Apocalyptica
No 1 / 2023
DOI: 10.17885/heiup.apoc.2023.1.24893

Gabriele Schwab

Nuclear Temporalities

Abstract: The invention and unleashing of the first atomic weapons generated a historical rupture in the order of things that irrevocably changed the ways in which humans inhabit the world and experience time. The haunting knowledge of the power of nuclear weapons to potentially annihilate planetary life leaves a profound mark on human temporality and psychic life and creates transgenerational nuclear trauma. One of its effects is a subliminal, if not unconscious haunting from the future that overshadows human temporalities. Apart from this haunting from the future, nuclear temporalities also extend to sites of slow or structural nuclear violence. In my contribution, I will trace the entanglement between nuclear temporalities and nuclear subjectivities, including reflection on scale, deep time, nuclear half-life, temporal necropolitics, and psychic toxicity.

Keywords: Hiroshima; temporal scale; haunting from the future; apocalyptic imaginary; transgenerational nuclear trauma

Nuclear Temporalities[1]

1. Time, Scale, and the Apocalyptic Imaginary

> However much we didn't want to, however little we would do
> about it, we'd understood:
> we were going to perish of all this, if not now, then soon, if not
> soon, then someday.
> Someday, some final generation, hysterically aswarm beneath an
> Atmosphere as unrelenting as rock,
> would rue us all, anathematize our earthly comforts, curse our
> surfeits and submissions.
>
> C. K. Williams, *Tar* (1995, 94)

The passage from C. K. William's *Tar* quoted above portrays a haunting that comes from the future of nuclear destruction. It invokes the desire not to know or act, yet insists on the understanding that someday "some final generation" will perish from the forces unleashed with the splitting of the atom and the inauguration of the nuclear age.

The reference to "some final generation" positions William's poem within the framework of nuclear temporalities. The very invention and use of the first atomic bomb and the knowledge of its power potentially to annihilate planetary life have generated a rupture in the temporal order of things that leaves a profound mark on the lived experience of time.[2] We could argue that after 1945, time has never been the same. This shift amounts to a new epistemic configuration that changes the very notion of human temporality.

Whether they are aware of it or not, most people are haunted by the fear of a future nuclear attack. According to polls, until the late eighties, half of all Americans expected to die in a nuclear war during their lifetime. Even when the country tries to mitigate this sense of doom with various defense mechanisms, such as, for example, the manic defense of omnipotent posturing, the marketing of 'Atoms for Peace,' or the silencing of public and media debates, the fear continues to live within the political unconscious. Moreover, the persistent collective forgetting of the nuclear threat in the media, especially after the Fall of the Soviet Union and the end of the Cold War, only heightens the actual threat. In his seminal study on forgetting in the digital age, Andrew Hoskins analyzes three instances when the public media have "forgotten" the nuclear threat. The first time was after the bombing of Hiroshima and Nagasaki, the second after the

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[1] In this essay, I am including specific edited and expanded sections from different chapters of my book 2020 book: *Radioactive* Ghosts Minneapolis: University of Minnesota Press. While *Radioactive Ghosts* has a much broader range and does not focus on nuclear temporalities, I am systematizing and expanding thoughts on the topic developed in the book.

[2] I'm using this in the Foucauldian sense of an epistemological configuration. See Foucault, Michel. 2005. *The Order of Things: An Archaeology of the Human Sciences*. New York: Routledge.

Cuban Missile Crisis, and the third after the Fall of the Soviet Union. Tracing the steep decline in the term "nuclear war" in public discourse after 1989, and especially in the opening years of the 21st century, Hoskins points to the dangerous complacency of this erasure, insisting that "the removal of a widespread perception of the threat of nuclear war actually makes that war more likely" (2018, 63).

After the onset of the Russian war with Ukraine, however, nuclear energy and even the danger of nuclear war have again been making headlines in the news. While awareness of the persistence of the nuclear threat has thus resurfaced, robust debates remain isolated and are far from proportional to the actual threat. Moreover, against all research that demonstrates the opposite, nuclear energy is once again being marketed as a safe, if not green energy.[3] Especially in European countries that have been overly dependent on Russian gas, the use of nuclear energy is seen as an alternative and support is growing, even in Germany, a country that had been at the forefront of anti-nuclear energy politics. The debate concerns the so-called *Laufzeitverlängerung*, that is, an extension on the 2022 moratorium on nuclear power plants. Many fear that an agreement on the extension beyond 2022 could be used by proponents of nuclear energy to undermine the moratorium altogether and re-legitimize nuclear power. At the same time, many experts, including employees at energy companies and corporations, doubt the very feasibility of this nuclear option (see among others Balser and Glas 2022, 6).

At the psychological level, the acceptance of nuclear energy will, of course, require a considerable amount of denial of the risks involved and a splitting from, if not forgetting of the debates and related fears that arose after Chernobyl and Fukushima. People may and indeed have become almost perfect at developing defensive mechanisms against nuclear fears such as splitting and denial, but these mechanisms merely relegate the fears to the unconscious. Psychoanalytic theories from Melanie Klein (1975) to Robert Meister (2011) have analyzed splitting as an ambivalent adaptive mechanism, designed to ward off overwhelming fear or trauma. On the one hand, it is clear that without adaptive splitting and a certain degree of psychic numbing, people will no longer be able to carve out a life for themselves, have children, engage in creative work, or experience a sense of a functional everyday life. Splitting has become the prime adaptive defense mechanism that allows people to live in a mode of 'as if' by ignoring the nuclear threat. However, living one's life as if this threat didn't exist comes with the cost of undermining awareness, resistance and political action and thus increases the risk. Moreover, isolating the threat as a partially unconscious element of psychic life, splitting also diminishes the relational aspect of nuclear fears and their translation into collectively shared cultural awareness and action. Finally, according to Melanie Klein (1975), splitting is a primitive defense mechanism that operates in a paranoid-schizoid psychic space in which the world is perceived according to a Manichean dualism between good and evil. If widely shared, such a defense can result in a schizoid-paranoid cultural and public sphere.

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[3] For a more detailed discussion that refutes this claim, see *Radioactive Ghosts*, 9–14 and 125–127.

More generally, under the surface of more tangible fears about everyday subsistence and survival, nuclear fear persists in form of a nameless dread that pervades everything, even if only unconsciously. In the wake of nuclear trauma, climate crises, and generally increasing ecological imbalance, a young generation is beginning to fear the loss of a viable future. Fridays for Future, Extinction Rebellion and Letzte Generation (The Last Generation), the highly symbolic names chosen by the most visible global activist groups, indicate that fears for the future overshadow the psychic lives of an entire generation. At the center of their fights is the problem of the finite temporalities generated by ecological crises, the threat of extinction, and the responsibility for future generations. Founded in Germany, the group The Last Generation openly states on their website that they consider the failure of governments, corporations, and individuals to assume this responsibility to be a crime against humanity:

> The Government ignores all warnings. It is still fueling the climate crisis and has brought us to the edge of the abyss.
> We are no longer willing to accept this crime against humanity without resistance.
> […]
> We are the last generation that can still prevent society from collapsing (Letzte Generation 2023).

The group's name also includes a direct reference to the biblical apocalyptic imaginary, especially the so-called Last Generation Theology, referring to the last generation before the Second Coming of Christ.

The sense of futurelessness and apocalypse also characterizes the stories and moods of an entire range of science fiction and climate fiction. Many highlight the compounding of two looming massive threats to planetary survival—nuclear war and climate change—to convey the sense of an ending and the terror of futurelessness. In *The Ministry for the Future*, his speculative reflection on possible planetary futures, Kim Stanley Robinson describes the accelerating erosion of future options in the mode of science fiction:

> Climate change caused by carbon dioxide and methane released into the atmosphere; […] rate of extinctions already as high as at any time in Earth's history […] subsequent to that coming extinction, inevitable famine, dislocation, and war — possibly nuclear war — leading to the destruction of civilization (2022, 293).

Locating this apocalyptic scenario of planetary destruction in the near future that is just a few decades away, Kim Stanley Robinson chooses the genre of hard science fiction, interspersed with short creative non-fiction essays on historical, sociological, and scientific data, to force his readers to look at the abyss of apocalypse from within.

More generally, the confluence of the threats of climate change and nuclearism inevitably mobilizes an apocalyptic imaginary. The very invention and unleashing of the first atomic weapons had already generated a historical rupture in the order of things that irrevocably changed the ways in which humans inhabit the world and experience its temporalities. The knowledge of the annihilating power of nuclear weapons shapes psychic life for generations to come, thus creating a transgenerational nuclear trauma. One of the traumatic effects is a subliminal, if not unconscious haunting from the future that overshadows human temporalities. Moreover, as I describe in more detail in *Radioactive Ghosts*, nuclear temporalities also extend to sites of slow or structural nuclear violence (Schwab 2020). Ultimately, they affect knowledge regimes, epistemologies and the boundaries of imagination and thought. They affect how people feel, shaping everything from psychosocial realities, ways of being in the world, communal lives, and relationalities, to the very boundaries of subjectivity, including conscious and unconscious psychic life.

In *Infrastructures of Apocalypse*, Jessica Hurley (2020) analyzes the futurelessness that is embedded in nuclearism as part of the new national infrastructure that "has determined the flow of resources and risks across the twentieth and twenty-first centuries" (2020, 3). The temporality at the heart of the nuclear imaginary, she argues, is apocalyptic. With reference to the nuclear catastrophe at Fukushima, Hurley states: "Nuclear apocalypse in the present forces upon us the realization that even dismantling the infrastructures of planetary destruction cannot take us back to an unspoiled time or forward into a nonnuclear future; while the infrastructure of nuclear apocalypse may be temporary, the environmental alterations that they produce are effectively permanent" (210). Hurley's argument implies that the temporality of nuclear destruction cannot be confined to the future. It is with us in the here and now, both materially in the form of permanent damages from the nuclear toxicity that will forever pervade our planet, and in the form of the psychic damages. The latter are created not only by the awareness of nuclear destruction and risk but also by their denial. Hurley speaks of the “graduated levels of harm that nuclear infrastructures produce in the present” and states that “[t]he nuclear mundane is the slow violence of the atomic age” (14).

Tracing the entanglement between nuclear temporalities and nuclear subjectivities, I will now focus on reflections on scale, deep time, nuclear half-life, temporal necropolitics, and psychic toxicity. Slow nuclear temporalities are marked by the material invisibility of the nuclear threat. Akira Lippit argues that the first use of the atomic bomb inaugurates the age of “invisible warfare” (2005, 4). Extending beyond the immediate damage into the distant future, waves of invisible radiation that infiltrate the survivors’ bodies continue the warfare for the rest of their lives. But this fallout of nuclear war happens imperceptibly, and often without the victims’ knowledge of the damage until it is too late. In addition to its immediate annihilating destruction, the atomic work of death thus continues to operate as a form of slow violence inside the bodies of victims, as such extending into the aftermath of the official end of the war. Only those victims affected at closest range suffer and die from radiation sickness soon after the attack. Many more will die later from cancers, and it is notoriously hard to prove beyond any doubt, except statistically, that excessive radiation is the cause. Moreover, by potentially inflicting genetic damage on subsequent generations of children of victims and their children, this invisible war also operates transgenerationally. While previous wars had left a psychic transgenerational legacy of war trauma, this invisible nuclear warfare is the first that may potentially leave a transgenerational physical legacy of genetic damage in addition to the psychic one.

With its past, present, and future damages, this invisible war as well as the uncontainable psychosocial fallout of nuclear politics more generally, shape the very structures of temporality and subjectivity. They create a haunting from the future for generations to come, if not the rest of planetary time. Since the onset of the nuclear age, people have been haunted by the knowledge of living on a planet where land, water and air suffer from radioactive contamination. They continue to be haunted by the awareness of invisible, yet potentially lethal toxins in their bodies and the bodies of future generations forced to live on toxic lands. This haunting also creates an often-unacknowledged psychic toxicity[4] (see Masco 2006, 236) that becomes firmly anchored in the political unconscious. Nuclear temporalities are thus marked by a double haunting. While the traumatic memory of Hiroshima, Nagasaki, and other nuclear catastrophes such as Chernobyl and Fukushima generate a haunting from the past, the fear of slow nuclear violence instilled by long-term planetary contamination, dramatic increase of cancers, and transgenerational genetic damage creates a haunting from the future.

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[4] The term “psychic toxicity” was coined by Herman Agoyo, Indigenous anti-nuclear activist from New Mexico.

This transgenerational haunting is not confined to visions of humans who might die in a future nuclear war. It also includes phantasms of the mutant body generated by the fear of mutant offspring. Reminiscent of the Lacanian phantasms of the fragmented body, phantasms of the mutant body are also a manifestation of the fact that nuclear fears have weakened the boundaries and stability of the self. As an example of slow nuclear violence, Rob Nixon, for example, refers to the children born in the wake of nuclear tests in the Marshall Islands: "well into the 1980s the history of nuclear colonialism, long forgotten by the colonizers, was still delivering into the world 'jellyfish babies'—headless, eyeless, limbless human infants who would live for just a few hours" (2011, 7). More generally, I would describe the psycho-ontological position of major nuclear trauma in terms of a double haunting, one from the past by the spectral ones who have been incinerated in Hiroshima or were born as mutant children, and one from the future by the spectral ones who have not yet arrived but might be born as mutant children or die in a future nuclear war.

Another crucial aspect of nuclear temporalities is the problem of scale. Both nuclear attacks or catastrophes and slow nuclear damage operate at scales that surpass the scope of human imagination and are inaccessible to sensorial experience. This also holds for the perception of (nuclear) time. In *Troubling Time/s and Ecologies of Nothingness*, Karen Barad writes:

> What is the scale of time? When the cascading energies of the nuclei that were split in an atomic bomb explosion live on in the interior and exterior of collective and individual bodies, how can anything like a fixed, singular, and external notion of time retain its relevance or even its meaning? In a flash, bodies near Ground Zero 'become molecular'—nay, particulate, vaporized—while *hibakushas,* in the immediate vicinity and downwind, ingest radioactive isotopes that indefinitely rework body molecules all the while manufacturing future cancers, like little time bombs waiting to go off (2018, 214).

Considering the scale of matter, Barad then adds: "The indeterminacy of space, time, and matter at the core of quantum field theory troubles the scalar distinction between the world of subatomic particles and that of colonialism, war, nuclear physics research, and environmental destruction" (2018, 215). Suggesting a "relational-ontology sensibility to questions of time, memory, and history" (223), Barad asserts that the nuclear story needs to trace "a journey across spacetime, nation states, species being, and questions of being/nonbeing" (222).

While the large-scale material effects of nuclearism operate on a transhuman, geological timescale, they also affect species being, both in the here and now and long-term. As I argued previously, the long-term effects are transgenerational since the temporal extension of nuclear destruction encompasses damage to biological reproductive capacities and genetic heredity. This means that, beyond killing instantly, or slowly through radiation sickness or cancers, nuclear weapons also threaten long-term survival at the most basic material level, that is, the genetic make-up of organic life. This is where fears about the nuclear impact on species being open to what Barad (2018, 222) calls "questions of being/nonbeing" and ultimately questions of extinction.

In addition, psychic transgenerational effects include a widespread, if often unconscious, nuclear fear linked to the haunting from the future of nuclear necropolitics. In contrast to the transgenerational trauma caused by traditional war where the trauma originates in a past violent history, transgenerational nuclear trauma thus encompasses past, present, and future. People live with the knowledge not only of the threat of future nuclear attacks but also of the devastating effects of nuclear contamination that extend over many generations into the distant future. In prenuclear times, once a war was over, survivors knew that they had survived. They could, for example, process the war trauma by propagating visions of 'never again.' While such visions have also been developed in the aftermath of Hiroshima and Nagasaki, nuclear trauma reaches into the future differently. It is not only fears of slow nuclear violence that generate a haunting from the future; it is also the knowledge that the radioactive contamination of the earth is irreversible and the stockpiling of nuclear weapons as well as the production of nuclear waste from nuclear power plants are ticking time bombs. Nuclear destruction is not encapsulated in the threat of a future annihilating attack; it is already in the here and now.

To face such haunting requires people to imagine thinking and communicating across immense scales that extend over millennia. Caring about planetary futures ultimately requires humans to relinquish forms of anthropocentric temporal thinking that focus on conceivable human lifespans. This challenge has profound implications for nuclear temporalities and their contribution to the formation of psychic life. In *Deep Time*, Gregory Benford writes: "Tempocentric notions of 'the human condition' do not survive" (1999, 2). Nuclear waste alone demands, he argues, "that we mark sites for times longer than the age of our civilization" (1999, 2).

To think about the condition of human and planetary life in the nuclear age thus requires the formation of nuclear subjectivities trained to thinking across vast temporal scales.[5] Benford speaks of a chasm between the deep human longing for perpetuity that is ubiquitous across the diverse histories of civilization and the fundamental fear generated by the awareness that human civilization now has the power to annihilate most life on earth. It is a tension, Benford writes, between a longing to "extend across time some lasting shadow of the present" and an "anxiety about the passing of all referents, the loss of meaning" (1999, 3).

Imagining extinction thus becomes of utmost political urgency. The haunting from the future of anticipated nuclear annihilation can only be ignored by a denial operating in collusion with the epistemology of (self)-deception that marks nuclear politics. The challenge then is to imagine possible forms of extinction without succumbing to the sensational or fetishizing lures of an apocalyptic imaginary. The latter looms large in the formation of nuclear subjectivities but remains confined to a paranoid-schizoid world. While apocalyptic phantasms propel a return of denied or repressed nuclear fears, these phantasms often come in the domesticated form of either illusory survival or of melancholic attachments to omnipotent visions of extinction. Both are fueled by the autoimmune logic of the death-drive that finds it ultimate satisfaction in species-suicide.

On the other hand, and in sharp contrast to apocalyptic phantasms of nuclear destruction, we find the politics of splitting and denial, often tied to a psychologically inevitable widespread disaster fatigue, if not disaster amnesia. How then can we negotiate the deep ambivalence that haunts apocalyptic visions as well as disaster fatigue? Imagining extinction will inevitably mobilize the arsenal of the apocalyptic imaginary that is intimately tied to nuclear temporalities. Insisting on the centrality of facing apocalypticism and "the continuing importance of apocalypse to disrupt conservative realisms," Jessica Hurley (2020, 34) distinguishes between two competing apocalyptic temporalities and modes, ending and revelation. "What if 'the insecurities of [the] now' demand that we take apocalypse more seriously?" she asks and asserts, against the devaluing of apocalypse in contemporary theory, that strategic radical apocalypticism "produces valuable forms of work, thought, solidarity, and care" (37f.).

In this respect, the apocalyptic imaginary may become a productive response to the sense of futurelessness discussed earlier. Hurley (2020, 223) concludes *Infrastructures of Apocalypse* with an emphatic statement about living in a futureless nuclear temporality: "Apocalypse as radical afuturity casts us into a present without ends," she writes, but only to qualify her point with a quote from Jean-Luc Nancy: "not an immo-

[5] Among other things, it is the technology of "radioactive dating" that has helped scientists to enhance such scalar imaginings.

bile present but a present within historical mobility, a living sense of each moment, each life, each *hic et nunc* [here and now]" (Hurley 2020, 223; Nancy 2015, 59). Nancy's insistence on historical mobility within the sense of futurelessness thus counters the threat of disaster fatigue, if not psychic paralysis generated by the fear of nuclear annihilation. Even more emphatically, Hurley concludes with a statement that opens a vision of living in the ruins of nuclear infrastructures and its temporalities: "apocalypse is where we must reside, with futurelessness affording the chance to keep the present open to radical change just a little longer, suspended between the unbearable past and the impossible future, here, at the end of the world" (2020, 35).

2. The Hiroshima Shadow Image

One globally circulated image "Human Shadow Etched in Stone" taken by Yoshito Matsushige perfectly embodies the specter of nuclear annihilation, namely the imprint of a human incinerated by the atomic bomb on the steps of a Hiroshima bank. While this imprint freezes the human forever in the immobility of a petrified image, countless poets, writers, and cultural critics have mobilized this image, bringing it back to life in poetic or philosophical reflection.

The imprint of this ghostly human shadow left by thermal rays on stone has proliferated in representations of the atomic attacks, including an entire range of poetry. I argue that it serves as a transformational cultural object shared worldwide for the processing of nuclear trauma. As the continuing history of its reception in the cultural imaginary demonstrates, the Hiroshima shadow image is haunting in its very iconic value. This trace of a human incinerated and burnt into stone has become a chronotope that spatially embodies nuclear temporality and turns viewers into mute witnesses of the shadow left by atomic annihilation. "Burning, another world enters through the shadows of bodies flashed on walls," (1994, 273) writes Linda Hogan in her poem *Prayer for Men and Children*. The 'other world' that enters through these shadow images is the beginning of the nuclear age. Evoked by the past trauma of an individual life that was annihilated by the first atomic bomb, this other world also mobilizes the knowledge of a possible future annihilation, a world of "bodies flashed on walls" that herald extinction of life and time. It is the latter that causes the permanent trauma of a hitherto unknown anticipatory haunting from the future.

The Hiroshima shadow image offers the perennial trace of a man's life as it was snatched away from him in a second, consumed by a murderous nuclear force whose radiation left nothing but a stain on the stair, icon and chronotope of atomic death. And yet, as another powerful poetic image from the poem *Shadow* by Stephanie Strickland reminds us, the stain erases the individual human in the very moment that monumentalizes his trace:

> The monument:
> a grey stain fused
> in concrete, a shadow
> cast on three steps in Nagasaki
> for a moment, by the silvery flash
> of the explosion;
> etched there by light
> from the suns
> that exposed it. Not a man
> Not a woman. An effigy: human
> by deduction,
> like a cloak (1994, 209).

Perhaps it is the very erasure of the human, its presence by mere deduction that turns this shadow image into a prime icon of the first atomic attacks that inaugurated the age of nuclear temporalities. As an empty graph, the image extends an invitation to viewers to project the affects that fuel their nuclear imaginary. Yet Strickland adds an important notion to the reception of the shadow image. Her poem likens the shadowgraph to an effigy, that is, a model of a particular person originally designed to be damaged or destroyed in protest or expression of anger. The image of the effigy has the capacity to invoke both, a haunting from the past nuclear attack that was, after all, conducted as an act of retaliation for Pearl Harbor, and a haunting from the future of an all-out nuclear annihilation that leaves nothing behind but a timeless shadow world of incinerated humans.

As I suggested earlier, it is this haunting from the future that distinguishes the temporality of nuclear trauma from that of other forms of trauma. In *Climate Trauma,* E. Ann Kaplan (2016) presents a reading of Michael Madsen's *Into Eternity* (2010), a documentary about nuclear waste. Kaplan proposes the concept of "pre-trauma" to address what I have been calling haunting from the future. Kaplan describes the film's dark mood in terms of a "pretraumatic scenario, a trauma waiting to happen" (2016, 120).

While Kaplan's concept of "pre-trauma" bears certain affinities with my concept of "haunting from the future," the main difference between the two concepts lies in two divergent notions of nuclear temporality. While Kaplan's term "pretrauma" suggests a time before trauma, I insist that a "haunting from the future" already generates trauma in the here and now. In alignment with Hurley's concept of nuclear infrastructures, we could argue that the life worlds we inhabit in the nuclear age are causing traumatic effects at the infrastructural level.

I agree with Kaplan's suggestion that *Into Eternity* positions viewers as witnesses to a catastrophe in an unfathomably distant future. But in addition, I argue, the documentary also invites us to engage in an experimental apprehension of a temporal scale that is almost impossible to imagine. Ultimately, I am reading Madsen's film as a cinematic reflection on nuclear temporality. It was the fascination with this problem of temporal scale, Madsen says, that motivated him to make *Into Eternity*. Thinking about the problem of the immense temporal scale of 100,000 years opened by the film, we could in fact argue that, apart from the irresolvable problem of toxic waste, it is temporal scale itself that haunts the film as well as its viewers. "How far into the future will your way of life have consequences?" (Kaplan, 2016, 123) Madsen, as the film's narrator, asks. This haunting by scale thus also bears upon the responsibilities humans today assume when they leave a deadly crypt of nuclear waste for future generations.

According to Kaplan, the viewer is put in the position of "the ghost-like human" (121) who is the film's imaginary addressee. And it is indeed this spectral addressee that haunts viewers of *Into Eternity* from a distance of 100,000 years. Madsen also anchors the scale of this haunting in the sheer unlimited capacity of radioactive substances to cause damage. He defines atomic light as "a fire that cannot be extinguished" because it has already penetrated everything, soil, crops and bodies, human or animal. Of course, the image of a fire that cannot be extinguished also resonates with the Christian vision of hell as a fire that burns for eternity. And, if one assumes that this catastrophic "eternal fire" has already irreversibly damaged the human gene pool (along with that of other species), the film's imaginary addressee is literally a radioactive human ghost.

But how does one alert a ghostly being who is supposed to discover the site 100,000 years from now about the dangers of the nuclear waste repository? We recall that Gregory Benford argued that the problem of nuclear waste demands "that we mark sites for times longer than the age of our civilization" (1999, 2). The scientists and philosophers Madsen interviews presume that in 100,000 years from now, the evolution of languages will have made current languages incomprehensible. Hence, they debate whether it might be better to leave the site completely unmarked or to try to imagine iconic markers that will remain readable and translatable across millennia. Among these are, for example, surrounding the site with a threatening wall of thorns and rocks. But they also think of cartoonlike warnings, and, at someone's suggestion, a copy of the universally terrifying painting by Norwegian artist Edvard Munch's *The Scream* (see Kaplan 2016, 124). Yet, all these ideas to use warning signs about the danger of radioactive materials are, of course, based on the remarkable hope not only that the human species does survive the next 100,000 years, but also that present-day humans are indeed capable of such a transgenerational, and possibly trans-millennial, iconic communication between ghosts that would save their distant descendants from the lethal danger they have left them as their haunting legacy.

The Hiroshima shadow image and Madsen's *Into Eternity* have become icons in the nuclear imaginary that confront viewers in different ways with the specter of extinction. Both images aim at disrupting the numbing and trauma fatigue that are prominent psychic manifestations of nuclear temporalities. In *Indefensible Weapons*, Robert J. Lifton and Kai Erikson (1982) explore this pervasive psychic numbing as a defining feature of nuclear subjectivities. At the end, they pose the haunting question "[W]ould the survivors [of a nuclear holocaust] envy the dead?" to which they give the following answer: "No, they would be incapable of such feelings. They would not so much envy as, inwardly and outwardly, resemble the dead" (1982, 278). This assumption alerts one to the fact that extinction needs to be thought of not only in terms of what Derrida (1984, 24) calls the "remainderless destruction" of an all-out nuclear war, but also in terms of what Lifton (1991) calls "death in life," that is, the psychic condition in which massive trauma has literally extinguished the capacity to feel. Lifton's interviews reveal that, in the immediate aftermath of a nuclear attack, psychic numbing is a protection against the terror of mass death. Someone unable to feel alive does not need to fear death. However, survivors continue to live a form of death in life.

As the term suggests, death in life is the manifestation of a paradoxical psychic temporality. Death is supposed to happen in the future after the end of life. Under exceptionally traumatic circumstances, however, psychic death can happen in the middle of life while the body still lives on. This paradoxical experience of temporality unfolds within the differential space between corporeal and psychic life. In the case of the paradoxical nuclear temporalities experienced by victims of atomic attacks, death in life is also a concrete manifestation of futurelessness. There is no sense of a future life because death has already happened prematurely. Past, present and future are enfolded in the here and now of death in life as the most extreme form of psychic numbing.

It is important to note that Lifton analyses psychic numbing not only in victims but also in perpetrators of nuclear attacks:

> [P]atterns of psychic numbing have surrounded the overall creation, testing, and military use (actual or planned) of nuclear weapons: a combination of technical-professional focus and perceived ideological imperative which excludes emotional perceptions of what these weapons do. It is no exaggeration to say that psychic numbing is one of the great problems of our age (1991, 508).

According to Lifton, psychic numbing and death-in-life thus occur as an isomorphic psychic damage that affects both victims and perpetrators, albeit in different ways and to a different degree. Survivors live a paradoxical life in which death is no longer awaited in the future but has prematurely, if not permanently arrived in the present. Perpetrators have deadened their world by killing the emotions they would experience if they fully faced the destructive forces they have unleashed by using atomic weapons.

Beyond the distinction between corporeal and psychic death, there is, however, another distinction that needs to be considered in theorizing nuclear temporalities. It is death by extinction. In *The Fate of the Earth*, Jonathan Schell contends that nuclear temporalities have enhanced the power of death on earth by introducing what he calls “the second death” (2000). Schell distinguishes two forms of death, namely the natural death of an individual and the death of a species by extinction. For humans—the species responsible for creating the conditions that propel extinction—this second death entails facing the death of mankind (2000, 115). Schell concludes that in the event of a nuclear holocaust the two forms of death merge and the distinction collapses:

> In extinction by nuclear arms, the death of the species and the death of all the people in the world would happen together, but it is important to make a clear distinction between the two losses; otherwise, the mind, overwhelmed by the thought of the deaths of the billions of living people, might stagger back without realizing that behind this already ungraspable loss there lies the separate loss of the future generation (2000, 115).

Nuclear necropolitics thus performs a double work of death, namely killing on a massive scale with the most lethal weapon of mass destruction and the potential extinction of the species. In short, nuclear necropolitics doubles the work of death with the work of extinction. As Schell writes, highlighting the paradox at the heart of nuclear temporalities: "Death is only death; extinction is the death of death" (2000, 119).

Interestingly, however, because of this very threat of extinction, nuclear temporalities have also simultaneously introduced an enhanced concern with the survival of the species. In his interviews with survivors of Hiroshima and Nagasaki, R. J. Lifton reports that, after the attacks, many survivors for the first time thought of themselves in terms of belonging to the human species rather than to a nationality, city or even family. To account for this new formation of subjectivity, Lifton coined the term "species self." He defines the latter as the recognition of "our *shared fate* as fellow members of a single species in trouble […] a sense of being part of humankind" (Lifton and Mitchell 1996, 355). In *Radioactive Ghosts*, I propose an expansion of the concept of species self, contending that in light of the confluence of nuclearism and other cataclysmic ecological catastrophes that threaten planetary life, we need to develop the more encompassing notion of a "transspecies self" (Schwab 2020, 237f.). The latter is based on an ethics of concern, responsibility and care for other species with whom we share the planet. Concomitantly, what Schell calls the "second death" needs to include the extinction of other species as well.

In the words of Hiroshima survivors interviewed by Lifton, the kind of death faced by victims of nuclear attacks is also a "false death" (1991, 309). The latter emerges from the feeling that, in a world whose entire order has been shaken by the introduction of nuclear weapons, the unprecedented possibility of total annihilation leaves the notion of natural death behind. Along with the sense of a natural lifetime, nuclear temporality, in other words, also preempts the notion of a natural death. If Lifton calls this a "false death" or "double death," it is because an entirely unnatural psychic death happens before the actual death of the body. This false death will henceforth haunt the survivors of nuclear attacks from within like an uncanny double of natural death. They continue living the life of ghosts, almost as if outside of time, revenants from a wrongful death that has already happened. Their world has become a nuclear crypt.

In *Hiroshima in America,* R. J. Lifton and Greg Mitchell (1996) argue that the nuclear phantasms of an "apocalyptic self" that are related to death and immortality are supported by this psychic mechanism of "doubling." While people are usually trying to make their way through the natural life cycle in measured ways, Lifton and Mitchell argue, certain traumatic events or psychic states reactivate the "apocalyptic self" that is preoccupied with premature or violent death, such as death through catastrophic illnesses, mass killings, genocide, or nuclear Holocaust. Lifton and Mitchell consider a doubling of the self in form of a division between a "measured self" and an "apocalyptic self" to be a ubiquitous psychological trait developed to cope with the knowledge of mortality. All ecologies of fear, we can surmise, mobilize phantasms of the apocalyptic self. We have seen, for example, that the inauguration of the nuclear age with Hiroshima and the ensuing arms race during the Cold War have forever disrupted the expectation of a natural life cycle and therefore released the dangerous energies of the apocalyptic self. In a ubiquitous ecology of nuclear fear, the apocalyptic self becomes part of the cultural imaginary. Everything depends, then, on how the dynamic between the measured and the apocalyptic self is negotiated, or, to put it differently, whether apocalyptic visions are used defensively or as a tool of confronting nuclear fears.

Psychologically, the apocalyptic self and death-in-life are complementary psychic manifestations of nuclear temporality. While the apocalyptic self is obsessed with visions of premature death and catastrophic annihilation, "death-in-life" is the psychic condition resulting from the numbing of the very fears that haunt the apocalyptic self. If the paralyzing condition of death does not occur at the very end of a lifetime because psychic death has already happened in the here and now, the curtailing of emotions to a manageable scale comes in the form of an injurious psychic splitting and collective denial. It is a schizoid splitting that creates an internal crypt which houses the shadow lives of foreclosed futures. As the crypt is removed from lived time, the shadow lives of radioactive ghosts act like a poison from inside. Herman Agoyo, the Indigenous activist from the nuclear borderlands, identified such a condition as "psychic toxicity" (2006, 30). In *Death in Life*, Lifton vividly describes such toxicity of the mind in the case of a Hiroshima survivor: "The embittered world-view becomes his total vision of the way things were and the way things are. Not having been able to 'vomit' his 'bitter water,' such a survivor finds his entire psychic life poisoned by it" (1991, 526).

In *The Shell and the Kernel* (1994), Abraham and Torok envision a crypt in which people bury unspeakable events or unbearable, if not disavowed, losses or injuries incurred during violent histories. In the twentieth century, Auschwitz and Hiroshima are the names that designate such unspeakable histories of violence. The "nuclear crypt" (see Schwab 2010) manifests as a collective psychic operation designed to ward off, if not deny the toxic legacies of nuclearism. It forms a space of haunting, a haunting that comes from both the past and the future, the outside world and psychic life. Nuclear trauma resists integration into the psychic fabric. According to Abraham and Torok, any form of unnatural death creates ghosts that come to haunt the living. The legacy of nuclear violence haunts not only its actual victims but, knowingly or unknowingly, everyone on the planet, including future generations.

Both Auschwitz and Hiroshima also stand for the first instances of technologically induced mass extermination. “In the extermination camps natural death was completely eliminated,” writes Günther Anders (1956, 148) and concludes that, as a consequence, “all men are exterminable.” The crucial step from Auschwitz to Hiroshima, he argues, lies in the fact that “what is exterminable today is not ‘merely’ all men, but mankind as a whole” (1956, 148). And, we should add, most other living species as well. It is this shift toward extermination that inaugurates the nuclear age and the vicissitudes of nuclear temporality.

The confluence of the complete elimination of natural death in Auschwitz and the fear of nuclear annihilation, a man-made unnatural event, create a collective haunting from both past and future. Formed in response to a refusal or inability to mourn the pre-nuclear world and the victims of nuclear violence, nuclear crypts harbor radioactive ghosts like undead vibrant matter (see Bennett 2010). Just like the material half-life of radioactive matter, the psychic half-life of nuclear trauma approximates notions of an immortal force in the perennial here and now of nuclear temporality.

Nuclear temporality is thus also predicated on the loss of a pre-nuclear world that provided humans with a sense of permanence and transgenerational continuity. Yet, while we may disavow the loss of such a world, we keep its memory psychically alive, if only unconsciously. In *Thermonuclear Monarchy*, Elaine Scarry argues that U.S. citizens have been disempowered for the last sixty years, becoming like the global population more generally, “frozen in structures of thermonuclear subjugation” (2016, 22). We may add to Scarry’s observation that this subjugation also operates in the nuclear unconscious through the capture by the nuclear in a mode of repression. We could indeed speak of a nuclear colonization of the mind.[6] Generating a particular form of transgenerational nuclear trauma, this colonization extends into the future. The unconscious however, as Freud insists, knows no time. The nuclear crypt and the nuclear unconscious more generally therefore hold us psychically captive in the dead time of a frozen here and now. This freezing of time is another form of death in life, a temporal one that cuts into the flow of lived history.

This is yet another instance of futurelessness. We might envision the *Angelus Novus* of our time, the Angel of Nuclear History, staring at, yet

[6] Moreover, the nuclear state of exception and the subjugation that Scarry notes extend beyond the parameters of nuclear weapons and war to include the nuclear energy empire that generates radioactive contamination of the environment, ozone depletion, and the unmanageable proliferation of nuclear waste. In response to the growing global resistance, nuclear energy industries have developed a widespread politics of cover-up, deceit, and outright lies.

moving away from, the world's nuclear contamination, his face turned toward the past. Does he, as Benjamin suggests, see one single catastrophe, which keeps piling wreckage upon wreckage and hurls it in front of his feet? Would the angel like to awaken the dead, and make whole what has been smashed? And is it a nuclear storm that is blowing from Paradise, getting caught in his wings with such violence that he can no longer close them? Benjamin (1968, 258) writes: "The storm irresistibly propels him into the future to which his back is turned, while the pile of debris before him grows skyward." Can we find a better image for the skyward-growing pile of radioactive waste and the nuclear storm that pushes life toward extinction?

Gabriele Schwab is Distinguished Professor at the University of California, Irvine with appointments in Comparative Literature and Anthropology. She received her Ph.D. at the University of Constance in 1976 and a Ph.D. in Psychoanalysis from the New Center for Psychoanalysis in LA in 2009. A recipient of a Guggenheim Fellowship and a Heisenberg Fellowship, her work ranges across critical theory, psychoanalysis, trauma studies, ecology, anthropology, and 20th- and 21st century comparative literatures. Monographs in English include *Subjects Without Selves* (1994); *The Mirror and the Killer-Queen* (1996); *Haunting Legacies* (2010); *Imaginary Ethnographies* (2012), Winner of the 2014 Choice Award for Best Academic Book; *Radioactive Ghosts* (2020); *Moments for Nothing: Samuel Beckett and the End Times* (2023). She is working on a new project on *Haunted Ecologies*.

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