# Introduction to Nuclear Conflict

Key concerns: Though the above-stated obscurity generally questions the very feasibility and narrative practices regarding an event which could wipe out most, if not all, narrative subjects, this paper's specific concern is the why and how of South Asia featuring so prominently in such narratives. Unlike in technological or 'peace studies,' the central concern here, as in this entire special volume, is not the likelihood of conflict, nor the scope of destruction or short-term 'horizontal' or 'vertical' spread of Nazi-Germany-originated violence between sovereign powers. Various authorial and readership choices, ranging from personal experience to global news values, very often produce far more detailed grotesque fantasies of this one 2000-odd mile stretch of territorial human habitation than any other. The cartographic and resilience practices depicted in these fictions therefore are involved not just in post-hoc geopolitical fantasy but in the in-advance imagining of possible catastrophe in our age.

Broader context: The fear of nuclear conflict features prominently in global imagination in times of strife. The specter of nuclear winter temporarily flattens nuanced historical, geopolitical, and civilizational insurgent negotiations between societies into a stark, frightening image. Debates on nuclear deterrence and escalation make typically obtuse foreign-policy theories and jargon part of our global culture. 'The varieties of nuclear conflict' section on historical experience and future possibilities of nuclear war in A Fierce Domain, the memoir of post-apocalypse disaster-contributor Fred Kaplan, is as thorough and well-researched as many academic 'nuclear studies' papers. However, a casual perusal of visual, performance, and literary genres rarely elicits cohesive, consensus accounts of what such conflicts might look, sound, or feel like.

### Historical Context of Nuclear Weapons

Nuclear weapons are a defining feature of the modern era. They were developed - first with governmental sponsorship, and later by additional states - during the Second World War, with the first explosion of a nuclear device occurring in New Mexico in 1945, and the first and to date only detonations of atomic weapons in wartime occurring over the Japanese cities of Hiroshima and Nagasaki. The latter strikes, associated with hundreds of thousands of casualties, have come to be seen variously as causing Japan to surrender, as shortening the war, or as constituting war crimes, among other interpretations. Since 1945, an extended accord among a number of states has held wartime uses of nuclear weapons in check. Yet, proponents of the practice regard the bombs dropped on Japan as pivotal historical events; a number of these individuals have further argued that the bombings are preferable to the use of other tactics to win the Pacific war, including warfare previously engaged in by the US in order to establish aerial firestorms in both Japan and Germany. The bombings are interlinked with issues of terminated wars, statecraft, atomic diplomacy, and the nature of deterrence, among other considerations.

In the years after the Second World War, trillions of dollars were spent to develop tens of thousands of nuclear weapons, which, at the height of the Cold War, were delivered by major powers via warplanes, land-based missiles, submarines, and associated infrastructure. Yet, during this time period nuclear weapons were used in no other wars. At present, the US and its key allies, Russia, China, India, Pakistan, and North Korea maintain nuclear arsenals, while the United Kingdom, France, and Israel are also believed to possess such arms, though this is unconfirmed in the case of the latter two. The field of nuclear weapons studies is directly related to understandings of modern history, including strategy, war, and peace, and broad interests including security studies, international relations, and other invested fields. These inquiries in turn subsume a number of historical, scientific, and mathematical considerations. The essay by Berreby and Peden comprising the present section focuses specifically on the question of how to examine imaginaries of nuclear conflict. This essay examines the history of those approaches.

# The Science of Nuclear Weapons

On the very basic level, there are two fundamentally different types of destructive forces at the heart of thermonuclear weapons as opposed to conventional bombs: nuclear fission, which is the splitting of the nucleus of an atom into two lighter parts, is the main destructive force behind an atomic bomb; and nuclear fusion, which is the joining of the nuclei of two light atoms to produce a heavier atom (and also release enormous destructive energy), which powers a hydrogen bomb. Both reactions involve a redistribution of nuclear forces, resulting in the release of tremendous amounts of energy. A nuclear reactor is a fission weapon that is designed to produce less energy, so the produced energy can be extracted in a controlled manner to drive the turbines in a power plant.

To cause a nuclear fission, a weapon must start with the fuel in a super-critical state, that is with too much fuel to be constrained by the inertial forces. It is necessary to start the reaction very rapidly, before the fuel can be dispersed by the energy release. Modern fission weapons require implosion systems, in which high explosives are used to compress the fuel to densities of two to five times normal, as well as various combinations of blocks of reflector material, neutron generators, target shaping and in the case of some boosted weapons, cylinders of fusion fuel (deuterium-tritium). Fission explosions are started by an extremely rapid release of energy in an implosion system. Depending on how the different systems are designed to work, there are two major classes of nuclear weapons.

### Nuclear Fission and Fusion

A practical discussion of the risk of nuclear war and the ways to reduce it requires a basic understanding of the physical principles underlying nuclear weapons. This and the subsequent section provide only the most rudimentary account of these principles. Contrary to the widespread impression, the primordial energy source of nuclear weapons operates neither by tearing apart the nucleus of the atom into smaller pieces with powerful cutting beams nor by causing them to "blow up" in some uncontrolled fashion. Instead, the destructive power of nuclear weapons is derived from two physical processes called nuclear fission and nuclear fusion.

During this event, some (typically two) of the protons located in the nucleus are transformed into neutrons, possibly by the emission of positrons and of high-energy neutrinos. Nuclear reactions are frequently accompanied by the release of energetic gamma rays. The total amount of energy liberated as the result of a nuclear transformation may be computed from measurements of the differences between the masses of the constituent particles of the reacting nuclei and those of the products, using the formal relationship E = Δmc^2, in which Δm is the change in mass and c is the velocity of light. Since the speed of light squared is equal to a fantastic number of about 9 × 10^16 m^2/s^2, a tiny change in mass translates into an enormous amount of energy.

# Key Players in the Global Nuclear Landscape

The fears concerning the nuclear conflict have been interwoven with the great power competition in much of the world, historically and also contemporarily. Since the cessation of the Cold War, the global power politics have been defined by the systemic transition that first constituted the unipolarity and later evolved to construct a complex structure of the multi-polar international system. Apart from the concerns related to the proliferation regime, the evolution, progression of events and dynamics among the major stakeholders also are an important element in envisioning the nuclear conflict. The areas of concern are coping with the strategic uncertainties, management and controlling the risks and finally stabilizing the deterrence. Countries with the relevant nuclear capabilities are major stakeholders in the international security landscape. United States, China, Russia, UK, France, Israel, India, and Pakistan hold nuclear capabilities and own nuclear weapons as underscored by the International Atomic Energy Agency (IAEA) and are not under its ambit. The situation of nuclear division or bifurcation is also evinced by the Treaty on the Non-proliferation of Nuclear Weapons (NPT); who were tested the bombs before the month of January 1967 are the Nuclear Weapons States (NWS) and others are Non-Nuclear Weapons States (NNWS). As per the article 4 for the NWS agreements, there is no timing provisions – there are no automatic surrender of military weapons and that the nuclear disarmament (part four) is obligatory and regards NPT as the genuine provision that the damage should be erased if the situation occurs. The State party withdraws from the treaty and concerns of supreme interest then he can do it after giving away three months advance notice.

Even the follow-up Seabed Treaty or Seabed Arms Control Treaty (President Kennedy: President Kennedy Signed the Nuclear Test Ban Treaty), which evinced the ban imposed on the seabed super weapons except the peaceful use did not mention the NPT treaty. Likewise, the Atoms for Peace (emphasis on sciences and research fields, medical recovery, industry and agriculture fields) concerning the nuclear energy and the bee in the man’s bonnet programme covering the nuclear weapons and international institutions (e.g. IAEA and Organization for the prevention of nuclear war) cannot be found in the NPT treaty. On the contrary, the Treaty of T3 or the Moscow Treaty which is also named as the Strategic Arms Reduction Treaty (START) has been discussed in and abbreviated as the clause two. A snake in the grass quandary as above, Article 1 of NPT bans the transfer of preventing of nuclear arms on behalf of itself and by himself concerned research and subject matters on considered events declining to the clause three. A conflict of interest and NPT treaty as the South Atlantic Peace or Stability Zone (Treaty of Tlatelolco) related to Latin America and the Caribbean but would get the criterion such as Luxembourg Accords and Saskatchewan Protocol have not been discussed in the NPT treaty. Satisfaction of the five pillars of the Thing, Protocol and NPT treaty, thus resulted in fulfillment of the treaty as one to the other. Consecutively, the clause 2 of the NPT treaty of the items related to guidelines, regulations and binding details does not find mention. Therefore, the items and the clause related to the treaty of the NPT make it famous as one of the world's vague and ambiguous treaties such that it is the rival of the Geneva Protocol Treaty dealing with the rules of law and customary court.

### Nuclear-Armed States

All members of the United Nations should be genuinely concerned by the ticking of the Doomsday clock. However, some states have more reason to worry than others – the United States, Russia, China, the United Kingdom, and France have the capacity to destroy the planet many times over. Israel, India, Pakistan, and the DPRK are estimated to possess fewer than 150 weapons among them, but their few could devastate the planet. The United States, Russia, China, the United Kingdom, and France issued a statement in response to the adoption of TPNW, noting that they can neither sign nor ever become party to it. They also wrote this: "… the initiative clearly disregards the realities of the increasingly challenging international security environment."

In sum, nuclear-armed states are highly unlikely to make a "no first use" pledge because they believe strongly in NATO's "flexible response" doctrine and in signaling the intention to use nuclear weapons when their very viability is in question. Moreover, NATO nuclear weapons are not mere weapons of last resort. According to NATO nuclear policy, the purpose of maintaining nuclear forces and cohesiveness across the alliance is to be able to preserve peace and prevent coercion and any kind of war, especially one (nuclear or conventional) that would threaten the very existence of the allies, however remote that may seem in the present international environment. The United States, in the French view, possesses the greatest nuclear capability among the NATO allies and has global reach with regard to defending the Euro-Atlantic area. Therefore, more than any other NATO ally, it does not want the intellectual and doctrinal aspect of its nuclear superiority to be "erased" by a NATO "no first use" pledge.

# The Impacts of a Nuclear Conflict

The humanitarian impacts of a nuclear explosion can be quite significant, depending on factors such as weapon size, height of the explosion, and current weather conditions. In a nuclear explosion, people and materials near the point of detonation are immediately subjected to extreme heat, followed by intense blasts and radiation. These events can lead to large numbers of dead and injured, as well as massive infrastructure damage. The cumulative effects can significantly harm public health and the environment.

In addition to these immediate consequences, there are several other serious and longer-term impacts that we need to consider. There might be significant radioactive fallout depending on whether the explosion occurs on the ground or in the air, the type of nuclear weapon, and the amount of particles absorbed by prevailing weather conditions. This type of toxicity can move with the wind and cover a large area, potentially causing contamination of soil, water, and food. Nuclear explosions also tend to release large amounts of toxic radionuclides and thousands of kilotons of hazardous extremely fine ash, which can push particles into the stratosphere, spread across large climate regions, and create a significant risk of cold and eventually lead to catastrophic global cooling. Aligning the methane properties of global conflicts is another major concern in the wider climatic fallout from nuclear explosions.

### Humanitarian Consequences

Against a backdrop of growing fears of detonation, experts have only recently begun to analyze the effects that a nuclear explosion today would have. The prospects are catastrophic. A recent study estimated that 33,000 people would die instantaneously from the blast of a single 150 kiloton detonation over London. A further 190,000 would be hurt and require medical attention, with radiation within the first hour killing up to half again of those who initially survive. If this attack was conducted using airbursts, detonating before reaching the ground to maximize the shockwave, the death toll could rise to 138,000 as properly built brick buildings collapsed on anyone inside. Using more powerful weapons, as the stockpiles of even UK rivals, would parallelly escalate the damage. The exercises such as the one outlined above model a single detonation, of a single missile, of a single warhead. A large-scale attack in a full-scale war would multiply the fatalities and the affected area – casualties from the dust and smoke in the air that could create massive fires.

The real number of the damaged and easily developed numbers surpass these illustrations, with the National Academies of Sciences presenting an estimate that a more modest airburst blast over Washington DC would cause 1.5 million prompt casualties. How large the damage is depends on the power of the explosion. If the warheads involved in causing those casualties detonated near the ground, in a fireball creating a rolling pressure wave that impacts everything around it, the presumed estimate varies to between 3.5 and 11 million burned, dead, or injured, with a maximum of 70,000 square kilometers of total blast damage. In addition to the immediate humanitarian concerns raised in this scenario, and excluding the massive secondary effects of ash cloud and nuclear winter, the cumulative effect of radioactive isotopes released into the environment as a result of the blast can be proportionally if not more damaging.

# Strategies for Prevention and De-escalation

How can nuclear conflict be prevented? Many measures have focused on de-escalation and have tended to be concerned with humanitarian, political, ecological, and economic impacts of nuclear warfare rather than with the likelihood of such warfare taking place. One branch of this argument has been the Campaign for Nuclear Disarmament's use of the phrase "countdown to midnight" to express nuclear danger. This approach has been informed by notions of human rights and the rule of law.

Another aim of such measures has been to remove any political view of nuclear use as some kind of possible deliberate political decision, instead reconceptualizing it as an unsought and uncontrollable accident. This did not necessarily conflict with de-escalation. Some international treaties (rather than unilateral moves) have sought to prevent unintentional nuclear war. The 1963 "partial" Test Ban Treaty (forbidding nuclear tests in the atmosphere, open water, and outer space) was driven to a significant extent by atmospheric, oceanic, and public health concerns, as well as by tactical military concerns about the Russian and American bomb yields. Likewise, the 1972 United States-Russian Anti-Ballistic Missile (ABM) Arms Control Treaty was driven by the logic of legitimizing an ongoing superpower military status quo and preventing nuclear accidents by preserved mutual deterrence, rather than by disarmament. Possession of missiles in the hundreds, rather than the thousands, has also been seen as creating the risk of entangling alliances and military accidents, including nuclear ones.

### International Treaties and Agreements

Negotiated and agreed by state members from all around the world, international treaties and agreements are important instruments for preventing and managing the risks of nuclear conflict. These legal instruments are adopted in peacetime to contribute to peace and security. What is important to note is that the value of these international treaties is not only their content, not only the concrete obligations on states-parties, but the treaty-making process itself is significant for reducing tensions among the participating states and closing disputes on principles and norms of conduct.

From their very inception, these treaties address the questions of the legitimacy and justifiability of the use of nuclear weapons. There is a strong moral understanding that the use of these weapons is beyond any military necessity. Moreover, their use carries huge risks and may result in unintended and tragic humanitarian impact on civilian populations. These considerations about the risks of nuclear use were the foundation of the Treaty on the Prohibition of Nuclear Weapons that was adopted in 2017, although that treaty, generally disavowed by the nuclear-armed states, has not made much impact on the prevailing national nuclear policies. However, even nuclear-armed states maintain that no one would benefit from the actual use of nuclear weapons and that their role is purely to dissuade others from using them.

# Imagining the Unthinkable: Scenarios of Nuclear Conflict

Nuclear weapons have been used in war only twice, at the end of the Second World War - the United States detonated fission bombs against the Japanese cities of Hiroshima and Nagasaki. Since the early 1960s, when the United Kingdom, United States, and Soviet Union entered into agreements to ban atmospheric nuclear tests, a complex regime, including the 1968 Non-Proliferation Treaty, has sought to prevent the further spread and use of this ultimate category of weapons of mass destruction. States not covered by the NPT, including India, Pakistan, and Israel, developed such weapons covertly. As of 2022, nine states were publicly committed to having these weapons, while some other states, including Japan, South Korea, and Germany, were known to have the capacity to quickly acquire them should the need arise.

Catastrophic nuclear war has remained a frightening feature of popular culture, and particularly political history, imaginations. Sudden, global-scale militarized conflict is hard, if not impossible, to predict in detail given its multimodal causes and hard-to-model systemic effects. Unlike hypermodeled, incrementally worsening climate change, nuclear war sharply and simplistically paradigm-breaks the regularia offered by Dayton's nuclear "general models". With this in mind, the contribution sought to begin a discussion on the unique and disparate complex of factors which might lead to such a theoretical outcome or which it might influence. The fictional scenarios of countdown narratives or indeed countdowns themselves have operated in two distinct dimensions. First, a countdown might actually expose, precipitate, or cause an event with a world-ending longitudinal history, culminating at the End of the countdown. Second, and by contrast, a countdown might be part of a designed or accidentally scheduled programmed event, disaster, or catastrophe, and it could indicate that the stakes and the attitudes of the parties to some explosion had undergone change in these few minutes.

### Limited Nuclear Exchange

While the concept of a limited nuclear exchange can seem like an abstraction or even a fantasy, mapping out a possible scenario is a necessary exercise in strategic planning and analysis. This particular scenario imagines a war between two hypothetical states in an area of the world that is strategically important, although not theoretical in any one particular way. As a work of imagination, and in compliance with existing nuclear weapons and civilian protection policy, it includes no classified information, yet invites you to consider the existential challenges such a scenario presents.

In considering the possible death, suffering, and displacement of millions, questions like these become not just flashcards of geopolitical fact or fodder for policy debate, but for moral reckoning. How does one prepare to defend such a place, or command such an attack, or minister to its victims? The consequences of any nuclear exchange are catastrophic, of course, but in any but the most apocalyptic scenarios, the nations and peoples of the world will have to reckon with the world in its aftermath. In the spirit of Countdown to Catastrophe, this piece is not intended to prescribe a particular set of policies but to incite moral reflection and strategic thinking.

# Media Representations of Nuclear Conflict

The catastrophic consequences of any nuclear conflict are by now well understood. The destructive power of the nuclear arsenals in existence today is such that any exchange of nuclear weapons would have terrifying outcomes for human communities and for the natural ecosystems that support us. Nuclear weapons, then, are distinguished by their qualities of destructiveness beyond any notion of victory or defeat. They are inherently indiscriminate and their deployment to harm people directly would be a grave violation of international humanitarian law. The very existence of these weapons poses real threats to life, peace, and security. Today, nuclear weapons are increasingly talked of as an urgent global problem by everyone from religious leaders to civil society actors, international peace maestros, and governments.

The likely effects of a nuclear conflict have been studied by scientists, military operatives, and activists. Mike Edwards writing in the early 1980s reports nuclear exchanges being seen as slow and protracted events which are not the sharp 'bolt from the blue' seen in Dr Strangelove. The film Countdown to Looking Glass showed the escalating human suffering such a conflict would produce on American, Russian, Chinese, and other people. Mindful of the destructive power of these weapons, calls for the preventive elimination of nuclear arsenals have become more commonplace, from UN resolutions on the humanitarian impacts of nuclear weapons to the Treaty on the Prohibition of Nuclear Weapons.

### Movies and Television

Movies and television, whether set in the near or distant future, also help us understand how the general population might react to a nuclear catastrophe. From the jeremiad of "On the Beach" to the Dark Ages of "The Day After" and "Testament," nuclear conflict is generally viewed as an end. Moving away from these narratives, movies of the past few years anticipate the disintegration of society as we know it rather than extinction. In Zack Snyder's adaptation of the "Dawn of the Dead," a group of survivors tries to carve out a new existence in the bowels of a shopping mall. "Save the Green Planet" from South Korea is a story that moves away from an apocalyptic future and into an apocalyptic frame of mind as an obsessive man tortures the wrong man to save the earth from "the intergalactic headquarters" who are slated to launch a satellite that will poison our planet.

Expressions of nuclear fears continue to be an important part of national and international cinema. Despite vast changes in the world over the past two decades, including the end of the Cold War and the U.S. triumph in the Gulf War, powerful forces and interests keep alive the uncertainties, anxieties of death and dying, ambiguities over science, and political paranoia that are the staples of the disaster film. Movies and television continue to frame issues and condition attitudes about the possibility of a nuclear conflict. These popular culture media play a crucial role in how nuclear apocalypse is "spent," as well as in how society would respond to such a threat or event. Nuclear war itself is viewed as something created or controlled by "madmen in high office, not the average taxpaying citizen." Filmmakers find this distancing from national responsibility to be profound, and foreign (usually Russian) leaders are generally cast as the initiators of nuclear holocaust. From "Dr. Strangelove" to "Atomic Twister," the exigencies are about the agony and existential absurdity of terrorism from the US government or from a foreign friend. Presidential perfidy and political paranoia is so much more compelling than the daily activities of preventing war. Films and television tell us how they construct social interactions and depended on specific and avoidable personal actions or the action of some manageable, if bad, government officials. More often than not, Americans in these movies and television programs share a view of nuclear conflict as a kind of cruel lottery or the result of a few, preventable human actions than as the logical result of a series of historical events and actions that led to nuclearism and atomic repression.

# Psychological and Societal Responses to Nuclear Threat

How do people respond when they are faced with the threat of nuclear conflict? The question is examined here from the perspectives of the social and psychological sciences. We focus first on fear and how it translates into personal and communal forms of anxiety, specifically examining the fear of betrayal by one's closest neighbors and how it may provoke particularly intense fear and trauma. Secondly, we provide an overview of research on the determinants of public anxiety over nuclear threat, considering public perceptions of the destructiveness and probability of nuclear war, the winnability of such a conflict, and perceived enemy intentions (i.e. the extent to which an opponent is considered to be potentially open to persuasion or deterrence). The research suggests that cognitive responses to threat (i.e. perceiving it to be relatively high in destructive power and probability) are not as strong determinants of public anxiety as emotional evaluations like perceived enemy intentions or national resolve. We conclude with a brief overview of research on societal reactions to the threat of nuclear war and summarize the principal potentially policy-relevant implications arising from the psychological and sociological study of nuclear danger.

Fear at the top of government can have unpredictable outcomes. In a severe crisis, a head of state may be drawn to adopt a cautious and conciliatory stance simply because responding aggressively "is inappropriate and dangerous—at most, in the face of potential disaster, decisive action of any kind could only add to already overwhelming tragic chaos". Behind the scenes, we do not know how policymakers react. Countless researchers have described humans' deep psychological capacities for rationalization, denial, and compartmentalization—all serving to help them blunt fear, postpone deep reflection, maintain the will to act when not all is known, and not have one's life consumed by potentially paralyzing fear. Indeed, sociologist Karl Weick owns the phrase "organizing is a regulating process of thinking that aims to help generate the courage to act and the wisdom to doubt". If necessary, fearful policymakers might well focus on the task of governing and leading the public, while cultivating the "courage to act and wisdom to doubt" that some of the options for dealing with nuclear conflict may have legacies that perpetuate conditions for multiple and mutually assured destruction. A more pressing question is: What kinds of fear are most likely to emerge and how are they likely to play out among ordinary Russians, Indians, and Chinese?

### Fear and Anxiety

Fear and particularly anxiety are popular topics. Almost everything that could worry us to an excessive degree is termed "anxiety-provoking." Though the feeling is familiar to virtually everyone, it has been a more salient concern during some times than others. From the late 1940s to the early 1970s, vast numbers of United States (U.S.) citizens either already feared or suffered from what was then more technically termed "atomic anxiety." As an early 1950 article in Consumer Reports noted, "It now constitutes the country's number one emotional problem." Given this obsession with the consequences of full-scale nuclear war, we might naturally assume that the film industry would offer a multitude of films that depict what the aftermath would be like. Instead, a mere handful of 1950s films dared to grapple with the freighted subject of what nuclear war would do to the planet that we know.

There are for the failure, made films in which hapless persons are exposed to radioactivity and go berserk; a small number of post-apocalyptic films do exist, most notably the little-seen 1959 film, The World, the Flesh and the Devil. It is into this latter category that the 1959 Twilight Zone episode "Time Enough at Last" would seem to fit. Based on an abbreviated version of Lyn Venable's 1953 short story (Venable's original is quite a bit less apocalyptic than that which cinema portrays) and adapted by the show's creator and host, Rod Serling, "Time Enough" offers a bleak and decidedly cold portrayal of humankind in the wake of a nuclear exchange. Serling can take scant comfort from the fact that, other than his series, Americans were equally disinclined to be confronted with the aftermath of nuclear novelty or how it dwells in the imaginations of a small and disillusioned slice of the remaining, surviving humans.

# The Role of Technology in Nuclear Conflict

Forward-thinking presentations often consider the role of technologies on the future of nuclear conflict, including questions of surveillance, AI, cyber-warfare, and hypersonic glide vehicles. Especially common is a focus on excess oversight, the cyber-vulnerabilities of nuclear systems, computer network breaches, and fears of a loss of control. This article is not a plea against discussing the role of technology in the future of nuclear conflict. Instead, I emphasize that we often lack the interdisciplinary conversations necessary for addressing these topics. This article's aim is to bridge the gap between nuclear and technology studies to conceive how technological issues might shape future threats in the realm of nuclear weapons.

Of the dangers lying at the intersection of nuclear weapons and digital technology, the emphasis rests, in the field of technology policy, on cybersecurity in external interim systems, particularly during the modernization of nuclear technology and arms control. Shortcomings in such forms of cybersecurity are dangerous, and the necessary improvements require specific policy initiatives. By addressing these lines of critique, one rather familiar thesis in the existing literature has been very well-regarded: the discrepancies between command-control systems make the command-control systems of nuclear weapons increasingly vulnerable to invisible cyber interventions, while – at the same time – the available time for decision-making is contradicted. In other words, digital technologies are increasingly contributing to the transformation of the vulnerability of nuclear weapons into a cyber-vulnerability. We contend that while this research is logical, conceptually clear and provides interesting recommendations for policy, the argument rests on premises in need of democratic interrogation.

### Cybersecurity Vulnerabilities

Nuclear weapons systems have always relied on advanced, state-of-the-art, networked technologies to operate, and these systems are increasingly dependent on software to communicate securely. Right from the earliest days of the computer, there has been a belief behind the science of computing, attested to by the award of the Turing Prize, that computing could solve complex strategic problems. Inherently, computer simulations are determined by data inserted or programmed into them, but as a subject of political theory, it is interesting to observe how states' perceptions of AI and machine learning as non-transparent black boxes that could potentially manipulate data have shaped responses to their use in the field of war and defense. One of the most significant changes would be the shortening of the time-scale in which humans would need to make decisions. The pace at which future human-machine interactions might take place, intersecting with problems in strategic stability, was put on display in an experiment in which, unbeknownst to DEFCON players, a worldwide nuclear conflict was set on "automatic". The attack was over in 4 seconds—and 1.2 billion people were dead. This report further identifies the mobile intercontinental ballistic missile, due to technological risks in cybersecurity, as a potential critical, and likely unintended escalatory role in shaping a nuclear conflict.

Of all weapons of mass destruction, nuclear weapons remain the most feared, and the most feared of their potential is when employed in war. The international conventions known as the law of armed conflict do not speak simply of weapons—the articles in the early treaties variously mention the means of war, and the armament of ground, sea, and air forces—but already war is referred to as engaging simultaneously computing, radio, and silent electronic commands to operate. Nuclear weapons systems have always relied on advanced, state-of-the-art, networked technologies to operate. Technology can be disarmed to produce effects in the future which will manifest themselves in current wars—and current wars expand to fill and then exceed the losses from future nuclear conflict. Once we establish the transmission of behavior from one state or conflict between AI and the problem of technological addiction and possible use on the part of enemy states, we then have to weigh the implications of the returns on our own posture. Software will continue to dominate the operation of military systems, and militaries will continue to require some level of interconnectivity between their platforms in order to operate.

# Ethical Considerations in Nuclear Warfare

Citing Lewis, Danchev illuminates the central ethical dilemma to be confronted in a nuclear exchange: "A model question of 'just war theory' is what, if any, restrictions there are upon one side learning from a nuclear first strike in an ongoing war, rather than in the downward spiral towards greater catastrophe." This makes a valid inference for the opposite, for a growing public and scholarly concern not with the strategically possible but the morally permissible. With parallels in missile defense on the table, such an inquiry has obvious present-day connections, and the book contends, "demands an adequate response."

The response can be framed as a gift of necessity to the broader strategic policy discourse. To slot such an enterprise into a just war theory paradigm suggests a focus on moral constraints at the operational or theater level. This approach can, however, miss much of what is of moral concern where weapons of mass devastation are involved and the wider context will be considered. Civilian protection and welfare, and achieving an enduring engagement with the belligerent parties (including rehabilitation and reconciliation) are also central to just war theory. Despite an established trend in the post-Cold War world deprioritizing nuclear weaponry, events like this year's North and South Korea encounters remind us that in some circumstances this is not only likely to be misplaced but dangerous. An exploration of the morality of nuclear warfighting, in the broadest sense of the word, is neither the indulgence of idealists nor the privy of realists but imperative to appropriate policy development.

### Just War Theory

What is a morally just war? Surely, it is not the wild and indiscriminate killing of innocents that a nuclear attack would bring about. Those who ask whether nuclear war can be won typically presuppose the reasonableness of intentionally killing hundreds of thousands—perhaps millions—of civilians. Yet almost every genuinely just war theorist has argued that, despite the carnage wreaked upon soldiers, just combatants cannot willingly kill the innocent. However much more powerful might be the arsenal of an army of the "good guys," these traditional thinkers have concluded that, in the dignity of the human person, battle must be waged as much as possible exclusively against combatants.

Explorations of the morality of nuclear war emerged in the 1940s and threaded their way through to the twenty-first century. In International Ethics, the just war tradition has been introduced not only in the context of an explicit understanding of traditionally justifiable resort to armed force, but also as a more general framework for assessing the justice of war and conflict. Those ethicists who think nuclear war can be justly fought, and most of them are Catholic, Jewish, and Protestant ethicists and theologians, tend to argue in one of two ways. Some focus upon what they maintain will be the moral justifications for launching a nuclear attack (proponents of nuclear deterrence, though, predict anew the improbability of nuclear war). Others emphasize how individuals, leaders as well as soldiers, ought to conduct themselves in the "anticipation" and "realities" of a nuclear conflict at both the tactical and strategic levels.

# The Future of Nuclear Conflict

In 2005, the Defense Science Board, an influential committee that advises the U.S. military on technical matters, published a report warning of a "transformational era" of military technology. "The end state for nuclear weapons," the panel wrote, "could be a variety of advances and new technologies providing the means for using nuclear weapons to affect outcomes with reduced collateral damage." The question is: in which direction will the end state of nuclear conflict transformation evolve? What has a nuclear exchange between nuclear-armed adversaries looked like in the past, and what could it look like in the future?

Would the remaining years of the 2020s, the 2030s, and perhaps the 2040s follow on the Cold War in an increasingly violent manner? Armed conflict between nuclear-armed adversaries in 2050 could become a norm. The bid to affect large-scale outcomes—that is, in practice, global power structures—would be the key feature of nuclear use, differentiating it from non-nuclear armed conflict. In the atmosphere of both fear of nuclear escalation and promises of escalation dominance, both sides may and probably will risk rather high levels of destruction. Neither side is totally vulnerable or impotent. However, the first user would understand that the reactionary nuclear actions of the second user would come with a higher risk of a decisive retaliatory strike in times of nuclear peace. This would increase first use incentives at the time of conflict.

### Emerging Technologies

That perspective doesn't actually exist yet. Technology is emerging in many areas with implications for the future of nuclear conflict, cyber warfare, and intelligence collection. Little is known or understood about their potential long-term effects, partly because the behavior and effects of these dual-use emerging technologies tend to be speculative. Our picture of the world 20 years from now is therefore provisional, containing many unknowns and uncertainties. This chapter takes a forward-looking approach to the technological dynamics that might shape the future of interstate nuclear warfare. It consists of a collection of speculative essays that track independent ideas and potential implications for the future nuclear conflict environment.

The uncertainty is by design and intended to serve as a provocation. Security specialists need to begin preparing for and discussing issues surrounding these emerging technologies as we understand more. Include suggestions ranging from weapons and analysis, through verification and verification systems, to humanitarian implications, including shifts in society: from emerging weapons and their testing, employment, and effect on strategy to broader nonproliferation regimes. Cover the effects at the country or regional level, like the impact of AI on emerging weapons in Pakistan.

# Conclusion: Moving Towards a Nuclear-Free World

The countdowns examined in this chapter ruled the world and our imagination for more than 40 years. They were constantly repeated, with changes arising from new global and local events. Their impact diminished socio-politically over time, coincident with a decreased sense, among major powers, of genuinely believing that nuclear Armageddon was likely. But there could be no such certainty. The irreversible nature of large-scale nuclear war meant that any future crisis, resolved badly, might yet result in the unthinkable. It now appears, once again, that the world is made up of many more potential theaters of nuclear conflict than we imagined even in the wildest days of the Cold War.

History, then, teaches us two lessons. First, a terrible eventuality undoubtedly exists when nuclear weapons exist and the political climate turns sour. We keep forgetting or not knowing what those catastrophic consequences might be, and it is to be hoped that we shall never learn them by experience. Secondly, if the foregoing sometimes reads like so much doom-mongering, we should remember that the Cold War came to a peaceful end, something possible only because, within the internal balance of terror, there existed a measure of rationality and a belief that the ultimate deterrent should not be used. Many things, however, could have turned that balance asymmetric, including adventurism or great-power confrontation in the less discernible political climate that now ensues. As unlikely as serious use of nuclear weapons may be, Hawthorne's words remind us that "none of the end results of history were likely ones."