

Producing Collapse: Nuclear Weapons as Preparation to End Civilization

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Madmen govern our affairs in the name of order and security. The chief madmen claim the names of general, admiral, senator, scientist, Secretary of State, even President. The fatal symptom of their madness is this: they have been carrying through a series of acts which will lead eventually to the destruction of mankind, under the solemn conviction that they are normal responsible people, living sane lives and working for reasonable ends – *Lewis Mumford*.¹

Introduction: On Living with Collapse

The possibility of an end of humankind has always existed, in fact and in the imagination.² What has changed over the last seventy-five years with the coming of nuclear and thermonuclear weapons, their structures of governance, the contentious politics around them and over the human future, in short the nuclear age, will be the focus of this chapter. The civilizational feature that characterizes this age has been described by E. P. Thompson as an exterminist structure encompassing “the [nuclear] weapons system, and the entire economic, scientific, political, and ideological support system to that weapons system—the social system which researches it,

¹ Lewis Mumford, “Gentlemen, You are Mad!” *The Saturday Review of Literature*, March 2, 1946, pp. 5-7, p. 5.

² Thomas Moynihan, *X-Risk. How Humanity Discovered its Own Extinction*. Boston, MIT Press, 2020.

‘chooses’ it, produces it, polices it, justifies it, and maintains it in being.”³ This structure is geared around the ambitions of producing and deferring the sudden catastrophic ending of civilization – what Thompson calls the “thrust of exterminism”.

From the beginning, those who set the world on the path to nuclear weapons understood this path led to and could end with catastrophe. In his memo of April 25, 1945, US Secretary of War Henry Stimson explained to President Harry Truman that the nearly completed atomic bomb would be “the most terrible weapon ever known in human history [...] modern civilization might be completely destroyed.”⁴ Stimson also shared his judgment that this weapon technology would be such a dominant political and moral structure as to overwhelm civilization itself, observing that “the world in its present state of moral advancement compared with its technical development would be eventually at the mercy of such a weapon.” For his part, Truman came to a different understanding. He recorded in his diary, “We have discovered the most terrible bomb in the history of the world. It may be the fire destruction prophesied in the Euphrates Valley Era, after Noah and his fabulous Ark.”⁵ A few months later, once the bomb had been built, tested in New Mexico, and used to destroy the Japanese city of Hiroshima, Truman wrote in his diary that the bomb was “the greatest thing in history.”⁶

The exterminist structure now exists in nine states, who as of 2020 together hold roughly 13,400 nuclear weapons, with the United States and Russia holding just over 12,000 (90 percent) of these weapons.⁷ A related shadow structure exists in those states allied to the United States who rely for their defense on U.S. use and threat of use of its nuclear weapons (Belgium, Germany, Italy, the Netherlands, and Turkey have U.S. nuclear weapons stationed on their territory, unlike other US allies in Europe or elsewhere who are covered by U.S. nuclear weapon use commitments). North Korea possesses an arsenal which is estimated currently to be the smallest

³ E. P. Thompson, “Notes on Exterminism, The Last Stage of Civilization,” *New Left Review*, Issue 121, May/June 1980, p. 22.

⁴ Henry Stimson, “Memorandum Discussed with the President, April 25, 1945,” <https://nsarchive.gwu.edu/documents/atomic-bomb-end-world-war-ii/006b.pdf>.

⁵ Harry S. Truman, Diary, July 25, 1945, <http://www.dannen.com/decision/hst-jl25.html>.

⁶ Martin Sherwin, *A World Destroyed: Hiroshima and the Origins of the Arms Race* (New York: Vintage Books, 1987) p. 221.

⁷ Hans M. Kristensen and Matt Korda, Status of World Nuclear Forces Federation of American Scientists, <https://fas.org/issues/nuclear-weapons/status-world-nuclear-forces>. The arsenal estimates are for 2020.

in size of any of the nuclear-armed states, but its few tens of nuclear weapons are sufficient to devastate nations. In all these states, the existence of an exterminist structure should not be taken to mean that it is supported by a majority of the population. In fact, it is largely invisible.

In this chapter, we aim to outline the production of a planetary scale nuclear destructive capacity over the last seventy-five years alongside the production of its invisibility. Our goal is to show how and why the dangers inherent in the nuclear age and its foreseen possible catastrophic ending have not been and still are not well understood.

I / Planning on Producing Nuclear Collapse at a Planetary Scale

The history of planning and preparing for nuclear war is the history of producing collapse and ending civilization. The early scientific efforts to understand the possibility of making a nuclear weapon included seeking to assess the possible consequences of the effects of such a weapon. A pioneering example is the secret Frisch-Peierls technical memorandum of 1940 “On the Construction of a "Super-bomb" based on a Nuclear Chain Reaction in Uranium” to the British government. This inferred from basic physical principles what would be needed technically to build a simple atomic bomb and its effects: the destruction of a city by blast and the killing of large number of civilians even miles away from the explosion by radioactive fallout.⁸

In 1942, as part of the secret US Manhattan Project to build the atomic bomb, which was inspired in part by the earlier British work in this direction, Edward Teller conjectured that the explosion from an atomic bomb might generate so much heat that it would trigger a runaway fusion reaction, igniting the Earth’s atmosphere. Robert Oppenheimer, who led the scientific work at Los Alamos on bomb design, was told of this and is reported to have “got quite excited” and declared “That’s a terrible possibility.”⁹ This concern about quasi-instantaneous extinction was questioned

⁸ Otto Frisch and Rudolf Peierls, “Memorandum on the Properties of a Radioactive Superbomb,” reprinted in Lorna Arnold, “The History of Nuclear Weapons: The Frisch-Peierls Memorandum on the Possible Construction of Atomic Bombs of February 1940,” *Cold War History* 3 (April 2003), pp. 111–26.

⁹ John Horgan, “Bethe, Teller, Trinity and the End of Earth - A leader of the Manhattan Project recalls a discussion of whether the Trinity test would ignite Earth's atmosphere and destroy the planet,” *Scientific American*, August 4, 2015, <https://blogs.scientificamerican.com/cross-check/bethe-teller-trinity-and-the-end-of-earth>.

by Hans Bethe, who led the Theoretical Division at Los Alamos. In a later interview Bethe said he judged the prospect “incredibly unlikely,” but noted that the concern clearly persisted since in July 1945, on the eve of the first nuclear weapon detonation, fellow Manhattan project physicist, and Nobel Laureate, Enrico Fermi offered to his colleagues: “let's make a bet whether the atmosphere will be set on fire by this test”.¹⁰ Some of the Manhattan Project scientists were willing to wager on this outcome. Uncertainty about triggering the end of the world did not stop the scientists and military planners from moving forward with the project of developing such weapons.

The first nuclear test (Trinity, carried out in New Mexico) inspired a vision of the bomb as a threat not only to mankind but to all forms of life. Physicist I. I. Rabi who witnessed the explosion observed:

“At first I was thrilled. It was a vision. Then a few minutes afterwards, I had gooseflesh all over me when I realized what this meant for the future of humanity. Up until then, humanity was, after all, a limited factor in the evolution and process of nature. The vast oceans, lakes and rivers, the atmosphere were not very much affected by the existence of mankind. The new powers represented a threat not only to mankind but to all forms of life: the seas and the air. One could foresee that nothing was immune from the tremendous power of these new forces.”¹¹

In the 1950s, the destructive capacity of nuclear arsenals in the United States and, to a lesser extent, the Soviet Union, increased massively with the creation of thermonuclear weapons (hydrogen bombs). The new weapons were orders of magnitude more destructive than the previous generation of weapons, with yields measured in thousands of kilotons (megatons), a thousand times the yield of the simple atomic weapon in the Trinity test and those later used to destroy the cities of Hiroshima and Nagasaki. As before, some leading scientists imagined and shared their concern about the pursuit and consequences of the destructive power being considered even before work started.¹²

¹⁰ Horgan, 2015.

¹¹ Ferenc Morton Szasz, *The Day the Sun Rose Twice: The Story of the Trinity Site Nuclear Explosion*, July 16, 1945, Albuquerque, NM: University of New Mexico Press, 1984, p.90.

¹² Zia Mian, “Out of the Nuclear Shadow: Scientists and the Struggle against the Bomb,” *Bulletin of the Atomic Scientists*, January 1, 2015.

The US government scientific committee that was set up in 1949 to consider the possibility of a hydrogen bomb included some of the physicists who had built the first atomic bomb, among them Robert Oppenheimer, Enrico Fermi, and I. I. Rabi. In its secret report the committee assessed that thermonuclear weapons could probably be built within five years, but strongly opposed it. The majority on the committee took the view that the proposed weapon would be a “weapon of genocide,” and a minority on the committee went further, declaring “The fact that no limits exist to the destructiveness of this weapon makes its very existence and the knowledge of its construction a danger to humanity as a whole. It is necessarily an evil thing considered in any light.”¹³

Focusing on the US arsenal only, Daniel Ellsberg dates the birth of a nuclear “doomsday machine” to the 1950s.¹⁴ On March 16, 1958, General Robert Cutler, President Eisenhower’s special assistant for national security affairs, wrote to the President that military requirements called for “all the nuclear weapons that could be produced and as rapidly as possible,” while noting that a recent war game had involved seven million kilotons of nuclear explosives and that he worried that “the effect of any such exchange is quite incalculable. [...] It is possible that life on the planet may be extinguished.”¹⁵ As Cutler proposed, the US nuclear arsenal expanded quickly, growing from around 7000 weapons in 1958 to around 20,000 weapons in 1960, with a total yield exceeding 20 million kilotons (20,000 megatons), almost three times larger than what had been imagined as would be used in the nuclear wargame.¹⁶ The “incalculable” and possibly life-ending consequences of such an arsenal appeared to offer no restraint.

A similar awareness that early nuclear war plans would produce collapse at least at the national level was shared among the few who studied the effects of nuclear warfare in Britain and

¹³ General Advisory Committee, United States Atomic Energy Commission, Report on the “Super,” October 30, 1949. Reprinted in: Herbert F. York, *The Advisors: Oppenheimer, Teller, and the Superbomb*. Stanford, CA: Stanford University Press, p.160-161.

¹⁴ Daniel Ellsberg, *The Doomsday Machine*, New York: Bloomsbury, 2017.

¹⁵ Cited in Martin J. Sherwin, *Gambling with Armageddon*, New York: Alfred Knopf, 2020, p. 136.

¹⁶ Robert S. Norris & Hans M. Kristensen, “U.S. Nuclear Warheads, 1945-2009,” *Bulletin of the Atomic Scientists*, 65:4, 2009, pp. 72-81.

France.¹⁷ As early as 1954, a French journal on civilian protection stated that fifteen thermonuclear weapons would suffice to annihilate France.¹⁸ Similarly, in 1955, in Britain, the secret report on the implications of thermonuclear weapons by the Ministry of Defence's Strath Committee judged that "something like ten "H" Bombs, each of a yield of about 10 megatons, delivered on the western half of the UK or in the waters close in off the Western seaboard, with the normal prevailing winds, would effectively disrupt the life of the country and make normal activity completely impossible."¹⁹ In 1955, the Soviet Union had a total of 200 nuclear weapons and by the end of the decade it would have over 1000 (the United States had over 12,000 nuclear weapons) and in thermonuclear weapons were to become an increasing fraction of their arsenals, and at no point in time since then has the destructive capability of the global nuclear arsenal been lower.²⁰

Military planners and political leaders prepared for nuclear war and believed they knew the consequences. In 1961, The US Joint Chiefs of Staff were asked by the White House to provide an assessment of the casualties expected from the current US nuclear war plan – Daniel Ellsberg wrote this question on behalf of President Kennedy. The answer: anticipated casualties of 600 million deaths within six months, not including deaths of people in the US from possible Soviet retaliation.²¹ The arithmetic of mass destruction was explained by US Secretary of Defense Robert McNamara in 1964, when he offered his judgement of what it could take to kill a country: "the destruction of, say, 25 percent of its population and more than two thirds of industrial capacity would mean the destruction of the Soviet Union as a national society." McNamara estimated that it would require about 400 nuclear weapons of the kind the US then had in its arsenal to wreak this level of devastation. Despite McNamara's analysis, the number of US warheads grew dramatically,

¹⁷ For Britain, see the work of British physicist Patrick Maynard Stuart Blackett, *Fear, War and the Bomb: Military and Political Consequences of Atomic Energy*, New York, McGraw-Hill, 1949; *Atomic Weapons and East-West relations*, Cambridge: Cambridge University Press, 1956; *Studies of War: Nuclear and Conventional*, New York: Hill and Wang, 1962.

¹⁸ Isabelle Micolot, "Guerre Nucléaire, Armes et... Parades?: Hypothèses Conflictuelles et Politique de Protection Civile en France Dans les Années 1950'-1960'," halshs-00816621, 2011 p. 10 note 29.

¹⁹ Jeff Hughes, "The Strath Report: Britain Confronts the H-Bomb, 1954–1955," *History and Technology*, 19:3, 2003, p. 263.

²⁰ Robert S. Norris and Hans Kristensen, "Global Nuclear Weapons Inventories 1945-2013", *Bulletin of the Atomic Scientists* 69(5), 2013, p. 78.

²¹ Daniel Ellsberg, *The Doomsday Machine*, p. 2

reaching its peak of over 31,000 weapons in 1967.²² That same year, Robert McNamara grimly noted:

“technology has now circumscribed us all with a conceivable horizon of horror that could dwarf any catastrophe that has befallen man in his more than a million years on earth. Man has lived now for more than twenty years in what we have come to call the Atomic Age. What we sometimes overlook is that every future age of man will be an atomic age. If, then, man is to have a future at all, it will have to be a future overshadowed with the permanent possibility of thermonuclear holocaust.”²³

Along with the expansion of violent destruction from city-killing to nation-killing, civilization-ending, and world-ending scales, and the extension of such a prospect into whatever was to be the future-time of humankind, the speed at which atomic collapse could actually be perpetrated changed dramatically. Intercontinental range ballistic missiles, first introduced into service at the end of the 1950s, typically have a range on the order of 10,000 km and an average speed of around 25,000 km/hour, while long-range aircraft typically travel at less than 1000 km/hour, roughly twenty times slower. This makes protection and defense against nuclear weapons explosions and the associated collapse effectively impossible when such nuclear-armed missiles are available. In January 1977, Secretary of State Henry Kissinger remarked that “It is an incongruous situation for a country to plan for nuclear war and not to save its society.”²⁴ The civil defense programs in the US and in the Soviet Union both reached the conclusion that saving their societies was an impossible goal in the nuclear age that they had helped create.²⁵ People, whole nations, were to be defended to death, even if that meant the end of civilization on a global scale.

²² Norris and Kristensen, 2013.

²³ Robert McNamara, “U.S. Nuclear Strategy,” Remarks to United Press International Editors and Publishers, San Francisco, September 18, 1967. Published in *Bulletin of the Atomic Scientists*, Vol. 23, No. 10 (December 1967), pp. 26-31.

²⁴ Memorandum of conversation, "Secretary's Meeting with the General Advisory Committee on Arms Control and Disarmament," 6 January [1977], Digital National Security Archive, available online at <<http://nsarchive.gwu.edu/nukevault/ebb521-Irans-Nuclear-Program-1975-vs-2015/07.pdf>>.

²⁵ Edward Geist, *Armageddon Insurance. Civil Defence in the United States and the Soviet Union*, University of North Carolina Press, 2018.

While it is true that since the end of the Cold War, the number of nuclear warheads on the planet has massively decreased, from a peak of over 70,000 in the 1980s, over 13,000 nuclear weapons remain as of 2020, and current nuclear weapons postures and plans largely unchanged from the Cold War, still aim at producing collapse. A first order simulation of a nuclear war between the US and Russia in 2020, using current forces, postures and doctrines, found that after only a few hours of conflict, immediate casualties and fatalities would exceed 90 million people, and expected deaths from nuclear fallout and long-term effects would certainly increase that estimate.²⁶ The destruction and casualties were based only on the effects of blasts and immediate heat and radiation rather than on what happens when cities are set on fire by nuclear weapons.

It is noteworthy that at least in the U.S. case, the fire effects of nuclear explosions have not been included in damage assessments for weapons requirements and targeting purposes by military planners.²⁷ The military historically has believed that prediction of fire effects should not be included in the consequence calculations of nuclear weapons use and therefore not in nuclear war planning, because it is more uncertain than the predictable effects of shockwaves from explosions. These shockwaves can be reproducibly measured, calibrated, and scaled. No one has ever deliberately set a whole city on fire to measure exactly the fire effects. The fire effects became salient in the nuclear winter studies of the 1980s.²⁸ Mandated by a United Nations General Assembly resolution in 1985, a United Nations expert study concluded in 1989:

“a major nuclear war would entail the high risk of a global environmental disruption. The risk would be greatest if large cities and industrial centres in the northern hemisphere were to be targeted in the summer months. In the opinion of the Group, residual scientific uncertainties are unlikely to invalidate this conclusion. The Group indicates that the depletion of food supplies that might result from severe effects on agricultural production could confront targeted and non-

²⁶ “Plan A: How a Nuclear War Could Progress,” *Arms Control Today*, July/August 2020, pp.23-36; video at <https://youtu.be/2jy3JU-ORpo>.

²⁷ Lynn Eden, *Whole World on fire. Organizations, Knowledge and Nuclear Weapons Devastation*, Cornell, Cornell University Press, 2004.

²⁸ Richard P. Turco, Owen B. Toon, T. P. Ackerman, J. B. Pollack, and Carl Sagan, “Nuclear Winter: Global Consequences of Multiple Nuclear Explosions,” *Science*, Vol. 222, Issue 4630, pp. 1283-1292, 23 Dec 1983; *The Cold and the Dark: The World after Nuclear War*, eds. Paul Ehrlich Carl Sagan, Donald Kennedy and Walter Orr, (Norton, 1984).

targeted nations with the prospect of widespread starvation. The socio-economic consequences would be grave... The socio-economic consequences in a world intimately interconnected economically, socially and environmentally would be grave. The functions of production, distribution and consumption in existing socio-economic systems would be completely disrupted... further global environmental consequences of a major nuclear exchange may yet be identified.”²⁹

More recent work using climate change models has shown that, beyond the already catastrophic levels of death and destruction from blast, fire and radiation at the target, the cities set ablaze by nuclear attacks would create soot that would self-loft into the stratosphere and have global environmental impacts lasting for more than a decade even for a conflict involving a few hundred modern nuclear weapons.³⁰ One of the environmental effects comes from the reduction in sunlight reaching the earth’s surface, as a result the temperature goes down. A second effect is a reduction in precipitation. There also is destruction of atmospheric ozone, allowing more UV to come through to the ground. All three effects have potentially catastrophic effects on biological systems, whether agricultural systems or natural biosystems. Nuclear war involving even a few hundred weapons could destroy modern civilization and condemn billions to starvation and death.³¹

Levels of casualties which would be incompatible with any notion of proportionality are planned and communicated by so-called smaller nuclear-armed states, most of which have arsenals of the order of a few hundred nuclear weapons each. For instance, in a 2016 documentary produced by the communication agency of the French Ministry of Defense, the voice-over states: “No surgical nuclear strike is possible. This is precisely the dreadful character of this weapon.”³² A similar remark could be made about all other nuclear-armed states: Britain, China, Israel, India,

²⁹ Department for Disarmament Affairs, Report of the Secretary-General, *Study on the Climatic and Other Global Effects of Nuclear War*, United Nations, New York 1989, p.6-7.

³⁰ Owen B. Toon, Charles G. Bardeen, Alan Robock, Lili Xia, Hans Kristensen, Matthew McKinzie, R. J. Peterson, Cheryl Harrison, Nicole S. Lovenduski, and Richard P. Turco, “Rapid Expansion of Nuclear Arsenals by Pakistan and India Portends Regional and Global Catastrophe,” *Science Advances*, Vol. 5, no. 10, 2019:

³¹ Alan Robock et al, “A Regional Nuclear Conflict Would compromise Global Food Security”, *Proceedings of the National Academy of Sciences* 117(13), 31 March 2020.

³² Voice over in Stéphane Gabet, *La France, le Président et la Bombe*, 2016, at 15’10s.

Pakistan.³³ Even South Africa, which built a nuclear arsenal of half a dozen weapons, the smallest in the history of the nuclear age, had developed a nuclear strategy which relied on the possibility of its own collapse as a society.

There is a particular irony here in that at heart of US and Soviet nuclear force sizing decisions has been the notion of reducing the damage one might suffer in case of nuclear war. This goal of nuclear planning as “damage limitation” may seem at first sight to run against the logic presented earlier of nuclear planning as being to produce collapse. The opposite is true. Trying to limit the scale of nuclear war through damage limitation logically required preparing to make it worse. A “damage-limiting” nuclear force structure relies on counterforce targeting, in which nuclear weapons target adversary nuclear weapons and related complexes to destroy them preemptively. If for no other reason than that conservative military planners assume it may take more than one of your weapons to reliably destroy one weapon of the adversary, the pursuit of a damage-limiting force structure was used to justify an expansion of the nuclear arsenal. It also led to investments in civil defense (later seen as futile). Both were claimed initially to contribute to the survivability of nuclear war.³⁴

If nuclear weapons are treated as fully controllable instruments, and as solutions to problems of possibly excessive damage in a war-prone world in which adversaries’ future intentions cannot be known for sure, and if it is wiser to plan for the worst, then reducing the vulnerability of your own weapons and increasing the vulnerability of the adversary’s weapons may be the foremost concern. A diversification of the arsenal is then a net benefit and the only conceivable solution. In the United States, this argument was articulated by Albert Wohlstetter, an early nuclear strategist, who argued that even with the coming of nuclear weapons “the basic aims of warfare had not changed. The destruction of an opponent’s fighting power remained the ultimate objective of any attempt to engage a predatory enemy. The best form of deterrence, then, would be to upgrade [...] ‘second strike’ in favor of a war-winning strategy of counterforce.”³⁵ For

³³ For South Asia, see e.g., Zia Mian, “Kashmir, Climate Change, and Nuclear War,” *Bulletin of the Atomic Scientists*, December 7, 2016.

³⁴ Gabriel Kolko, “Can Civil Defense be Effective?” in Seymour Melman, ed., *No Place to Hide: Fallout Shelters-Fact and Fiction* (New York: Grove Press, 1962), 131.

³⁵ Ron Robin, *The Cold World They Made : The Strategic Legacy of Roberta and Albert Wohlstetter*, Cambridge: Harvard University Press, 2016, p. 85.

Wohlstetter, “the best defense would be a spending offense: an investment in technologically sophisticated nuclear arms that possessed both offensive and defensive capacities.”³⁶ Independently from the influence of Albert Wohlstetter as an individual strategist, this logic of damage-limiting was one of the drivers of US nuclear weapons procurement.³⁷ While the Soviet Union did not explicitly use the concept of damage limitation, its nuclear war planning from the early 1960s was also based on the imperatives of producing a collapse of the enemy – hit the adversary nation hard enough to knock it out of the war and be sure to destroy its nuclear forces to reduce its ability to strike back again.³⁸

General Lee Butler, who served at the end of the Cold War as head of US Strategic Air Command and its successor body US Strategic Command, and had responsibility for all nuclear forces, looked back on his experience a decade later and concluded “The Cold War lives on in the minds of those who cannot let go the fears, the beliefs and the enmities born of the nuclear age. They cling to deterrence, clutch its tattered promise to their breast, shake it wistfully at bygone adversaries and balefully at new or imagined ones. They are gripped still by its awful willingness not simply to tempt the apocalypse but to prepare its way.”³⁹ In the two decades since Butler wrote these words, there is no evidence that this situation has changed.

II / Making the Possibility of Nuclear Collapse Invisible

Nuclear war and the consequent collapse of civilization could start in at least four ways: a deliberate, accidental, inadvertent, or unauthorized nuclear strike. As demonstrated above, large bureaucracies keep preparing and planning for it. In this section, we emphasize two mechanisms which have contributed to making these four possibilities invisible: a universal form of shortsightedness of our imagination which affects us all and situated commitments and beliefs on

³⁶ *Ibid.*, p. 86.

³⁷ Lynn Eden, “The U.S. Nuclear Arsenal and Zero: Sizing and Planning for Use—Past, Present, and Future”, dans Catherine Kelleher et Judith Reppy (eds.), *Getting to Zero: The Path to Nuclear Disarmament*, Stanford (Calif.), Stanford University Press, 2011, p. 69-70; Daniel Ellsberg, *The Doomsday Machine*, p. 120-3, 341, 344-5, 349.

³⁸ David Holloway, “Racing Towards Armageddon? Soviet Views of Strategic Nuclear War 1955-1972” in John Ikenberry and Michael Gordin (eds), *The Age of Hiroshima*, Princeton: Princeton University Press, 2020, p. 76-77.

³⁹ Lee Butler, “The False God of Nuclear Deterrence,” *Global Dialogue*, Autumn 1999, pp. 74-81, p.81.

the part of nuclear weapons experts and officials which make them prone to make and keep invisible (to invisibilise) the possibility of nuclear collapse.

The first mechanism has been diagnosed by nuclear-age philosopher Günther Anders in the late 1950s-early 1960s. Reflecting on Hiroshima, he identified it as “world-condition” marked by what he called a “promethean discrepancy” between our ability to produce collapse and our ability to imagine it, represent it and relate to it morally, which makes us “inverted utopians”:

“We are incapable of mentally realizing the realities which we ourselves have produced. Therefore we might call ourselves “inverted utopians”: while ordinary Utopians are actually unable to produce what they are able to visualize, we are unable to visualize what we are actually producing.”⁴⁰

Anders’ insight is important because it reminds us that this promethean discrepancy is not limited to a segment of the population. Elites in charge of those weapons are not immune. Indeed, it is not enough to say that nuclear-induced collapse is possible to believe that it is and to act accordingly. President Barack Obama’s attitude on the matter seems to give a recent illustration of this problem. In 2016, on the first ever visit to Hiroshima by a U.S. President, standing at the Hiroshima Peace Memorial, Obama declared: “Hiroshima teaches this truth. Technological progress without an equivalent progress in human institutions can doom us. The scientific revolution that led to the splitting of an atom requires a moral revolution, as well.”⁴¹ His reaction to the review of the US nuclear war plan (Single Integrated Operational Plan or SIOP) however illustrates both a sense of disbelief and a failure to translate it into actions anywhere near the “revolution” he was calling for. During one of the follow-up meetings of the National Security Council to lay out the nuclear weapons employment guidance (the principles and policies underlying decisions on nuclear arsenal size and structure, posture, and use of nuclear weapons),

⁴⁰ Günther Anders, “Theses for the Atomic Age,” *Massachusetts Review* 3, no. 3 (Spring 1962), pp. 496-7.

⁴¹ Remarks by President Obama at the Hiroshima Peace Memorial, Hiroshima, Japan May 27, 2016, <https://obamawhitehouse.archives.gov/the-press-office/2016/05/27/remarks-president-obama-and-prime-minister-abe-japan-hiroshima-peace>.

Obama grew impatient with the scenarios and calculations that were presented to him and said: “Let’s stipulate that this is all insane” but left the numbers and the plan unchanged.⁴²

Another indicator of the problem is how unwilling and unprepared people, including decision makers, are to think about nuclear war and the role they would play. Public attention to nuclear dangers historically has been at best episodic and linked to immediate crises and the official and mainstream expert discourse on the matter has pictured more public involvement in the nuclear debate as ill-informed, unnecessary, and troublesome. As for leadership, the last U.S. President who has been personally involved in a nuclear crisis simulation was Jimmy Carter, over four decades ago. A broad set of interacting psychological and behavioral factors has been offered as explanation for such shortsightedness in the nuclear age. No one, not even a President, has been adequately prepared to decide on the use of nuclear weapons because we have been psychologically desensitized through “psychic numbing, compassion collapse, tribalism, dehumanization of others, blaming of victims, attentional failures, and faulty decision-making processes, all of which work to destroy feelings and understanding that would normally stop us from planning, executing, and tolerating such inhumane acts.”⁴³ In Anders’ terms, we have become “lazy people of the apocalypse” in dire need of exercising our moral sense and imagination.⁴⁴

The playing out of these behavioral factors is evident in a study of U.S. nuclear war planners by sociologist Lynn Eden, who concluded “planners strip out the human meaning of the consequences of the hypothetical actions they are planning.” One self-reflective “government official working in strategic nuclear war planning” told Eden that it was:

⁴² Fred Kaplan, *The Bomb: Presidents, Generals and the Secret History of Nuclear War*, New York: Simon & Schuster, 2020, p. 243-4.

⁴³ Paul Slovic and Herbert S. Lin, “The Caveman and the Bomb in the Digital Age”, in Harold Trinkunas (ed.), *Three Tweets from Midnight*, Stanford (Calif.), Hoover Press, 2020, p. 58 and Paul Slovic et Daniel Västfjäll, “The More Who Die, the Less We Care. Psychic Numbing and Genocide”, in Scott Slovic et Paul Slovic (eds.), *Numbers and Nerves: Information, Emotion, and Meaning in a World of Data*, Corvallis (Or.), Oregon State University Press, 2015, p. 55-68.

⁴⁴ Günther Anders, “L’Homme Sur le Pont,” *Journal d’Hiroshima et de Nagasaki*, 1958 reprinted in Günther Anders., *Hiroshima est Partout*, p. 194. On the role of fiction as a way of moving beyond this defective condition, see Benoît Pelopidas, “Imaginer la Possibilité de la Guerre Nucléaire Pour y Faire Face”, *Cultures et Conflits*, forthcoming.

“[an] emotional burden to read the war plans. You begin to lose sight that you're talking about the end of civilization. You look at this and think you might actually have to employ one of these [plans] some day and it's just mind boggling.... I thought, “My God, [it] isn't just an abstraction, it's real. This is what we intend to do in x, y, or z situation.” So that was incredibly overwhelming and.... It was actually hard to work during the first couple of weeks. Hard to take any of them seriously because I ... wanted to shake them and say, “Are you fucking kidding me?.... Are you out of your mind? How can you possibly consider an attack option that looks like that?”.... I think that when you work long enough on targeting, you ... at a certain point [you] have to stop thinking about what executing one of those options really means. Because I don't know how you could live with yourself if you did.”⁴⁵

The second mechanism grows from what E.P. Thompson called the “scientific, political, and ideological support system” to the nuclear exterminist structure, “the social system which researches it, ‘chooses’ it, produces it, polices it, justifies it, and maintains it in being.” This system is characterized by an unusual level of secrecy, technological complexity, and the privileging of specialized competence and access.⁴⁶ However, the positions and commitments of experts and officials in this system tend to make them largely incapable of shedding light on all forms of nuclear-induced collapse, which we will call material nuclear vulnerabilities. In other words, one cannot count on such experts to compensate for our failure to imagine the possibility of nuclear-induced collapse.

Officials and most experts in nuclear weapons states are caught in the double work, descriptive and performative, of the discourse of deterrence.⁴⁷ Their specialized competence

⁴⁵ Lynn Eden, “U.S. Planning for Pandemics and Large-Scale Nuclear War Lynn,” Working Paper presented to The 75th Anniversary Nagasaki Nuclear-Pandemic Nexus Scenario Project, October 31-November 1, and November 14-15, 2020, http://nautilus.org/wp-content/uploads/2020/11/Eden_WP_Nagasaki_20201124_Final.pdf.

⁴⁶ The planners of nuclear war frequently consider that their practices and discussions should not be made public. See for instance Former US Stratcom Commander Russell E. Dougherty states it explicitly in, “The Psychological Climate of Nuclear Command,” in *Managing Nuclear Operations*, Washington (D.C.), Brookings Institution Press, 1987, p.420.

⁴⁷ Benoît Pelopidas, “Nuclear Weapons Scholarship as a Case of Self-Censorship in Security Studies,” *Journal of Global Security Studies*, 1(4), November 2016.

and/or access to classified information make them go-to-people for a description of the workings of nuclear weapon systems. At the same time, their discourse about deterrence is aimed to convince several audiences of the adequacy and effectiveness of the policy of nuclear deterrence. This goal of performativity in a context where even one nuclear explosion is intolerable creates specific constraints on what can be said. Those experts end up having to claim that the nuclear system as a system of control works perfectly, so that their audiences believe in the credibility of the pledge of nuclear retaliation and do not fear accidental explosions, escalation, or a nuclear first strike caused by a breach in the command and control protocol. This excessive display of control over the future is particularly visible in the United States in the production of government planning documents on managing nuclear war consequences by institutions as diverse as the Federal Emergency Management Agency or the US Postal service. The production of such “fantasy documents”, as described by sociologist Lee Clarke, was part of a performance of control, predictability, and survivability even in the face of nuclear war.⁴⁸

Beyond these discursive obstacles to an acknowledgement of all paths to nuclear-induced collapse, the institutional positions of the experts who would be consulted on these matters create a possible duty to hide or understate vulnerabilities and limits of control on this matter. Information can only be gathered from individuals who have pledged for some mix of professional and patriotic reasons to serve institutions which have an interest in not displaying the limits and weaknesses of the national nuclear weapon infrastructure. This interest is also part of their mandate. Even one unwarranted nuclear explosion would be so consequential, and deemed so intolerable, that nuclear weapon system controls are almost unique in the requirement of perfection imposed upon them. In a major assessment of the history of US nuclear weapon system accidents, Eric Schlosser has suggested that “had a single weapon been stolen or detonated, America’s command-and-control system would still have attained a success rate of 99.99857 percent”.⁴⁹ This is not uniquely American, however. The French agency for nuclear weapons, the *Directeur des Applications Militaires* of the Atomic Energy Commission, presents a similar sense of the intolerability of any

⁴⁸ Lee Clarke, *Mission Improbable: Using Fantasy Documents to Tame Disaster*, Chicago: Chicago University Press, 1999, pp. 30-40.

⁴⁹ Eric Schlosser, *Command and Control*, New York: Allen Lane, 2013, p. 480.

unwanted nuclear explosion.⁵⁰ More generally, it is worth noting that to date there have been no accidental or inadvertent nuclear weapon explosions reported by any of the ten states that so far have made nuclear weapons.

In the United States, Sandia National Laboratory nuclear weapon safety engineers Robert L. Peurifoy and Gordon O. Moe have spoken to the difficulty of letting the upper management of a nuclear weapons laboratory acknowledge the limits of the institution's control over their nuclear weapons.⁵¹ A similar attitude can be found in the memoirs of Admiral Jean Philippon, Chief of Staff to President de Gaulle, where he confessed never reporting to the President the case of a Mirage IV which took off with a nuclear weapon under its wing because of a technical failure, because this would have been assessed as a serious loss of control.⁵² These incentives converge in overstating the level of control over nuclear weapons in the present or past cases of avoidance of unwanted nuclear weapons explosions.⁵³ For such institutions and their employees, acknowledging the limits of their control and knowledge of possibilities is admitting failure. So, in the best-case scenario, one can expect institutional and personal limits on what is actually said regarding the limits of control over nuclear-induced collapse, but in any case the picture of those limits will be far from complete.

Through a series of unproven assumptions, beliefs, and an ideology of “nuclear order”, most nuclear weapons experts and officials have managed to act and speak as though they believed that nuclear war will never happen.⁵⁴ Such beliefs may be sincere or simply loyalty to the

⁵⁰ François Gezelnikoff in Stéphane Gabet, *La France, le Président et la Bombe*, 2016, at 27'.

⁵¹ Private archives of Robert L. Peurifoy, Kerrville, TX, USA and Robert L. Peurifoy. (2012) “A Personal Account of Steps Towards Achieving Safer Nuclear Weapons in the US Nuclear Arsenal” in George P. Shultz and Sidney D. Drell, (eds.), *The Nuclear Enterprise. High-Consequence Accidents: How to Enhance Safety and Minimize Risks in Nuclear Weapons and Reactors*, Stanford: Hoover Press, 2012, pp. 67- 89; Interview of one of the authors with Gordon O. Moe, who submitted in July 1988 a study on the Grand Forks fire of September 1980. Kerrville, Texas, 26 November 2017.

⁵² Vice-amiral Jean Armand Marc Philippon, *La Royale et Le Roi*, Paris, France Empire, 1982, p. 154.

⁵³ For further analysis of how limits of control over and knowledge about nuclear weapons are underestimated, neglected or treated inconsistently, see Benoit Pelopidas, “The Unbearable Lightness of Luck: Three Sources of Overconfidence in the Controllability of Nuclear Crises”, *European Journal of International Security* 2:2, 2017, p. 245-8 and “Power, Luck and Scholarly Responsibility at the End of the World(s)”, *International Theory*, 12(3), 2020.

⁵⁴ Steven Kull, *Minds at War: Nuclear Reality and the Inner Conflicts of Defense Policymakers*. New York: Basic Books, 1988; Kjølsv Egeland, “The Ideology of Nuclear Order”, *New Political Science*, forthcoming.

commitments made to institutions mandated to maintain the credibility of nuclear deterrence. Either way, the effect of denial of possibilities of nuclear-induced collapse is the same and gives an intellectual layer to Anders' diagnosis of the short-sightedness of the imagination. For strategists, the seduction of techno-strategic discourse makes nuclear war look impossible through an illusion of perfect control over a docile technology.⁵⁵ Anthropologist Hugh Gusterson has called this the "central axiom" present in most of his conversations with scientists at the Lawrence Livermore National Laboratory at the end of the 1990s.⁵⁶ It seems based on the belief that technology is inert and only depends on and responds to human demands – in effect an instrumentalist philosophy of technology – and that humankind (or least some part of it based on views about gender, race, class, education, and other social distinctions) is sufficiently rational to not use those weapons and so to conclude that nuclear war is impossible and will never happen. These baseless assumptions are enough to invisibilize the four possible origins of nuclear-induced collapse: an accidental explosion following a technological malfunction, a false alarm, an unauthorized launch, and a deliberate launch.

War gaming professionals, whose mission was to identify specific conditions under which nuclear war could begin, were not better at this. Indeed, the most famous designers of those games from the beginning of the 1960s did not manage to get nuclear war started, which reveals how difficult it is to conceive of its possibility within the framework of classic strategic thought.⁵⁷ In a 1986 PBS interview, former Secretary of Defence Robert McNamara broadens this observation to the entirety of the Cold War.⁵⁸ And, this is not typically American. Similar assumptions can be

⁵⁵ Carol Cohn, "Sex, death and the rational world of defense intellectuals," *Signs* 12 :4, 1987; Robert J. Lifton and Eric Markusen, *The Genocidal Mentality*. New York: Basic Books, 1990.

⁵⁶ Hugh Gusterson, *Nuclear Rites. A weapons laboratory at the end of the Cold War*, Berkeley, University of California Press, 1996, chap. 3.

⁵⁷ Fred Kaplan, *The Wizards of Armageddon*, (New York, 1983), 302; Thomas Schelling, "Harvard Kennedy School Oral History: Thomas Schelling," minutes 39 and 40; Robert Dodge, *The Strategist. The Life and Times of Thomas Schelling*, Holis Pub. Co, 2006, pp. 82-83 and Marc Trachtenberg, "Strategic thought in America," *Political Science Quarterly* 104/2 (1989), 301-34 at 310.

⁵⁸ Thomas Schelling's "disappointment" and "incomprehension" in the face of the self-explanatory ending of Dr. Strangelove is revealing of this blindness. He says: "*Strangelove* ending; you're not sure what the ending is because somebody goes down with a bomb and then the movie is over and then there are mushroom clouds all over the place and you don't know whether that's meaning 'and so war occurred' or this just emblematic and you don't know what the outcome is." Thomas Schelling, "Harvard Kennedy School Oral History: Thomas Schelling," minute 43. As Sharon Ghamari-Tabrizi wrote: "Strangelove's meaning was undeniable but not everyone could see it." *The Worlds of Herman Kahn; The Intuitive Science of Thermonuclear War* (Cambridge, 2005), 278.

found in a 1971 interview by one of the most respected French nuclear strategists, General André Beaufre.⁵⁹

The inability to see and accept the possibility of nuclear-induced collapse is shared widely by the people of the nuclear weapon support system. The 2015 testimony of Lieutenant Kristin Nemish of the US Air Force, in charge of launching a set of 10 nuclear-armed intercontinental ballistic missiles, reveals a direct expression of self-deluding faith in nuclear control. She can comfortably assert that: “Regardless of what happens at work, it always is fine when you walk through that door and see [the smiling faces of my children].”⁶⁰ She forgets that what could happen at work, and what justifies in large part her work, is the beginning of nuclear war, in which – in all likelihood – her children would not survive, especially since they live in an area close to missile silos and an airbase that would certainly be nuclear targets.

The challenge of taking seriously the possibility of nuclear collapse therefore seems common, even among the professionals in charge of planning and unleashing it. Beyond the central axiom described above, “nuclear taboo” talk also contributes to perpetuating a sense of impossibility of one of the modes of nuclear-induced collapse, i.e. deliberate nuclear strike.⁶¹ President Obama is said to have conducted his nuclear weapons policy as though he believed that a nuclear taboo existed and mattered.⁶² The shared idea of a fundamental taboo allows strategic, political and technical decision-makers to take risks that open the door to nuclear weapon use by serving as a moral safety-net of last-resort for a death-defying performance. This allows the exterminist system to continue to operate as normal and be risk-tolerant, rather than have to bring to a crashing halt the planning and preparation for the threat and use of nuclear weapons. Nuclear age historian Richard Rhodes has corroborated this insight: “Despite several close calls, ... no one

⁵⁹ Jean Offredo, “Interview avec André Beaufre et Gilles Martinet, “La guerre atomique est- elle possible?”, in Jean Offredo (dir.), *Le Sens du Futur*, Paris, Éditions Universitaires, 1971, p. 110.

⁶⁰ “BLUE Episode 4: A Nuclear Family”, *Air Force TV*, 20 April 2015.

⁶¹ Nina Tannenwald, *The Nuclear Taboo. The United States and the Non-use of nuclear weapons since 1945*, Cambridge, Cambridge University Press, 2007, p. 16 and “The legacy of the nuclear taboo in the twenty-first century,” in Michael Gordin and G. John Ikenberry (eds.), *The Age of Hiroshima*, Princeton (N.J.), Princeton University Press, 2020, p. 292. For critiques, see T. V. Paul, *The Tradition of non-use of nuclear weapons*, Stanford (Calif.), Stanford University Press, 2009; Lynn Eden, “The Contingent taboo,” *Review of International Studies*, 36(4), 2010, p. 831-837.

⁶² Fred Kaplan, *The Bomb*, p. 230.

in authority believes the damned things will go off, and so everyone wants to play with them, like treasure hunters wallowing in a vault of golden coins laced with guardian scorpions, like children discovering the loaded gun their parents thoughtlessly neglected to lock away.”⁶³

A final word on the current situation can be given to General. John Hyten, who was head of U.S. Strategic Command from 2016 to the end of 2019. Hyten described in 2018 the annual Global Thunder command and control exercise run by his command:

“I just want you to ask in your own head, how do you think it ends? It ends the same way every time. It does. It ends bad. And the bad meaning it ends with global nuclear war. And guess what? We have to actually practice that every day. And we do. We practice it every day because we have to be good at it.”⁶⁴

Conclusion: The Future of Nuclear Collapse

The beginning of the nuclear weapons age, through the worldwide radioactive fallout traces left by atmospheric nuclear weapon testing, is one candidate for marking the shift of our planetary history into a new geological era, often called the “Anthropocene”. In this era, humankind’s intended and unintended but often foreseeable agency over the biosphere of the planet has been magnified – we and our actions are now a planet-shaping process.⁶⁵ If it is true that the nuclear age creates this new form of agency for the species, it is crucial that we become fully aware that this power is tied to a small number of deeply entrenched and powerful exterminist structures with the capability and willingness to produce planetary collapse through nuclear war. Out of the 193 member-states of the United Nations, only nine states have nuclear weapons today.

⁶³ Richard Rhodes, ‘Absolute power’, *New York Times Sunday Book Review*, (21 March 2014)

⁶⁴ General John Hyten, “The Mitchell Institute Triad Conference,” U.S. Strategic Command, July 17, 2018, <http://www.stratcom.mil/Media/Speeches/Article/1577239/the-mitchell-institute-triad-conference>.

⁶⁵ Joseph Masco, “Terraforming planet earth” in Casper Sylvest and Rens van Munster (eds.), *The Politics of Globality since 1945: Assembling the Planet*, London, Routledge, 2016 ; Matt Reynolds, “Welcome to the Anthropocene: Nuclear testing and pollution have pushed Earth into a new epoch”, *Wired UK*, 30 August 2016.

This chapter has tried to establish that for at least the past 75 years, there has been the technical possibility and a related political imagination to produce catastrophic nation-level collapse and possibly end civilization, with catastrophic consequences for human well-being worldwide. The planning and preparation of this collapse has been a central thrust of the nuclear weapons institutions and policies of the nuclear-armed states, and implicitly of their allies, who reproduce the claims that only nuclear weapons can produce national security.⁶⁶ There has been throughout these years individual and collective resistance and a determined continuous politics around the world aimed at confronting this set of exterminist systems and the threats it poses.⁶⁷ The two processes together have served as one factor binding humanity into a common global experience over this period. If we are a global civilization in part it is because nuclear weapons create a world-condition that we are compelled to share and all life and politics, even that aimed at the future, takes place within this condition because of the shadow of the catastrophe it embodies.

At the dawning of this age of exterminism, the newly founded Emergency Committee of Atomic Scientists, led by Albert Einstein, warned in 1947 of the danger and sought to chart a path to contending with the bomb:

“through the release of atomic energy, our generation has brought into the world the most revolutionary force since prehistoric man's discovery of fire. This basic power of the universe cannot be fitted into the outmoded concept of narrow nationalisms. For there is no secret and there is no defense; there is no possibility of control except through the aroused understanding and insistence of the peoples

⁶⁶ Benoît Pelopidas, “Renunciation, Reversal and Restraint” in Joseph Pilat and Nathan E. Busch, (eds.), *Routledge Handbook of Nuclear Proliferation and Policy*. London: Routledge, 2015, pp. 337-348 and “The Nuclear Straightjacket: American Extended Deterrence and Nonproliferation” in Stéfanie von Hlatky and Andreas Wenger (eds), *The Future of Extended Deterrence: NATO and Beyond*. Washington, D.C.: Georgetown University Press, 2015, pp. 73-106.

⁶⁷ Lawrence S. Wittner, *A Short History of the World Nuclear Disarmament Movement*. Stanford University Press, 2009. See also the three-volume series *The Struggle Against the Bomb* detailing the history and impacts of the contentious politics for nuclear disarmament around the world since 1945: *One World or None: A History of the World Nuclear Disarmament Movement Through 1953*, Stanford, 1993; *Resisting the Bomb: A History of the World Nuclear Disarmament Movement, 1954-1970*, Stanford, 1997; *Toward Nuclear Abolition: A History of the World Nuclear Disarmament Movement, 1971-Present*, Stanford, 2003.

of the world... In this lies our only security and our only hope -- we believe that an informed citizenry will act for life and not death.”

With so much of the burden of effort placed on trying to understand the nuclear danger and the possibility of control, a space is opened up to a temptation to seek reassurance, to want to believe the claims of leaders and experts that it is possible to live with the bomb safely, even though they do not know and cannot explain or control all the possibilities leading to nuclear war and the resulting collapse. We have yielded to this temptation over these many years. It took at least two forms: the promethean discrepancy, identified by Gunther Anders, that leads our ability to cause harm to overwhelm our ability to represent this harm and relate to it, and the inability of nuclear weapons professionals to want to search for and describe all paths to nuclear-induced collapse when their privileged position within the exterminist structure puts them in a unique place to do so. This epistemic vulnerability adds to the material vulnerability of the possibility of civilization collapse.

Proponents of national and international security based on nuclear weapons – the part of the exterminist system that “‘chooses’ it, produces it, polices it, justifies it, and maintains it in being” – ultimately claim that the continued possibility of producing collapse is a requirement to preventing it. Whereas the anti-systemic movement, seeking non-nuclear national and international security, claims that avoiding such collapse requires dismantling the weapons, facilities, institutions, and knowledge-structures that produce the “thrust to exterminism.” In ethical terms, the first camp would not give up the possibility to commit mass nuclear violence under any circumstance as a condition to its survival – a permanent present for nuclear states, their regimes, and institutions, serving to colonize and close off other possibly benign futures for humankind. The nuclear weapon free world camp would not support, threaten, or commit nuclear violence anywhere or whatever the consequences – survival permits future politics and actions able eventually to realize and create new human possibilities. As the late Jonathan Schell recognized “The day that the last nuclear weapon on earth was destroyed would be a great day. It would be a day for celebrations. We would have given substance to our choice to create the human

future. We would have dispelled once and for all the fatalism and lack of faith in man which, like some dark shadow of extinction itself, have crept over us.”⁶⁸

Those two political and ethical positions are radically incompatible. The entry into force in early 2021 of the United Nations Treaty on the Prohibition of Nuclear Weapons, supported by 122 countries but none of the nine nuclear-armed states, acts as a stark reminder of this incompatibility. Among other international legal obligations, the treaty commits states “never under any circumstances to: Develop, test, produce, manufacture, otherwise acquire, possess or stockpile nuclear weapons or other nuclear explosive devices ... use or threaten to use nuclear weapons or other nuclear explosive devices.”

While the possibility of nuclear collapse still looms, it is deeply contested and likely to become more given the contradictions between the nuclear-armed states and the non-weapon states and between mobilized citizens and nuclear establishments within the nuclear-armed states, especially the ones with democratic political governance.⁶⁹ Choosing how one handles it as an individual, a collective or a political community, requires first and foremost coming to terms with the existence of exterminist systems and the material and epistemic dimensions of the nuclear vulnerabilities they generate and we suffer.

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⁶⁸ Jonathan Schell, *The Abolition*, New York: Knopf, 1984, p.163.

⁶⁹ Zia Mian, “After the Nuclear Weapons Ban Treaty: A New Disarmament Politics,” *Bulletin of the Atomic Scientists*, July 7, 2017.