### Introduction

# New Horizons of the Nuclear Age

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A B61 thermonuclear gravity bomb (©Jon G. Fuller/VW Pics via ZUMA Press Wire/Kyodo News Images)

There is a period called the "second nuclear age," a term considered L to have been first coined by Colin Gray. While the Cold War marked by U.S.-Soviet strategic rivalry in a nuclear security environment (the "first nuclear age") had ended, it was perceived that the advantages of possessing nuclear weapons, like gunpowder arms, had not diminished and they effectively had entered human arsenals forever. He therefore foresaw that the "first nuclear age" would be replaced in the future by a "second or third new nuclear age."1 Scholarly studies on the "second nuclear age" are generating substantial intellectual insight, and their number continues to rise, including papers and other publications with the "third nuclear age" in the title. The breadth of the literature suggests that the "second nuclear age" may have evolved over the years, newly incorporating phenomena that are thought to represent the "nuclear age" based on the international political and security dynamics of the times. Instead of keywords such as nuclear disarmament and elimination of nuclear weapons, the "second nuclear age" is often discussed in the context of nuclear multipolarity,<sup>2</sup> nuclear proliferation and competition for nuclear modernization (nuclear arms race), the increasing complexity of nuclear deterrence calculations, nuclear threats, limited nuclear war, and the spread of emerging technologies that offset nuclear weapons.<sup>3</sup> This appears to be a characteristic of the "nuclear age" discourse.

Three decades have already passed since the end of the Cold War, and the international security environment surrounding nuclear weapons continues to change significantly. Among the literature on the "second nuclear age," Rod Lyon's article on its three variations has become a convincing explanation. In the first phase, from around 1995 to 1998, the spread of nuclear weapons to "rogue states" and whether it will affect the significance of nuclear deterrence and nuclear doctrines were discussed extensively. In the second phase in the mid-2000s, the debate shifted to the potential erosion of international norms due to fears of a cascading proliferation. And in the third phase in around 2015, the discourse revolved around the competition for nuclear modernization.<sup>4</sup> In other research, Paul Bracken has compared the characteristics of the "second nuclear age" and those of the "first nuclear age" during the U.S.-Soviet Cold War. He suggested that nuclear deterrence, formerly a two-player game between the United States and the Soviet Union, has turned into an n-player game requiring more complex dynamics, and that much of the horizontal nuclear proliferation occurred with advantages to latecomers and with relatively low costs, mainly in Asia.<sup>5</sup>

However, the recent transformation of the international nuclear security landscape may not be an extension of such traditional discourse on the "second nuclear age." Rather, it may be signs of a new development.

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Specifically, the number of nuclear warheads in China may increase non-negligibly (vertical proliferation), and by the 2030s, be nearly on par with that in the United States and Russia where warhead numbers had been decreasing in the post-Cold War era. This is anticipated to give rise to "three nuclear superpowers" for the first time in history. Furthermore, backed by nuclear threats, Russia, a permanent member of the United Nations Security Council (UNSC), is attempting to use force to change the status quo of Ukraine, a non-nuclear-weapon state. Additionally, key arms control treaties, including those covering nuclear weapons, are successively facing threats of termination. Considering these new elements, the "second nuclear age" appears to be approaching a turning point.<sup>6</sup>

What political and military changes will the "nuclear age" undergo in the future, and how will they shape the international security environment? In particular, how are nuclear deterrence, strategic stability, compellence based on nuclear threats, the expansion of domains into space, cyberspace, and the electromagnetic spectrum, nuclear weapons systems, and arms control expected to change or not change? Bearing such questions in mind, this book revisits the new horizons of the "nuclear age" from an academic perspective.

Some key points for reading this book are offered below.

#### The "Revival of Nuclear Weapons" and Heightening Expectations and Concerns about Nuclear Deterrence

In the mid-2010s, a narrative spread that under the concept of "escalate to de-escalate" (E2DE) purportedly adopted by Russia, the country was attempting to de-escalate conflicts fought with conventional forces through coercive threats, including the limited use of nuclear weapons.<sup>7</sup> Some observers have indicated that this E2DE concept was actually not very different from the escalation control approach adopted by the United States and other countries.<sup>8</sup> However, a nuclear-weapon state's probability of using nuclear weapons was deemed to have decreased considerably after the end of the Cold War. Coupled with Russia's modernization of nuclear forces, particularly new low-yield nuclear weapons, the E2DE concept had enough impact to refresh the debate in the United States and the North Atlantic Treaty Organization (NATO) to the idea of escalation control.9 In addition, around this time a series of events occurred on the international political stage that recalled the "long shadow of nuclear weapons." Beginning with President Putin's threatening nuclear rhetoric following Russia's annexation of Crimea in 2014,10 the outbreak of a nuclear crisis on the Korean

Peninsula from 2017 to 2018, the exchange of nuclear threats between the U.S. and North Korean leaders,<sup>11</sup> and repeated assertions of nuclear blackmail by President Putin, senior Russian government officials, and others since Russia's invasion of Ukraine in 2022<sup>12</sup> have all had considerable impact on the international security environment.

Amidst the increasing awareness of the threat posed by nuclear weapons, a trend known as the "revival of nuclear weapons" has gained momentum. This trend involves a reevaluation of nuclear deterrence, which has been in place since the Cold War era.<sup>13</sup> Across the international community, this undeniably raised both expectations for the stability provided by nuclear deterrence as well as concerns about it.<sup>14</sup> Some examples include, firstly, Sweden and Finland, which have long adopted a neutral foreign policy, applying to join NATO in response to Russia's increasing nuclear threats and its invasion of Ukraine.<sup>15</sup> While the moves have drawn mixed reactions, it can be surmised that NATO, a "nuclear alliance," will be extending its nuclear umbrella. NATO, for its part, is thought to have greatly altered its perception of Russia since the annexation of Crimea. In the new 2022 Strategic Concept, it views Russia to be the most significant and direct threat and strongly criticizes its coercive nuclear signaling and other actions. Additionally, China is mentioned for the first time in this document. NATO writes that China is pressing forward with the development of nuclear weapons and strategic delivery vehicles without transparency or engaging in arms control and risk reduction, and emphasizes that China and Russia are subverting the rules-based order which runs counter to the values and interests of NATO members.<sup>16</sup> In Northeast Asia, subjected to a string of North Korean military provocations and nuclear threats, South Korea began making public remarks about the reasonableness of its nuclear deterrence capabilities, especially around the time North Korea announced a nuclear doctrine that clarifies its policy on first use of nuclear weapons and refers to the use of tactical nuclear weapons.<sup>17</sup> Under these circumstances, at an Extended Deterrence Strategy and Consultation Group meeting, the United States and South Korea affirmed to use all means, including diplomatic, informational, military, and economic tools, to strengthen deterrence capabilities against North Korean aggression and counter North Korea's threat.18

#### The "Three Nuclear Superpowers"

The "three nuclear superpowers" refer to the new nuclear deterrence structure emerging from China's substantial buildup of nuclear forces and

As shown in Table 1, the United States and Russia currently possess 90% of the world's inventory of nuclear warheads. Under an agreement in the New Strategic Arms Reduction Treaty (New START), both countries limit the number of deployed strategic nuclear warheads to 1,550. Meanwhile, the U.S. Department of Defense's "Military and Security Developments Involving the People's Republic of China" estimated that China possessed a stockpile of more than 500 operational nuclear warheads by May 2023, and that it will deploy over 1,000 operational nuclear warheads at high readiness levels by 2030. Furthermore, it estimated that China will continue to build up nuclear forces to achieve basic modernization of the People's Liberation Army by 2035 under President Xi Jinping's goal to turn it into a world-class military by 2049.19 If this materializes, current numbers forecast that the United States, China, and Russia will supposedly reach near parity in deployed nuclear warheads. This would undoubtedly have a large impact, both politically and militarily. Some scholars view that the logic of bipolar nuclear stability formed during the "first nuclear age" will be challenged in a situation of great power competition, where the "three nuclear superpowers" are vying with each other, which in turn will further increase both the risk of a nuclear arms race and incentives for states to rely on nuclear weapons in a crisis.<sup>20</sup> Previous scholarship in the United States have, for example, called for revising the deterrence theory since the Cold War era, reviewing the current approach of maintaining strategic stability through retaliatory second-strike capabilities, and shifting to a nuclear posture that emphasizes high precision and responsiveness.<sup>21</sup> Others have argued that the nuclear balance could be upended by the rise of hypersonic weapons, which are difficult to detect and shoot down, and by the rise of space and cyber weapons, which threaten command and control systems.<sup>22</sup> Moreover, a situation where nuclear weapons and non-nuclear weapons, including advanced military technology, become "entangled" arouses concerns about an unintended escalation in great power competition.<sup>23</sup>

are sometimes dubbed the "three-body problem" in previous literature.

Furthermore, there is another important point to keep in mind from the perspective of strategic stability. In the "second nuclear age," all nuclearweapon states and other de-facto nuclear powers<sup>24</sup> face the threat of two or more potential adversaries, and changes in their nuclear posture or nuclear weapon policy may trigger a chain reaction on these states.<sup>25</sup> This suggests that the nuclear arms race or the race to modernize strategic delivery vehicles may create a complex interplay of action-reaction dynamics. It is a reminder that strategic stability is in an extremely delicate balance in today's "nuclear age" that is approaching a turning point. In fact, it has been noted that if the United States attempts to deter Russia and China equally, it may fuel a debate that the 1,550 deployed nuclear warheads under New START are inadequate. At the same time, if the United States shifts to building up nuclear forces, Russia will follow suit to maintain a balance with the United States, and China too will seek to further increase its nuclear forces. Taken together, it is pointed out that they may lead to an outbreak of a new nuclear arms race.<sup>26</sup>

In these circumstances, the U.S. Biden administration's National Security Advisor Jake Sullivan indicated in June 2023 that the United States will take new steps, stating that it will renew its efforts to urge China to engage in arms control and aim to establish a global accord specifying that artificial intelligence (AI) programs will not be used to authorize the use of nuclear weapons without a human in the decision loop. He also remarked that the United States will maintain comprehensive deterrence by supplementing its 1,550 deployed nuclear warheads with new technology, rather than entering into an arms race in response to China's nuclear buildup.<sup>27</sup>

#### **Nuclear Proliferation and Modernization**

Needless to say, India's and Pakistan's nuclear tests and declaration of possession of nuclear weapons in 1998 were in the backdrop of the development of the "second nuclear age" discourse. In addition, North Korea's possession of nuclear weapons declared in 2005 and nuclear tests from 2006 to 2017 can be regarded as supporting evidence for Gray's "second nuclear age" argument. Nuclear proliferation, however, may not be limited to these cases. For example, amid the political upheaval over the Joint Comprehensive Plan of Action (JCPOA), Iran is enriching uranium and is believed to have shortened the breakout time required to produce weaponsgrade highly enriched uranium to a mere few days.<sup>28</sup> Saudi Arabia's Crown Prince Muhammad bin Salman said that his country would seek to acquire nuclear weapons if Iran possesses them,<sup>29</sup> while Turkish President Tayyip Erdogan stated that it is unacceptable that his country is forbidden from possessing nuclear weapons.<sup>30</sup> As these examples reveal, concerns about nuclear proliferation still persist. As great power competition intensifies under the banner of the "revival of nuclear weapons," it is necessary to continue paying attention to new trends in horizontal and vertical nuclear proliferation.

During the Cold War, which was the "first nuclear age," it is believed that the most number of nuclear warheads existed on earth in the 1980s (see Figure 1). Subsequently, the Cold War ended, and the world's nuclear warhead count declined consistently for nearly 30 years during the "second

Country	Deployed warheads	Stored warheads (requires preparation for use)	Total stockpile (total military stockpile)	Total number of warheads, including warheads retired or awaiting dismantlement and disposal	Development status of strategic delivery vehicles, etc. (hypersonic weapons)
United States	1,770	1,938	3,708	5,244	AGM-183 ARRW, etc. Initial operating capability in FY2022 (conventional hypersonic weapons)
Russia	1,674	2,815	4,489	5,889	Avangard deployed and operational in 2019, Kinzhal in 2018 (can carry warheads)
United Kingdom	120	105	225	225	Development via the AUKUS security partnership between Australia, the United Kingdom, and the United States
France	280	10	290	290	Unknown
China		410*	410	410	Deployed DF-17 medium-range ballistic missile (carrying HGV DF-ZF) in 2020
India		164	164	164	Developing BrahMos-II cruise missile (Russia-India joint development)
Pakistan		170	170	170	Developing P282 anti-ship ballistic missile
Israel		90	90	90	Details unknown
North Korea		30	30	30	Developing (details unknown)
Total	3,844	5,732	9,576	12,512	

\*China is estimated to possess over 500 operational warheads by 2023 and over 1,000 warheads by 2030.

Source: Prepared by the author based on "States Invest in Nuclear Arsenals as Geopolitical Relations Deteriorate, New SIPRI Yearbook Out Now," Stockholm International Peace Research Institute (2023); Shannon Bugos and Kingston Reif, "Understanding Hypersonic Weapons: Managing the Allure and the Risks," Arms Control Association website, September 2021; [U.S.] Department of Defense, "Military and Security Developments Involving the People's Republic of China 2023 Annual Report to Congress," October 2023 [ ...] : A decrease from the previous year, ...] : An increase from the previous year).

nuclear age." However, the nuclear forces that have been decreasing are mainly those of the P5, while emerging nuclear-armed states have continued to expand their nuclear arsenals. Furthermore, as nuclear-armed states proceed with their long-term modernization and expansion plans, it was reported that the number of operational nuclear weapons began to increase, albeit marginally, by 2023.<sup>31</sup> At the same time, the modernization of strategic delivery vehicles has become an important focal point, drawing attention to major nuclear-weapon states' and other de-facto nuclear powers' development and possession of hypersonic weapons, with the development of interceptors being urgently needed.<sup>32</sup> In this connection, some view that not only hypersonic technology, but also the pace of modernization and technological progress in recent years may increase new sources of instability in the form of threats and concerns, rather than improved strategic stability. Where technological progress is extremely fluid, it is argued that states are



## Figure 1. Nuclear proliferation trends from the "first nuclear age" to the "second nuclear age" (1980–2023)

Note: This graph shows the trend of estimated values at five-year intervals and does not explicitly reflect, for example, the development status of nuclear explosive devices for nuclear testing.

Source: Graphed by Yoshida Tomoaki, data prepared by the author based on Hans M. Kristensen, Matt Korda, and Eliana Reynolds, "Estimated Global Warhead Inventories 1945-2023," Federation of American Scientists, 2023.

constantly absorbing emerging technologies into their nuclear postures and nuclear doctrines, creating a new nuclear order that is distinctly different from the previous one.<sup>33</sup>

#### The End of Arms Control?

Since the "first nuclear age," arms control has been seen as broadly contributing to: lowering the likelihood of war and the political and economic costs of national defense; narrowing the objectives of war and the scope of violence if war occurred; freezing, limiting, reducing, or abolishing certain categories of weapons; preventing certain military activities; regulating the deployment of armed forces; reducing the risks of accidental events; slowing down arms races; and increasing predictability.<sup>34</sup>

The major arms control agreements that were established between the "first nuclear age" and the "second nuclear age" can be roughly divided into four categories: (1) arms control and disarmament treaties between nuclear-weapon states; (2) arms control treaties spanning nuclear-weapon states and non-nuclear-weapon states; (3) multilateral disarmament and non-proliferation treaties; and (4) nuclear-free zone treaties. Among them, mainly (1) and (2) are believed to be in successive danger of termination in the

"second nuclear age." An example is the U.S.-Soviet and U.S.-Russia Anti-Ballistic Missile (ABM) Treaty that entered into force in 1972. In 2001, the United States notified its withdrawal from the treaty, citing increasing missile threats and the need for missile defense, and the treaty subsequently expired in 2002.<sup>35</sup> Another is the Intermediate-Range Nuclear Forces (INF) Treaty, which entered into force in 1988. The United States long expressed concerns over Russia's missile launch tests in violation of the treaty, and in 2019, suspended implementation of the treaty, citing Russia's development of the SSC-8 (9M729) ground-launched cruise missile (GLCM) as the reason. Russia responded with similar measures, and the treaty was terminated that same year.<sup>36</sup> In 2007, Moscow suspended implementation of the Conventional Armed Forces in Europe (CFE) Treaty, which entered into force in 1992, citing NATO members' failure to ratify the Adapted CFE Treaty. In 2011, the United States decided to withdraw from certain treaty obligations due to Russian actions.<sup>37</sup> In May 2023, while the European security environment was greatly shaken by the invasion of Ukraine, President Putin of Russia signed a decree terminating its participation in the treaty. Russia officially withdrew from the treaty in November of that year.<sup>38</sup> In the case of the Treaty on Open Skies, which entered into force in 2002, the United States announced its withdrawal from the treaty in 2020, citing Russian violations as the reason. In 2021, Russia also announced it would start withdrawal procedures and withdrew from the treaty in the same year.<sup>39</sup> In the case of New START, too, President Putin announced the suspension of the implementation of the treaty in February 2023, and its future remains uncertain as the treaty's 2026 expiration date approaches.<sup>40</sup> In November 2023, Russia decided to withdraw its ratification of the Comprehensive Nuclear Test-Ban Treaty (CTBT).<sup>41</sup> It issued a statement that Russia would not resume nuclear tests unless the United States conducts a nuclear test first, and would continue to observe the moratorium on nuclear testing and operate the monitoring stations of the International Monitoring System (IMS) on Russian territory.42 These examples point to the fact that certain arms control treaties are being terminated or suspended in the midst of the "second nuclear age," signifying a harsh reality-the undermining of the aforementioned value and role expected of arms control, i.e., the "end of arms control treaties."43

Alongside this concerning situation, it should be mentioned that (3) multilateral disarmament and non-proliferation treaties have also faced the problem of stagnating nuclear disarmament. The Nuclear Non-Proliferation Treaty (NPT), which entered into force in 1970, is comprised of three pillars: nuclear non-proliferation; nuclear disarmament; and the peaceful uses of nuclear energy. It forms the cornerstone of today's international nuclear

order and is known particularly for stipulating an obligation to pursue negotiations in good faith on nuclear disarmament (Article VI). However, it has been noted that the erosion of the U.S.-Russian nuclear arms control regime, regional security and nuclear proliferation issues in East Asia, South Asia, and the Middle East, the uneven implementation of commitments made at past NPT review conferences, the lack of universality of the NPT, and differing national views on the positive and negative roles of nuclear weapons have acutely divided the international community over nuclear disarmament.44 For this reason, maintaining and strengthening an NPTcentered international nuclear order as well as international norms on nuclear non-proliferation has become an immediate priority. Meanwhile, some non-nuclear-weapon states have taken actions in response to the calls of civil society and advanced treaty negotiations in a short period. As a result, the Treaty on the Prohibition of Nuclear Weapons (TPNW) was adopted by the United Nations General Assembly in 2017 and entered into force in 2021. While the TPNW is considered to be ineffective without the participation of nuclear-weapon states,<sup>45</sup> it is positioned as a "way out" toward a "world without nuclear weapons"46 and represents a new multilateral movement on nuclear weapons arising from a different cause than the "end of arms control treaties."

#### About the Structure of This Book

This book is broadly organized into the following four chapters, each of which has an academic focus within their respective themes.

Chapter 1 (by Kurita Masahiro) poses a theoretical question: is the establishment of strategic stability always desirable in nuclear rivalries? It examines how strategic stability based on mutual vulnerability affects the sub-nuclear level of conflict and what implications such effects bring to the deterrence relationship at the nuclear level in today's nuclear rivalries. These questions are explored primarily in a theoretical manner, examining the logic of relevant theoretical propositions developed in the Cold War era; however, contexts unique to contemporary nuclear powers are also taken into account. In today's nuclear rivalries, a state of mutual vulnerability may give rise to the so-called stability-instability paradox. This is anticipated to give conventionally inferior revisionists more leeway to engage in violence at lower levels of the escalation ladder. Such actions may trigger a vicious action-reaction cycle in which nuclear-armed rivals seek a variety of options for the limited use of military force, which implicates an increased risk of actual nuclear use. In this light, Kurita indicates that strategic stability based

on mutual vulnerability could be accompanied by nonnegligible negative implications in contemporary nuclear rivalries. However, the intensification of lower-level aggression under the stability-instability paradox, which will trigger this pernicious cycle, is not inevitable. The lower-level actions that weaker revisionists exploiting the paradox can take have some limitations in terms of managing the risk of further escalation. Furthermore, Kurita argues that having lower-level response options that can impose sufficient costs on the adversary can be a promising solution for the status quo powers to deter aggressive actions by nuclear-armed revisionists.

Chapter 2 (by Ohnishi Ken) presents a study on the effectiveness of nuclear compellence-a strategy that uses nuclear threats to change an adversary's behavior-and the conditions for its success from a theoretical perspective. The chapter first reviews previous research on nuclear compellence and outlines its concept and mechanisms. It then looks at the cases of deliberate use of nuclear compellence listed in an existing study and explains that many of these cases ended in failure. Building on this review, the remaining part of the chapter conducts a comparative case study to examine the factors that affect the outcome of nuclear compellence, using the Cuban Missile Crisis and the Sino-Soviet Border Conflict as examples of exceptionally successful cases of nuclear compellence among nuclear-armed states, as well as the Berlin Crisis, the Korean Peninsula Crisis of 2017-2018, and the Russo-Ukrainian War as unsuccessful examples. In this analysis, Ohnishi identifies wide-ranging factors that could affect the success or failure of compellence and suggests that the conditions for success may differ by type of nuclear compellence. For brinkmanship-type nuclear compellence, the conditions for success are: (1) the terms of the demand avoid the adversary's vital interests; (2) the compeller is able to launch a nuclear attack on the adversary's homeland; (3) the balance of nuclear forces is favorable to the compeller; (4) the parties use conventional forces; (5) an incident occurs which indicates a lack of control over the actions of the actors involved; (6) the compeller uses pressure of denial; (7) the compeller uses an ultimatum; and (8) the compeller uses positive inducements. For successful compellence based on the threat of deliberate use of nuclear weapons, Ohnishi discusses that the following conditions apply in addition to (1) to (4) above: (5) there is no incident which indicates a lack of control over the actions of the actors involved; (6) there is strong domestic support for the compeller; (7) there is precedent demonstrating the compeller's strength of resolve; and (8) the adversary is isolated. Ohnishi admits that these factors do not necessarily cover all the requirements for successful nuclear compellence, because there are few examples of past nuclear compellence. Still, he points out that a situation of considerable danger is likely to be necessary to create sufficient

terror in brinkmanship, and in case of a threat of deliberate nuclear attack, its success is likely to require overwhelming nuclear superiority at a level that the first use of nuclear weapons for disarming the adversary becomes a realistic possibility. For these reasons, this chapter contends that it is not easy to achieve successful nuclear compellence.

Chapter 3 (by Arie Koichi) examines how operations in new domains (space, cyberspace, electromagnetic, and cognitive domains) relate to and affect nuclear weapons systems. The analysis covers the impact of AI and other emerging technologies, which can be technological enablers of operations in new domains. The main question this chapter asks is whether the link between new domains and nuclear weapons systems stabilizes or destabilizes nuclear deterrence. In the case of the space domain, although early-warning, communication, and other satellites are among the nuclear weapons systems vulnerable to various types of attack, there have never been serious attacks that disabled the functions of these satellites. This suggests that nuclear-armed states have an incentive to refrain from attacking each other's satellites that constitute nuclear weapons systems, which would contribute to stabilizing nuclear deterrence. On the other hand, such incentives may not always be available in a crisis. An actual attack on a satellite would weaken the second-strike capability of the attacked country, which would destabilize nuclear deterrence. Considering these factors, it can be concluded that the link between new domains and nuclear weapons systems is likely to destabilize nuclear deterrence. In addition, this chapter asks what the policy issues are for stabilizing nuclear deterrence in new domains and what kinds of arms control approaches are desirable to stabilize relations between nuclear-armed states over new domains. Assuming that the development of emerging technologies will usher in rapid advances in the near future in space, cyberspace, the electromagnetic spectrum, and the cognitive domain, placing additional burden on nuclear weapons systems, Arie emphasizes the need to first attempt a normative arms control approach. In the context of expanding domains and emerging technologies such as AI, which are likely to intersect with nuclear weapons systems in the future, this chapter's analysis contains crucial insights for deriving policy prescriptions aimed at enhancing the stability of nuclear deterrence in new domains.

Chapter 4 (by Ichimasa Sukeyuki) addresses the theme of nuclear weapon policy and arms control. It deals comprehensively with how nuclear weapons are regarded by nuclear powers and what rationales underlay the development of leading arms control discourses of recent years. The former analysis examines two of the many aspects that have traditionally characterized nuclear weapon policy: negative security assurances (NSAs), which have attracted attention due to the invasion of Ukraine and nuclear threats; and the policy of no first use (NFU), which has been adopted by China, a country that has significantly expanded its nuclear arsenal amid great power competition, raising the question of whether Beijing will be maintaining this policy. It then broadly considers the nuclear doctrines of nuclear powers, including the aforementioned conditions for nuclear use. It reveals that states have ultimately subscribed to a first use policy, despite the adoption of NFU becoming a focal point in a number of cases. It concludes that while states have been modernizing nuclear forces to maintain and enhance deterrence capabilities amid the "revival of nuclear weapons," nuclear-weapon states and nuclear-armed states do not necessarily share commonalities in arms control approaches and nuclear weapons reduction policies.

The latter analysis examines recent research to illuminate a new discourse on arms control that contributes to strategic stability, starting with a reexamination of the hawks', doves', and owls' approaches to nuclear deterrence and arms control since the "first nuclear age." Specifically, the characteristics and critiques of these major discourses are organized into three categories: (1) arms control that emphasizes avoidance of inadvertent nuclear war and enhancement of deterrence capabilities; (2) arms control that highlights the importance of international norms; and (3) arms control for achieving a "world without nuclear weapons." This chapter proposes what it newly calls a "reasonable approach to arms control under great power competition," a set of short- and medium/long-term owlish arms control measures focused on avoiding inadvertent nuclear war. They include measures that should be taken in the short-term, such as technological updates of hotlines, multi-tiered strategic dialogues, sharing of a verification culture, and the rebuilding of international norms on nuclear non-proliferation. Other measures that are considered, albeit being difficult to implement in the current security environment, include negotiating toward a verifiable nuclear arms control agreement and a reciprocal NFU agreement. In sum, Chapter 4 looks at the present "second nuclear age," mainly from a viewpoint of public policy, and explores new ways of arms control that are practical policy measures for realizing strategic stability.

The above four chapters are accompanied by columns written by spirited and promising young researchers. "Two Schools of Thought on the Logic of Nuclear Strategy" (Motoyama Isao) focuses on the nuclear deterrence and the nuclear superiority schools of contemporary theory in U.S. nuclear strategy and attempts to understand the U.S. 2022 Nuclear Posture Review based on their respective discourses. "Reputation as a Means of Deterrence and Compellence" (Maeda Yuji) takes a multifaceted look at the concept of "reputation" involving variables such as resolve and capability, which becomes important in discussing the reliability and credibility of nuclear deterrence. "Iran and the Nuclear Leverage of Non-Nuclear-Weapon States" (Yoshida Tomoaki) takes Iran as a case study and examines nuclear negotiation approaches that use nuclear weapons development as diplomatic leverage. In particular, it considers the implications of the concept of virtual nuclear arsenals in Iran.

In this book, scholars at the National Institute for Defense Studies specializing in international politics, various issues related to nuclear weapons, and other issues lying between these two areas of study attempt to explore the new horizons of the "nuclear age" from a variety of academic perspectives. The discussions on the "nuclear age" are broad in scope, with previous literature offering substantial intellectual insight. While it is not possible to cover the varied issues exhaustively, the contributors in this book provide analyses and thoughts based on in-depth research into new issues of the "nuclear age," drawing on numerous discussions conducted between them and the arguments made by their predecessors. It is hoped that this book will serve as a "lens" through which readers will understand what is happening today in the "nuclear age" and what prospects may open up in the future.

Lastly, it should be noted that all the views expressed in this book are the personal views of the respective authors and do not represent the views of their affiliated institution.

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