages. In the case of the Moon, it is so close to Earth that rearing adults for reproduction would not be worthwhile: a regular shipment of fertilized eggs for monthly generation would avoid costly fish-spawning management on the lunar base. For a more distant destination such as Mars, the embryo stage would be realistic for the first part of the mission, but the total flight would be longer than the duration of embryogenesis. In this case, larval development would need to be considered during the multi-month journey. For farther destinations, studies would need to determine the possibility of rearing broodstock to control the entire biological lifecycle in space. Space aquaculture would provide a valuable food source in addition to those already studied for long-term missions. The diversity of nutrients provided by fish and the benefits for human metabolism may help in the challenges of space medicine, in particular the prevention of cancer caused by long-term exposure to radiation. The activity of fish farming itself could have positive psychological and cognitive effects. Reports about plant-growth chambers on manned missions have described the psychological benefits of working with living organisms in space. An investigation involving social scientists could be conducted to better understand the possible positive benefits of human–animal interaction in space. Vertebrates may recall basic human activities and provide a psychological umbilical cord with the Earth. Modern recirculating aquaculture systems share many characteristics with the closed bioregenerative life-support systems planned for space. Progress in aquaculture technology on land and in space can feed into each other. For example, developments that allow space aquaculture systems to recover and convert waste molecules into edible food could be deployed on Earth to increase food availability while avoiding waste discharge in the environment and preserving biodiversity. Joint efforts to design such waste conversion systems will be applicable above all to human activities on Earth. Like other aspects of BLSS, while space aquaculture is close to being a reality, it is highly dependent on the water and energy available in situ. At the turn of the 20th century, the Russian father of astronautic science Konstantin Tsiolkovsky wrote: “Earth is the cradle of humanity, but one cannot remain in a cradle forever.” Plants and animals are part of the human biosphere and food chain. Space exploration will likely be more successful if humans leave the cradle with a part of their own biosphere and their knowledge of agricultural science, including aquaculture.

## 6

### 1nc – k

#### Settler colonialism is the ontological permeating structure of the nation-state which requires the elimination of indigenous life and land via the occupation of settlers. The appropriation of land turns Natives into ghosts and chattel slaves into excess labor.

Tuck and Yang 12

(Eve Tuck, Unangax, State University of New York at New Paltz K. Wayne Yang University of California, San Diego, Decolonization is not a metaphor, Decolonization: Indigeneity, Education & Society Vol. 1, No. 1, 2012, pp. 1-40, JKS)

Our intention in this descriptive exercise is not be exhaustive, or even inarguable; instead, we wish to emphasize that (a) decolonization will take a different shape in each of these contexts - though they can overlap - and that (b) neither external nor internal colonialism adequately describe the form of colonialism which operates in the United States or other nation-states in which the colonizer comes to stay. Settler colonialism operates through internal/external colonial modes simultaneously because there is no spatial separation between metropole and colony. For example, in the United States, many Indigenous peoples have been forcibly removed from their homelands onto reservations, indentured, and abducted into state custody, signaling the form of colonization as simultaneously internal (via boarding schools and other biopolitical modes of control) and external (via uranium mining on Indigenous land in the US Southwest and oil extraction on Indigenous land in Alaska) with a frontier (the US military still nicknames all enemy territory “Indian Country”). The horizons of the settler colonial nation-state are total and require a mode of total appropriation of Indigenous life and land, rather than the selective expropriation of profit-producing fragments. Settler colonialism is different from other forms of colonialism in that settlers come with the intention of making a new home on the land, a homemaking that insists on settler sovereignty over all things in their new domain. Thus, relying solely on postcolonial literatures or theories of coloniality that ignore settler colonialism will not help to envision the shape that decolonization must take in settler colonial contexts. Within settler colonialism, the most important concern is land/water/air/subterranean earth (land, for shorthand, in this article.) Land is what is most valuable, contested, required. This is both because the settlers make Indigenous land their new home and source of capital, and also because the disruption of Indigenous relationships to land represents a profound epistemic, ontological, cosmological violence. This violence is not temporally contained in the arrival of the settler but is reasserted each day of occupation. This is why Patrick Wolfe (1999) emphasizes that settler colonialism is a structure and not an event. In the process of settler colonialism, land is remade into property and human relationships to land are restricted to the relationship of the owner to his property. Epistemological, ontological, and cosmological relationships to land are interred, indeed made pre-modern and backward. Made savage. In order for the settlers to make a place their home, they must destroy and disappear the Indigenous peoples that live there. Indigenous peoples are those who have creation stories, not colonization stories, about how we/they came to be in a particular place - indeed how we/they came to be a place. Our/their relationships to land comprise our/their epistemologies, ontologies, and cosmologies. For the settlers, Indigenous peoples are in the way and, in the destruction of Indigenous peoples, Indigenous communities, and over time and through law and policy, Indigenous peoples’ claims to land under settler regimes, land is recast as property and as a resource. Indigenous peoples must be erased, must be made into ghosts (Tuck and Ree, forthcoming). At the same time, settler colonialism involves the subjugation and forced labor of chattel slaves, whose bodies and lives become the property, and who are kept landless. Slavery in settler colonial contexts is distinct from other forms of indenture whereby excess labor is extracted from persons. First, chattels are commodities of labor and therefore it is the slave’s person that is the excess. Second, unlike workers who may aspire to own land, the slave’s very presence on the land is already an excess that must be dis-located. Thus, the slave is a desirable commodity but the person underneath is imprisonable, punishable, and murderable. The violence of keeping/killing the chattel slave makes them deathlike monsters in the settler imagination; they are reconfigured/disfigured as the threat, the razor’s edge of safety and terror. The settler, if known by his actions and how he justifies them, sees himself as holding dominion over the earth and its flora and fauna, as the anthropocentric normal, and as more developed, more human, more deserving than other groups or species. The settler is making a new "home" and that home is rooted in a homesteading worldview where the wild land and wild people were made for his benefit. He can only make his identity as a settler by making the land produce, and produce excessively, because "civilization" is defined as production in excess of the "natural" world (i.e. in excess of the sustainable production already present in the Indigenous world). In order for excess production, he needs excess labor, which he cannot provide himself. The chattel slave serves as that excess labor, labor that can never be paid because payment would have to be in the form of property (land). The settler's wealth is land, or a fungible version of it, and so payment for labor is impossible.6 The settler positions himself as both superior and normal; the settler is natural, whereas the Indigenous inhabitant and the chattel slave are unnatural, even supernatural. Settlers are not immigrants. Immigrants are beholden to the Indigenous laws and epistemologies of the lands they migrate to. Settlers become the law, supplanting Indigenous laws and epistemologies. Therefore, settler nations are not immigrant nations (See also A.J. Barker, 2009). Not unique, the United States, as a settler colonial nation-state, also operates as an empire - utilizing external forms and internal forms of colonization simultaneous to the settler colonial project. This means, and this is perplexing to some, that dispossessed people are brought onto seized Indigenous land through other colonial projects. Other colonial projects include enslavement, as discussed, but also military recruitment, low-wage and high-wage labor recruitment (such as agricultural workers and overseas-trained engineers), and displacement/migration (such as the coerced immigration from nations torn by U.S. wars or devastated by U.S. economic policy). In this set of settler colonial relations, colonial subjects who are displaced by external colonialism, as well as racialized and minoritized by internal colonialism, still occupy and settle stolen Indigenous land. Settlers are diverse, not just of white European descent, and include people of color, even from other colonial contexts. This tightly wound set of conditions and racialized, globalized relations exponentially complicates what is meant by decolonization, and by solidarity, against settler colonial forces. Decolonization in exploitative colonial situations could involve the seizing of imperial wealth by the postcolonial subject. In settler colonial situations, seizing imperial wealth is inextricably tied to settlement and re-invasion. Likewise, the promise of integration and civil rights is predicated on securing a share of a settler-appropriated wealth (as well as expropriated ‘third-world’ wealth). Decolonization in a settler context is fraught because empire, settlement, and internal colony have no spatial separation. Each of these features of settler colonialism in the US context - empire, settlement, and internal colony - make it a site of contradictory decolonial desires7. Decolonization as metaphor allows people to equivocate these contradictory decolonial desires because it turns decolonization into an empty signifier to be filled by any track towards liberation. In reality, the tracks walk all over land/people in settler contexts. Though the details are not fixed or agreed upon, in our view, decolonization in the settler colonial context must involve the repatriation of land simultaneous to the recognition of how land and relations to land have always already been differently understood and enacted; that is, all of the land, and not just symbolically. This is precisely why decolonization is necessarily unsettling, especially across lines of solidarity. “Decolonization never takes place unnoticed” (Fanon, 1963, p. 36). Settler colonialism and its decolonization implicates and unsettles everyone.

#### The thesis of the aff itself is settlerist – their arg is that we need to go to the moon to establish moon dominance and to put our presence on space !! like bro 💀😭– that’s the logic of terra nullius that is used to continually justify the extermination of indigeneity

#### Their understanding of “space” replicates a Western theorization of place as neutral space that relegates indigenous peoples to colonial authority by creating “cultural blanks” to be filled in by peaceful settlement

Barker and Pickerill 12 (Adam J Barker, and Jenny Pickerill, Department of Geography @ Univ of Leicester. “Radicalizing Relationships To and Through Shared Geographies: Why Anarchists Need to Understand Indigenous Connections to Lands and Place” Antipode.

Colonial Impacts on Perceptions of Place Indigenous understandings of place have generated criticism of many aspects of society in the northern bloc: Christian theology’s influence on political and economic colonial practice (Deloria 2003); the concept of “sovereignty” and the state system (Alfred 2006); constitutionalism as a method of governmental organization (Tully 1995; 2000); capitalism and relationships under a capitalist system (Adams 1989:17); language and culture (Basso 1996) and many other understandings of place, space, nature, and human relationships. Indigenous relationships to place fundamentally challenge colonial spatial concepts, from the ways that we move from place to place and through spaces (Pandya 1990) to how we move through time (Jojola 2004). Indeed Coulthard (2010:79) asserts that for Indigenous people place is central to understandings of life, whereas “most Western societies . . . derive meaning from the world in historical/developmental terms, thereby placing time as the narrative of central importance”. Historically, EuroAmerican cultures conceived of human relations to the environment in one of two ways, which John Rennie Short labels the “classical and romantic” (Short 1991:6): either “natural” places are improved through development and human spatial creation and use (with “wilderness” as a frightening, exterior “ other”), or despoiled through human contact and change (with the natural environment as a pristine and perfect spatial concept, and the suggestion that human identity must be bounded within it). Both conceptually marginalize or fully erase Indigenous presence in place. Contra this erasure, Indigenous peoples’ understandings of place have become important to the understanding of colonial geographies and the efforts of anti-colonial activists.2 Indigenous peoples have traditionally related to place through spatially stretched and dynamic networks of relationships (Cajete 2004; Johnson and Murton 2007). These networks bear some resemblance to Sarah Whatmore’s concept of hybrid geography, “which recognizes agency as a relational achievement, involving the creative presence of organic beings, technological devices and discursive codes, as well as people, in the fabrics of everyday living” (Whatmore 1999:26). Through these, Indigenous peoples have challenged the classical/romantic dichotomy that continues to haunt some aspects of anarchist spatial perceptions. For Indigenous peoples, place holistically encapsulates networks of relations between humans, features of the land, non-human animals, and living beings perceived as spirits or non-physical entities. All of these—humans included— are understood to have autonomy and will, but also obligation and responsibility to all of the other elements to which they are related and among whom they are situated. As such, we acknowledge that land and place are different to each other but seek to use the way they are interrelated throughout this article. Although land can be considered as material, its meaning is constantly interwoven into the relationality of place so that land is often taken to have multiple meanings beyond its simple materiality—as a resource, as identity and as relationship (Coulthard 2010). Indigenous peoples assaulted by settler colonization have and continue to face concerted attempts to break Indigenous connections to place. Religious conversion, for example, has had a massive impact on the ways that Indigenous peoples perceive the spaces occupied by spirit and otherwise metaphysical beings. Though no longer considered “tantamount to a complete transformation of cultural identity” (Axtell 1981:42), conversion to and participation in hierarchical-organized, spatially dislocated, and temporally defined Judeo-Christian religions (Deloria 2003:62–77) encouraged Indigenous peoples to see the spiritual as something above (literally) and beyond the direct contact of the human world. The general result is displacement and dislocation.

#### Thus, the only alternative is decolonization. Prioritize impacts that center indigenous scholarship and resistance – any ethical commitment requires that the aff places itself in the center of native scholarship and demands; independently, the judge must surrender to indigenous resistance because an ethic of incommensurability necessitates

Tuck and Yang 12

(Eve Tuck, Unangax, State University of New York at New Paltz K. Wayne Yang University of California, San Diego, Decolonization is not a metaphor, Decolonization: Indigeneity, Education & Society Vol. 1, No. 1, 2012, pp. 1-40, JKS)

An ethic of incommensurability, which guides moves that unsettle innocence, stands in contrast to aims of reconciliation, which motivate settler moves to innocence. Reconciliation is about rescuing settler normalcy, about rescuing a settler future. Reconciliation is concerned with questions of what will decolonization look like? What will happen after abolition? What will be the consequences of decolonization for the settler? Incommensurability acknowledges that these questions need not, and perhaps cannot, be answered in order for decolonization to exist as a framework. We want to say, first, that decolonization is not obliged to answer those questions - decolonization is not accountable to settlers, or settler futurity. Decolonization is accountable to Indigenous sovereignty and futurity. Still, we acknowledge the questions of those wary participants in Occupy Oakland and other settlers who want to know what decolonization will require of them. The answers are not fully in view and can’t be as long as decolonization remains punctuated by metaphor. The answers will not emerge from friendly understanding, and indeed require a dangerous understanding of uncommonality that un-coalesces coalition politics - moves that may feel very unfriendly. But we will find out the answers as we get there, “in the exact measure that we can discern the movements which give [decolonization] historical form and content” (Fanon, 1963, p. 36). To fully enact an ethic of incommensurability means relinquishing settler futurity, abandoning the hope that settlers may one day be commensurable to Native peoples. It means removing the asterisks, periods, commas, apostrophes, the whereas’s, buts, and conditional clauses that punctuate decolonization and underwrite settler innocence. The Native futures, the lives to be lived once the settler nation is gone - these are the unwritten possibilities made possible by an ethic of incommensurability.*when you take away the punctuation he says of lines lifted from the documents about military-occupied land its acreage and location you take away its finality opening the possibility of other futures* -Craig Santos Perez, Chamoru scholar and poet (as quoted by Voeltz, 2012)

Decolonization offers a different perspective to human and civil rights based approaches to justice, an unsettling one, rather than a complementary one. Decolonization is not an “and”. It is an elsewhere.

#### Our interpretation is that the judge ought to evaluate the aff as a research project – they don’t get to weigh the material implementation of the case

#### 1. Plan focus restricts the debate to a ten second statement and leaves the rest of the aff unquestioned. They should be responsible for the way their knowledge is constructed and used because that produces the best model for activism and ethics in the context of their aff

#### 2. The K is a prior question – it informs the value of the game – if we win debate trains students to be violent outside of their rounds, that should come first

#### 3. Performance DA – you’re an educator responsible for judging the behavior and scholarly production of the aff – that means you should TKO them if we win a link

#### 4. George Bush DA—justifications and representations influence our political advocacy. Even though George Bush and Marxists both hate Donald Trump, the reasons why matter as much. Winning a link argument means that their political advocacy looks more like a blue lives matter trust fund rather than anti-racist movements.

## Case

### 1nc – framing

#### I’ll preempt extinction first – we agree materiality is good, but it’s a question of impact calc – blum doesn’t apply

#### 1. Every piece of impact defense to the aff is a justification for why you should reduce the aff’s risk down to infitismely small – proves that their scenarios are fabricated for settlerism, especially when the 1AR inevitably kicks out of them

#### 2. Links are offense – we have indicts of every single one of their scenarios that affect the consequences of their policy and the way it’s implemented. This implicates every piece of aff solvency and means they don’t solve extinction and just further participate in genocidal structures.

#### 3. This is another link – it justifies the 1% risk cheney doctrine of intervening in the middle east for a false threat, which was a worse political solution and caused massive suffering – this is the exact fear based politics that all of the K criticizes

#### 4. Value to life outweighs – we can’t experience ethical value in the first place if people are ontologically excluded by securitizaiton

#### 5. D/b – either you only die once so it’s painless or timeframe means you reduce their impacts down to a negligible amount and our ontological claims means settlerism ow/s either way

### 1nc – solvency

#### 1) Sample – about a program from the 1900s, doesn’t apply

#### 2) Fessl – aff doesn’t solve bc none of these are part of the llunar heritage

#### 3) Hertzfeld and Pacee are about speculative missions in the future – no fucking clue how that applies

#### 4) OSTP is about future operations that the aff cant resolve – independently no one knows what research will occur, how would they know it would solve?

5) No warrant for why heritage sites are key --- proves alt causes aka the rest of the move

#### 6) Emerging moon development is inevitable and causes accidental and intentional artifact destruction – heritage sites would be destroyed inevitably by public actors – OST allows it and overriding current OST policies would deck scientific research and space stability

Pace & Hertzfeld 13 [Dr. Henry R. Hertzfeld is a Research Professor of Space Policy and International Affairs in the Space Policy Institute at the Elliott School of International Affairs. Scott Norman Pace currently serves as the Executive Secretary of the National Space Council. Pace was formerly the Director of the Space Policy Institute at the Elliott School of International Affairs at George Washington University, where he was also a Professor of the Practice of International Affairs. “International Cooperation on Human Lunar Heritage.” <https://cpb-us-e1.wpmucdn.com/blogs.gwu.edu/dist/7/314/files/2018/10/Hertzfeld-and-Pace-International-Cooperation-on-Human-Lunar-Heritage-t984sx.pdf>]

The U.S. Apollo Space Program was a premier technological accomplishment of the 20th century. Preserving the six historic landing sites of the manned Apollo missions, as well as the mementos and equipment still on the Moon from those and other U.S. (e.g., Ranger and Surveyor) and Soviet Union (e.g., Luna) missions is important. Some of the instruments on the lunar surface are still active, monitored, and provide valuable scientific information. But recent government and private-sector plans to explore and potentially use lunar resources for commercial activity raise questions about the use of the Moon and potential accidental or purposeful threats to the historic sites and scientific equipment there. Although some steps to protect these sites have been proposed, we suggest a better way, drawing on international, not U.S. unilateral, recognition for the sites.

Less than 2 years before the fi rst footsteps on the lunar surface on 20 July 1969 (see the image) , the United Nations Outer Space Treaty (OST) was drafted, ratifi ed, and came into force ( 1). Article II of the OST reinforced and formalized the international standard that outer space, the Moon, and other celestial bodies would not be subject to claims of sovereignty from any nation by any means, including appropriation. The OST prohibits ownership of territory or its appropriation by any state party to the treaty, which includes the United States, Russia, and 126 other nations. It does not prohibit the use of the Moon and its resources. In fact, the treaty emphasizes the importance of freedom of access to space for any nation and the importance of international cooperation in space exploration. These principles of the space treaties have enabled gains in science and technology and have contributed to international stability in space.

### 1nc – aquaculture

#### 1) Aff doesn’t solve – their card advocates for a proposal to do a mission – they havent read a card that it occurs as a result of the plan

#### 2) Piesse misses an internal link to their card so its irrel

#### 3) Cribb makes 0 sense – about food writ large which their aquaculture ev isnt about

#### 4) Schubel and Thompson says potential extinction like 70k years ago, which obviously would only apply to like 100k humans living in one densely populated area

#### 5) Aquaculture fails – companies lie about their efficiency and they’re not any more sustainable than farm animals

Bethune 18 (Claudette, Ph.D., pharmaceutics and pharmacokinetics, is an associate director of clinical development at a pharmaceutical company in California. From 2003 – 2006, Bethune was a senior scientist at the Norwegian Institute for Nutrition and Seafood Safety in Bergen, Norway, Organic Consumers Association, "Nordic Aquafarms' Claims of 'Sustainably Produced' Farmed Salmon for a Hungry World Don't Hold Up," <https://www.organicconsumers.org/blog/farmed-salmon-unsustainable-unhealthy> MDRJ)

The developers of today’s salmon aquaculture often claim that their industry is “sustainable.” In response to concerns regarding the dangers of open-net salmon pens—where feces, chemicals, parasites and disease are directly transmitted into the bodies of water in which they are located—certain companies are moving their salmon farms on land to “closed-containment” models. But are these farmed Atlantic salmon any more nutritious or sustainable than farmed land-animals? Is salmon farming really helping to feed a hungry world? Nordic Aquafarms (NAF), a Norway-based company that proposes to build a mega-sized closed-containment salmon farm in Maine, claims that “the world has a growing need for protein sources produced in a sustainable way” and that “farmed Atlantic salmon has proven to be a more sustainable product than most other comparable protein sources." However, reviewing the actual analysis and results in the scientific literature to date, it is clear that the results related to fish feed do not support the typical claims that closed-containment salmon farming operations can produce sustainable or more nutritious products than conventional salmon aquaculture. Currently, NAF has not yet stated unequivocally or publicly what the company intends to feed the salmon at its proposed Belfast, Maine facility, which is described as “one of the largest [salmon farms] in the world.” However, a review of what is currently used or available for use as feed for farm-raised salmon shows that none of the options pass the sustainability test, nor do they result in a more “nutritious” product for consumption. Misconceptions around the use of fish meal and fish oils in farmed-fish feed One of the key concerns about farming carnivorous and omnivorous fish such as Atlantic salmon is the use of fish meal and fish oils as ingredients in feed for farmed salmon. That’s because the production of fish meal and fish oils requires raising or catching vast quantities of other fish to produce—fish that could be directly used for human consumption. From a food security, safety, and sustainability perspective, it is highly questionable that farms that consume more fish in feed than they produce could rival the best available protein alternatives.

#### 6) Makes pesticide use explode when scaled up for more countries

Bethune 18 (Claudette, Ph.D., pharmaceutics and pharmacokinetics, is an associate director of clinical development at a pharmaceutical company in California. From 2003 – 2006, Bethune was a senior scientist at the Norwegian Institute for Nutrition and Seafood Safety in Bergen, Norway, Organic Consumers Association, "Nordic Aquafarms' Claims of 'Sustainably Produced' Farmed Salmon for a Hungry World Don't Hold Up," <https://www.organicconsumers.org/blog/farmed-salmon-unsustainable-unhealthy> MDRJ)

Vegetables and animal byproducts in fish feed raise GMO and pesticide concerns

As stated above, to reduce the use of fish meal and fish oil, the salmon aquaculture industry has steadily increased its use of vegetable protein and oil over the last 20 years. This includes an increase in the use of soy, rapeseed, wheat, palm oil, groundnuts, and corn—and their genetically-modified counterparts. The industry has also increased its use of terrestrial animal byproducts. [6]

With the increased use of vegetables in salmon feed, there has been a concurrent increase and concern for the increase in the allowable limit for pesticides used on plants for fish feed. For example, in 2012, a 10-fold increase in the allowable limit of the pesticide endosulfan was approved for salmon feed, because the pesticide was widely present in plants sourced for feed. [7] This occurred despite the fact that in 2011, the Stockholm Convention on Persistent Organic Pollutants during their 5th meeting added endosulfan to its list of dangerous pollutants because it is known to be highly toxic to humans and wildlife.

#### 7) More contaminants and synthetic antibiotics are bad for the environment

Bethune 18 (Claudette, Ph.D., pharmaceutics and pharmacokinetics, is an associate director of clinical development at a pharmaceutical company in California. From 2003 – 2006, Bethune was a senior scientist at the Norwegian Institute for Nutrition and Seafood Safety in Bergen, Norway, Organic Consumers Association, "Nordic Aquafarms' Claims of 'Sustainably Produced' Farmed Salmon for a Hungry World Don't Hold Up," <https://www.organicconsumers.org/blog/farmed-salmon-unsustainable-unhealthy> MDRJ)

In addition to increased levels of pesticides, such as endosulfan, in farmed salmon feeds, other pesticides and contaminants found in fish feed, including PCBs, are known to accumulate in farmed salmon at up to 10-times more than in farmed land animals. National monitoring data on commercial fish feed and farmed Atlantic salmon on the Norwegian market found persistent organic pollutants (POPs) such as PCBs up to 10-times higher than those reported for terrestrial meat products on the same feed. [8]

Compared with wild fisheries, farmed salmon feed also uses synthetic antioxidants, such as ethoxyquin, to prevent the feed going rancid. Ethoxyquin and its metabolites that are present in farmed salmon accumulate from feed at relatively high concentrations and are known to be toxic to dogs, and likely to humans as well. [9]

The use of animal byproducts (pig and chicken) in fish feed raises additional concerns about environmental contaminants and synthetic additives. This practice recycles the contaminants and antibiotic residues from farmed animals in the food chain, even when closed-containment systems themselves do not routinely use antibiotics and other contaminants known to be used in industrial poultry and hog production. [10]

#### 8) Worse for food prices – turns insecurity over food

Bethune 18 (Claudette, Ph.D., pharmaceutics and pharmacokinetics, is an associate director of clinical development at a pharmaceutical company in California. From 2003 – 2006, Bethune was a senior scientist at the Norwegian Institute for Nutrition and Seafood Safety in Bergen, Norway, Organic Consumers Association, "Nordic Aquafarms' Claims of 'Sustainably Produced' Farmed Salmon for a Hungry World Don't Hold Up," <https://www.organicconsumers.org/blog/farmed-salmon-unsustainable-unhealthy> MDRJ)

Some have suggested that insects could be used in farmed salmon feed, which would benefit the fish and the consumer. However, the use of insects as fish feed is still unproven. As of yet, there is no evidence of the development of an insect-based compound feed that would be sufficient to supply large salmon aquaculture systems, such as the one proposed by NAF.

As we can see, feeds for livestock and farmed salmon rely largely on the same crops. We know that many of these crops, as well as the forage fish used to make fish feed, are also consumed directly by humans, and provide essential nutrition for low-income households. As salmon aquaculture grows, competition for these crops will increase, and demand for wild fish as feed inputs, will also grow. This will potentially lead to higher prices and price volatility, worsening food insecurity among the most vulnerable populations. [11]

### 1nc – neutrinos

#### 1) This prolif internal link is nonsensical – their evidence asserts that countries would stop building bombs because there’s more data – if countries have the motive to and are actively building or pursuing WMDs they’d think that they’d get away with it and independently they could just offshore to a country that already has nukes

#### 2) They cannot solve the unraveling prolif intnl link either – their evidence Identifies that barriers to prolif and detection are unraveling incredibly quickly which means that we need a quick response which is not what neutrino research is

#### 3) Also not a complete scenario – they’ve read prolif easy and possible evidence but have not identified who will proliferate or why motive exists

#### 4) Their Kroenig evidence – perception of prolif I.e thinking that a state is developing nucs still triggers the impact – they would have to win that they so deter nuclear development so much that no country even develops nuclear power or research in that area

#### 5) Dalton says nothing – just says people are being less wary, not that it’s bad

#### 6) Idk how second gen proliferators become drawn in so irrel

#### 7) Star is about US and Russia – doesn’t apply

#### 8) Says the tech doesn’t exist, only works within 10 km, which doesn’t solve prolif! – yellow

1AC Lee 20 Thomas Lee "Can tiny, invisible particles help stop the spread of nuclear weapons?" <https://engineering.berkeley.edu/news/2020/03/can-tiny-invisible-particles-help-stop-the-spread-of-nuclear-weapons/> (Associate Adjunct Professor, Research Scientist Operations & IT Management.)//Elmer

The key to preventing nuclear proliferation may depend on a little bit of ghost hunting. Scientists have long been interested in a device that can detect neutrinos, ghost-like particles that have no electric charge and nearly no mass — and therefore can pass through matter. Now, researchers are closer than ever to deploying technology that can spot those elusive subatomic particles and, in doing so, alert international authorities to the illicit production of plutonium, a key fuel for nuclear bombs. The technology may provide a “way to monitor the plutonium content in a nuclear reactor in real time that we just don’t have right now,” said Bethany Goldblum (M.S.’05, Ph.D.’07 NE), a top researcher with UC Berkeley’s Department of Nuclear Engineering. Goldblum, the executive director of the Berkeley-based Nuclear Science and Security Consortium, co-wrote a study published this week in the Review of Modern Physics that examines the feasibility of neutrino detectors in nuclear nonproliferation efforts. The study’s co-authors include Adam Bernstein and Nathaniel Bowden from Lawrence Livermore National Laboratory, Patrick Huber from Virginia Tech, Igor Jovanovic from the University of Michigan and John Mattingly from North Carolina State University. The study ultimately concludes that such technology deployed outside nuclear reactors could prove effective in ensuring that countries are not making weapons-related material under the guise of peaceful civilian energy production. The report also advances the idea that researchers could one day use the technology to discover or exclude the presence of reactors at distances of a few hundred kilometers. “Over several decades, physicists have conceived many ideas for using ﬁssion neutrinos in nuclear security,” the study says. “Some ideas remain in the realm of pen and paper, constrained by basic physical and practical considerations. For other concepts, demonstrated technology is catching up with real opportunities.” The ghost particle Neutrinos are the most abundant particles in the universe, having been formed by large nuclear explosions like the Big Bang, supernovas and the fusion process that happens inside the sun. They travel near the speed of light, have little mass and carry no electric charge. Because of these attributes, neutrinos can pass through matter and are incredibly difficult to detect, which is why scientists often refer to them as “ghost particles.” For example, if 10 trillion neutrinos struck the Earth, all but one would pass through the planet without having interacted with anything at all. In 1956, Clyde Cowen and Frederick Reins, two scientists at the Los Alamos National Laboratory in New Mexico, confirmed the neutrino’s existence, work that eventually earned the Nobel Prize in Physics. The duo placed two large water tanks near a nuclear reactor, which produces electron antineutrinos in huge quantities, as part of the fission process. As it turns out, neutrinos can collide with protons in the water and produce a neutron and a positron through a process called inverse beta decay. When the positron moves through the water, it produces a flash of light that special sensors can detect. Up to this point, scientists were primarily interested in finding neutrinos because the particles might offer clues to the universe’s origin and the formation of stars and galaxies. But starting around the turn of the 21st century, the idea that neutrino detectors could be used in nuclear nonproliferation efforts started to gain real traction. In 2000, Adam Bernstein, then a postdoctoral fellow at the Sandia National Laboratory in Livermore, California, wrote a paper exploring the idea of using detectors filled with purified water to spot neutrinos produced from nuclear explosions. In many ways, water is a great medium to detect neutrinos because it is easy to purify, cheap and is transparent to light produced by neutrinos colliding with water molecules. The key would be to build detectors big enough to hold enough water to see the neutrino signal above background radiation. However, finding neutrinos in water is still pretty hard. Bernstein found that adding small amounts of gadolinium — a rare earth metal with unusual nuclear properties — to the water could significantly boost the detector’s chances of spotting neutrinos. In gadolinium-doped water, neutrino interactions produce a much stronger signal than neutrinos in water alone. Bernstein eventually abandoned the idea to monitor explosions because the cost and size of such neutrino detectors would make the technology impractical, especially compared to existing, cheaper technologies like seismic detectors, he said. Instead, Bernstein turned his attention to using the gadolinium-doped technology to catch neutrinos from nuclear reactors. “Since we’re still mostly using water, it is possible to build large detectors, up to 100 kilotons in size or more, to spot these reactor neutrinos,” said Bernstein, now a staff physicist at the Lawrence Livermore National Laboratory (LLNL) and director of the lab’s Rare Event Detection group in the Nuclear and Chemical Sciences division. “The neutrino signature would stand out much more readily above background radiation even in a big detector,” he said. LLNL is the lead laboratory for a proposed United States/United Kingdom experiment, called WATCHMAN, to demonstrate remote monitoring of nuclear reactors using a kiloton-scale antineutrino detector. This experiment has already “exceeded my expectations,” Bernstein said. “The idea that the nonproliferation community might one day be able to use this technology that until now has been the exclusive province of fundamental science is an exciting motivation for this work.” Halting the spread of nukes Since 1970, nearly 200 nations signed the landmark Treaty of the Non-Proliferation of Nuclear Weapons (NPT), which seeks to limit the spread of nuclear weapons. Through a combination of remote monitoring and on–the–ground inspections, containment and surveillance, the International Atomic Energy Agency (IAEA) commands plenty of tools to figure out if countries are using nuclear energy for peaceful purposes, Goldblum said. But what happens if the line between civilian and military use of nuclear energy is not so clear? For example, the United States has long accused Iran of trying to make nuclear weapons, but Iran says it wants to develop nuclear capabilities for civilian power generation. The knowledge to construct a nuclear bomb is actually pretty well known. The hard part is getting enough materials — either enriched uranium or plutonium — to fuel the weapon. A country can reprocess the spent fuel from a civilian nuclear reactor and extract plutonium for a weapon. And a nuclear bomb only requires about 10 kilograms of plutonium. The so-called “dual-use” capabilities of nuclear reactors presents a significant challenge to the IAEA. “None of the countries now embarking on civil nuclear power programs say they are planning to acquire reprocessing capabilities,” according to a 2017 report by the Brookings Institute think tank. “But many of them are unwilling to forswear what they consider to be their ‘right’ eventually to have dual-use capabilities.” The neutrino detection technology could offer a solution. In addition to the large systems like WATCHMAN, scientists have constructed much smaller detectors that can be deployed close to reactor cores — provided operators allow such access. Optimizing reactor power levels to produce plutonium, a telltale sign that a country is trying to build a bomb, will change the rate and energy spectrum of antineutrinos that a device parked outside of the reactor can detect. And since these particles can pass through matter, the operator can’t shield the reactor’s release of antineutrinos the same way lead blocks X-rays. So if a country wants to operate a civilian nuclear power program, an antineutrino detector could provide an effective tool to continuously verify the reactor is only producing energy for peaceful purposes. For now, a detector must stay within tens of meters of the reactor to be effective. But in the future, could such technology spot antineutrinos from longer distances and even across borders? For distances 100 kilometers or beyond, the Review of Modern Physics study shows detectors would need to be 10 to 100 times bigger than WATCHMAN. But researchers hope WATCHMAN will demonstrate the basic technology and provide a platform for study of a range of possible enhancements to improve standoff and overall sensitivity. And in any case, the mere knowledge that such technology has become a reality could prove to be a powerful deterrent to nuclear proliferation in itself.

#### 9) No spread AND no impact

Jonas Schneider 20. Senior researcher at the Center for Security Studies, held post-​doctoral fellowships at the German Institute for International and Security Affairs (SWP) in Berlin and at the CSS and worked as a research associate at the Institute for Security Policy at the University of Kiel, holds a PhD in Political Science from the University of Kiel. 2020. “Chapter 26 Nuclear Proliferation and International Security.” Understanding Global Politics: Actors and Themes in International Affairs, edited by Klaus Larres and Ruth Wittlinger, Routledge, pp. 409–425.

Other analysts have sounded a much less alarmist tone, however. Some scholars even suggested that an Iranian bomb held great potential for stabilising an unbalanced and volatile Middle East (Waltz, 2012). Closer to the mainstream of Western strategic discourse, various experts have argued that despite the risks of proliferation, nuclear weapons, and the deterrent they provide should get (more) credit for contributing, in combination with other factors, to what has been labelled ‘the Long Peace’ among the great powers since 1945 (Gaddis, 1999, p. 268–271; Gavin, 2012a, p. 164; Acton 2010, pp. 16–17). Still others have contended that because nuclear proliferation is such a rare phenomenon, and since robust nonproliferation measures tend to be disruptive, the net destabilising effect of new nuclear countries is quite small and, therefore, manageable (Mueller 2010, pp. 95–99; Hymans 2013, pp. 293–296).

The question of whether nuclear proliferation has stabilising or destabilising effects is not just fascinating for scholars of the nuclear age, but also highly consequential for practical policy issues. For in order to debate the merits of particular policy choices – such as preventive military strikes against nuclear facilities, grand bargains with potential proliferators or complete nuclear disarmament – we need to understand first how the spread of nuclear weapons impacts regional and global security.

The chapter proceeds in three steps. The first section provides the foundation for the other parts by summarising what we know about empirical patterns of proliferation and the utility of nuclear weapons for statecraft. The second section then engages the literature on the consequences of proliferation, focusing in particular on how proliferation has influenced international stability. The final section explores whether some states have been more affected than others, and what measures these states have taken to prevent proliferation, or at least mitigate its negative consequences.

Patterns of nuclear proliferation and the utility of nuclear weapons

Nuclear proliferation is commonly defined as the spread of nuclear weapons to states that did not previously have them. Within a broader conceptual framework that is rarely used by scholars, yet popular in the arms control community, this diffusion of nuclear weapons to additional states is labelled horizontal proliferation. It is conceptually accompanied by the notion of vertical proliferation, which refers to qualitative improvements and increases in the number of nuclear weapons in the stockpiles of existing nuclear weapon states. In accordance with the typical usage of the term in the scholarly debate, this chapter focuses only on how the horizontal proliferation of nuclear weapons affects international stability.

One important empirical pattern that has shaped how nuclear proliferation is understood concerns the way in which nuclear weapons have spread. The word ‘spread’ appears to suggest that the established nuclear powers have provided other interested nations with (at least a few) operational nuclear warheads. Yet such transfers have never been undertaken. Certainly, states that sought nuclear weapons have often received significant assistance from other nations (Schofield, 2014; Fuhrmann, 2012), sometimes in the form of highly sensitive technologies (Kroenig, 2010). Nonetheless, since all these transfers remained well below the weapons threshold, nations seeking nuclear weapons always had to build them indigenously. Hence, in reality, the spread of nuclear weapons has meant that merely the ambition to possess a nuclear arsenal has spread to additional states, each of which then had to pursue that goal primarily through indigenous efforts.

#### 10) Prolif doesn’t cause nuke war or preemptive strikes – it’s overstated

* Prolif impact exaggerated – wrong about China in the 60s and wrong now
* Iran and Korea are both defensive, won’t escalate
* Cascade disproven by Israel and NoKo
* Weapons don’t get used – just ego booster for leaders and deterrence policy

Mueller 6/22/20 [Mueller 6/24/20 [John Mueller is a political scientist at Ohio State University and a senior fellow at the Cato Institute. His latest book, The Stupidity of War: American Foreign Policy and the Case for Complacency, is forthcoming from Cambridge University Press. "Nuclear Anti‐​Proliferation Policy and the Korea Conundrum: Some Policy Proposals." https://www.cato.org/publications/policy-analysis/nuclear-anti-proliferation-policy-korea-conundrum-some-policy]

Like the notion accepted in the 1950s that World War III was pretty much inevitable, the notion that nuclear weapons proliferation is a major problem has been substantially overwrought.2 At the same time, the costly impact of aggressive policies to combat proliferation has often been overlooked or ignored.

The Benign Consequences of Proliferation

When China began building a nuclear capac­ity, President John F. Kennedy seriously considered bombing Chinese nuclear facilities. He was heard to declare that “A Chinese nuclear test is likely to be historically the most significant and worst event of the 1960s,” and his director of the Central Intelligence Agency soberly prophesied that, with that event, nuclear war would become almost inevitable.3

Declamations like Kennedy’s continue to this day.4 Elected officials and foreign policy experts have repeatedly warned that if Iran or North Korea were to get a nuclear weapon, there would be a proliferation cascade, resulting in an increased risk of nuclear war or, in the words of Mohamed ElBaradei, the head of the International Atomic Energy Agency, “the beginning of the end of our civilization.”5 North Korea has now had the weapons for well over a decade, but there is little sign of the warned‐​about cascade: thus far, no country in the region has altered its commitment to remain a nuclear‐​weapons‐​free state.

#### 11) No prolif and no impact – time, incentive, won’t escalate

* Alarmism about prolif and nuke terror is endemic to the entire field
* Acquisition is slow, MAD deters use, and sanctions make it to expensive
* Decades prove even optimistic forecasts are pessimistic – reject pundits extrapolating from bad case studies
* **Spec Answers**: Taiwan, SoKo, Argentina, Brazil, Libya, Belarus, Kazakhstan, South Africa, and Ukraine

Mueller 6/24/20 [John Mueller is a political scientist at Ohio State University and a senior fellow at the Cato Institute. His latest book, The Stupidity of War: American Foreign Policy and the Case for Complacency, is forthcoming from Cambridge University Press. "Nuclear Alarmism: Proliferation and Terrorism." https://www.cato.org/publications/publications/nuclear-alarmism-proliferation-terrorism]

There are good reasons to avoid alarmism in this area, however. First, the pace of nuclear proliferation has been far slower than has been commonly predicted primarily because the weapons convey little advantage to their possessor. Second, the consequences of such proliferation that has taken place have been substantially benign: those who have acquired the weapons have “used” them simply to stoke their egos or to deter real or imagined threats.6

And thirdly, the costs of anti‐​proliferation policy have been very substantial: the number of people who have died as a consequence of dedicated efforts to contain nuclear proliferation runs well into six figures.

Pace

Alarmists have been wrong for decades about the pace of nuclear proliferation. Dozens of technologically capable countries have considered obtaining nuclear arsenals, but very few have done so. Indeed, as Jacques Hymans has pointed out, even supposedly optimistic forecasts about nuclear dispersion have proved to be too pessimistic.7 Thus, in 1958, the National Planning Association predicted “a rapid rise in the number of atomic powers … by the mid‐​1960s.“8 A few years later, C. P. Snow sagely predicted, “Within, at the most, six years, China and several other states [will] have a stock of nuclear bombs,” and John Kennedy observed that there might be “ten, fifteen, twenty” countries with a nuclear capacity by 1964.9

As part of that forecasting, it has generally been assumed that nuclear weapons would be important status — or virility — symbols; therefore, all advanced countries would want to have them in order to show how “powerful” they were. Thus, France’s de Gaulle opined in the 1960s, “No country without an atom bomb could properly consider itself independent,” and Robert Gilpin concluded that “the possession of nuclear weapons largely determines a nation’s rank in the hierarchy of international prestige.“10 In Gilpinian tradition, some analysts who describe themselves as “realists” have insisted for years that Germany and Japan must soon come to their senses and quest after nuclear weapons.11 Such punditry has gone astray in part because the pundits insist on extrapolating from the wrong cases. A more pertinent prototype would have been Canada, a country that could easily have had nuclear weapons by the 1960s but declined to make the effort.12 In fact, over the decades, a huge number of countries capable of developing nuclear weapons have neglected even to consider the opportunity — for example, Canada, Italy, and Norway — even as Argentina, Brazil, Libya, South Korea, and Taiwan have backed away from or reversed nuclear weapons programs, and Belarus, Kazakhstan, South Africa, and Ukraine have actually surrendered or dismantled an existing nuclear arsenal.13 Some of that reduction is no doubt due to the hostility of the nuclear nations, but even without that, the Canadian case seems to have proved to have rather general relevance.

#### 12) No prolif impact – empirics and rational leaders

* Weapons stoke leader’s egos, never get used
* Even “bad countries” are peaceful – Mao and Stalin are worse than any current regime
* Anti-prolif policies are more escalatory

Mueller 6/24/20 [John Mueller is a political scientist at Ohio State University and a senior fellow at the Cato Institute. His latest book, The Stupidity of War: American Foreign Policy and the Case for Complacency, is forthcoming from Cambridge University Press. "Nuclear Alarmism: Proliferation and Terrorism." https://www.cato.org/publications/publications/nuclear-alarmism-proliferation-terrorism]

Concerns about the dangers inherent in nuclear proliferation and in nuclear terrorism certainly seem overwrought.

It would be desirable that a number of variously designated regimes (and quite a few others) never obtain nuclear weapons. Accordingly, there is nothing wrong in making nonproliferation a high priority. Indeed, if the efforts successfully dissuade Iran from foolishly launching a nuclear weapons program, they would be doing it a favor — though, quite possibly, the Iranians wouldn’t notice.

However, if new nations acquire the costly weapons, they are most likely to put them to use — if that is the term — the same way other nuclear countries have: to stoke their collective egos and to deter real or perceived threats. Even countries that once seemed to be hugely threatening such as Communist China in the 1960s have been content to use their weapons for those purposes. Accordingly, history suggests that the proliferation of nuclear weapons scarcely presents a major danger to the word.

Moreover, any anti‐​proliferation priority should be topped with a somewhat higher one: avoiding militarily aggressive actions under the obsessive sway of worst‐​case‐​scenario fantasies, actions that might lead to the deaths of tens — or hundreds — of thousands of people.