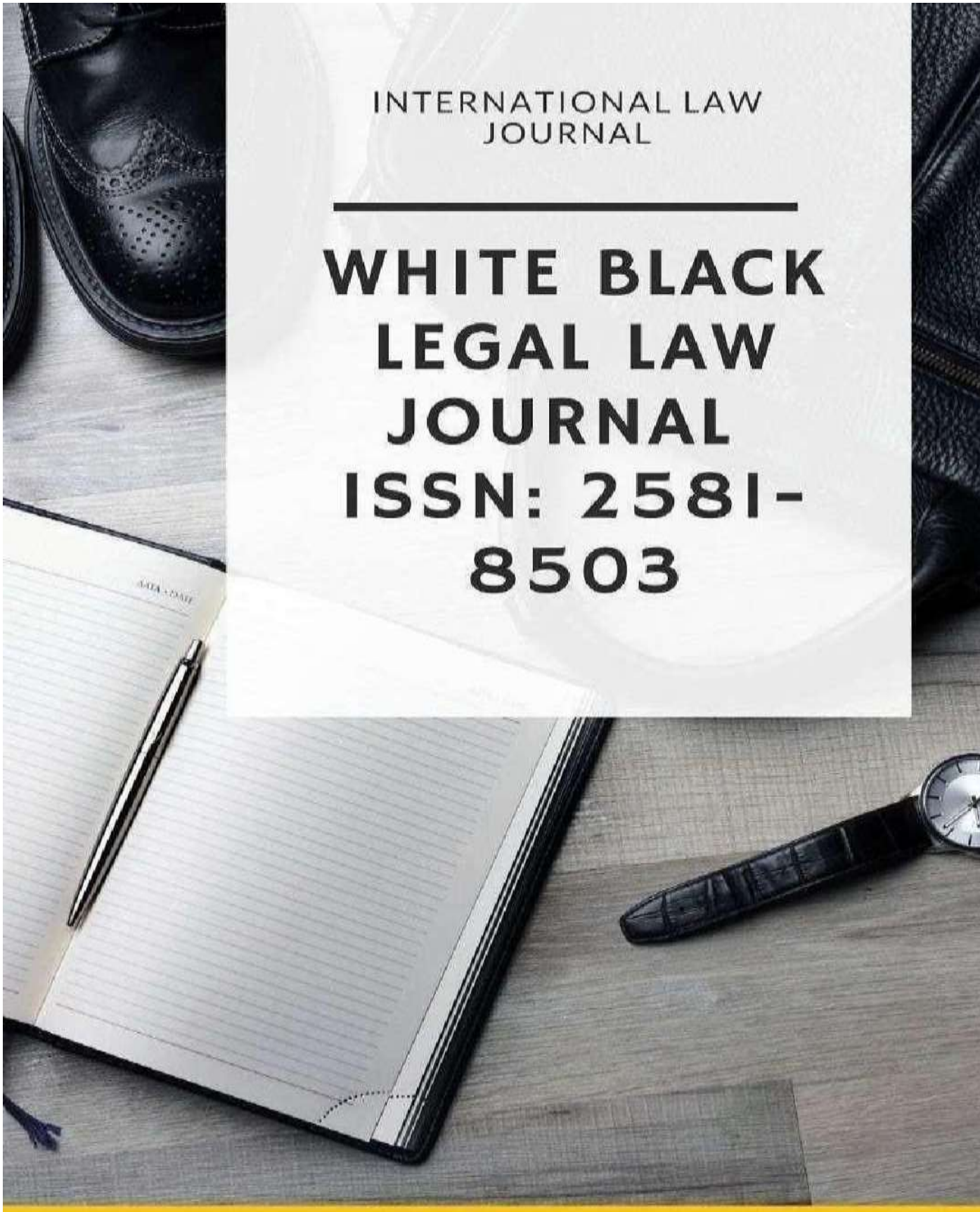

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WHITE BLACK LEGAL is an open access, peer-reviewed and

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With this thought, we hereby present to you

SPACE WEAPONIZATION, OUTER SPACE TREATY AND ITS SHORTCOMINGS: AN INTROSPECTION

AUTHORED BY - MUHAMMED RAYHAAN
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Abstract

"That's one small step for man; one large step for mankind" might be a statement that inspires thousands across the world, but the flip side of the rather celebrated milestones of space exploration is often overlooked, something that has the possibility of instilling a large magnitude of regret in people. With the advent of space militarisation and the increasing use of outer space for strategic advantages over opposing powers, the weaponization of space emerges as an infected limb to an otherwise healthy body, posing unforeseeable threats to peace and security. Tests such as ARGUS and Starfish Prime are etched in history books for highlighting the raw destructive capabilities of humans and portraying just the level of damage humans can cause to our ecosystems if they act without discretion. This, coupled with modern-day technology such as inter-continental ballistic missiles and anti-satellite systems, paves the way for an atmosphere of fear and concern, which this paper aims to understate as its objectives. These aspects further actively breed calamitous issues such as that of space debris and can have devastating ramifications now that we rely on space for almost everything, even as simple as driving and watching movies. This brings into question the Outer Space Treaty of 1967; a landmark piece of international legislation that governs several key aspects of international space law, setting the standards for what would be the most optimal use of space. But for a treaty that is almost 60 years old and inadequate regarding certain technologies, it is unable to achieve its desired effectiveness and needs to be addressed. Therefore, this paper seeks to understand the possible consequences of the developments in space weaponization that have taken place in the past seven decades, with special reference to the space debris question. Additionally, this paper aims at decoding the several clauses of the outer space treaty that relate to the issue of weaponization of space and further identifying and analysing the alarming shortcomings of the outer space treaty, including but not limited to kinetic bombardment. The resulting grey area and lack of concreteness demand striking a careful balance and considering an international effort due to the global impact this treaty has on international space law. The

paper attempts secondary research to uncover the aforementioned aspects and carefully disseminates the intricacies of the weaponization of space, its relation to the outer space treaty, and its relevant shortcomings, further suggesting certain avenues the international community may pursue to mitigate the issue at hand. Over and beyond everything, the alarming threat posed by the agenda at hand is certain and demands action in the interest of international peace and security and the people of the world, whether they are simple civilians or military personnel.

Introduction

The dalliance of the industrial revolution and the developments in science and technology bore in their wake advancements that would redefine international security. Humanity outdid itself when it launched earthly objects past the exosphere into the vast void we recognise as space, although it was soon not spared from the realities of contemporary politics and conflicts. The Oxford English Dictionary defines 'Outer Space' as the region of space beyond the earth's atmosphere or beyond the solar system. In the modern world, the Karman Line is the most widely accepted boundary of demarcation between the earth and space, and while it may not be precisely defined at a particular altitude, it is taken to enrobe the earth somewhere between 80 and 100 kilometres above mean sea level[1].

Outer Space continues to serve as an expansive and unlimited resource of information about the ever-expanding universe we dwell in and treasures within itself marvellous scientific phenomena of which humans have uncovered barely a fraction. Man has always been actively involved in satisfying his curiosity about space, and the earliest testament to this would be the launch of Sputnik 1 on October 4, 1957, by the Soviet Union. This launch, boasting itself as a first milestone in space exploration, inspires space programs to date, with over 77 countries operating their own space programs, of which 16 have launch capabilities[2], the notable ones being the United States of America's National Aeronautics and Space Administration (henceforth NASA), the European Space Agency (henceforth ESA), and the Russian Federal Space Agency (henceforth ROSCOSMOS). This achievement would only be amplified with

[1]'Karman Line | Definition & Facts | Britannica' (6 September 2024) <https://www.britannica.com/science/Karman-line> accessed 9 October 2024

[2] 'Space Agencies around the World' (*Space Crew*) <https://spacecrew.com/blog/space-agencies-around-the-world> accessed 9 October 2024

the first human entering space in 1961 and going as far as stepping foot on the moon in 1969 on the world-renowned Apollo 11 mission.

However, this virtuous resource intersects with human characteristics of violence and war when it comes to its weaponization. With the conclusion of the Second World War and the commencement of the Cold War, humans and political superpowers have spared no element of earth in their conquest for superiority, with armed conflict plaguing lands, seas, and air, leaving only space untainted by the viscous characteristics of humankind. Unfortunately, the monumental year of 1960 falsified the above statement as the world's first military satellite, the American SAMOS, was launched.

Satellites continued to be launched by major superpowers throughout the Cold War, and with the intensification of geopolitics and formation of military associations like the North Atlantic Treaty Organisation (henceforth NATO), the use of space became elementary to ensure national peace and security. As of 2023, there are a total of 570 satellites launched by ten independent nations exclusively or partially for military purposes, which constitute about 5% of all the active satellites in orbit[3]. While preliminary impressions of the militarisation of space may seem harmless, with the primary purpose being only intelligence, there is a branch of space militarisation that bears consequences beyond any justification.

Weaponization of Space, History and Statement

The ability to use the realm of space to gain advantage over opposing superpowers was a concept long understood by the leaders before us, a concept they exploited to the maximum with the militarisation of space. The concept of weaponization of space, however, is only a subset and focuses only on the area of overlap between weapons and outer space, which this paper aims to focus solely on. While militarisation continues to be a broad concept, the weaponization of space has several nuances that by and large raise questions, even in the 21st century.

The genesis of this concept dates to August 27, 1958, when the United States of America marked the beginning of Operation ARGUS, a codename given to a series of 'high-altitude

[3] 'Military Satellites by Country 2024' <https://worldpopulationreview.com/country-rankings/military-satellite-by-country>.

nuclear weapon tests', infamously marking itself as the first weapon tested in outer space[4]. ARGUS was only the beginning of over a dozen nuclear tests conducted between 1958 and 1962 by both the United States of America and the Soviet Union, the final one being Starfish Prime, a nuclear test conducted as part of the United States' Fishbowl series of tests. This test, dated July 9, 1962, conducted with the objective of testing the effect of nuclear weapons, consisted of a massive yield of 1.4 megatons of trinitrotoluene (henceforth TNT), about 68-times that of the bomb dropped on Hiroshima. The Starfish Prime test allowed humanity to witness an unprecedented level of military potential encased in a nuclear warhead, which resulted in the creation of an artificial radiation belt in the magnetosphere. Its consequences were further understood when TELSTAR, a satellite launched a day after the test, experienced one hundred times the expected radiation, leading to an immediate satellite failure, setting a testament to the magnitude of military development[5].

The weaponization of space is not restricted to testing weapons of mass destruction (henceforth WMDs) in space alone but rather includes four categories of weapons, depending on the location of their employment, the source of their usage, and their target. A keen example would be the Rikhter R-23, a 23mm autocannon developed by the Soviet Union that was employed in the Almaz Space Station, taking space weaponization in its literal sense and showcasing the world of its first and only ever defensive space weaponry[6]. Despite being the only instance of a space-to-space weapon, there are several other players in the arena over and above the R-23, and while most of the aforementioned developments date back to the cold war, the problem persists even today, owing to the introduction of the intercontinental ballistic missile (henceforth ICBM), paving the way for the modern, 21st century issue of space weaponization.

Current Situation

The inter-continental ballistic missiles dominate the space weapon scene today, with over 400 silo-based ICBMs within the United States alone that are ready to be launched within a hair

[4] 'Nuclear Test Personnel Review' <https://www.dtra.mil/DTRA-Mission/Reference-Documents/NTPR-Info/> accessed 9 October 2024

[5] E. G. S, 'The STARFISH Exo-Atmospheric, High-Altitude Nuclear Weapons Test' (2015) <https://nepp.nasa.gov/files/26652/2015-561-Stassinopoulos-Final-Paper-Web-HEART2015-STARFISH-supplemental-TN26292.pdf>

[6] 'Remembering That Time the Soviet Union Shot a Top-Secret Space Cannon While in Orbit' (*Popular Mechanics*, 24 October 2022) <https://www.popularmechanics.com/military/weapons/a18187/here-is-the-soviet-unions-secret-space-cannon/> accessed 9 October 2024

trigger order[7]. ICBMs are essentially land based missiles used to deliver any weapon system, although generally only a nuclear warhead, across distances exceeding 5,600 KM[8]. Since their introduction in 1958, they are what separate the world from darkness, catering to the 13,000 nuclear warheads spread across 9 nuclear weapon states.

Although ICBMs are launched from the surface of the earth and strike a target on the surface of the earth, the path it takes to travel such distances is part of outer space. ICBMs launched from either fixed or mobile sites power through the atmosphere into orbit, where they enter free flight, therefore classifying them as a space weapon. There have been no instances of countries employing ICBMs for nuclear delivery, but they are being actively developed, as can be noted in North Korea, with its landmark Hwasong-15, and Russia, with its RS-28 Samrat, a hypersonic ICBM with speeds recorded as high as Mach 20.5! That is twenty times the speed of sound, or approximately 25,300 KMPH[9].

ICBMs are responsible for somewhat of a cascading effect when it comes to space weaponry, as with the advent of ICBMs, defence agencies across the world went scrambling for countermeasures to ensure sovereign security, which tapered down to the development of anti-ballistic missiles (henceforth ABMs). Furthermore, the increasing number of military satellites to identify ICBM sites as well as for general reconnaissance purposes as a countermeasure invited a countermeasure in the form of anti-satellite missiles (henceforth ASATs), a technology specialised by the USA, Russia, China, and India, recording 80+ tests since the late 1950s[10].

While the common person today may understand the devastating ramifications of modern-day WMDs, their consequences in space are not simple, involving innumerable intricacies, tiny margins or errors, and several butterfly effects, requiring a superficial yet comprehensive understanding of the change in severity due to the lack of gravity and air. And one concern that trumps all the others is the concern about space debris.

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[7] 'Nuclear weapons Worldwide | Union of Concerned Scientists' <https://www.ucsusa.org/nuclear-weapons/worldwide> accessed 9 October 2024

[8] 'ICBM | Intercontinental, Nuclear, Ballistic | Britannica' (9 October 2024) <https://www.britannica.com/technology/ICBM> accessed 9 October 2024

[9] 'RS-28 Sarmat' (*Missile Threat*) <https://missilethreat.csis.org/missile/rs-28-sarmat/> accessed 9 October 2024.

[10] 'Swf-Asat-Testing-Infographic-May2022.Pdf' <https://swfound.org/media/207392/swf-asat-testing-infographic-may2022.pdf> accessed 24 August 2024.

Consequences of Space Weapons: Space Debris

Space debris is a broad term used for manufactured objects in space that are no longer of any use and are defunct. There is not a defined size for debris, and everything from large parts of a rocket to tiny bolts counts as debris if they are of no more material use to man. This issue is not new and is universal, with over 25,000+ recorded pieces of debris exceeding 10 cm in diameter[11].

The most direct consequence of space debris is the increasing risk of collision. With 9,900 satellites active in orbit[12], and satellites averaging a cost of USD 290 million, a collision will prove extremely burdensome on the aggrieved party. This is further aggravated by the fact that there is no drag in space, and debris, due to its high speeds, is almost guaranteed to decimate other satellites regardless of their size. This would further trigger a domino effect, as a healthy satellite being destroyed due to debris ends up creating more debris, magnifying the risk exponentially.

While there is a plethora of causes for the creation of space debris, space weaponization does not mitigate it but rather amplifies it. If an ICBM is successfully hit by an ABM or any other relevant countermeasure in its free flight stage, it results in debris. Similarly, ASAT tests or employment, destroying existing satellites for whatever purpose may be, only adds to the quantum of debris. The same can be understood for other air-to-space and space-to-space instruments.

This was the case in the 1970s and 1980s where both the United States and the Soviet Union aggressively conducted ASAT tests to establish space superiority. The Soviet technology involved striking the target at relatively lower speed, which alone created more than 700 pieces of large debris and several thousand pieces of small debris. The Americans on the other hand used the opposite technology using high-speed, kinetic energy weapons, destroying a major satellite in mid 1980s. Both these instances contributed significantly to the issue, and while

[11]'ARES | Orbital Debris Program Office | Frequently Asked Questions' <https://orbitaldebris.jsc.nasa.gov/faq/> accessed 9 October 2024

[12] Ieva, 'How Many Satellites Are in Space?' (*NanoAvionics*, 4 May 2023) <https://nanoavionics.com/blog/how-many-satellites-are-in-space/> accessed 9 October 2024

some of it has burned in the upper atmosphere, a substantial proportion continues to linger in the earth's lower orbit[13].

This discussion tapers down to one simple conclusion: considering the alarming nature of the issue and the possible consequences it may have when considering international peace and security, what major past action has been taken in this regard? And this question is answered by the landmark international treaty, the Outer Space Treaty of 1967.

The Outer Space Treaty

The Outer Space Treaty of 1967 is the primary document governing International Space Law. It was signed on the 27th of January 1967 in the United States of America, the United Kingdom, and the Soviet Union (now the Russian Federation) and was pushed into effect on the 17th of October of the same year[14].

Originally examined by a Legal Subcommittee in 1966, the Outer Space Treaty was formally named the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies. But it was not until that same year's General Assembly that Resolution 2222 was finally reached. A 1963 GA Resolution (Resolution 1962), namely the Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space, served as a major source of inspiration for the treaty[15]. While the Outer Space Treaty addresses several key issues related to international law, including but not limited to sovereign rights over space, jurisdiction and use of moon and the other space bodies, and authorities, responsibilities, and accountabilities, it also directly addresses the question of space weaponization, as discussed below.

Article IV of the Outer Space Treaty asserts that the moon and other celestial bodies shall exclusively be used for peaceful purposes alone. Article IV also directly forbids state parties from placing any WMDs and/or nuclear weapons in Earth's Orbit.

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[13] 'Space Debris from Anti-Satellite Weapons | Union of Concerned Scientists' <https://www.ucsusa.org/resources/space-debris-anti-satellite-weapons> accessed 9 October 2024

[14] 'The Outer Space Treaty' <https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introouterspacetreaty.html> accessed 9 October 2024

[15] ibid.

Article VI of the Outer Space Treaty indirectly discusses the issue by fixing the liability, accountability, and responsibility of all activities they conduct in space, whether military, scientific, or otherwise. This is not affected by the ownership of the enterprise deciding to conduct said activity, whether it is public or private. This article is further strengthened by Article VII, which ensures responsibility for damages caused to another party[16]. This is particularly useful with reference to this agenda, as ASAT systems, either directly targeted at a foreign space object or a test that indirectly causes harm to another satellite through the creation of debris, remain covered. This ensures that the aggrieved country is fairly compensated for the damage caused, serving as a powerful confidence building measure for the international community.

Before proceeding, one must understand that the Outer Space Treaty is simply a multi-lateral treaty and is not subject to all countries in the world, or even member states of the United Nations. Article XIV does subject the signatories of this treaty to ratification, but Article XVI does also allow them to withdraw after a fixed period of one year of ratification.

This would imply that although Article IV directly solves the issue of space weaponization, it is only binding to the countries that have signed and ratified the treaty, which, as of 2024, only includes 115 of the 193 member nations of the United Nations. A further twenty-three countries have signed the treaty but still have not completed its ratification[17]. This list of 115 fortunately does include all countries that currently operate a space program, but if a new non-signatory country were to develop a space program, it falls outside the scope of this article, and, the treaty.

Shortcomings of the Outer Space Treaty

Since the institution of the Outer Space Treaty in 1967, the technological environment in the world has changed substantially. Originating from a common meme, the Apollo Guidance Computer aboard the Apollo 11, the spacecraft that put man on the moon under the leadership of Commander Neil Armstrong, had a total random-access memory (henceforth RAM) of 4 KB. In comparison, the lowest end of student laptops that retail on Amazon for 150 USD has

[16] ibid.
[17] *United Nations Treaties and Principles on Outer Space* (United Nations 2002) accessed 9 October 2024

4 GB of RAM, which is about one million times more RAM than an entire spacecraft credited with one of the biggest milestones in the field of science and technology.

While the treaty is credited significantly for addressing several matters regarding international space law, clarifying, and regulating several aspects, and ensuring harmony between different countries, it does fall short on some aspects. Although it may not be defective in nature, the treaty is certainly inadequate with reference to privatisation of space, tourism, and exploitation of resources.

This brings us to Article XV of the Outer Space Treaty, stating member nations are permitted to propose amendments. Such amendments are forced into effect if it is accepted by a majority of state-parties, and the amendments are only binding on those members that approve the amendment. Despite said provisions, the Outer Space Treaty has not gone through one successful amendment since institution[18].

Kinetic bombardment, or alternatively, kinetic orbital strike or orbital bombardment, is a form of attack on a particular target using kinetic energy. It involves launching an inert projectile at such high speeds, which is what defines the destructive power of this system. Kinetic bombardment does not resemble any conventional WMD, nor is it a nuclear weapon, and therefore is outside the scope of Article IV of the Outer Space Treaty.

Despite emerging as early as the Cold War, an orbital bombardment remains hypothetical in the 21st century. Early concepts have been witnessed as early as World War I, in the form of flechettes. These tiny, arrow-like projectiles were launched from aircraft when military technology was still in its preliminary stages of development and proved lethal with enough energy to cause bodily mutilations[19].

This technology would evolve into the Lazy Dog bomb, an American Cold War instrument used primarily in Korea and Vietnam. The Lazy Dog was just a projectile that strikingly

[18] Tingkang A, "These Aren't the Asteroids You Are Looking For: Classifying Asteroids in Space as Chattels, Not Land" (2012) 35 Seattle University Law Review < These Aren't the Asteroids You Are Looking For: Classifying Asteroids in Space as Chattels, Not Land (seattleu.edu)> accessed 9 October 2024

[19] Harvey I, 'WWI Flechettes - The Troop Piercing Arrows Dropped from Planes onto German Trenches | The Vintage News' (*thevintagenews*, 3 March 2018) <https://www.thevintagenews.com/2018/03/03/the-flechettes/> accessed 9 October 2024

resembled ordinance but had no explosive material in it. Its purpose was to simply be dropped by aircraft and despite its smaller size, was able to generate enough energy to penetrate soft armour. Today, with evident concepts from history and a proposal dating back almost 2 decades, costs and minor scientific dilemmas alone prevent fixing such a projectile in orbit. Its scientific feasibility was discussed extensively and theoretically testes proving that with time and investment into space defence research and development, kinetic bombardment may just be difficult, and not impossible[20].

Possible Solutions

Every year, as billions of dollars get channelled into space research and developments, advancements in space weapons is certain and will only contribute further to the risk faced today. That, faced with a dynamic scientific environment, and an inadequate and outdated treaty require careful deliberation as to what avenues one could take to mitigate and eradicate the issue at hand. A few ideas on how this issue could be addressed are discussed below.

For the sake of simplicity, the idea can be divided into five parts each addressing a pillar of the agenda at hand. Part I deals with revising and updating previously failed international action at solving the issue. This would involve deliberations at the United Nations Committee on the Peaceful Uses of Outer Space (henceforth COPUOS) where different shortcomings of the Outer Space Treaty can be considered and deliberated on how they could be addressed. Inadequacies including but not limited to kinetic orbital strike, exploitation of resources and privatisation of space. This measure could also consider setting stricter repatriation measures on countries such as impositions of economic sanctions and trade embargoes, an increased compensation percentage, restriction on international facilities such as international credit and financing and freezing of foreign assets of individuals and entities.

Part II and III involve confidence building measures among different countries regarding international space law and non-hostile uses of outer space and advocating for more transparent space regimes among different countries. The former is an attempt at moral suasion and usage of non-legal and non-regulatory measures to solve the issue. Similarly, the latter aims solely at convincing member nations to be more transparent with space activities in accordance with

[20] 'Wayback Machine' (May 2019) <https://web.archive.org/web/20190502012501/https:/apps.dtic.mil/dtic/tr/fulltext/u2/352807.pdf> accessed 9 October 2024

Article XI of the Outer Space Treaty. While neither can be enforced, they are meaningful steps towards resolution of the issue.

Part IV occupies the bulk of this package, aimed at directly mitigating space weaponization. This measure would involve international organisations like COPUOS and the United Nations Office for Outer Space Affairs (henceforth UNOOSA), and perhaps, the creation of another international treaty or convention. The terms may include restriction on conducting any further direct ascent ASAT tests, and development of ASAT technology. The restriction would further extend to development of inter-continental ballistic missiles and anti-ballistic missiles as well as their technological advancements or upgradation. For units that have already been created, a progressive decommissioning effort could be taken, where timestamps of 2030, 2035 and 2040 can be kept for decommissioning of a certain proportion of the existing stockpile.

Finally, Part V acts as a response to the damage already crossed and addressed the space debris question. This would again require international effort, maybe even including organisations like the UNOOSA. It would start with identifying as much space debris as possible and disseminating the information. This would further include international contributions to a research and development initiative on new technologies to capture space debris. A differential system could be established on countries who are responsible for a large amount of debris.

The Way Forward

While this may be an issue that is actively discussed and has been resolved through past action, several nuances regarding space weaponization continue to be overlooked. The lack of jurisdiction over technology like kinetic bombardment in the Outer Space treaty is testament of the necessity of such action to be constantly amended to the contingent and prevailing situations across the world, be it scientific or political. Any technological advancements post this period need to be carefully identified and analysed to maintain the spirit of international space law.

With regards to the problems currently faced, the technical plausibility and feasibility in implementation of the aforementioned solutions need to be considered as while in theory they may solve problems, their practical and realistic application may be widely different, and any miscalculation or misinterpretation may aggravate the issue as opposed to mitigate it.

International space law isn't confined to the weaponization of space alone, but a large number of aspects this paper does not discuss. The Outer Space Treaty defects in several other matters which, again, need to be carefully identified and analysed. With ever changing scientific, technological and economic environments, it is unequivocally important for such regulation to stay up to date.

Discussions and Conclusions

While outer space may be a bottomless bag of scientific marvels humans earn to discover, it has lost its status as a free and safe medium of exploration, owing to the intensifying geopolitics and power-hungry nature of the Cold War. While the Cold War met its conclusion with the dissolution of the Soviet Union in 1991, the menacing technology developed then has been left behind and has only been improved, not discarded.

The use of outer space for military purposes was a major milestone in the in the human record with reference to outer space, but one particular arm of militarisation that deals specifically with space weapons and the use of space for armed defence brings us to the current situation, one with imminent risks to government, militaries, and civilians worldwide.

ARGUS and Starfish Prime showed the world the true nature of the scale and magnitude of weapons humans were capable of developing, and with modern-day technology such as ICBMs and ASAT systems, it would be foolish for anyone to underestimate the cascading effects that these have on different ecosystems, and to think that humans are capable of effectively preventing and responding to such an instance is only more grave.

This brings us to the status quo, a reality where space debris looms over our heads while we stand clueless as to when it will happen and how adversely it is going to affect the order of the world. Therefore, there would only be one fitting conclusion: an international effort recognising the magnitude of the issue at hand and taking effective measures to resolve it. In which way the world seeks to achieve this is largely subjective, but it needs to address leading issues of inadequate statues, lack of transparency, and ceasing and reversing the vicious development already made. Actions like the outer space treaty are deeply commended, but one cannot deny their ineffectiveness.

If the history of space weaponization teaches us anything, it is that the rate at which developments have taken place in the past two hundred years is ludicrous, and the downside of such a rate of development is obvious. Like everything else, space defence, especially weaponization, will have diminishing returns to a point where it may be too late to revert to a safe reality.

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